HYDROGRAPHICAL AND BIOLOGICAL INVESTIGATIONS

IN

NORWEGIAN FIORDS

By

O. NORDGAARD

THE PROTIST PLANKTON AND THE DIATOMS IN BOTTOM SAMPLES

By

E. JØRGENSEN

WITH 21 PLATES AND 10 FIGURES IN THE TEXT

BERGEN

JOHN GRIEG

1905
III. BOTTOM-LIFE.
NOTES.

When dredgings have been made, soundings, both at the start and finish of the haul, have generally been taken. So that when, for instance, Oxsund 450—630 m. is noted, it is to be understood that the depth was 630 m. where the dredge was thrown out, and 450 m. where the dredging was ended.
### A. Results of Dredgings.


A table is presented below detailing the results of various dredging stations from 1899 to 1900, including the name of the station, the department involved, the temperature and salinity of the bottom layer, and the nature of the bottom. Remarks are also included.

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The table details various stations with their respective departments, temperatures, salinities, and nature of the bottom, along with remarks where applicable.
b. Outcome of Dredgings.

Porifera.¹)

W. Lundebeck, Mag. scient., Copenhagen, determ.

Asheseliana penicillata, O. Schmidt.
The Lyngen Fiord, 300 m.

Chabertia abyssicola, M. Sars.
The Saltfjord, Skroyen (Vest Fiord), 400 m.

Bulavis vermiculata, Bowerbank.
Reine (the Vest Fiord), 150 m.

Stylocelidella borealis, Lovén.
The Skjerstad Fiord, 230 m.

Tetiarina scutiferites, O. Schmidt.
The Skjerstad Fiord, 230 m.

Holoceliana verticillata, Bowerbank.
Moskenstrømmen, 200 m.

Tetrastroma hemisphaericum, M. Sars.
The Lyngen Fiord, 250 m.

Tethya lymnaeum, Johnst.
The Persanger Fiord, 200 m.

Crinodonta crinoides, Müll.
The Sag Fiord, 200 m.

¹) Not many sponges were found, but those which were obtained were classified at once by Mag. Lundebeck, together with material belonging to the Danish Ingolf expedition. Only a few species are noted here, the names of which Mag. Lundebeck has kindly furnished me with.

Hydrozoa.

Hydroida.

Miss Bonnevie, Kristiania, determ. Remarks by the author.

Caryophyllus saxatilis, Steenstrup.
Melanis (1884).

Tabularia medusia, LIN.
Svolvær (1894); Balstad (1896); Breisund, 100 m.; the Persanger Fiord, 200 m.

Tabularia burgi, ELL. & SOL.
Nordkyn (1894).

Tabularia variabilis, Bonn.
The Persanger Fiord, 200 m. This species has previously been found at Raunberget in the Trondheiem Fiord, and by the Norwegian North Atlantic Expedition at stations 325 and 392.

Tabularia hamilti, Allam.
Svolvær (1894); Nordkyn (1894).

Peripatium repens, Weight.
Balstad (1996). Has been observed from bergen to Lofoten.

Desoyne conferta, Alder.
Svolvær (1894).

Hydroclathrus echinatus, Flemming.
Svolvær (1894); Balstad (1896).

Eulobonia ramosa, PALL.
The Ostnes Fiord.
Eudendrium tenuirese, Hincks.
Moskenstrommen. Only collected on the Norwegian coast in Moskenstrommen.

Eudendrium tenellum, Allman.
Moskenstrommen.

Halecium boreinum, Lin. 
Napstroomen (1896); the North Cape (1894).

Halecium boreinum, Alder. 
Moskenstrommen; the North Cape (1894).

Halecium tortile, Bonn. 
Balstad (1897). Up to the present, only known from Balstad (Lofoten).

Halecium scutatum, Clark. 
The North Cape (1894); Nordkyn (1894).

Halecium sessile, Norman. 
The North Cape (1894).

Halecium schwederi, Bonn. 
Nordkyn (1894).

Lofoea serperns, Hassal. 
The Ingo Sea, 300 m.; Nordkyn (1894).

Lofoea obturata, M. Sars. 
Moskenstrommen; Balstad (1897); The Ingo Sea, 300 m.; The North Cape (1894).

Lofoea gracillima, Alder. 
Balstad (1897); The Ingo Sea, 300 m.; Malangen 100—200 m.

Lofoea ovum, Flemming. 
Hammerfest (1894).

Lofoea fruticosa, M. Sars. 
Moskenstrommen; Balstad (1897); Malangen 100—200 m.; Hammerfest (1894); Sverdrup (1894); The Porsanger Fiord, 200 m.

Lofoea symmetrica, Bonn. 
The Ingo Sea, 300 m. This species has been found, in addition to the place here mentioned, at station 313 (The Norw. North. Atl. Exp.).

Campanularia reticulata, Lin. 
Malangen, 100—200 m.; Hammerfest (1894); The North Cape (1894); The Porsanger Fiord; Nordkyn.

Campanularia geniculata, Mell. 
Svolvaer (1894); The North Cape (1894); Nordkyn (1894).

Campanularia dichotoma, Lin. 
The North Cape (1894).

Campanularia hypnoida, Hincks. 
Balstad (1897); The Porsanger Fiord, 200 m. Up to this time, the most northerly known limit was The Trondhjem Fiord.
Scyphozoa.

*Lucernaria quadricornis*, Müll.

Hammerfest (1894); Melavik (1894); The Skjerstad Fiord.

M. Sars has given a detailed description of this animal.) He notes the following places where it has been found: Gjesvær, Saløvik, Flora, Kinn, all of these being on the Bergen coast. My locality in the Skjerstad Fiord (S. XVI) lies just inside Saltstømmen. Here several specimens of *Lucernaria* were found on algae at a depth of from 10—20 m.

Anthozoa.

Alcyonaria.

James A. Grieg det. Remarks by the author.

Alcyonina digitata. Lin.

The Skjerstad Fiord (S. X), 10—30 m. The locality in the Skjerstad Fiord is the northern limit for this species as far as is now known. Its distribution, according to Dr. Walter May, is confined to Norway and England.  

Parapagopodes freetae, M. Sars.

The Skjerstad Fiord (S. III), 230 m. The possessing four arms. The species is common in the Arctic Sea.

Parapagopodes rosea, Dan. & Kor.

Baestad, 80 m.

Paramuricea phanera, Lin.

Amd. 300—400 m.

The species has not, up to the present, been found north of this place. In "Beskrivning over en zoologisk Reise (1840)" M. Sars mentions the following animals belonging to this group: *P. homobranch, Lin*, from the Ons Fiord and Hammerfest, and *Parapagopodes argus, Lin.*, from the Ons Fiord. The last mentioned species has been taken at two stations (185—250 m.), in the Murman Sea by the Austro-Hungarian Expedition.  

Loeida hipparia, Gunnerus.

The Søg Fiord, 200 m.; Trondhyet, 687—640 m.; Oksund, 600 m.; Brettes-Skroven, 350—400 m.

It has caught this species in the Trondhjem Fiord, according to Grieg 1), and Gunnerus mentions it from Smeden. Under the name of *Myaena borealis* it is fully described by G. O. Sars 2) from specimens caught at the fishing station Skroven in Lofoten.

*Penea aurita*, Dan. & Kor.

At Risvær (Lofoten), 130—150 m.

Kopkehollemon stelliferum, O. F. Müller.

The Søg Fiord, 320—380 m.; Landeø, 400 m.


According to Grieg 3), this species was known from the Kristiania Fiord to the Trondhjem Fiord. Its northern limit is now the Vest Fiord.

Zoantharia.

James A. Grieg det. Remarks by the author.

Uroghythus arcticus. M. Sars.

The Saltin Fiord, 320 m.; Landeø, 400 m.; The Folden Fiord, 530 m.; Oksund, 600 m.; Mortsgen, 200 m.; Ure, 250 m.; Reine, 150 m.; The Lyngen Fiord, 300 m.

During his expedition in the summer of 1841, Michael Sars found this peculiar species in the Ox Fiord, and in the account a short description was given of it. Later on, it was thoroughly described.  

A contribution respecting its anatomy has been made by Miss Emily Arnesen.  

The Austro-Hungarian expedition collected this species at two stations in the Murman Sea, (183 m., 230 m.)*

*Lophocelia prolifera*, Pall.

Trondhyet, 450—530 m.; The Tys Fiord (T. I), 500 m.

This species was seen in large quantities especially at the place last mentioned. The *Lophocelia-reef* at the mouth of the Tys Fiord is, as far as I know, the most northerly which has hitherto been observed. Later on in this treatise, I will refer somewhat more in detail to this interesting formation.

Actinaria.

Dr. Carlsgren, Stockholm, det. Remarks by the author.

*Pedalienus simplex*, Carlsgren.

The Tys Fiord (T. I), 500 m. On *Lophocelia prolifera*, Pall. Carlsgren says, in a written communication to me that *Pedalienus* is only found in Bohnsen and on the Norwegian coast. The distribution of this species hitherto known is Bohnsen—Loften.

*Euderia annulis*, Dan.

The Lyngen Fiord (I. III), 500 m.; The Skjerstad Fiord, 320 m.

It was caught by the Norw. North Atl. Exp. at St. 253 (The Skjerstad Fiord, 481 m.).

*Parechelemonia arcuata*, Carlsgren, nov. gen. nov. sp.

The Skjerstad Fiord, 320 m.

The new genus and species will later on be thoroughly described by Dr. Carlsgren. In a written communication to me he says: *Parechelemonia* is characterized by 8 complete mesenteries like *Euderia*, but the scars in *Parechelemonia* is furnished with
papilla like Holocampa, and foreign bodies (grains of sand) are fastened to these papillae.

*Bolocera lineata*, Johnst.
The Malangen Fiord, 380 m.; Stoknesbotn, 40—80 m.

*Tealia* (Modoniactis) lophensis, Dan.
Stomnesbotn, 40—80 m.; The Ogs Fiord 1, 100 m.

*Actinostola eveska*, Veer.
Stomnesbotn, 40—80 m.; The Jokel Fiord, 80—100 m.
This species was also observed in several other fiords, but no specimen was preserved.

*Melitilla diomantes*, Ellis.
Kvænangen II, 90 m.
M. Sars in his account of his expedition in 1849 says that this form was commonly found between the pebbles on the beach in the Ox Fiord and at Hammerfest.

*Chondrachtinia digitata*, O. F. Müller.
The Ogs Fiord, 100 m.; Stomnesbotn, 40—80 m.; Malangen, 100—200 m.; The Jokel Fiord 1, 100 m.; The Porsanger Fiord, 200 m.
This form is very common in the fiords of Northern Norway.

*Chondrachtinia nodosa*, Farr.
The Porsanger Fiord, 200 m. (3 specimens).
This is surely the first time that this genuine arctic species is noted from any Norwegian fiord. The Norw. North Atl. Exp. collected it at St. 290 (between Norway and Beeren Eiland. Danielson) mentions it under the name of *Actinage* (Verrilli) nodosa Farr. Carlgren says in a written communication that he has numerous specimens of Fabreri's species from Greenland, Spitzbergzen and Beeren Eiland. At the same time, he gives the important information that *Actinotha nodosa*, Farr., is not identical to the chief variety of *Actinage nodosa*, Ver. The latter has therefore since been named *Actinage verrilli*. On the other hand, Carlgren declares that *Actinage nodosa* et al. *leucolobus*, Ver. = *Chondrachtinia nodosa*, Farr., which species is also found on the east coast of North America.

*Epizoanthus erythraea*, Dan.
Malangen, 380 m.; Lyngen I, 280 m.; Lyngen III, 300 m.; Kvænangen, 300—433 m.
The Norw. North Atl. Exp. took this species at four different places.

*Isoscoranthus (Epizoanthus) arboreus*, Dan.
Mortsund I, 200 m.; Tranoydjet, 607—640 m.
Danielson notes this species from St. 149 (The Vest Fiord). Carlgren has classified *Isoscoranthus* as a new genus, which differs from *Parazoanthus* in wanting a ring sinus.

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**Crinoidea.**

1) *Crinoidea.*

**James A. Grønn, determ.**

*Rhizocodium lophensis*, M. Sars.
Tranoydjet, 610 m.; Oxmod, 600 m.; The Sag Fiord, 200 m.; Brettesnes, 350—400 m.; Rye, 150 m.; Moskenstrommen, 200 m.

*Antedon luella*, Retz.
The Beier Fiord, 30—150 m.; The Skjerstad Fiord, 330—490 m.; The Tys Fiord, 500 m., Malangen, 100—200 m.

**Ophiuroidea.**

**James A. Grønn, determ.**

*Ophiura albida*, Forbes.
The Salten Fiord, 15—20 m.; Gtro, 4 m.; The Ostnes Fiord, 30 m.; The Tross Fiord, 40 m.

*Ophiura sarsi*, Lütken.
Numerous specimens both from the outer and inner fiord districts, 30—400 m., and on soft as well as hard bottom.

*Ophiura robusta*, Ayres.
The Skjerstad Fiord, on hydroids: The Ogs Fiord, 100 m.; The Kirk Fiord, 30—50 m.; The North Cap (1894).

*Ophiura arenaria*, M. Sars.
The Sag Fiord, 100 m.

*Ophiocereus sericeus*, Forbes.
Was seen at a number of stations, both out at sea and in the fiords, 100—100 m.

**Amphiopis narvegiensis**, Lundeman.
Landega, 300—400 m.; The Salten Fiord, 220—380 m.; The Folden Fiord, 530 m.; Oxmod, 600 m.; Brettesnes—Skraeven, 350—400 m.; Tranoydjet, 610 m.

*Ophioplloides cuculota*, Lin.
Exceedingly common at most of the stations, 10—700 m.

*Ophiocantha buolata*, Retz.
Commonly distributed. Especially numerous in the Ogs Fiord, the Porsanger Fiord etc.

*Ophiocantha abyssicola*, G. O. Sars.
Sea NW of Rost, 300—500 m.

*Ophiocantha spectabilis*, G. O. Sars.
Arns, 300—400 m.; The Tys Fiord, 500 m.; Tranoydjet, 450—530 m.

*Ophiotrix frugilis*, O. F. Müller.
Rost, 100 m.

*Ophiocereus glacialis*, Mull. & Trosch.
The Skjerstad Fiord, 470—190 m.; The Salten Fiord, 220—380 m.; Landega, 260—400 m.; The Folden Fiord, 530 m.; The

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Asteroida.

James A. Grieg determ.

*Pontaster tenuispinus*, Düb. & Kor.

From a number of stations between Salten Fiord and Malangen, 100—640 m.

*Platanaster parleii*, Düb. & Kor.

Balstad, 150 m.; The Folds Fjord, 530 m.; Svolvær (1894); Sverdlof (1894).

*Crenocidaris crispata*, Retz.

Of very common occurrence on the mud in the basins of the fjords between the Skjerstad and Porsanger fjords, 30—530 m.

*Leptophyescher koreckii*, M. Sars.

From numerous stations, 30—100 m.

*Astropecten irregularis*, Pennant.

Seivangen (Salten Fiord), 15—17 m.

*Palaster andromeda*, Müll. & Trosch.

The Beier Fiord, 50 m.; The Skjerstad Fiord, 30—50 m.; Landego, 200—400 m.; The Folden Fiord, 530 m.; Mortsund (Vest Fiord), 200 m.; the mouth of Râtsund, 250—300 m.

*Pentagonaster granularis*, Retz.

The Salten Fiord, 320—380 m.; The Óstnes Fiord, 130 m.; Reine, 100 m.; Mortsund, 200 m.; Balstad, 150 m.; Moskenstrommen, 200 m.; Rost, 150 m.; Malangen, 150—250 m.; The North Cape (1894); Sverdlof (1894).

*Hypotectus pharynx*, Parelius.

The Skjerstad Fiord, 230 m.; Sverdlof (1894).

*Paranuxanophora roea*, Dan. & Kor.

The Folden Fiord, 530 m.

*Sclaster pappeus*, Lin.

The Skjerstad Fiord, 10—30 m.

*Sclaster endeeri*, Retz.

Balstad, 30—70 m.; The Óstnes Fiord, 30 m.

*Sclaster syrtensis*, Verk.

The Beier Fiord, 50 m.

*Pleaster perlitus*, M. Sars.

Henningsvær, 150 m.; Sverdlof (1894).

*Pleaster miliarius*, O. F. Müller.

The Óstnes Fiord, 500 m.; Trondhjelm, 450—530 m.; Reine (Vest Fiord); Sea W of Inga, 300 m.; The Jokel Fiord, 100 m.; Sverdlof (1894).

*Gibellaster angulicorns*, O. F. Müller.

Common, especially on the Loften banks, 30—300 m.

*Pellicellaster typicus*, M. Sars.

Balstad (Vest Fiord), 80 m.

*Stichaster roosaic*, O. F. Müller.

The Óstnes Fiord, 130 m.

*Asterias glacialis*, Lin.

Moskenstrommen, 90 m.; The Kanstad Fiord, 30—90 m.; Breisund, 100 m.

*Asterias molleri*, M. Sars.

Occurs from a number of stations between The Skjerstad Fiord and Sverdlof, 10—250 m.

*Asterias limbki*, Müll. & Trosch.

The Kanstad Fiord, 90 m.; The Jokel Fiord, 60—100 m.

*Asterias rubens*, Lin.

From several localities in Loften.

*Beiringia caronata*, G. O. Sars.

The Folden Fiord, 530 m.

Echinoidea.

James A. Grieg determ.

*Echinus norvegicus*, Düb. & Kor.

Moskenstrommen, 200 m., Rost, 150 m.

*Echinus simplex*, Düb. & Kor.

The Óstnes Fiord, 500 m.

*Echinus esculentus*, Lin.

Malangen, 100—200 m.

*Strongylocentrotus droebachiensis*, O. F. Müller.

From 13 places between Skjerstad Fiord and Sverdlof.

*Echinoidea pusillus*, O. F. Müller.

Skrove (Vest Fiord), 200—400 m.; Moskenstrommen 90 m.; Rost, 100 m.

*Schizaster fragilis*, Düb. & Kor.

Landego, 300—400 m.; The Kanstad Fiord, 30—90 m.; The Kirk Fiord, 70—100 m.; Malangen, 100—200 m.

*Spatangus purpureus*, O. F. Müller.

The Skjerstad Fiord, 330 m.; The Óstnes Fiord; Moskenstrommen, The North Cape (1884); Sverdlof (1894).

*Echinocardiom cordatum*, Pennant.

Sverdlof (1894).

*Echinocardiom flavescens*, O. F. Müller.

The Salten Fiord, 15—20 m., Stene (Vest Fiord), 120—200 m.; Trondhjelm, 10 m.; Sverdlof (1894).
Holothuroidea.

Dr. Hjalmar Østergren, Upsala, detern.5)

Stichopus tremulus, Gunnerus. The Salten Fiord, 320—380 m.; Landege, 300—100 m.; Balstad, 150 m.; Balstad (13), 1897, in the stomach of cod (Gadus callarias).

Bothylus orbatus, M. Sars.
The Folden Fiord, 550 m.; Oksund, 600 m.

Mesothoe orbicularis, Ascarius.
The Folden Fiord, 530 m.; Oksund, 600 m.

Cucumaria fornicata, Gunnerus.
Balstal (1897): Reine, in the stomachs of cod (Gadus callarias); Rost, in the stomachs of cod; Trondhjemsund, 30—40 m.

Cucumaria hispida, Barnett.
The Salten Fiord, 320—380 m.; Landege 300—100 m.; The Sag Fiord, 200 m.; Oksund, 600 m.; Skroven, 200—100 m.; Breitesness, 350—100 m. TronDByt, 607—640 m.

Plephophorus helobius, Fleming.
Dyremulen, 100—150 m.; Kvenangen, 90 m.; Rost, in the stomachs of haddock (Gadus aeglefinus).

Plephorus phlebus, Struusenfeldt.
The S. Beier Fiord, 30—150 m.; The Østnes Fiord, 50—70 m.; Moshavn (1894).

Lapillus baski, Mistosh.
The Kirk Fiord, 50 m.

Myriotrochus vianki, Steenstrup.
The Lyngen Fiord, 250 m.; Kvenangen, 300—343 m.; The Jokel Fiord, 100 m.

Myriotrochus vitaeous, M. Sars.
Breitesness, 350—400 m.

Nemertinea.2)

Dr. R. C. Pennett, Cambridge, detern.

Linum scandinavics, Pennett, n. sp.
The Jokel Fiord, 100 m.

Linum cinereus, Pennett, n. sp.
The Tys Fiord, 500 m., on Lophocrates.

Ennemiwca nordwysi, Pennett, n. sp.
The Salten Fiord, 200 m.; Balstad, 150 m.

Amphiporus pusillus, Pennett, n. sp.

Amphiporus magnus, Pennett, n. sp.
The Tys Fiord, 500 m.; on Lophocrates prolifera.

Amphiporus thompsonii, Pennett.
Balstal, 50 m.; The Persanger Fiord, 200 m.

Drachypholus halesius, Pennett.
The Lyngen Fiord 11, 250 m.

Annelida.

Polychaeta.

O. Bidentaf, Kristiania, and G. M. R. Levissen, Copenhagen, detern. Remarks by the author.

Harmothoe esthionia, Storm.

gaukvedo, 250 m.
The species had previously been known as distributed from Banneiieen to The Troudbhjem Fiord.

Harmothoe molis, M. Sars.
Reine (West Fiord), 150 m.

According to Bidentaf, this species is rare on the Norwegian coast.

Harmothoe virei, M. Sars.
The Skjerstal Fiord (8, XVI); Malmogen, 100—200 m.; Lyngen III, 300 m.; Kvenangen, 300—343 m.; The Persanger Fiord, 200 m.

Harmothoe propinquus, Malgren.

Henningsværtstrommen, 20—40 m.
The northern limit for this species hitherto was The Troudbhjem Fiord.

Harmothoe acris, Kinberg.
The Sag Fiord, 200 m.; Lyngen III, 300 m.; The Jokel Fiord, 100 m.

Harmothoe nolose, M. Sars.
Malmogen, 100—200 m.; The Skjerstat Fiord, 10—20 m.; Breisund, 100 m.

Harmothoe inbricitos, Linn.

Napstrommen (Loften); Trondhjemsund, 40 m.; Sverholt (1894); The Kjelle Fiord (1894).

Harmothoe impur. Johnst.
The S. Beier Fiord, 50—150 m.; The Skjerstal Fiord, 230 m.; The Tys Fiord, 500 m.; Ingerhavet (hay = sea), 300 m.

Harmothoe elaviger, M. Sars.
The list of places where found is lost. The species has previously been caught near Christiansund by M. Sars and in The Troudbhjem Fiord by Storm. I caught specimens in 1899, my district was then The Beier Fiord—The Persanger Fiord. So that this species is also found north of the arctic circle.


Harpactes aspericrura. M. Sars.
Malangen, 100—200 m.

It is the northern known limit for this species had been Bodø.

Lepeodorida squamata, LINN.
Svolvær (1894); Nappstrømmen (1897), 30—40 m.

Lepeodorida cirrus, PALL.
The Beier Fiord, 50 m; The Sag Fiord, 200 m.

Lepeodorida aquanubeni, MALMGEN.
Stønnesbøtø, 10—90 m.
The Trondtjøen Fiord was previously the northern limit for this species.

Aphrodite acaeleata, LINN.
Moskenstrømøen, 200 m; Tranøybø, 607—640 m.

Lectanion plicornis, KINBERG.
The Folden Fiord, 530 m; Landego, 200—100 m; Oxsund, 600 m; The Sag Fiord, 200 m; Tranøybø, 607—640 m; Gaulkverø, 250 m; Malangen, 100—200 m.

Lesride tetragona, KIND.
The Skjerstad Fiord (several places); The Salten Fiord, 250 m; Landego, 200—100 m; The Folden Fiord, 530 m; Risten, 150—180 m; Malangen, 380 m.

Eunice sanguinea, ORSTED.
The Skjerstad, 20 m.

Phyllodoce macalata, LINN.
The Beier Fiord, 30—150 m; The Skjerstad Fiord, 330 m; The Salten Fiord, 15—20 m; The Kirk Fiord, 70—80 m; Sverdbølt (1894).

Etrone depressa, MALMGEN.
The Kirk Fiord, 70—80 m.

This species is not mentioned in BIDENKAP's list of the Poly-echata of Norway. Later on, however, BIDENKAP found a specimen at Horsesø in The Lyngen Fiord. It is known from Greenland, Spitzbergen and Novaja Semlja.

Nephys malagenica, THÉEL.
The KJEstad Fiord, 30—90 m; Ristenflaket, 150—180 m; Gaulkverø, 250 m; Lyngen II, 250 m; Kvænangen, 300—353 m; The Jokel Fiord, 90 m.

Nephys incisa, MALMGEN.
Svolvær (1894); Malangen, 380 m; The Jokel Fiord, 160 m; BIDENKAP mentions Lofoten as the northern limit, but this must now be changed to Kvenangen and the Jokel Fiord.

Nephys ciliata, MÜLLER.
The S. Beier Fiord, 50 m; Landego, 200—100 m; Svolvær (1894); The Ogs Fiord, 100 m; The Kirk Fiord, 50—40 m; Digermølen, 100—150 m; The Kansad Fiord, 30—90 m; Stønnesbøtø, 10—80 m; Malangen, 100—200 m; Kvenangen, 300—343 m; The Jokel Fiord, 90 m.

Nephtys cava, FABR.
The Beier Fiord, 30—150 m; The Ogs Fiord I, 100 m; mouth of Raftsundet, 250—300 m; Svolvær (1894); Hemningsøve I, 150 m; The Kirk Fiord, 30—50 m.

Glycera capitata, ORSTED.
The Skjerstad Fiord X, 10—30 m; Skroven, 200—400 m; Rest II, 100 m; Sverdbølt (1894).

Stoerophalus cruenformis, MALMGEN.
Balstad, 150 m.

Laubriocris frigilis, MÜLLER.
The Kirk Fiord, 70 m.

Onuphis oxyleptes, M. SARS.
The Beier Fiord, 50—150 m; The Skjerstad Fiord I, 30—50 m; The Oksnes Fiord; The Kjejstad Fiord, 30—90 m; Lyngen III, 250 m; The Jokel Fiord, 100 m; The Persanger Fiord, 70 m.

Onuphis quadricospis, M. SARS.
Ure l (Vest Fiord), 250—250 m.

Hydroides lobatula, MÜLLER.
Svolvær (1894).

Christiansand was the previously known northern limit.

Nervia pelagic, LINN.
The Skjerstad Fiord XIII, 110 m; Trollefordsund, 10 m; Breisund, 100 m; Sverdbølt (1894); The Kjolle Fiord (1894); Nordkyn (1894).

Ledlina norvegica, LINN.
The Beier Fiord, 50 m; The Skjerstad Fiord, 30—50 m; The Tys Fiord I, 500 m; The Kjejstad Fiord, 30—90 m; Digermølen, 100—200 m; Hemningsøve, 150 m; Mortsund, 200 m; Balstad, 150 m; Rest II, 150 m; Kvenangen, 90—200 m; Breisund, 100 m; The Persanger Fiord, 50 m.

Ledlina gunki, STORM.
The Tys Fiord I, 500 m.

? Ceratothoe abranchiatus, AR. HANSEN.
The Jokel Fiord II, 80 m.

Aricia kupperi, EHLERS.
Landego, 200—400 m.

This species had previously on the coast of Norway only been found in The Bergen Fiord.

Trophonia plurica, MÜLLER.
Glen (Rest) on the beach; The Ogs Fiord; The Folden Fiord, 530 m; The Jokel Fiord; Kvenangen.

Brada villosa, RATHKE.
The Skjerstad Fiord, 250 m; The Salten Fiord I, 15—20 m; The Folden Fiord, 530 m.

Brada granulosa, ARMAFIER HANSEN.
Malangen, 100—200 m; The Persanger Fiord, 200 m.

The southern limit for this species must thus, for the present,
be considered to be Malangen. It is now for the fauna of Norway; the places at which The Norw. North Atl. Exp. found it all lie at a considerable distance from the Norwegian coast.

*Brevela granulata*. MALMGR.

Glea (Rost) on the beach; Malangen 100—200 m.; Kvænangen.

*Euphrosyne borealis*, ORSTED.

Malangen, 100—200 m.

*Spirularia oniscoides*, JOHNST.

The Porsanger Fiord, 220 m.

According to a written communication from Mr. LEVINSSEN, *S. oniscoides*, JOHNST. = *S. major* LEVINSSEN = *S. arctica* ARMSTR. HANSEN.

*Eunicea crusii*. ORSTED.

The Skjerstad Fiord IV, 330 m.; The Skjerstad Fiord VII, 170—190 m.

*Arctica marina*, LIN.

Sund (Beier Fiord) in sand on the beach.

*Clypeus productus*, MALMGR.

The Kirk Fiord, 100 m.; in large quantities. According to MALMGR., this species is common on clay bottom in Finnmarken.

*Neopycha hyperborea*, MALMGR.

The Skjerstad Fiord III, 130 m.; The Ogs Fiord I, 190 m.; Stønnestøan, 10—80 m.; Lyngen III, 300 m.; Kvænangen, 300—343 m.

*Mablanus bipes*, M. SARS.

The Skjerstad Fiord III, 250 m.; Landegga, 200—160 m.

*Pectinaria hyperborea*, MALMGR.

The Skjerstad Fiord I, 30—50 m.; The Kirk Fiord III, 70—80 m.; The Østnes Fiord, The Ogs Fiord, 100 m.; The Jøkel Fiord, 100 m.

*Pectinaria koreni*, MALMGR.

Malangen, 380 m.

BIDENKAP mentions this species only from the west and south coast of Norway. The northern limit must now be moved much higher, viz. right up to Malangen.

*Trebella striumi*, M. SARS.

The Skjerstad Fiord, 230 m.; mouth of Kvalund, 250 m.; Malangen, 100—200 m.; Lyngen III, 300 m.; Kvænangen, 300—343 m.; The Jøkel Fiord II, 80 m.; The Porsanger Fiord, 70 m.

*Artacama procloca* MALMGR.

Lyngen III, 300 m.

This species has not often been collected on the Norwegian coast. Prof. ESMAILKE found it at Nakhelmen in the Kristiania Fiord, and G. O. SARS at Lofoten.

*Theclepus circumcatus*, FAB.

The Skjerstad Fiord IX, 40—50 m.; The Kirk Fiord IV, 30—50 m.; Najstrømmen, 30—40 m.; Henningsværsstrømmen, 20—40 m.; Kvænangen, 90 m.; Breisund, 100 m.; The Porsanger Fiord, 200 m.

*Amphithrite curvata*, MÜLLER.

Kvænangen, 90 m.; The Porsanger Fiord, 200 m.

*Amphithrite gronovii*, MALMGR.

The Jøkel Fiord II, 80 m.

BIDENKAP mentions that this species has rarely been found at Vadsø by M. SARS and G. O. SARS. Thus it is new from Vest Finnmarken.

*Trebella debilis*, MALMGR.

The Østnes Fiord (1894).

*Euchone papillosa*, M. SARS.

Kvænangen, 300—343 m.

*Chone inframutiliformis*, KRÖYER.

The Salted Fiord I, 15—20 m.; The Folle Fiord, 530 m.

*Dosychona dalylelli*, KÜLLIKE.

Kvænangen, 90 m.

BIDENKAP gives Bodo as the northern limit. This must now be altered to Kvænangen.

*Sabella paronis*, SAVIGNY.

The Saeg Fiord, 200 m.; Gaukværo, 250 m.; Malangen, 100—200 m.; The Jøkel Fiord II, 80 m.

*Sabella fabricii*, KRÖYER.

Kvænangen, 90 m.

*Potamilla neglecta*, M. SARS.

The Beier Fiord, 50—130 m.; The Skjerstad Fiord XVI, on Hydroida: The Jøkel Fiord II, 100 m.; Breisund, 100 m.

The hitherto known southern limit on the Norwegian coast for this species was Tromsø. It must now be changed to the Beier Fiord.

*Potamilla reniformis*, MÜLLER.

Nordkyn (1894) in numbers.

*Leptochone stevensoni*, KRÖYER.

Svolvaer (1894).

*Filigrana impexa*, BERKLEY.

The Beier Fiord, 50—150 m.; The Skjerstad Fiord II, 230 m.; Mortsmul (Vest Fiord) 100 m.; Nordkyn (1894).

*Pomatoceros trirugatus*, MÜLLER.

The Jøkel Fiord, 80 m.

Common on stones and shells.

*Hydroids norvegica*, GUNNERUS.

Digerumlen, 100—150 m.; Lyngen III, 300 m.

Common on stones and shells.

*Phascolus trilobulatus*, FABERUS.

Gaukværo, 250 m.; The Jøkel Fiord, 100 m.; Hammerfest (1894).

*Delicopha arietina*, MÜLLER.

Røst L, 120 m.; Balstad, 150 m.; Steine (Vest Fiord), 200 m.; Uro I (Vest Fiord), 200—250 m.; Svolvaer (1894); Gaukværo, 250 m.; Sverdgirl (1894).
Bryozoa or Polyzoa.

Determ. by author.

Cheilostomata.

Genellaria levista. Lin.
The Trold Fjord Sund. 30—40 m.; Nordkyn, 30 m.

Menipera tenuata. Ellis and Solander.
The Beier Fjord, 50—150 m.; The Skjerstad Fjord II, 100—185 m.; Balstad (The Vest Fjord), 30—50 m.; Mortsund III (The Vest Fjord), 100 m.; Heningavet-trøndrumen, 20—40 m.; The Øgs Fjord, 130 m.; The Øgs Fjord I, 100 m.; Stonesbeta, 40—80 m.; The Trold Fjord Sund, 30—40 m.; The North Cape (1894); The Porsanger Fjord, 70 m. It was var. gracilis which occurred at most of the above mentioned places.

Menipera jeffreysi. Norman.
Mortsund III, 100 m.; Moskenstroomen, 200 m.

Menipera normani. Nordgaard.
The sea NW of Rost, 700 m.
This species is easily recognized by the pedunculate avicularia on the front wall.

Scruposcellaria scabra. I. van Beneden.
Balstad, 30—50 m.; Groto, 6—24 m.; The Kaustad Fjord, 30—90 m.; The Trold Fjord Sund, 30—40 m.; The North Cape (1894); Nordkyn (1894).

Cubera eliisi. Fleming.
The Beier Fjord, 50—150 m.; Balstad (The Vest Fjord), 30—50 m.; The Øgs Fjord; Malangen, 100—200 m.; Stonesbeta, 40—80 m.; Kvenangen H, 90 m.; Insohavet, 300 m.; Breisund, 100 m.; The Porsanger Fjord, 200 m.; Nordkyn (1894).

Bicellaria ableri. Brøsk.
Moskenstroomen, 200 m.; Reine I (The Vest Fjord), 150 m.; The Sea NW of Rost, 700 m.

Bugula elongata. Nordgaard.
The Beier Fjord, 50—150 m.; Rost I, 150 m.; The Kirk Fjord III, 70—80 m.; Svolvaer (1894); Malangen, 100—200 m.; Breisund, 100 m.; Melvann (1894).

Membranipora lineata, Linn.
Hammerfest (1894).

Membranipora obtusa, D’Orbigny.
Kvænangen, on algae; The North Cape (1894); Norvik (1894).

Membranipora verticilata, Alder.
On an usiolid near Hammerfest (1894); The Lakse Fiord (collected by Sperre-Schneider).

Membranipora cyaneoformis, Hincks.
The North Cape (1894) on algae.

Membranipora trifoliata, S. Wood.
The Østnes Fiord, 50—70 m.; Digerudden, 100—150 m.; Stoneshoan, 40—80 m.; The Jokel Fiord III, 100 m.; Hammerfest (1894).

Membranipora minor, Busk.
Pl. II, fig. 11.
Rost II, 150 m., on Waldheimia; Moskenstrommen II, 150 m., on Waldheimia; Digerudden, 100—150 m., on stone; Malangen, 100—200 m., on Waldheimia.

Leprolia (Membraniporella) nitida, Johnston.¹
Rost II, 150 m.; Norvik (1894).

Geophytes (Cribillina) nitida-porcellata, Smitt.
Moskenstrommen II, 150 m.; Norvik (1894). Lovén had specimens from Hammerfest.

Cribillina cryptosperma, Norman.²
The Kjalle Fiord (1894); Norvik (1894).

Cribillina annulata, Fehr.
The North Cape (1894).

Micropora citata, Pallas.
Svolvær (1894), Sverdloft (1894).

Micropora impressa, Audouin.
Ingohavet. 300 m., on stones; Breisund, 100 m., on stones.

Doryporella² spatulifera, Smitt.
Breisund, 160 m., on Rhynchoporella psittacea. An excellent illustration of the zoecia in this peculiar species, will be found in Waters’ (Bryozoa from Franz-Josef Land. Journ. Linn. Soc., XXVIII, pl. 12, fig. 6).

Haplocia² secklubi, Busk.
Norvik (1894), on stones.

Tessarodana gracilis, M. Sars.
Mortsund III, 100 m.; Digerudden, 100—150 m.; The Sag Fiord, 200 m., on dead branches of Isidella hippuris; Tramodybet.

607—610 m., on dead branches of Isidella hippuris; Malangen. 100—200 m., Ingohavet, 300 m.

Para tubulosa, Norman.
Hammerfest (1894); The Lakse Fiord (collected by Sperre-Schneider).

Hippodella hypina, Linn.
Grotta. 6—24 m., on algae; The Trolt Fiord Sund, 30—40 m., on algae; Breisund, 100 m., on an ascidian. This species has sometimes been mentioned as a Schizoporella, sometimes as a Collepora.

Hippodella divaricata, Lamouroux.
Tromsø (collected by Sperre-Schneider); The Lakse Fiord (collected by Sperre-Schneider).

Schizoporella abberi, Busk.
Moskenstrommen, 90 m., on stones; The Østnes Fiord, 50—70 m.; Hammerfest (1894); Ingohavet, 300 m.; Sverdloft (1894).

Schizoporella sinuosa, Busk.
Pl. III, figs. 9, 10.
Moskenstrommen, 90 m., on stones and Waldheimia; The Østnes Fiord, 50—70 m., on stones and and; Digerudden, 100—150 m., on stones; Malangen, 100—200 m., on Modiolula nodulosa. Operculum (cfr. fig. 10) presents a divergent appearance from the genus Schizoporella, and the species sinuosa ought indeed to be removed.

Schizoporella linearis, Hassall.
Pl. V, fig. 26.
Moskenstrommen, 90 m., on shells.

Schizoporella uncinaris, Johnston.
Pl. V, figs. 23—25, 27.
„Glea“ (Rost), on the beach.
The specimens from Rost differ somewhat from those I have collected in the Hjelte Fiord, near Bergen, but the variations are not so great as to make a new species necessary. Besides fig. 23 agrees well with Hincks’ figures in Brit. Mar. Pol.

On comparing opercula¹ of Schizoporella uncinaris from the Hjelte Fiord and from Rost, it was found that those from the latter place were somewhat larger. (Cfr. figs. 21, 27). The zoecia in the specimens from Rost also had a rather wider sinus on the proximal edge of the oral aperture. The species has a wide distribution and probably varies very considerably. Lofoten is up to the present the northern known limit, both for uncinaris and linearis.

Schizoporella caulifera, Smitt.
Pl. IV, figs. 5, 7.

¹ Cfr. Norman, Finnmark Polyzoa, p. 100.
³ Norman, Finnmark Polyzoa, p. 106.
⁴ Norman, Finnmark Polyzoa, p. 107.
⁵ It is practical to measure the maximum breadth (b, pl. V, figs. 20, 27) and the maximum height (h), when comparing opercula. These measurements may also be found useful in determining species, for, not taking their absolute value into account, in some species b will be larger than h (b > h), in others they will be equal in size (b = h) and in others less (b < h). It is also sometimes useful to take similar measurements of the maximum breadth and height of the zoecia.
Schizoporella storni, n. sp.
Pl. V, figs. 1, 2.

On a stone form the North Cape (1894), a Schizoporella was found, which I suppose to be a new species. The zoecia, which were rather broad in proportion to their length, had a single row of pores along the margin, together with a few small pores on the frontal side (cf. fig. 1). No ooeia were present in the colonies, but large avencilariu was found under and a little to the side of the oral aperture. The manifold was very pointed. The surface of the zoecia was finely granulated and had weak radial stripes. The zoecia were separated by distinct lines, and it may be mentioned as a peculiarity that there is a crossline (cf. fig. 1) by the oral aperture. I think the species will easily be kept distinct from others on account of the distinct opercular ribs (cf. r., fig. 2). I have this species both from the North Cape and Hammerfest.

I have taken the liberty of naming this species after the manager of the zoological collection, V. Storm, in Tromhjem.

Schizoporella herzogenii, n. sp.
Pl. V, figs. 12, 13.

Formed a little crust on stone from Kveanangen II, 90 m. It is possibly this species which Smith has illustrated on pl. 25, fig. 79a) under the name of Mellia vulgaris, forma ornata.

It is easily recognized by its six-sided zoecia whose frontwall is punctuated, but not perforated. The zoecia are separated by distinct lines. On my specimen there were neither ooeia nor avencilariu.

A characteristic feature of this species is the large proximal lobe of the operculum (fig. 13). In the operculum b < h.

Schizoporella levinseni, n. sp.
Pl. V, figs. 3, 4.

Kveanangen II, 90 m., on stone.
The zoarium formed a crust on a stone. In a dried state, the majority of the zoecia were of a deep red colour. The zoecia have a few pores on the frontal wall, and between the pores there are hollows (remining one of a thimble). The ooeia, which are nearly ball shaped, are furnished with deeper holes, but are not pierced. There were no avencilariu on the colonies which I have had an opportunity of examining. The proximal border of the oral aperture is straight with a marked sinuses in the middle.

The operculum has a lobe which answers exactly to the sinuses mentioned (fig. 4). In the operculum b > h.


I have taken the liberty of calling this species after the Inspector of the Museum in Copenhagen, G. M. R. Levinson.

Schizoporella reticulato-punctata. HINCKS.
Pl. IV, figs. 16, 17.


1884. Leprolia reticulato-punctata. LORENZ. Bryozoan from Jan Mayen, p. 88.

1887. Escharella reticulato-punctata. LEVINSEN, Dijmphna Togtets zool-bot. Ulybytte, p. 318, pl. 27, fig. 4.


Hammerfest (1894); the North Cape (1894); the PorsangerJord, 200 m., Nordkyn (1894).

In my list of Norwegian Cheilostomata I entered this species as a Smittia, but on closer examination it became clear that the species cannot be left there. Neither can it be considered to be a Leprolia, as Hincks does.

I at first thought of setting it up as the type for a new genus, together with Smith's Escharella porifera, forma typica, and the one which I described as Smittia lineata, but on further consideration, I have not ventured to start a new genus. In all three species mentioned, there is a distinct sinuses on the proximal margin of the oral aperture, and notwithstanding that the opercula in these three species vary from that which is usual in the genus Schizoporella, they have, however, at any rate a trace of a proximal lobe. Waters has described a form, Schizoporella harmsworthii, from Franz Josef Land, which he has identified with Smith's Escharella leguiti, forma prototypa. This can hardly be correct. True, the mouth in young zoecia of forma prototypa may bear a certain resemblance to the oral aperture in Waters's species, but there is a great difference in the developed zoecia, harmsworthii having a smims on the proximal margin (cf. Waters l. e. pl. 9, fig. 10), while forma prototypa has a nucro (cf. BIDENKAP, Bryozoa von Ost Spitzbergen, pl. 25, fig. 3, and also the present work pl. IV, fig. 24).

Besides, in harmsworthii the ooeia are perforated (cf. Waters, pl. 9, fig. 10), while in l. prototypa they are provided with hollows, reminding one of a thimble. On the other hand, there seems to be complete resemblance between harmsworthii and Smith's Escharella porifera, forma criminal, but as this form was raised to the rank of a species by Hincks in 1857, harmsworthii must give way to reticulato-punctata which form I consider, as also does Waters, to be a Schizoporella. In one specimen from the Porsanger Fjord, I could plainly see the oral glands at the opening of the tentacular sheath, as illustrated by Waters.
Schizoporella parifera. SMITT.
PL. V, fig. 32.


As to other synonyms, cf. Norman, Notes on the Nat. Hist. of East Finnmark, p. 121.

Napstroomen (Lofoten), 30—40 m.; Malangen, 100—200 m.; The Jokel Fiord II, 80 m.; Hammerfest (1894); The Kjølle Fiord (1894); Mehavn (1894).

Both the shape of the mouth and the operculum with its proximal lobe, prove that there is a relationship to Schizoporella (PL. V, fig. 32). It must, at any rate, be more correct to classify this species as a Schizoporella than as a Suttilina or Eschara (Leprolia). The southern limit of the species which has been found up to the present is Lofoten; its distribution is arctic.

Schizoporella linearis, NORDGAARD.
PL. V, figs. 33, 34.


Norman has taken this species in East Finnmark, on Escharopsis rosea, dredged off Vardo. He remarks also (l. c.): — "Other specimens in my collection are one received from SMITT taken at Spitzbergen, and named Escharella auriculata; others from the Gulf of St. Lawrence (Whiteaves), and off Holsteinborg, Greenland, in 57 fathoms."

From this it will be seen that linearis has an arctic distribution, and it is probable that what has been stated to be Schizoporella auriculata, Hassal, from these latitudes should be transferred to linearis. The two species appear to be very closely allied, so that it is easily explained that the arctic form (linearis) is confused with the more southern one (auriculata).

Leichshorn versetata, M. SARS.

Moskenstroomen, 90 m.; Malangen, 100—200 m.; Kvænangen II, 90 m.

Leichshorn plana, DAWSON.

The Jokel Fiord II, 80 m.; Kvænangen, Sverkholt (1894).

Norman1 has made it clear that Myriozoma crustacea, SMITT = Leprolia plena, DAWSON. Water's is2 probably right in placing this species under the genus Schizoporella.

Eschara polita, NORMAN.


Hammerfest (1894), on stone.

In his work on "the Bryozoa of East Finnmark", from which several quotations are taken in this paper, Norman has given the reasons for substituting Eschara for HINCKS' genus Leprolia. The synonyms for Leprolia polita may be found in my paper: — "Die Bryozoen des we-dlichen Norwegens". Die Meeresfonna von Bergen, p. 87.

Eschara mossensis, n. sp.
PL. IV, figs. 3—5.

Moskenstroomen II, on stone, 150 m.

This species is particularly noticeable on account of its large, wide zoecia (fig. 3), which are scantily pierced with small holes in the sides. The oral aperture is partly surrounded by 1—6 short spines. On the surface of the oecium (fig. 4) there are fine punctures, but they are not pierced through. The oecumen (fig. 5) is quite solid, and the muscle insertions are very distinct.

It is probable that SMITT3 has this form in his paper of 1871, under the name Discopora megastoma, for fig. 26 shows no slight resemblance to the above mentioned species. I have, however, given a new name, as I consider that SMITT's Discopora megastoma includes two species, neither of them being identical to Leprolia megastoma, BESK. (Cfr. SMITT's illustrations and description just quoted with Crag Polyzoa, p. 55, pl. 8, fig. 51).

Eschara nordlandica, n. sp.
PL. IV, figs. 32—33.

Kvænangen II, 90 m., on stone.

The zoecia large, but not so broad as in the preceding species. The front wall is perforated by conspicuous pores and there are no spines on the edge of the oral aperture. Under the aperture there is a protrusion (umbo). There are raised lines between the zoecia (fig. 32) nearly all over. The oecia are punctuated, but not perforated. The oecumen is quite solid and has distinct ribs (fig. 33). In fig. 32 it may be seen how these ribs lie against the conules of the oral aperture.

It is not improbable that this species is included under SMITT's definition Discopora megastoma. In SMITT's paper of 1871, the figs. 24, 25 show no little resemblance to the above mentioned species. In his description (l. c., p. 1129), SMITT also mentions a protrusion at the front of the zoecium. But there are hardly sufficient grounds for supposing that this species is identical to Leprolia megastoma, BESK. His species has, for instance, "a single row of channelled pores".3 On the other hand, there is a stronger resemblance between Eschara nordlandica and Eschara (Leprolia) pertusa, ESCH., according to HINCKS' characterisation of this species in Brit. Mar. Pol. (1888), p. 365, pl. 48, figs. 4, 5. But the shape of the oral aperture seems to be different, as well as the puncturing of the oecium. I think it is justifiable to enter it as a new species, for I share the opinion that less harm is done by introducing a new name for a known species than by classing two different species under an old name.

The name Leprolia megastoma is used, in addition to the places above mentioned, also by LORENZ4 and BIDENKAP5, the latter also mentions the species as being a Muconella. BIDENKAP remarks that "die stark verkalkten Zoecien haben die ganze Vorderseite mit grossen Poren durchlöchert", from which it appears extremely likely that the species, which BIDENKAP had before him (from Spitzbergen) was E. nordlandica.

2) Crag Pol., p. 55. Cfr. pl. 8, fig. 51.
Echinartheca senea, SMIT.

18. III, figs. 12—14.

Balstad (Loftot): The Ostnes Fiord, 50—70 m., on coal; Dizermulen, 150 m., on stone; The Lyngen Fiord, 250 m.; The Jokel Fiord II, 80 m.; The North Cape (1894); Mehavn (1894).

I have previously classified this species as belonging to the genus Macroura, and although, I now enter it as an Echinartheca, it is not at all because it can be said to be any typical form of this genus.

Dioepaea (Uniohnsa) cunnosusa, ESP.

In the beach at "Grea", Rest.

I have previously found this interesting form near Bergen. The northern limit for the species is henceforth Loften.

Porella minuta, NORRMAN.

Groto, 6—24 m., on algae.

Norman was the first to find this species in Norway, he took it in the Bag Fiord and the Lang Fiord (East Finmark).

Porella concina, BUSM.

Breisund, 100 m., on Rhynchonella psithecus; Mehavn (1894), on shells.

Porella aperta, BUSM.3)

The Beier Fiord, 50—150 m., on Pecten citreus.

Porella acuстроенis, SMIT.

Svolvær (1894), on coal from the bottom.

The species is a new one to our fauna.

Porella princeps, NORRMAN.

P. IV, figs. 21—23.

1892. Manoporella spinulifera, var. prochava, HINCKS, „The Polyzoa of St. Lawrence“. Ann. and Mag. Nat. Hist., ser. 6, vol. 9, p. 152, pl. 8, fig. 3.


In the work already mentioned of Norman, he has availed himself of the opportunity of describing „a Greenland Porella“, to which he has given the name above. This species has now also been shown to be European; for on looking through some dried material from Mehavn (Finmark, 1894), I found a little red colony on Neptunea despecta. There is perfect agreement with Norman’s description, but so as to prevent any doubt with regard to identity, I have illustrated the characteristic operculum (Pl. IV, fig. 21).

Below the oral aperture of the zoecium, a swelling is indicated, both in Hincks’ and Norman’s figures. Below the swollen frontal wall is the chamber of the avicularium. From this chamber


a passage goes to the lateral walls. (Pl. IV, fig. 23). The mandible of the avicularium is very small. (Pl. IV, fig. 22).

This species has previously been mentioned from St. Lawrence (Hincks). Norman speaks of it (l. c., p. 115) as being „taken by the Valorous“, 1875, off Holsteinborg, W. Greenland, „in 57 fathoms“. Mehavn in Finmark now comes as a third locality. I have also found a little colony on a stone from Hammerfest (1894).

Porella glaciate, WATERS.

P. V, fig. 5—7.


Mehavn (1894), on Neptunea despecta.

As a synonym for his Porella glaciate, Waters adds, in the work above referred to, the designation, followed by a note of interrogation, Euchora c ervicornis, f. lepordine, SMIT.

Waters remarks (l. c., p. 78): — „The peristome is raised at the side, the avicularian chamber is wide and distinct with the mandible within the peristome, but on the top of a more or less tubular projection.“ If this belongs to the description of glaciate, it is not correct. But, on the other hand, this description is applicable to Porella propinquae. I have no doubt that SMIT’s forma lepordinea and WATERS’ glaciate are identical. It also seems to be certain that it was glaciate which I took at Mehavn in Finmark. SMIT’s specimens were from Greenland, so that the distribution of the species as at present known is: — Greenland, Finmark, Franz Josef Land.

Porella straminea, NORRMAN.

Balstad (Loftoten), 80 m.; Dizermulen, 150 m.; Malangen, 100—200 m.; The Jokel Fiord, 100 m.; Inghovatet, 300 m.; The North Cape (1894); The Porsanger Fiord, 70 m.

Porella levius, FLEMING.

III, fig. 15.

Moskenstrommen, 90 m.; Balstad, 150 m.; Mortsund III, 100 m.; Malangen, 100—200 m.; The North Cape (1894).

Porella aevacuta, BUSM.1)

P. III, fig. 10.

Breisund, 100 m.; The North Cape (1894); The Porsanger Fiord, 200 m.

Porella propinquae, SMIT.

P. IV, figs. 18—20 b.

Euchora propinquae, SMIT (part.), ÖfV. Kgl. Vet. Akad. Förh., 1867 (Bihang), pp. 22, 146, pl. 26, figs. 120—123.


Hammerfest (1894), on hydroids and Bryozoa, Kgl. Vet. Akad. Förh., 1894, on hydroids and Menipheus; Mehavn (1894).

1) Cfr. WATERS, P. J. B.; p. 81.
Under the name Escharella sp., SMITT has entered two forms which undoubtedly are separate species. In the explanation of the illustrations it is mentioned that figs. 131—134 represent zoecia of specimens found in Finnmark on Flakstø. These belong to the species which HINCKS later described as Porella probosidea. In the latter species, the zoecium is unperforated, while it has a characteristic perforation (Pl. IV, fig. 29 b) in *propinquae*.

In *propinquae* the peristome is very elevated on the sides of the oral aperture, and the operculum has a characteristic shape (20 b). Another peculiarity of *propinquae* is the occurrence of small perforations on the backside of the zoarium (fig. 19).

The lateral wall of the zoecium has two multipored rosette-plates.

Porella probosidea, HINCKS.

PL. IV, figs. 8—11.


Porella *skenei* var. probosidea, WATERS. F. J. B., p. 79, pl. 11, figs. 17, 18.

Hammerfest (1894); The North Cape (1894); Nordkyn (1894); Meløyv (1891).

The avicularian rostrum is much larger in this species than in the foregoing one. (Cfr. figs. 8 and 18.)

The zoecium is poreless, and so is the basal wall of the zoecium.

The opercula are also different with regard to shape. *Probosidea* is so different from *skenei* that the former can scarcely be considered to be a variety of the latter.

Palmicellaria *skenei* var. *tribea*, BUKK.

PL. IV, fig. 12.

Moskenstroomen, 90 m.; Malangen, 100—200 m.; The Porsanger Fiord, 200 m.

With regard to this variety, I beg to refer to my paper: — Die Bryozoen des westlichen Norwegens. Meeresfauna von Bergen. p. 89.

The operculum is, however, not very carefully illustrated there (pl. I, fig. 14), for which reason I give another illustration here (fig. 12).

Palmicellaria *skenei* var. *hirsuta*, BUKK.

PL. IV, fig. 13.

Lepatia *hirsuta*, BUKK. A Mon. of the foss. Pol. of the Crag, p. 47, pl. 8, figs. 6, 7.

The Jokel Fiord III, 100 m.

I have also taken this variety in the Tromsøen Fiord.

Escharopsis (Escharodes) *sarsi*, SMITT.

Tromsø Sound, 70 m.

From Sparré Schneide, I got a colony which was 17.5 cm. in length and 8 cm. in width.

The cavity of the colony served as a hide-place for *Ophioplatus aculeata*, *Clibella* etc. The colony itself was covered with *Thaliacea thais* and other hydroids.

Escharopsis *rosea*, BUKK.

PL. III, fig. 17.

Moskenstroomen, 90 m.; Digermulen, 100—150 m.; Malangen, 100—200 m.; Kvenangen II, 90 m.; Breisund, 100 m.

Pseudoeulalia *solida*, STINSON.¹)

Kvenangen II, 90 m.; The Porsanger Fiord, 70 m.

Mureonella *spinifera*, HINCKS.²)

PL. IV, figs. 14, 15.


In my list of the Norwegian Bryzoa (Bergens Mus. Aarb. 1894—95), I have entered this species as *Mureonella* *cruenta*. NORMAN, as I, with SMITT took NORMAN'S *Lepatia cruenta* to be the same as *Discopora cruenta*, SMITT. I had, however, noticed at that time that there was a resemblance between *Discopora cruenta*, SMITT and *Mureonella* *spinifera*, HINCKS. The identity of these two forms has later been confirmed by HINCKS and NORMAN. It must, however, be observed that SMITT both mentions and illustrates a single row of marginal pores on the zoecium, while HINCKS¹ does not even hint at their presence. In other respects the resemblance is striking, and the only possible explanation is that HINCKS has overlooked the marginal pores. On PL. IV, fig. 15 the arrangement of the marginal pore-chambers will be seen.²)

The species is known from St. Lawrence, Greenland, Spitzbergens and King Charles' Land.³) I found it to be quite common on stones at Hammerfest in 1894.

Eschararella *innomata*, FLEMING = *Mureonella* (Lepatia) *pachii*, JOHNSTON.⁴)

PL. IV, fig. 27.

Moskenstroomen II, 150 m.; Malangen, 100—200 m. (var. *octaedrata*).

Escharella *centricostat*, HASSALL.

PL. IV, fig. 28.

Moskenstroomen II, 150 m.; Solvær (1894), on coal; The Østnes Fiord, 50—70 m., on stone and shells. Hammerfest (1894) on stones.

Escharella *bipora*, NORMAN.

PL. IV, fig. 29.

Moskenstroomen II, 150 m.; The Østnes Fiord 50—70 m., on stone; Malangen, 100—200 m., on stone, Hammerfest (1894).

Escharella *abyssoidea*, NORMAN.

PL. IV, fig. 30.

The Tys Fiord I, 500 m., on *Lophothela prolifera*; Kvenangen II, 90 m., on shells.

Escharrella bahia, Boeck.

PI. IV, figs. 25, 26, 31.

The Jokel Fiord, 50—150 m.; The Kirk Fiord III, 70—80 m.; Smitt (1894), on coal; Malangen, 160—200 m., on Retepore collia: The Jokel Fiord II, 80 m.; Breisund, 100 m., on Retepore collia: The Porsanger Fiord, 200 m.: Sverdlov (1894); Melvain (1894).

In this species the basis of the oecium is perforated (fig. 26). Lobata is different from obgysocola in that it has several rows of marginal pores (fig. 25).

The Norwegian species of this genus can fairly easily be distinguished by the help of the oral denticle, as this varies both in form and size in the species which I have had an opportunity of examining (figs. 27—31).

Phlyctella peristomata, n. sp.

Pl. V, figs. 28—31.

The Jokel Fiord II, 80 m., on Waldheimia.

The genus Phlyctella was started by Hincks, and it is characterized as follows in the Brit. Mar. Pol. (p. 356): — "Zooecia with the primary orifice more or less semicircular, the lower margin usually dentate; peristome much elevated, not produced or channelled in front. No avicularia. Zoarium (in British species) incrusting."

As belonging to the British fauna, Hincks mentions three species, labron, colbris and ermina. Of these, labron is stated to have a porous front wall and a "triplet" of oral denticles. Colbris has neither pores nor denticles; ermina is provided with marginal pores.

On Waldheimia from the Jokel Fiord, a form was found which, on account of its unusually elevated peristome, suggested Phlyctella. On most of zooecia there was a single row of marginal pores, and it corresponded so far to ermina (fig. 28), but differed from it in having quite smooth oecia (fig. 29). Further, the peristome was elevated to the same height and thus was not provided with lateral, triangular lobes as is the case in ermina. The specimen from the Jokel Fiord also had small avicularia with semicircular mandible (fig. 30). On young zooecia the avicularia are quite plainly seen (fig. 29), but they are not so easily seen on older individuals which have the large collar below the oral aperture.

According to the diagnosis of the genus made by Hincks, there should be no avicularia, but as the resemblance between the species from the Jokel Fiord and the hitherto described Phlyctella species is striking in other respects, it is, I think, most practical to extend the limits of the genus to include also those species which have avicularia.

The oral denticle (fig. 31) is similar in shape to that of Escharrella bahia (Pl. IV, fig. 31), but it is much narrower. Below the oral aperture, there is a swelling for the avicularium chamber, which is connected with the surface by help of a few pores (fig. 28).

Escharrella's jacksoni, Waters.

PI. III, fig. 19.


Smittia's reticulata, Macgillivray.

Reine, 100 m.; Mortenland III, 150 m. Lofoten is the hitherto known northern limit for this species.

Smittia triquata, Johnston.

(B. V., fig. 33).

Balstad (Lofoten).

Smittia arcata, Norman.


Mossokstrommen, 90 m., on shells; The Oasen Fiord, 50—70 m., on stone; Malangen, 160—200 m.; Kyvangen II, 90 m.; Hammerfest (1894); Breisund, 100 m.: Sverdlov (1894); The Jokle Fiord (1894); Nordkyn (1894).

In the work above quoted, Norman has entered Smitt's forms of Escharella porifera (f. minusculea and majuscula) under the name of Smittia arcata. During my excursion to Finnmark in 1894, I found numerous specimens of f. minusculea, of which I also found some in the Lysse Fiord (59° 3' N.) in the winter of 1902. In the course of investigations made in 1893 in northern Norway, I found it at several places, and I also succeeded in one locality in obtaining forma majuscula, on a stone in the Porsanger Fiord, 200 m. A closer examination of the latter species has led to the conclusion that it must be considered to be a distinct one. It is doubtless most correct to retain Norman's designation, arcata, but this term will now have a different meaning to that originally given to it by Norman, as it will now only apply to forma minusculea. Smitt.

Smittia majuscula, n. sp.

Pl. IV, figs. 36—38.


The Porsanger Fiord, 200 m., on a stone.

Smith (l. c., p. 75) calls attention to the fact that the ectocyst in zoecia and oscaria are thinner than in the foraminifera.

In *arcia* there are in the oscaria often transverse and longitudinal lines or sutures, these are also mentioned by Smith (l. c., p. 74, pl. 24, fig. 35). Smith also says that these lines sometimes occur in the oscaria of *majuseula*, but I have not noticed them.

It is easy to distinguish between the two species. With regard to size, it may be mentioned that the oscaria in *arcia* are 0.8 mm. in length from the lower end to the tip of the oral denticle, and the corresponding measurement in *majuseula* gives 0.5—0.6 mm. Oscaria in *arcia* are rather oval, in *majuseula* they are approximately ball-shaped, in both species they are punctured like a thimble, but this is cresor in *majuseula* than in the other species.

The perforation in the frontal wall of the oscaria of *majuseula* is closer than in *arcia*, where it is, indeed, somewhat different. Hincks (l. c., pl. 14, fig. 2) has illustrated the oral denticle as being pointed, and I found some of them of this shape in the colony which I had under examination.

Operculum in *arcia*, I have not yet succeeded in isolating, in *majuseula*, on the other hand, it has a characteristic form, which also differs from the usual one in the genus *Santinia* (fig. 37).

A very evident difference between the two species is that the oscaria in *majuseula* are plainly separated, while in *arcia* they more evenly merge into each other.

This species is most likely exclusively arctic. In addition to the Porsanger Fiord, in Finnmark, the following finding places are mentioned, Spitzbergen, (Smith, St. Lawrence (Hincks).

*Santinia smithi*, Kircheneauer. (Pl. IV, fig. 21.)

The Ors Fiord I, 100 m.

In "Bryozoen des westlichen Norwegens", I used a new name for this form, *Santinia lacunosa*, as Kircheneauer's name for Smith's *Echinula lacunosa*, forma *punctata* had quite slipped out of my memory, notwithstanding that I made a note of it several years ago. Norman's here too made the necessary correction. I beg reference to Norman's list of synonyms, at the same time remarking that Schizoporella *Harmeniellii*, Waters, ought to be excluded from it, in accordance with what I have previously pointed out, that this must be *Santinia relictula-punctata*, Hincks.

Each zoecium has 6—8 lateral rosette-plates. As far as I could see, the two upper ones were bi-pored and the two next ones tri-pored.

This species has not previously been found in Norway.

*Santinia jeffreysi*, Norman.²

The Porsanger Fiord, 70 m.

The species was not previously found in Norway.

*Rhamphostomella costata*, (FABR.), SMIT.

(Pl. V, figs. 8—11.)


¹) Finnmark Polyzoa, p. 123.
²) Refer to synonyms in "Finnmark Polyzoa", p. 120.

Digeremalen, on stone, 150 m., The Jokel Fiord i, 100 m.; The Porsanger Fiord, 70 m.

Lorenz divided Smith's *Cellepora seabra* into two species, and as far as I can judge this division is perfectly justifiable. The difference between them may be characterized as follows.

*R. costata* has an oral denticle (fig. V, fig. 22) but in *seabra* it is wanting. In *costata* the avicularian mandible is about half as long as it is wide, while in *seabra* the height is only very little more than the width.

The oscaria in *costata* have usually more pores than those of *seabra* have (cf. figs. 9, 211). The rostrum in the latter species is shorter and blunter than in the former one. It is generally the case too that the radial lines in *costata* are continued on the rostrum, but this is not often so in the case of *seabra*. Both species are punctured on the basal wall of the zoecium (fig. 100) but more closely in *seabra* than in *costata*.

Hidenkø has found *Rhamphostomella costata* in the Lyngen Fiord. So that the species is now known from the coast of Finnmark to Lofoten.

*Rhamphostomella costata*, Lorenz.

(Pl. V, figs. 21, 22.)

1867. *Cellepora seabra*, Smith (part), Krit. fort., p. 30, pl. 28, figs. 186—188.

1886. *Rhamphostomella costata*, Lorenz, Bryozoa von Jan Mayen, p. 12 (94), pl. 7, fig. 11.


Tromsø, Mehlert (1894).

Norman has taken this form in the Varanger Fiord, and Hidenkø in Lyngen. The hitherto known southern limit for this species is Tromsø.

*Rhamphostomella plicata*, SMIT.

(Pl. V, figs. 14, 15.)


Nordkyn (1894) on an anemoid tube.

As is the case with *costata*, this species too has an oral denticle, which is, however, longer and narrower than in the species mentioned.

The oscium is as a rule provided with a few pores. I was not able to discover any punctures on the back side of the colony. It is therefore probable that Smith's fig. 190 does not represent this species.


Hammerfest (1894); The Troll Fiord Sund. 40 m.; The North Cape (1894); The Kjolle Fiord (1894).

I found this species quite common on algae and hydroids which I took on the east of Finmark in the autumn of 1894.

The zoecia are rather small, and the species is easily distinguished from the foregoing one, in that it wants the suboral rostrum and by the presence of the peculiar elevated peristome, about which HINCKS (l. c., p. 104) very appropriately remarks that it has "a very fantastic appearance".

The species is now known from Labrador, Iceland, Spitzbergen, Jan Mayen and Finnmark.


The Ostnes Fiord, 50-70 m., on stone; Hammerfest (1894), on stone; Breisund, 100 m., on a gastropod shell; Meiyva (1894), on Bulimus.

The species of the genus *Cellepora* have characteristic opercula with a more or less distinct proximal lobe as in the *Schizopyllula* species.

The shape of the operculum in the above mentioned species proves that it is quite impossible to look upon it as a variety of *C. vanduzo*, as it can, indeed, not be considered to belong to the *Cellepora* genus, Neither is it a typical *Rhamphostella*, but I retain it for the present under that genus, as I do not now know any more suitable place for it.

The surface of the zoecia are quite even, occasionally there is a suggestion of radial stripes. The young zoecia have as a rule 4 spines on the distal side of the oral aperture. The operculum is more solid than in the other *Rhamphostella* species. The mandible of the avicularia is not of the same shape either as is characteristic of the other species which belong to the same genus.


Breisund, Hammerfest: Alcyonidium Tsidella and Radosund, 'ellepora Fucus. The K»0 1123, have entered into Malangen. I (1894); havn North Balstad; Kirk Sag III, 200 m.; Rost, 100—200 m.; Moskenstrommen, The arctic Waters 100—200 m.; The North Fiord, 1871. Mag. 34. The Kirk Fiord, 100 m.; The Tys Fiord I, on Lophohelia, 500 m.; Malangen, 100—200 m.; Ingolavet, on sponges, 300 m.

Retepora bellii, LIN. Malangen, 100—200 m.; Hamnerfest (1894); The North Cape (1894); The Porsanger Fiord, 200 m.; Sverholt (1894). This species has not hitherto been found by me south of Malangen.

Retepora vallichius, Rsk. Pl. III, fig. 29. The Beier Fiord, 50—150 m.; Balstad; Stonesbota, 10—80 m.; Malangen, 100—200 m.; The North Cape (1894); Nordkyn (1894). I have also found this form in Røsdale, a little north of Bergen. The species is arctic in its distribution.

Cyclostomata.

Crisia clavata, LIN. Moskenstrommen I, 200 m.; The Kirk Fiord IV, 30—50 m.

Crisia denticleata, LAMARCK. The Kirk Fiord, 100 m.; Malangen, 380 m.

Tubulipora litorea, PALLAS. Pl. III, fig. 30. The Sag Fiord, 200 m.; on dead branches of Liodella hippariss; Malangen, 100—200 m.

Tubulipora penicillata ?, FAIR. Pl. III, fig. 32. The North Cape (1894); Malahyn (1894).

Flabellula atlantica, FORBES. Pl. III, fig. 32. The Sea N. W. of Rost, 700 m.; Moskenstrommen I, 200 m.; The Kirk Fiord, 30—50 m.; The Beier Fiord, 50—150 m.; Reine, 100 m.; Balstad, 30—50 m.; Mortsmund I, 200 m.; The Ostnes Fiord, 130 m.; The Jokel Fiord I, 100 m.; Breisund 100 m.; The North Cape (1894); The Porsanger Fiord, 70 m.

Diatyrella patina, LAMARCK. Malangen, 100—200 m.

Diatyrella obelia, JOHNSTON. Moskenstrommen, 90 m., on Balstad: The Kirk Fiord III, 70—80 m.; Digerdalen, on stone, 150 m.; The Tys Fiord I, on Lophohelia, 500 m.; Malangen, 100—200 m.; Ingolavet, on sponges, 300 m.

Retepora intricaria, SMIT. Sverholt (1894).

Horneria lichenoides, (PONTOP), LIN. Pl. III, fig. 35. Rost II, 150 m.; Moskenstrommen, 90 m.; Reine, 100 m.; Mortsmund II, 100 m.; Stonesbota, 10—80 m.; Malangen, 100—200 m.; Kvænangen II, 90 m.; Malahyn (1894).

Hornera cidaceae, M. SARS. Malangen, 100—200 m.; Malangen, 380 m.

Lichenpora hispida, FLEMING. The Kirk Fiord, 100 m.; The Tys Fiord I, on Lophohelia, 500 m.; Malangen, 100—200 m.; The Porsanger Fiord, 200 m.

Lichenpora verrucosa, FabRICOUS. Grobe, on algae, 6—24 m.

Dinopora stellata, GOLDFUSS. Pl. III, fig. 34. Reine (Lofoten), 100 m.; Malangen, 100—200 m.; Malangen indicates the northern limit of the species.

Defrancea borerinæ, M. SARS. The Kirk Fiord, 50—80 m., both living and dead colonies; The Ogs Fiord I, 100 m. (dead colony); Kvænangen II, 90 m.; The Jokel Fiord I, 100 m.; The Jokel Fiord II, 80 m.; The Porsanger Fiord, 70 m.

Ctenostomata.

Aleyonidium gelatinosum, LIN.¹) Malangen, 100—200 m.

Aleyonidium disciforme, SMIT. Pl. III, fig. 35.

Lyngen III, 320 m. This peculiar species had not previously been found on the Norwegian coast.

Flustrella hispida, FabRICOUS. The North Cape (1894), on Fucus serratus; Nordkyn (1894). on Fucus serratus. NOBMAN has found this species at Svolvær, Lofoten.

Flustrella corniculata, SMIT. Pl. III, fig. 37, 38.


¹) Aleyonidium kirkii, FLEM, has been found by NOBMAN on Fucus at Svolvær, Lofoten.
0. Nortgard.


Svolvær, Lofoten (1894), on alac.

Norman was the first to find this species on the Norwegian coast. He found it living between tidemarks at Vadso. It is interesting that this form which had previously only been found in the arctic regions can exist as far down as Lofoten.

Smith has described the species from Spitzbergen, where it has later been taken by Kittenthal and Walter, as well as by Römer and Schimanns. (Cf. Bredenk., l. c.).

Miss Robertson has described a species from material from Alaska, under the name *Aegonychina corniculata*, which is probably the same as Smith’s species. The only thing which might suggest a difference, is the aperture of the zoecium in *corniculata* is mentioned as being circular, while in *corniculata* (as in hospita) it is a fissure which is provided with two lobes. In preserved material, however, these facts may easily be wrongly interpreted. The characteristic, branched spines (Pl. III, figs. 37, 38), which are situated one at each corner between the zoecia, from which they are separated by an intermediate wall, seem to be alike in the two forms. They appear really to be identical. Both in *hospita* and *corniculata*, there are two semicircular shaped thickened places near at the oral aperture, these probably serve the same purpose as the operculum in *Chilosolenia*.

*Bowerbankia subcilicata*, Adams. P. III, fig. 36.

Nordkyn (1894), on Laminaria. I have a specimen from the North Ocean Expedition, st. 343, in which several colonies have grown together, forming comparatively thick branches (Pl. III, fig. 36).

The foregoing list of Bryozoa from the northern part of the Norwegian coast is not complete, but it is my opinion that it is fairly representative. The number has been increased by the addition of several species.

Of those forms described by Smith from the numerous Swedish arctic expeditions, there are now only exceedingly few which have not been observed by me on our northern coast. The Bryozoa fauna from Lofoten to the Varanger Fiord proves to contain more arctic elements than was previously supposed.

**Brachiopoda.**

Herman Friele and J. Sparre Schneider det. Remarks by the author.

*Orania anomala*, Mül.

The Kirk Fiord II, 70—80 m.; Mortsund (Vest Fiord), 200 m.; Digerumlen, 100—150 m.; Hammerfest (1894).

G. O. Sætre mentions the Komag Fiord in Vest Finnmarken as the northern limit for this species. Hammerfest is a little further north.

*Rhyacosmona palliacea*, Chemn. Malangen, 100—200 m.; Kvenangen II, 90 m.; The Jokel Fiord III, 100 m.; Breisand, 100 m.; The Porsanger Fiord, 200 m.

The southern limit for this species is The Malangen Fiord.

*Teretina unisetosae*, Lütz.)

The Beier Fiord, 50—150 m.; The Teys Fiord, 500 m.; The Kirk Fiord II, 70—80 m.; Mortsund II (Vest Fiord), 200 m.; The Ocs Fiord I, 100 m.; Malangen, 100—200 m.; Stounesbotten, 40—50 m.; Kvenangen II, 90 m.; The Jokel Fiord III, 100 m.; Hammer- fest (1894); Inoehavel, 300 m.; The Porsanger Fiord, 200 m.; The Kjøle Fiord (1894).

*Teretina septatophyllae*, Cuth.

The Beier Fiord, 50—150 m.; The Skjerstad Fiord III, 230 m.; The Salten Fiord II, 320—380 m.; Balstad (Vest Fiord), 150 m.

*Wahlheimia crassina*, Mül.

The Skjerstad Fiord III, 230 m.; The Teys Fiord, 500 m.; Rest III, 150 m.; Moskenstroomen, 90 m.; Reine (Vest Fiord), 100 m.; The Kirk Fiord IV, 30—50 m.; Balstad (Vest Fiord); Mortsund II, 290 m.; Stone (Vest Fiord); 100 m. The Ostnes Fiord; Digerumlen, 100—150 m.; Malangen, 100—200 m.; Kvenangen II, 90 m.; Hammerfest (1894); Inoehavel, 300 m.; The Kjøle Fiord (1894).

**Pelecyopoda.**

Herman Friele and J. Sparre Schneider det. Remarks by the author.

*Anomia ephippium*, Lin. Balstad, 80 m.; Digerumlen, 100—150 m.; Malangen, 100—200 m.; Kvenangen, 90 m.; The North Cape (1894); The Porsanger Fiord, 70 m.

*Anomia ephippium*. Mül.

The Skjerstad Fiord III, 230 m.; The Sæ Fiord, 200 m.; The Kirk Fiord, 70 m.; Stounesbotten, 40—80 m.; Malangen, 100—200 m.; The Jokel Fiord, 100 m.

**Petten islandicus**, Mül.

The Beier Fiord, 50—150 m.; The Skjerstad Fiord X (Mis- var Fiord), 10—30 m.; Moskenstroomen, 90 m.; The Ostnes Fiord; The Kanstad Fiord, 30—90 m.; Malangen, 100—200 m.; Kvenangen II, 90 m.; Breisand, 100 m.; The Porsanger Fiord, 50 m.

The largest specimen from The Skjerstad Fiord X was 80 mm. in length.

*Petten arctas*, Gmelin.

Moskenstroomen, 90 m.; Balstad (Vest Fiord), 150 m.


10) Some of the places have mentioned doubtless have reference to *T. sep-tatophyllae*, Schneider having considered it to be a variety of *unisetosae* but Friele has treated it as a separate species.
The specimen from Moskenstrommen was 15 mm. in height and 11 mm. in length.

The northern limit for this species is Lofoten.

*Pecten septemradiatus.* MÜLLER.
The Beier Fiord, 50—150 m.; (1 spec., 11 mm.); The Sag Fiord, 200 m. (s); Malangen, 100—200 m. (s); Gaukvåra, 250 m.
The largest specimen from Gaukvåra was 32 mm.
At Tromso, SCHNEIDER only found shells, but both M. and G. O. SARS collected the species in the Varanger Fiord.

*Pecten irieturn.* MÜLLER.
The Ostnes Fiord.
This species was previously known right up to The North Cape. NORMAN in 1890 took it in The Lang Fiord (South Varanger).²

*Pecten striatus.* MÜLLER.
Stromesholm, 40—80 m.
Hayosund (Finmark) is the northern limit for this species.

*Pecten inconspicuus.* RISSE.
The Ostnes Fiord, 30 m.
Lofoten is the northern limit for the species.

*Pecten imbrifer.* LOVÉN.
Malangen, 380 m.; Kvænangen H, 90 m.

*Pecten cirrosus.* CHEMBTZ.
The Beier Fiord, 50—150 m.; The Skjerstad Fiord III, 250 m.; The Tys Fiord, 500 m. (in quantities on *Lepidodex pruifera*); The Ogs Fiord I, 100 m.; The Kanaas Fiord, 30—90 m.

*Pecten abyssorum.* LOVÉN.
The Skjerstad Fiord IV, 330 m.; Brettesnes—Skroven, 350—400 m.; Malangen, 380 m.

*Pecten similis.* LASKEY.
Moskenstrommen I, 200 m.; Balstad (Lofoten), 150 m.

*Pecten granulatus.* SOWERBY.
Lyngen H, 250 m.; Lyngen H, 300 m.; Kvænangen, 300—343 m.
The southern limit for the species is Tromso.
At St. Lyngen H several specimens were taken, the largest measured 22 mm., thus being very nearly as large as the specimens from Spitzbergen which are given as being 24 mm.

*Lima excavata.* FABR.
Arto, 300—400 m.; Tys Fiord I, 500 m.
The largest specimen measured 135 mm.
G. O. SARS has caught this species at Skroven (Lofoten). According to SARS³ the species is mentioned from Finnmark by Mr. ANDREW, but is has, however, not been taken there later.
FRIELE and GRIEß² give the distribution of this species to the depths between The Hebridies end The Faroe Isles, Portugal, The Azores and Senegambia. On our coast the species is limited to the great fiord depths with their particularly constant temperature and salinity (6—7°C., about 35 ‰).
As The Vest Fiord is the most northern of the principal fiords where these physical conditions prevail, I am inclined to think that the mention of this species from Finnmark must be a mistake.
The northern limit should be looked upon as Lofoten, until there is definite information that it is distributed still further northwards.

*Lima hescambia.* SOWERBY.
Moskenstrommen, 90 m.
G. O. SARS has found shells of this species at Skroven. My catches in Moskenstrommen prove that the species still exists at Lofoten, which must therefore be considered to be its northern limit on our coast.

*Limaria reussii.* FORBES.
Moskenstrommen I, 200 m.

*Mylus calathis.* LIN.
Nordkyn (1894). Common other places too.

*Melida capillata.* LIN.
The Skjerstad Fiord X, 10—50 m.; Hammerfest (1894); Troddhørsund, 40 m.; Nordkyn (1894).

*Melida phascolina.* PHILIPPI.
Moskenstrommen, 200 m.; Reine I, 150 m.; Balstad, Steine, 120—200 m.; Henningsæver-Strommen, 20—40 m.; The Sag Fiord, 250 m.; Malangen, 100—200 m.; Troddhørsund, 40 m.; Breisund, 100 m.

*Dreisia cirrata.* MOLLER.
Ute I (Vest Fiord), 250—300 m.; month of Raftsund, 250—300 m.; The Ogs Fiord I, 100 m.; Malangen, 380 m.; Lyngen H, 250 m.

*Cerulla decussata.* MONT.
The Skjerstad Fiord II, 100—150 m.; Gaukvåra H, 25 m.; Hammerfest (s).

*Mollusca beziquata.* GRAY.
The Beier Fiord, 50—150 m.; The Ostnes Fiord, 20 m.; Breisund, 100 m.; The North Cape (1894).
The Beier Fiord is the southern limit for this species. I collected a small specimen here.

*Mollusca nigra.* GRAY.
The Beier Fiord, 50—150 m.; The Kirke Fiord H, 50 m.; Morstøl III, 100 m.; Gaukvåra, 250 m.; Stromesholm, 40—80 m.; The Jokel Fiord I, 100 m.; Troddhørsund, 40 m.

*Nicula tremulida.* MALM.
The Skjerstad Fiord IV, 330 m.; The Skjerstad Fiord VII, 190 m.; The Salten Fiord II, 320—380 m.; Brettesnes—Skroven, 350—400 m.; Tramdybey, 407—410 m.

*Nicula laevis.* MONT.
The Skjerstad Fiord VII, 400 m.; The Ogs Fiord I, 100 m. (s); The Jokel Fiord, 100 m.
The typical form extends to Malangen, or, at any rate, to Lotofen; var. septentrionalis is limited southwards in the Beier Fiord.

**Arenula glacialis**, GRAY.

The Persanger Fiord, 200 m.

According to G. O. Sars, this species has been caught at Magere by Vaksvekm. Further westwards and southwards this species has not hitherto been noticed on our coast.

**Limopsis minuta**, PHIL.

The Salten Fiord I, 320—380 m.; The Folden Fiord, 530 m.; Landego, 240—450 m.; Oxsund, 600 m.; The Sug Fiord, 200 m.; Moskenstrommen, 200 m.; Balstad, 150 m.; Steine (Vest Fiord), 120—200 m.; Ure I, 200—250 m.; Skroven, 200—400 m.; The Kaustad Fiord, 30—90 m.

FRIELE and GRÉG mentioned that this species was taken by The Norw. North Atl. Exp. at St. 290, which is situated about half way between Norway and Beeren Eiland, which is the most northern place where it is known.

**Cardium molestum**, TEC.

The Kanstad Fiord, 30—90 m.

**Cardium echinatum**, LIN.

The Salten Fiord I, 15—20 m.

**Cardium fasciatum**, MONT.

The Beier Fiord, 50—150 m.; The Skjerstad Fiord VI, 125 m.; The Skjerstad Fiord VII, 490 m.

**Cardium leptica**, MOLLER.

The Beier Fiord, 50—150 m.; The Skjerstad Fiord, 100—150 m.; The Skjerstad Fiord VI, 125 m.; The Kirk Fiord IV, 70—80 m.; Mortsmund I, 200 m.; The Ogs Fiord I, 100 m.; The Kanstad Fiord, 30—90 m.; Malangen, 380 m.; Stomnesbotn, 40—80 m.; The Jokel Fiord II, 80 m.

**Lambis limata**, SAY.

The Kirk Fiord, 70—80 m.; Svolvær, 150 m.; The Ogs Fiord, 30—40 m. (several specimens, the largest being 35 mm.); Stomnesbotn, 40—80 m.; The Kjolle Fiord (1894).

The southern limit for this species is Lorboten.

**Mallea oktama**, M. SARS.

Moskenstrommen I, 200 m.; Bretteles—Skroven, 300—400 m.; Tranoydyb, 640 m.

The northern limit for this species is Lorboten.

**Acre pentameroidea**, SCACCH.

The Beier Fiord, 50—150 m.; (var. septentrionalis); The Skjerstad Fiord III, 230 m.; (var. septentrionalis); The Skjerstad Fiord VI, 125 m.; (var. septentrionalis), the largest specimen 9.5 mm.; The OxSand, 600 m.; The Sug Fiord, 200 m.; Moskenstrommen, 200 m.; Ure I, 200—250 m.; Mortsmund I, 200 m.; Bretteles—Skroven, 300—400 m.; The Ogs Fiord I, 100 m.; mouth of Rais- sand, 250—300 m.; Tranoydyb, 640 m.; Gaukvaro II, 250 m.; Malangen, 100—200 m.; (var. septentrionalis); Malangen, 380 m.; The Jokel Fiord III, 100 m.; (var. septentrionalis); Kvenangen, 300—345 m. (var. septentrionalis).
The Salten Fiord, 15—20 m.

Syndosmya ulva, Wood.
The Salten Fiord I, 15—20 m.

Syndosmya fragilis, Scaliun.
The Salten Fiord II, 320—380 m. (s); The Folden Fiord, 530 m.; Landego, 200—450 m.; Mortsund I, 200 m.; Skroven, 200—100 m.

Syndosmya nivalis, MÜLLER.
Mortsund I, 200 m.; Tranøybet, 640 m.; Gaukvåg II, 250 m.; Malangen, 380 m.

Tellina (Musum) calceina, CHEMN.
Mortsund II, 90 m. (s).

Solen sellucidus, PеньN.
The Salten Fiord I, 15—20 m.
The northern limit for this species is Lofoten.

Novia arctica, M. SARS.
The Beier Fiord, 50—150 m.; The Skjerstad Fiord IX, 80 m.
FRIELE and GRIGG mention that this species was only known from one place on the Norwegian coast, viz. Vadsø (Varanger Fiord).

Novia obsota, LAM.
The Beier Fiord, 50—150 m.; The Salten Fiord II, 320—380 m.; The Folden Fiord, 530 m.; Oxssund, 600 m.; The Kirk Fiord IV, 30—50 m.; Mortsund I, 200 m.; Bretekaas—Skroven, 350—400 m.; Risvårdshølet, 150—180 m.; The Kanstal Fiord, 30—90 m.; Tranøybet, 640 m.; Gaukvåg II, 250 m.; Malangen, 380 m.; Lyngen III, 300 m.

Novia obsota var. glaucalis, G. O. SARS.
The Beier Fiord, 50—150 m.
In my collection there were most likely several forms of this variety which have been classified under the chief form. (*N. obsota, LAM.)*

Novia salaltata, G. O. SARS.
The Skjerstad Fiord VI, 125 m.; The Jokel Fiord, 100 m. The Skjerstad Fiord is the southern limit for this species, as far as is now known.

Novia rathbra, SPENDEL.
The Salten Fiord II, 320—380 m.; The Folden Fiord, 530 m.; Landego, 200—400 m.; Bretekeas—Skroven, 350—100 m.
This is one of the southern forms, which G. O. Sars has found at Hasvik on Soro.

Novia caspiacea, OLAVI.
The Skjerstad Fiord VI, 125 m.

Parama granulata, NYST.
Malangen, 100—200 m.

Carapace gibba, OLAVI.
The Ostnes Fiord, 20 m.

Scaphopoda.

Herman Frielle and I, Speare Schneider determ.
Remarks by the author.

Deudalium exiguum, LIN.
The Skjerstad Fiord IX, 80 m.; Rest II, 150 m.; Svolvær (1894); Digerum men, 100—150 m.; The Oos Fiord I, 100 m.; Malangen, 100—200 m.; The North Cape (1894); The Kjolle Fiord (1894).

Zyphera crispatula, LIN.
On the farm Sund in The Beier Fiord, on the beach. This is one of the mussels which are used as bait.

Scaphopoda.

Herman Frielle and I, Speare Schneider determ.
Remarks by the author.

Deudalium exiguum, LIN.
The Skjerstad Fiord IX, 80 m.; Rest II, 150 m.; Svolvær (1894); Digerum men, 100—150 m.; The Oos Fiord I, 100 m.; Malangen, 100—200 m.; The North Cape (1894); The Kjolle Fiord (1894).

Zyphera crispatula, LIN.

On the farm Sund in The Beier Fiord, on the beach. This is one of the mussels which are used as bait.

Scaphopoda.

Herman Frielle and I, Speare Schneider determ.
Remarks by the author.

Deudalium exiguum, LIN.
The Skjerstad Fiord IX, 80 m.; Rest II, 150 m.; Svolvær (1894); Digerum men, 100—150 m.; The Oos Fiord I, 100 m.; Malangen, 100—200 m.; The North Cape (1894); The Kjolle Fiord (1894).

Zyphera crispatula, LIN.

On the farm Sund in The Beier Fiord, on the beach. This is one of the mussels which are used as bait.
**Natica groenlandica, Beck.**

The Salten Fiord I, 15–20 m.; The Kirk Fiord III, 70–80 m.; Mortsund I, 100 m.; The Ogs Fjord I, 100 m.; The Ogs Fjord II, 200 m. (s).

**Natica (Lamellia) intermedia, Phil.**

The Salten Fiord I, 15–20 m.; The Kirk Fiord II, 50 m.; The Kirk Fiord III, 70–80 m.; The Kirk Fiord IV, 30–50 m.; Mortsund III, 100 m.; The Ogs Fjord I, 100 m.; The Ogs Fjord II, 200 m. (s); The Porsanger Fjord, 200 m. (s).

**Margarita sowerbyi, Fabr.**

The Kirk Fiord III, 70–80 m.; Balstad, 10–35 m.; Mortsund I, 100 m.; The Ogs Fjord I, 100 m.; The Ogs Fjord II, 150–150 m.; The Kanstad Fjord, 30–90 m.; Malangen, 100–200 m.; Stonnesbotn, 40–80 m.; Trolldalsund, 10 m.

**Margarita cinerea, Couth.**

The Kirk Fiord IV, 30–50 m. (s); The Jokel Fiord III, 100 m.; Hammerfest (1894) (s).

**Margarita cinerea var. Couth.**

The Kirk Fiord, 50–150 m. (s); Stonnesbotn, 10–80 m.; Malangen II, 90 m. (s); Trolldalsund, 10 m.; Hammerfest (1894) (s).

**Gibbula cinaria, Lin.**

The Salten Fiord I, 15–20 m.; The Salten Fiord II, 320–350 m.; The Kirk Fiord III, 70–80 m.; Balstad, 10–35 m.; Svolvær (1894); Risværflaket, 150–150 m.; The Kanstad Fjord, 30–90 m.; Lyngen III, 300 m.

**Gibbula unaloida, Most.**

The Salten Fiord I, 15–20 m.; Henningsværstrommen, 20–40 m.; The Kanstad Fjord, 30–90 m.; Kvænangen II, 90 m.

**Trophus occidentalis, Migh.**

The Beier Fiord, 50–150 m.; Reine, 100 m.; Balstad, 10–35 m.; Malangen, 100–200 m.; The Jokel Fiord I, 100 m.; Hammerfest (1894) (s); Breisund, 100 m.; Inghavet, 300 m.

**Unio multigranosus, Phil.**

Digerumalen, 100–150 m.

The northern limit for this species is Digerumalen.

**Capulus hungarius, Lin.**

Rost II, 150 m.

I collected two dwarf-like specimens at Rost, which is the most northerly place where the species has been observed alive.

**Pallium berghei, Penn.**

Svolvær (1894); Breisund, 100 m.

**Pallium flexile, Most.**

Breisund, 100 m.

**Lamellaria latens, O. F. Müll.**

Arno, 300–400 m.

A giant specimen, about 50 mm.

**Murex procilius, O. F. Müll.**

Mortsund III, 100 m.; Svarholt (1894).

**Oxystoma ochraceum, M. Sars.**

Tys Fiord, 500 m.

**Asterias islandica, Gmelin.**

The Beier Fiord, 50–150 m. (s); Malangen, 100–200 m. (s); Hammerfest (s); Trolldalsund; Breisund.

**Littorina littorea.** several large specimens.

**Littorina rudis, Meton.**

The Skjærgaard Fiord I, 30–50 m.; The Salten Fiord, 320–350 m.; Ossund, 500 m.; Ure I, 200–250 m.; Ossund Fiord (s); Geitvær, 250 m.; Malangen, 100–200 m. (s); Kvænangen II, 90 m. (s); The Jokel Fiord I, 100 m.; The Jokel Fiord III, 100 m.; Breisund, 100 m.; The Porsanger Fjord, 200 m.

**Trichactis borealis, Brot. & Sow.**

Moskenstrommen I, 200 m.; Balstad, 10–35 m.; Malangen, 100–200 m.; The Jokel Fiord I, 100 m.; The Jokel Fiord II, 80 m.; Hammerfest (s); Trolldalsund, 40 m.; The Porsanger Fjord, 200 m.

**Trichactis conica, Moll.**

The Jokel Fiord.

Tromse is the southern limit for this species.

**Littorina palliata, Say.**

From Olaf Vaade, factory-manager, I zot specimens of this species, which were collected at Vardo.

**Littorina obscurata, Lin.**

„Glea“ (Rost), several large specimens.

**Littorina vulpina, Say.**

The Skjærgaard Fiord IX, 80 m.; Risværflaket, 150–180 m. (s).

**Littorina gemmula, Moll.**

collected at Vardo was given me by my friend Olaf Vaade.

**Littorina palliata, Say.**

From Olaf Vaade, factory-manager, I zot specimens of this species, which were collected at Vardo.

**Littorina obscurata, Lin.**

„Glea“ (Rost); Risværflaket, 150–180 m. (s).

**Lamina saccata, Fabr.**

The Salten Fiord I, 15–20 m.; Balstad, 10–35 m.; Henningsværstrommen, 20–40 m.; Svolvær (1894); Risværflaket, 150–150 m.; The Kanstad Fjord, 30–90 m.; Kvænangen II, 90 m.; Trolldalsund, 40 m.; The North Cape (1894); Svarholt (1894).

**Rissoa (Alvania) jefferisi, Waller.**

The Skjærgaard Fiord VI, 125 m.; Hammerfest (s).

**Rissoa (Onoba) aculeus, Gould.**

Hammerfest (s).
Lovenella melitae, LOY.  
The Kirk Fjord II, 50 m.; Bretenes—Skroven, 300—400 m.  
Geriithaspis costulata, MOLL.  
Hammerfest (s).  
Lovenchis grunni, WOOD.  
Reine I, 150 m.  

Aphais perpellean, LIN.  
The Salten Fjord I, 15—20 m. Several rather large specimens.  
G. O. Sars has occasionally caught this species in the Ox Fjord.  
On the inner coast, from Lofoten to the Ox Fjord, the species has not been noticed; but on the outer coast it is mentioned by Schneider as being collected at Lyngo and Vanda.  

Scolacia greemallicola, CHERN.  
The Skjerstad Fjord III, 250 m. (s); Lyngen III, 300 m.; Hammerfest (s); Tromsörsund, 40 m.; The Porsanger Fjord, 200 m.  
At Hammerfest and at the station Lyngen III empty shells of var. loveni were found.  

Scolacia oblongostata, WOOD.  
Lyngen III, 300 m. (s).  

Hemiaris cervana, JEFFREYS.  
The Sag Fjord, 200 m.  

Eschnia sellor, SACCHEL.  
The Folden Fjord, 550 m.  

Echinia intermedia, N. CANTE.  
The mouth of Raftsund, 250—300 m.; Oxund, 600 m.  

Echinia stenosoma, JEFFREYS.  
Landeo, 200—400 m.; Montsund I (Vest Fjord), 200 m.; the mouth of Raftsund, 250—300 m.; The Sag Fjord, 200 m.  
According to Schneider the former northern limit for this species was Tromsö; but The Norw. North Atl. Exp. collected specimens not only in the Skjerstad Fjord, but also in the Vest Fjord, The Alten Fjord, The Porsanger Fjord and The Tana Fjord.  

Adnaka cirrata, FABR.  
The Beier Fjord, 50—150 m.; The Skjerstad Fjord I, 30—50 m.; The Skjerstad Fjord IX (s); Moskenstroomen, 200 m.; Balstad, 150 m.; Montsund II, 200 m. (s); Steine (Vest Fjord), 100—200 m.; Gaukvaro II, 250 m.; Lyngen II, 250 m.; The Jokel Fjord, 100 m.; The Porsanger Fjord, 200 m.  

Mangelia (Raphidina) nana, EXCWH.  
Moskenstroomen I, 200 m.  
This is one of the southern forms which has been caught by G. O. Sars at Hasvik on Sare.  

Tevania cirrata, BRUGNOS.  
Lyngen II, 250 m.  

Beia pyramidalis, STROM.  
Lyngen II, 100 m.  

Bela sarci, VERHIL.  
The Kirk Fjord IV, 30—50 m.; The Porsanger Fjord, 70 m.  

Bela skelitis, LOY.  
The Beier Fjord, 50—150 m. (s); The Jokel Fjord, 100 m. (s).  

Bela melitae, MOLLER.  
The Jokel Fjord I, 100 m.  

Bela scalaris, MOLLER.  
Gaukvaro II, 250 m. (s); Malangen, 100—200 m. (s); Lyngen III, 300 m. (s).  

Bela rugulata, MOLLER.  
The Beier Fjord, 50—150 m.; The Skjerstad Fjord II, 185 m.; Malangen, 100—200 m.; Kyvangen II, 90 m.  

Bela carinata, MOLLER.  
Lyngen II, 250 m.; Kyvangen, 300—343 m. (s).  

Bela harpullaria, COUTH.  
The Salten Fjord I, 15—20 m.; Stennesboth, 40—80 m. (var. rasset).  

Bela leevyana, TURT.  
The Skjerstad Fjord VI, 125 m.  

Bela terricostata, M. SARS.  
The Beier Fjord, 50—150 m.; The Skjerstad Fjord IX, 80 m.; Montsund I, 200 m.; Gaukvaro II, 250 m.  

Tychamoengilia arctica, LOY.  
The Beier Fjord, 50—150 m.; The Skjerstad Fjord IX, 80 m.; The Sag Fjord, 200 m.; Montsund II, 200 m.; Ure I, 200—250 m.; Digerunten, 100—150 m.; Gaukvaro II, 250 m.; Malangen, 100—200 m.; Lyngen II, 300 m.  

Spirelopsis carinata, PHIL.  
Moskenstroomen, 200 m.; Balstad, 150 m.; Digerunten, 100—150 m. (s); The Sag Fjord, 200 m.; Gaukvaro II, 250 m.; Malangen, 380 m.  

Metzgeria olba, JEFFREYS.  
Moskenstroomen, 200 m.; Ure I, 200—250 m. (s); Malangen, 100—200 m.  

Trophon transnullus, STROM.  
Henningsværstrommen, 20—40 m.; Hammerfest (s).  

Trophon ophthalos, LIN.  
The Beier Fjord, 50—150 m. (var. gunneri); Moskenstroomen, 200 m.; The Kirk Fjord II, 70—80 m. (s); The Kirk Fjord III; Svolvær (1894) (var. gunneri); Breisund, 100 m. (the typical form and var. gunneri); The Porsanger Fjord, 200 m.  

Trophon bacenti, JOHNST.  
The Beier Fjord, 50—150 m.; The Skjerstad Fjord IX, 80 m.; Moskenstroomen, 200 m. (s); Malangen, 380 m. (s).  

Papurea lapillus, LIN.  
The Salten Fjord I, 15—20 m.; „Glen“ (Rost), on the beach; The North Cape (1894); Nordkyn (1894).  

1) Beretning om en zoologisk Reise Sommeren 1849. Ssp. p. 64.
Ascophyllum nodosum, COUTH.

"Glea" (Rost), on the beach; Hammerfest (s); Breisund, 100 m. (s).

Nussa incongruata, STRÖM.

Svolvær (1894).

Bacillaria ambulans, LINX.

The Beier Fiord, 50—150 m.; The Salten Fiord l, 15—20 m.; The Skjerstad Fiord l, 30—50 m.; The Skjerstad Fiord IX, 50 m. "Glea" (Rost); The Ostnes Fiord, 10 m.; Malangen, 100—200 m.; Stonessboth, 40—80 m.

Bacillaria gowenolakin, CHEMS.

The Jokel Fiord II, 60 m.

Tronso is its southern limit.

Bacillaria finnarchicosa, VERKE.

Kvænangen II, 90 m. (s); Breisund, 100 m.; The Porsanger Fiord, 200 m.; Sverdhol (1894).

There is no certain proof that this species has been seen alive south of the Bals Fiord, where, according to SCHNEIDER, it has been caught on a fishing line.

Üko tortoni, BEAN.

The Porsanger Fiord, 200 m.

Volatopsis norvegica, CHEMS.

Reine (Vest Fiord), 100 m.; Balstad II, 80 m.; The Ostnes Fiord; The Kanstad Fiord (s).

The southern limit, as known at present, for this species is The Vest Fiord.

Nephrops species, LINX.

The Beier Fiord, 50—150 m.; The Skjerstad Fiord IX, 80 m.; The Kanstad Fiord, 30—90 m.; Malangen, 100—200 m.; Kvænangen II, 90 m.; Breisund, 100 m.

Sipho insulicnicus, CHEMS.

Røst I, 100 m.

Sipho gowenii, var. globier, VERKEÜZEN.

Reine, 100 m.; Balstad; The Ostnes Fiord; Malangen, 100—200 m.; Sverdhol (1894); Melavå (1894).

Sipho borealis, M. SARS.

Reine, 100 m.; Balstad, 150 m. (s); Mortnsund, 200 m. (s); Svolvær (1894).

Sipho obtusus, MORT.

The Skjerstad Fiord II, 155 m. (s); The Folden Fiord, 530 m.; Amø, 300—400 m. (s); Malangen, 100—200 m.

Sipho leuconychus, MÜLLER.

The Jokel Fiord III, 150 m. (s); Breisund, 100 m. (s); The Porsanger Fiord, 200 m. (s).

The southern limit is Tronso.

Cylichna abed, BROWN.

The Skjerstad Fiord IV, 330 m.; The Skjerstad Fiord VII, 190 m.; Mortsund I, 200 m.; The Ostnes Fiord; The Porsanger Fiord, 200 m.

Amphipyra expansa, JEFF.

The Folden Fiord, 530 m.

Amphipyra bicolor, COUTH.

The Beier Fiord, 50—150 m.; Ripsen, 150—180 m.

Scaphander puncto-strictus, MORT.

The Salten Fiord II, 320—380 m.; The Folden Fiord, 530 m.; The Sag Fiord, 200 m.; The Kirk Fiord III, 70—80 m.; Svolvær (1894); The Kanstad Fiord, 30—90 m.; Malangen, 380 m.; The Jokel Fiord III, 100 m.

Scaphander hyacinus, LINX.

Balstad, 150 m.; Mortsund III, 100 m.

The northern limit is Løkken. In the neighbourhood of Bergen (Horda Fiord) the species reaches a length of 40 mm., the largest specimen from Mortsund measured 19 mm.

Pholoe quinquecola, WOOD.

The Skjerstad Fiord VII, 490 m.; Røste I, 150 m.

Pholoe finnarchica, M. SARS.

The Skjerstad Fiord IV, 330 m.; The Skjerstad Fiord VII, 490 m.

The Skjerstad Fiord is the southern limit for this species, as far as is now known.

Pleurobranchus planula, MONT.

The Tys Fiord, 500 m.; Breisund, 100 m.

GIESEN mentions it from the Vane Fiord (Nord Fiord) and Storskjerstad from Rødberg in the Troondhjem Fiord.

The northern limit must now be changed to the Breisund.

Nudibranchiat.3)

Remarks by HERMAN FRÈLE, who has also determ.

Calidus obscura, O. G. MÜLLER.

C. repanda, A. & H. (2).

Kvænangen, 90 m.

A small specimen. The teeth correspond to C. obscura, but in external appearance, there seems to be some difference; I do not, however, venture to name a new species after my examination of a specimen which was possibly only imperfectly developed, and was also greatly contracted.

Demodocus arboricola, MÜLLER.

Røst II, 150 m.; The Porsanger Fiord, 200 m.

Demodocus robustus, VERHOLZ.

The Skjerstad Fiord II, 100—185 m.; The Skjerstad Fiord IV, 330 m.; Stonessboth, 40—80 m.; The Jokel Fiord, 80 m.

Campeotea major, BERING.

The Skjerstad Fiord III, 230 m.

3) Descriptions by Mr. Furse of the new species here mentioned will soon be published.
Only one specimen of this species, which is described by RuB. BerGn in "Nitidibranchien" from the Wilhelm Barents Expedition, has previously been found, and that was at Vardo.

Coryphella rufibranchiens, Bom. 1899, Breisund, 100 m. Two specimens.

Coryphella rufibranchiens, n. sp., M. S.

The Skjerstad Fiord H. 190—185 m. Four specimens.

Coryphella sp.

The Skjerstad Fiord IV, 330 m. One specimen. Judging from the structure of the teeth and the edges of the jaws, it would seem that this specimen belongs to an unknown species; but it was in such a mutilated condition that its external appearance cannot be described.

Anableps pusilla, n. sp. M. S.

Kvænangen, 90 m.

Cephalopoda.

Ommastrephes babaruns, Rop.

Jaws of this species were found in the stomachs of cods and coal fish (Gadus eivenes) at Sundero (in Vesteraalen) in February 1897.

Rossia glacialis, Loy.

Mortsund I. 200 m.; Malangen, 190—200 m.; Kvænangen H. 90 m.; Stovholt (1894).

Crustacea.

Copepoda.

The author determ.

Euryple longicorda, Philippi.

(Thorellia brunnea, Borek). 1

Repvaag (Porsanger Fiord), 10 m.

The species was very common at this place, the females generally had ovisacks.

Dactylopus striatus, Bried.

Repvaag (Porsanger Fiord), 10 m.

Thysbeis (Dactylopus gibbus, Kroeyer. (G. O. Sars determ.). Repvaag (Porsanger Fiord), 10 m.

Harpactes rufifer, Müller.

Repvaag (The Porsanger Fiord), 10 m.

Elina furcata, Bried.

Repvaag (The Porsanger Fiord), 10 m.

Important contributions to the knowledge of the Copepoda of northern Norway have recently been made by Prof. G. O. Sars, 2 Dr. Thomas Scott, 3 and the Rev. Canon A. M. Norman. Dr. Scott has described several new species from Finnmark.

Branchiopoda.

Nebalia bipes, Fabr. 1898.

Repvaag (Porsanger Fiord), 10 m.


Ostracoda.

G. O. Sars determ.

Paradoxostoma carinale, Bried.

Repvaag (Porsanger Fiord), 10 m.

Cyprioides norvegicus, Bried.

Oksund, 600 m.; The Sag Fiord, 200 m.; Moskenstrømmen, 180 m.; Reine (Vest Fiord), from the stomach of cod; Holm (Vest Fiord) 250 m.; Gaukvatn H. 250 m.

I also found this species in the stomach of cod (Gadus vulgaris) caught at Christiansund 35° and at Sartoro 38° 1898.

Contributions to the knowledge of the Ostracoda of Northern Norway have especially been made by A. M. Norman 4 and G. O. Sars, 5

Cirripedia.

The author determ.

Lepas umbilicata, Lin.

Moskenesøya (Lofoten), on a glass ball.

Candeevidna marinum, Lin.

Mehavn (Finnmark) on Megoptera hoops fastened to Corallina chilorea.

Scolopelium stromi, M. Sars. 6

Tramodychet, 607—610 m.; The Porsanger Fiord, 200 m.

Balanus balanoides, Lin.

Common on the rocks along the beach.

Balanus crenata, Bruck.

The North Cape (1894). Is found in tolerably deep water.

Balanus porrectus, da Costa.

Kvænangen H. 90 m.; The North Cape (1894).


5) G. O. Sars determ.
Botanus longus, Sarsius.

Rost I, 120 m.
The specimen was about 50 mm. in length. G. O. Sars has collected some specimens, in the Sorvaund near Hamnerfjord, which were 90 mm. in length and 50 mm. in height.

Several (possibly all) of the specimens collected at Rost contained a very large number of nauplius larvae (23) (1899).

Flanagania stramina, Müll.
Common in all fiords.

Ceratoma doinéïna, Linn.
Mehaun (Finmark) on the skin of Megapleurus hoops. According to Weitzner, this species is a thorough cosmopolitan.

Amphipoda.

J. Sparre-Schneider det. Rer.
Remarks by the author.

Scorites eridi, Kroeyer.
Trollhórdandsud, 10 m.; Breisund, 100 m.

Andrascia danica, Boeck.
The Skjerstad Fiord III, 230 m.; Ure I (Vest Fiord), 200—250 m.

Andrascia tanae, Kroeyer.
Reine (Vest Fiord), 150 m., januaris.

Calipsona hippoc. A. Costa.3

Calipsona cromata, G. O. Sars., Amphipodi, p. 53, Pl. XIX. Fig. 1.
The Skjerstad Fiord IX, 80 m.

Hippocampe desentricus, Bate.
The Salten Fiord I, 15—20 m.; Næstrommen (Lofoten) 30—40 m.

Hippocampe propinquus, G. O. Sars.
Kvænangen II, 90 m.

Oechoneae cervata, Boeck.
Henningsvær I (Vest Fiord), 150 m.; The Tys Fiord I, 500 m.

Oechoneae amblyops, G. O. Sars.
Mortsund I (Vest Fiord), 200 m.

Oechoneae minuta, Kroeyer.
Trollhórdandsud, 10 m.; Repvåg (Porsanger Fiord), 10 m.

Oechoneae pinguis, Boeck.
Repvåg (Porsanger Fiord), 10 m.

Tryphosella (2) boring, Boeck.
The Skjerstad Fiord II, 100—185 m.; The Folden Fiord, 530 m.; The Søg Fiord, 200 m.; Mortsund (Vest Fiord), 200 m.; Ure I (Vest Fiord), 200—250 m.; Malangen, 350 m.


Schneider has used the names of Sars in Amphipoda. I have made some alterations in this respect, as I have acted upon Norman’s remarks in his revision of British Amphipoda.

Uristes ambisonis, G. O. Sars.
Ambistylipes ambisonis, G. O. Sars.
Reine (Vest Fiord) from the stomach of cod.

Angon**** shag. Phipps.
The Salten Fiord I, 15—20 m.; The Kirk Fiord II; The Kanstad Fiord, 30—90 m.; The Jokel Fiord, from the stomach of cod; Repvåg (Porsanger Fiord), 10 m.

Hypolyra ciraba, Fabr.
Reine (Vest Fiord), from the stomach of cod; Svolvær (Vest Fiord), from the stomach of cod; The Jokel Fiord II.

Chirocerinae debraunii, Hoek.
Kvænangen II, 90 m.

This species is previously known from The Barents Sea (Hoek); Lofoten, The Trondhjemen Fiord, Christiansund (G. O. Sars).

Leptophysetum amblo, Goze.
The Beier Fiord, 50—150 m.; Hela (Vest Fiord), 150 m.; Støunestøtn, 10—80 m.; The Jokel Fiord II, 80 m.

Leptophysetum falcatus, G. O. Sars.
Malangen, 380 m.

This species was previously known from Bohuslen and up to the coast of Nordland. The northern limit must now be taken to be Malangen.

Paraliphasus equilabatus, G. O. Sars.
The Skjerstad Fiord VII, 490 m.

Amphiceros macerophaïla, Lilljeborg.
Kvænangen II, 90 m.

Amphiceros creniceros, Kroeyer.
The Beier Fiord, 50—150 m.; The Skjerstad Fiord IX, 80 m.; The Kirk Fiord, 50 m.; The Ogs Fiord, 100 m.; The Kanstad Fiord, 30—90 m.

Amphiceros equicernus, Brueelius.
Malangen, 100—200 m.; Kvænangen II, 90 m. The previously known northern limit was Lofoten; this must now be changed to Kvænangen.

Amphiceros amblyops, G. O. Sars.
Malangen, 380 m.

This species was previously known from Bohuslen, and Sars has collected it in the Kristiania Fiord and the Trondhjemen Fiord. Its northern limit must now be taken to be Malangen.

Hypolyra tubicola, Lilljeborg.
The Kirk Fiord II, 50 m.; Malangen, 380 m.

Stegophasus inflatus, Kroeyer.
Rost, from the stomach of cod; Malangen, 380 m.; Ingohavet, 300 m.; The Porsanger Fiord, 200 m.
Stephanopus similis, G. O. Sars.
The Skjerstad Fiord VII, 190 m.; Henningsvær (Vest Fiord), from the stomach of cod; Malangen, 380 m.
The most northerly place at which Sars has collected this species is Tjøtta. Its northern limit must now be changed to Malangen.

Anulina abyssi, Boeck.
Malangen, 380 m.
The northern limit must now be moved from Lofoten to Malangen.

Amphilectus levaimanus, Boeck.
Malangen, 380 m.
Sars has caught this species at different places on the west coast right up to Stabbvik, which is a little north of the arctic circle. Its northern limit will now be Malangen.

Melicope abbreviata, Bate.
The Skjerstad Fiord XVI; The Tys Fiord, 500 m.

Lencithoe spinicarpa, Abildgaard.
Henningsvær I, 150 m.; Translybet, 530 m.; Malangen, 380 m.
Sars has found this form at different places on the south and west coasts of Norway as far up as the Trondhejm Fiord. Its northern limit will now be Malangen.

Oxyclerus saugantus, Kroyer.
Trollfjordsund, 40 m. Occurred in very large numbers and with young.

Parasclerus hyrcaeus, M. Sars.
The Kvanlen Fiord, 30—90 m.; Stonnesbotn, 40—80 m. The southern limit for the species on our coast is, according to Sars, Apelvær.

Parasclerus propinquus, Goes.
The Beier Fiord, 50—150 m.; Lyngen II, 250 m.

Munsckales subnudus, Norman.
(Munsckales falcatus, G. O. Sars).
The Kirk Fiord III, 70—80 m.; Ure I (Vest Fiord).

Holmoclus nailler, Boeck.
Mortsund I (Vest Fiord), 200 m.; Gaukvearo II, 250 m.

Holmoclus acutifrons, G. O. Sars.
Mortsund I (Vest Fiord), 260 m.; Gaukvearo II, 250 m.

Holmoclus megaplos, G. O. Sars.
Repvaag (Porsanger Fiord), 10 m.

Holmoclus brevicaudatus, Goes.
Malangen, 350 m.

Bathyneclis longimanus, Boeck.
(Vest Fiord), 150—180 m.

Aceras phylophryx, M. Sars.
The Beier Fiord, 50—150 m.; The Skjerstad Fiord I, 30—50 m.; The Saltan Fiord, 200 m.; The Foblen Fiord, 530 m.; Landego, 200—450 m.; The Kirk Fiord IV, 50 m.; Mortsund I, 200 m.; The Ogs Fiord I, 100 m.; The Kvanlen Fiord, 30—90 m.; Gaukvearo II, 250 m.; Stonnesbotn, 40—80 m.; The Jakel Fiord I, 100 m.

Plesies panopha, Kroyer.
Røsthavet, 700 m.; Repvarg (Porsanger Fiord), 10 m.

Paramphitoe pelchella, Kroyer.
The Skjerstad Fiord XVI, on Hydroclad.

Paramphitoe hircaspis, Kroyer.
Trollfjordsund, 10 m.

Paramphitoe assimilis, G. O. Sars.
Malangen, 380 m.

Parasclerus latipes, M. Sars.
The Beier Fiord, 50—150 m.; The Skjerstad Fiord III, 230 m.; The Kvanlen Fiord, 30—90 m.

Epineura corrigera, Fabr.
The Sag Fiord, 260 m.
The northern limit is thus changed from the Trondhejm Fiord to the Sag Fiord.

Epineura parvissima, M. Sars.
Balstad (Vest Fiord), 150 m.
As far as I know, this form has not previously been observed so far north as in Lofoten.

Epineura tuberculata, G. O. Sars.
Malangen, 380 m.
This species was not previously found north of the Trondhejm Fiord.

Epineura kovaci, G. O. Sars.
Malangen, 100—200 m.; Lyngen II, 250 m.; Sars has collected this form at Hasvik, West Finnmark. Malangen is the southern limit for the species.

Acanthozone cespitata, Lutechii.
The Ogs Fiord, 100 m.
The southern limit for this arctic form is the Trondhejm Fiord.

Acanthozone armata, Sars.
The Beier Fiord, 50—150 m.; Grøno, 0—24 m.; The Kvanlen Fiord, 30—90 m.; Stonnesbotn, 40—80 m.; Kvenangen, 340 m.; Trollfjordsund, 40 m.

Iphimeletta obesa, Rathke.
Balstad (Vest Fiord).

Sycilene cespitata, Goes.
The Beier Fiord, 50—150 m.; The Skjerstad Fiord II, 185 m.; The Skjerstad Fiord III, 330 m.

Parselous cespitata, Kroyer.
The Jakel Fiord, in the stomach of cod.
**Vest Ingehavet, 500 m.**

*Euxinus minutus*, G. O. Sars.
Malangen, 380 m.
This species has previously only been found by Sars at Rødesøya in the Tromsøfjord.

**Rhacotropis acutata**, LEECHIN.
Ingehavet, 300 m.; The Porsanger Fiord, 70 m.

**Rhacotropis Helleri**, BESSAC.
The Skjerstad Fiord II, 100—185 m.; The Skjerstad Fiord IV, 330 m.; The Skjerstad Fiord VII, 190 m.; The Folden Fiord, 530 m.; Malangen, 380 m.; Lyngen II, 250 m.; Kvaenangen, 300—313 m.

**Rhacotropis meropus**, G. O. Sars.
The Saltstraumen Fiord II, about 200 m.; The Skjerstad Fiord IV, 330 m.; Oxsund, 600 m.; Mortsund (Vest Fiord), 200 m.; Tromsoy, 607—610 m.

**Halirangites invescis**, G. O. Sars.
Mortsund I (Vest Fiord), 200 m.; The Sag Fiord, 200 m.

**Halirangites falsecinctus**, M. Sars.
The Skjerstad Fiord IV, 320 m.; Lillesund—Sloven, 350—400 m.; Risverlahket, 150—180 m.; The Sag Fiord, 200 m.; Kvaenangen, 300—343 m.

**Apelana tricolorata**, BRUZELUS.
Trollfjordsund, 40 m.

**Calliopbus brazzae**, KROGER.
Repvåg (Porsanger Fiord), 10 m.

**Parathylopsis armuandensis**, H. MILNE-EDWARDS.
Trollfjordsund, 40 m.

**Meliphilampus bavaricus**, BÖECK.
Malangen, 380 m.

*Anatilithia homari*, FABE.
Balstad (1897); The North Cape (1894); Sverdahl (1894).

**Gammaropsis borealva**, LIN.
Rest II, 150 m.; Balstad, 30—40 m.; Reine, from the stomach of cod.

**Melita dentata**, KROGER.
The Skjerstad Fiord IV, 330 m.; Trollfjordsund, 40 m.; The Jokul Fiord II, 80 m.

**Liljeborgia pilicauda**, BATE.
Ure I (Vest Fiord); Malangen, 380 m.

**Liljeborgia jussieui**, M. SARS.
The Sag Fiord, 200 m.; Malangen, 380 m.; Lyngen II, 300 m.

**Ibareaa squieriana**, G. O. SARS.
Kvaenangen, 300—313 m.
This species has on the coast of Norway previously only been collected in the Varanger Fiord (NOGMAK, G. O. SARS). The occurrence in Kvaenangen is thus very interesting.

**Gammaropsis cryophyllethala**, LILLJEBORG.
Rosthavet, 700 m.
This form had not previously been collected so far north as the Tromsøfjord. It was therefore remarkable to find it on the 68th degree of latitude.

**Amphithoe Platyrhacotropis**, MONT.
Balstad (1897); Henningstverstrommen (Vest Fiord), 20—40 m.; Groto, 9—24 m.

**Ischyrocerus anglicus**, KROGER.
Rosthavet, 700 m.; Inganhavet, 300 m.; Repvåg (Porsanger Fiord), 10 m.

**Ischyrocerus minutus**, LILLJEBORG.
The Skjerstad Fiord XVI.

**Erichthonius abietis**, TEMPLETON.
Ingsund, 300 m.
This species is, according to SARS „not unfrequently off the south and west coast of Norway”. Its northern limit will now be the sea off Ingo.

**Umbelia borealis**, KROGER.
Rosthavet, 700 m.
On the coast of Norway, this form had, hitherto, only been observed in the Varanger Fiord.

**Epigelia spinata**, BÖECK.
The Skjerstad Fiord XVI; Malangen, 380 m.; Inganhavet, 300 m.; Breisund, 100 m.; The Porsanger Fiord, 70 m.

**Cormella septembrina**, KROGER.
Breisund, 100 m.; The North Cape (1894).

**Cormella monacera**, G. O. SARS.
The North Cape (1894).

**Paracypris boops**, LITTKEN.
On Megathela boats at Mehamn.

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**Literature concerning the** Amphipoda **of Northern Norway:**

It is worth noticing that the majority of the Amphipoda mentioned in the foregoing list were caught in the winter. In the list
only the localities and depths are given, but the dates of catch may be found in the list of dredging stations.

**Isopoda.**

J. Sæter-Schneiderei. deterrn.

*Ampyx spinosa*. M. Sars.

Gauvøen: Ure I (Vest Fiord), 200—250 m.

*Eug. peroni*. Linn.

Balstad, 150 m.; Mortsmund (Vest Fiord); Skroven (Vest Fiord), 200—400 m.

*Eug. ventosa*. M. Sars.

Inzahavet, 300 m.; two specimens, one of them with eva.

**Indahan baikian. Pallas.**

Hool (Vest Fiord), from the stomach of cod; Stennesbotn, 10—80 m.; Kvaenangen, 300—343 m.

**Indahan inermis*. Fabr.

Steine in Ro, several specimens from the stomachs of cods; Trolldalfrænd, 10 m.

*Astacilla longvaruis*. Sowe.

Rosthavet, 700 m.

*Janiva anadensis*. Leach.

The Tys Fiord I, 500 m.; Malangen, 350 m.

*Manna fabricii*. Kroeyer.1)

Repvag (Porsanger Fiord), 10 m.

*Manna typica*. M. Sars.

Several places in the Skjerstad Fiord; The Folden Fiord, 330 m.; Landare, 200—450 m.; Malangen, 350 m.; Lyngen I, 250 m.; Lyngen II, 300 m.; Kvaenangen, 300—343 m.

**Eurycope cornata*. G. O. Sars.

The Skjerstad Fiord IV, 330 m.; The Skjerstad Fiord VII, 400 m.; The Folden Fiord, 330 m.; The Sag Fiord, 200 m.; Tranøybyet, 200—340 m.; Malangen, 380 m.; Lyngen II, 250 m.; Kvaenangen, 300—343 m.

Concerning the Isopoda of northern Norway, reference should be made to Norman2) and G. O. Sars.3)

**Cumacea.**

G. O. Sars deterrn.

*Lamprops fasciata*. G. O. Sars.

Repvag (Porsanger Fiord), 10 m.

*Leconion norvegics*. Kroeyer.

Malangen, 380 m.

1) G. O. Sars deterrn.
3) Cumacea of Norway, vol. II.

**Eulacilla inermis*. Kroeyer.

The Jokel Fiord, 80 m.

**Bisylgis rathkei*. Kroeyer.

Several places in the Skjerstad Fiord: Moskenstrømmen, 200 m.; The Kirk Fiord (several places); Ure I, 200—250 m.; Mortsmund I, 200 m.; Malangen, 100—200 m.; The Porsanger Fiord, 200 m.

**Bisylgis goesi*. Bell.

Malangen, 100—200 m.; Lyngen II, 250 m.; The Jokel Fiord I, 100 m.

It has never previously been noticed so far south as Malangen. It was, however, known from Kvaenangen (Apiriculina, Schneiderei), the Porsanger Fiord (G. O. Sars) and from the Varanger Fiord (M. Sars).

**Cumycopidgus rubirostrus*. Lilljeborg.

Mortsmund I (Vest Fiord), 200 m.

**Schizopoda.**

The author deterrn.

**Boreosomus tripus*. G. O. Sars.)

The Skjerstad Fiord VII, 450 m.; The Folden Fiord, 550 m.; Oxsend, 500 m.; Tranøybyet, 410 m.; Malangen, 380 m.

Norman3) has caught this form in the Trondhjem Fiord, and G. O. Sars4) in the Vest Fiord.

Malangen is thus the most northerly place at which this species is found.

**Eurhythrops gesi*. G. O. Sars.

The Skjerstad Fiord IV, 330 m.; The Jokel Fiord I, 100 m.

**Eurhythrops serrata*. G. O. Sars.

Mortsmund I (Vest Fiord), 200 m.; Ure I (Vest Fiord), 200—250 m.

**Eurhythrops abyssorum*. G. O. Sars.

The Skjerstad Fiord IV, 330 m.; The Skjerstad Fiord VII, 400 m.; Mortsmund I, 200 m.

**Pseudonuma roseum*. G. O. Sars.

Malangen, 380 m.

**Pse udnoma truncatum*. E. J. Smith.

Lyngen II, 250 m.

G. O. Sars has caught it in the Ijo Flord, a branch of the Varanger Fiord.

The southern limit for the species will now lie the Lyngen Fiord.

1) Boreosomus articus and Hemingia abyssicola are included among the plankton forms.
3) Monographie over Norge Mysider, h. III, p. 17.
Pandalus hewesi, SARS.
The Beier Fiord, 50—150 m.; The Salted Fiord H. 320—380 m.; The Foden Fiord, 530 m.; The Sag Fiord, 290 m.; Tromadybet, 607—610 m.; Balstad, 150 m.; Mortsand 1, 100 m.; Ure I, 290—250 m.; Henningsvæl I, 150 m.; Skroven, 200—400 m.; The Osnes Fiord, 100 m.; the mouth of the Raftsund, 250—300 m.; Gavkvea I, 250 m.; Malangen, 380 m.
Females bearing eggs, without ocular spots, occurred on 
1/4 1899, The Osnes Fiord, 100 m.;
1/4 1900, Balstad, 150 m.;
1/4 1900, The Beier Fiord, 50—100 m.;
1/4 1900, The Salted Fiord H, 320—380 m.
The species is now in Malangen, which must now be considered as its northern limit on our coast.

Cragon gaudini, RATHKE.
Stone (Vest Fiord), 120—200 m.; Henningsvæl, 150 m.
G. O. SARS says that the species is found right up to the Varanger Fiord.

Sekalvango hewesi, PRIFFER.
The Skjerstad Fiord XVI: The Skjerstad Fiord IX, 30—10 m.; Groto, 6—24 m.; The Kanstad Fiord, 30—40 m.; Tromsfjordban, 40 m.; Brelsund, 100 m.
Females bearing eggs with ocular spots occurred on 
1/4 1900, the Skjerstad Fiord IX, 30—40 m. The Skjerstad Fiord is, as far as is known at present, the southern limit for this species, but it is probable that its distribution extends further south.

Cragon crosignon, LAM.
Females bearing eggs, without ocular spots, occurred on 
1/4 1900, Groto, 6—24 m.

Cragon olivai, RATHKE.
The Beier Fiord, 51—130 m.; Rost II, 150 m.; Svolvær, (1894): The Osnes Fiord: The Kanstad Fiord, 30—90 m.; Stonesbovn, 40—80 m.; Melaya (1894).
Females bearing eggs, without ocular spots, occurred on 
1/4 1900, the Beier Fiord.

Pandalus hewesi, SARS.
The Beier Fiord, 50—150 m.; Langdeo, 200—450 m.; The Salted Fiord H, 200 m.; The Skjerstad Fiord I, 30—50 m.; Rost II, 150 m.; Moskenstrømmen, 200 m.; Balstad, 30 m.; Henningsvælnstrømmen, 20—40 m.; the mouth of the Raftsund, 250—300 m.; The Kanstad Fiord, 30—90 m.; Malangen, 100—200 m.; Stonesbovn, 40—80 m.; Kvraangen, 300—343 m.; Brelsund, 100 m.; Melvyn (1894).
Females bearing eggs with ocular spots were observed on 
1/4, 1899, Malangen.

1/4 1900, Langdeo.

Pandalus platypus, BRANDT.
(= P. lepaharguem, RATHKE).
The Salten Fiord H, 320—380 m.

1) In doubtful cases Prof. G. O. SARS has identified.
2) This species is also included in the plankton forms, vide present work, p. 37.
Subinea suplementaria, Sars.
The Beier Fiord, 50—150 m.; The Skjerstad Fiord I, 30—50 m.; The Skjerstad Fiord II, 100—185 m.; The Kirk Fiord II, 50 m.; The OstsFiord, 150 m.; Stonesbøna, 40—80 m.; Lyngen II, 250 m.; The Jokel Fiord I, 100 m.; The Jokel Fiord III, 100 m.; The Porsanger Fiord, 200 m.; The Kjølle Fiord (1894); Melvær (1891).

Females bearing eggs with ocular spots occurred on

\[1/4 \quad 1899, \] The Jokel Fiord, 100 m.

\[1/4 \quad 1899, \] The Porsanger Fiord, 200 m.

\[1/4 \quad 1900, \] The Skjerstad Fiord, 30—50 m.

Hippolyte gaudardi, M. Eow.
The Beier Fiord, 50—150 m.; The Salten Fiord I, 15—20 m.; The Skjerstad Fiord IX, 30—40 m.; Groto, 6—24 m.; Napstrømnen (1896), 30—40 m.; The Osts Fiord I, 50 m.; Riervrålaet, 150—180 m.; The Kunstad Fiord, 50—90 m.; The Jokel Fiord I, 100 m.; Trolldfiordsund, 10 m.; The Porsanger Fiord, 200 m.

Females bearing eggs with ocular spots occurred on

\[1/4 \quad 1890, \] Riervrålaet, 150—180 m.

\[1/4 \quad 1890, \] Kaustad Fiord, 30—90 m.

\[1/4 \quad 1899, \] The Jokel Fiord, 100 m.

\[1/4 \quad 1904, \] Trolldfiordsund, 40 m.

\[1/4 \quad 1904, \] The Osts Fiord I, 30 m.

\[1/4 \quad 1905, \] The Skjerstad Fiord IX, 30—50 m.

\[1/4 \quad 1905, \] The Salten Fiord I, 15—20 m.

\[1/4 \quad 1905, \] Groto, 6—24 m.

Hippolyte pasioba, Kroeyer.
The Salten Fiord I, 15—20 m.; Balstad (1896), 30 m.; Trolldfiordsund, 10 m.; Breisund, 100 m.

Females bearing eggs, without ocular spots, occurred on

\[1/4 \quad 1899, \] Breisund, 100 m.

Hippolyte turgida, Kroeyer.
The Osts Fiord, 30 m.

Hippolyte spinos, Sow.
The Beier Fiord, 50—150 m.; The Skjerstad Fiord IX, 30—40 m.; The Skjerstad Fiord XVI, 10; Balstad, 150 m.; Henningsverstrome, 20—40 m.; The Kanstad Fiord, 30—90 m.; Gaukevra II, 250 m.; Malangen, 380 m.; Stonesbøna, 40—80 m.; Lyngen II, 250 m.; Kvenangen II, 90 m.; The Jokel Fiord, 100 m.; Trolldfiordsund, 10 m.; Breisund, 100 m.

Females bearing eggs with ocular spots occurred on

\[1/4 \quad 1899, \] The Jokel Fiord, 100 m.

\[1/4 \quad 1899, \] The Trolldfiordsund, 10 m.

\[1/4 \quad 1900, \] The Skjerstad Fiord, 30—40 m.

Hippolyte liliphasa, Danielsen.
(= H. ovicostata, Norren.)
The Beier Fiord, 50—150 m.; The Skjerstad Fiord III, 250 m.; The Skjerstad Fiord IV, 350 m.; The Skjerstad Fiord X, 10—30 m.; The Skjerstad Fiord XIII, 110 m.; The Oxsund, 600 m.; The Sag Fiord, 200 m.; Landego, 200—150 m.; The Kirk Fiord III, 70—80 m.; Mortsund, 200 m.; The Osts Fiord, 130 m.; Malangen, 380 m.; The Porsanger Fiord, 70 m.

Females bearing eggs with ocular spots occurred on

\[1/4 \quad 1900, \] Landego, 200—150 m.

\[1/4 \quad 1900, \] The Skjerstad Fiord III, 250 m.

\[1/4 \quad 1900, \] The Skjerstad Fiord X, 10—30 m.

Hippolyte polaris, Sars.
The Beier Fiord, 50—150 m.; The Skjerstad Fiord III, 230 m.; The Skjerstad Fiord X, 10—30 m.; The Skjerstad Fiord XVI; The Tys Fiord I, 500 m.; Roshavet, 300—500 m.; Moskenstvømnen, 200 m.; The Kirk Fiord III, 30—50 m.; The Ogs Fiord I, 100 m.; The Kanstad Fiord, 30—90 m.; Tranedybet, 450—530 m.; Stonesbøna, 40—80 m.; Malangen, 100—200 m.; The Jokel Fiord III, 100 m.; Inselhavet, 300 m.; Breisund, 100 m.; The Porsanger Fiord, 200 m.

Females bearing eggs with ocular spots occurred on

\[1/4 \quad 1899, \] The Tys Fiord I, 500 m.

\[1/4 \quad 1900, \] Malangen, 100—200 m.

\[1/4 \quad 1900, \] The Porsanger Fiord, 200 m.

\[1/4 \quad 1900, \] The Skjerstad Fiord II, 230 m.

\[1/4 \quad 1900, \] The Skjerstad Fiord XVI.

At several of the foregoing stations, males were found, which have been described as a separate species (H. borealis). In all of them the rostrum was without teeth or a slight indication of such could be seen. The lowest corner of the fore edge of Cephalo thorax was rounded.

Bathyfoerus simplexcostatus, G. O. Sars.
Tranedybet, 607—610 m.; Malangen, 100—200 m.

Cryptocetes cooperi, G. O. Sars.
The Folden Fiord, 530 m.; Tranedybet, 607—610 m.

At the former place females bearing eggs, without ocular spots, occurred on \[1/4 \quad 1900, \]

Eupagurus bernhardus, Lin.
The Salten Fiord I, 15—20 m.; Groto, 6—24 m.; Napstrømnen, 30—40 m.; Svolvær, 15—20 m.; Trolldfiordsund, 10 m. (2 small specimens).

Females bearing eggs with ocular spots occurred on

\[1/4 \quad 1900, \] The Salten Fiord I, 15—20 m.

Eupagurus pollescens, Kroeyer.
The Beier Fiord, 50—150 m.; The Skjerstad Fiord IX, 30—50 m.; The Skjerstad Fiord XVI, 10—100 m.; Rost I, 120 m.; Moskenstvømnen, 200 m.; Reine, 130 m.; Balstad, 150 m.; Stone (Vest Fiord), 120—200 m.; The Osts Fiord, 20 m.; Dземерут, 100—150 m.; Groto, 6—24 m.; The Kanstad Fiord, 30—90 m.; Gaukevra II, 250 m.; Malangen, 100—200 m.; Kvenangen II, 90 m.; Trolldfiordsund, 10 m.; Inselhavet, 300 m.; Breisund, 100 m.; The Porsanger Fiord, 200 m.; Svarvøl (1894).

Females bearing eggs with ocular spots occurred on

\[1/4 \quad 1899, \] Malangen, 100—200 m.

\[1/4 \quad 1899, \] Inselhavet, 300 m.

\[1/4 \quad 1899, \] Breisund, 100 m.

Lithodes minuta, Lin.
Malangen, 100—200 m.; The Kjølle Fiord (1894).
Galathaea nova, Emdeeton.
Balstad, 20 m.; Hemningsvaestrommen, 20—40 m.

Galathaea dispera, Bay.
The Beier Fiord, 50—150 m.
As far as I know, this species has not previously been found north of the arctic circle. The Beier Fiord must now be considered to be its limit to the north.

Galathaea intermedius, Lilleborg.
Hemningsvaestrommen, 20—40 m.; Stolwer (1894).

Galathea tychoidea, Emdeerton.
The Tys Fiord I, 500 m.; Tranodyneth, 450—530 m.
At both places, the species was found on Lophelia bottom. Tranodyneth is the northern limit, as far as is known at present.

Munida vagina, Fabr.
The Beier Fiord, 50—150 m.; Arno, 300—400 m.; Landego, 200—150 m.; The Saltene Fiord II, 320—350 m.; The Folden Fiord, 530 m.; The Sag Fiord, 200 m.; The Tys Fiord I, 500 m.; Moskenstrommen, 200 m.; Reine, 130 m.; Balstad, 150 m.; Mortund I, 200 m.; Ur I, 200—250 m.; Stolwer (1894); Breitnes—Skroven, 350—400 m.; Digermulen, 100—150 m.; Gaukvaro II, 250 m.; Malangen, 100—200 m.; Lyngeii, 300 m.

Females bearing eggs without ocular spots occurred on

1899, Breitnes—Skroven, 350—400 m.;
1895, Ingohaven, 300 m.;
1895, Balstad, 150 m.

Munida oceana, G. O. Sars.
The Folden Fiord, 550 m.; Oxnum, 600 m.; The Tys Fiord, 500 m.; Breitnes—Skroven, 350—400 m.; Tranodyneth, 667—640 m.

Hyps acanae, Lin.
The Misser Fiord (arm of the Skjerstad Fiord), 10—50 m.
(1 female carrying eggs).

Hyps concava, Lin.
The Misser Fiord, 10—50 m.; The Saltene Fiord I, 15—20 m.; Rost II, 150 m.; Moskenstrommen, 50 m.; The Kirk Fiord III, 70—80 m.; Balstad, 15—30 m.; Stone in Bo, from the stomach of cod; Malangen, 100—200 m.; Stoneseath, 40—80 m.; The Jekel Fiord, 100 m.; The Persanger Fiord, 200 m.

Portunus depurator, Lin.
The Saltene Fiord I, 15—20 m.; Troldfjordsund, 40 m.
As far as I know, this species has not previously been found so far north.

Portunus hokator, Fabr.
Stone in Bo (Vesteraalen), from the stomach of Fleponsechus platessa.
It is not likely that this species has been previously noted from Lofoten. Its northern limit must now be taken to be Vester-

Portunus pasillus, Leach.
Mortund II, 200 m.
This is also a new species for Lofoten.

Pantopoda.1

Dr. Appelot, Bergen, determ.

Pyrgocamptus littoralis, Strem.
Skjerstadfiord III, 230 m.; Kvevangeren, 300—343 m.; Jekel-

Portunus morsorum, Fabr.
Napstrenn, 30—40 m.; Balstad, 30 m.; Napstrenn, 30—40 m.

Pseudopallene spinipes, Fabr.
Napstrenn, 30—40 m.; Stoneseath, 40—50 m.; Hammerfest

Nymphea glacialis, Lilleborg.
Melvyn (1894). New for the Norwegian fauna.

Nymphea grossipes, Fabr.
Ofsdal, 100 m.; Troldfjordsund, 40 m.; Nordkap (1891);

Nymphea mixta, Kroeyer.
Kirkeffl II, ca. 50 m.

Nymphea toplacheles, G. O. Sars.
Morsblafjord, 50 m.; Malangen, 380 m.

Nymphea sarsi, Kroeyer.
Morsblafjord, 50—150 m.; Balstad (Lofoten); Risversfjord, 150—150 m.; Kavstafjord, 90—300 m.; Arno, 300—400 m.; Oks-

Nymphea argusa, Wilson.
Ffjorden, 530 m.; Ofsdal I, 100 m.; Malangen, 100—200 m.

Charybdis spinipes, Bell.
Balstad (Lofoten), 10—35 m.; Malangen, 100—200 m.; Jekel-

Charybdis spinipes, Emdeerton.
Arno, 300—100 m.; Saltene fiord I, 320—350 m.; Morsblafjord, 50—150 m.; Reine I (Lofoten), 150 m.; Malangen, 100—200 m.

Tunicata.

Synascidiae.
H. Huttelfeldt-Kaas, Kristiania, determ.

Aplidium sarsi, Huttel-Kaas.
Hammerfest (1894).
According to Huttelfeldt-Kaas2 this species has previously been collected by M. Sars at Kristiania and Leina.

Anomalacea mutabile, M. Sars.
Hammerfest (1894); Troldfjordsund, 40 m.
Sars collected his specimens too at Hammerfest.

Ascidiacea simplices.

Dr. R. Hartmeyer, Berlin, and Dr. Johan Kleer, Kristiania, determ.

onium intestinale, LIN.

1900. Platysomatichthys Polyearpa 1897. believe, Lofoten, Study 1899, Sunder© 1896. Mull. (1). The depth 1899, A Reine, mentions along (1). The 25 Chirolophis have The the 12. (The Ki.ki;. The the 1899. had /Found southern 1899, several body Vesteraalen, 1899. List (25 (1). Exp. night whose shells (3). 1899, length. Lithothamnia, Bo 1899, 1897. 'ottus has 24 11)11 (1897)

2

80 Kler

Henningsvær (1894). The North Cape (1894). Ascidia promana, O. F. MELL. Mortsmund I (The Vest Fiord), 200 m. Styela rustica, LIN.

Vadso."

The Skjerstad Fiord IV, 330 m. Kleer. The Skjerstad Fiord is a southern limit, as far as is now known. Cynthia ochiata, LIN.

Nordkyn (1894).

Pisces.

Prof. Collett and the author determ.

Selache marina, LIN.

17/3 1897. Sundera in Vesteraalen, from the stomach of cod. Centridermichthys microura, Reinh.

3/4 1900, The Beier Fiord, 50 m. (several specimens); 7/4 1899, Reine, 100 m. (1 specimen); 19/4 1899, Malangen, 100—200 m. (1); 15/4 1899, Stonesund, 40—80 m. (1); 25/4 1899, Breisund, 100 m. (1).

Centridermichthys haematus, Kroeyer.

5/4 1899. Henningsvær, 150 m. (1); 29/4 1899, The Jokel Fiord II, 80 m. (1); 24/1 1899, Inghavet, 300 m. (1); 25/4 1899, Breisund, 100 m. (4).

2) Holosomi Ascidiacea, p. 36. Meeresschauen von Bergen.

Triglophus pingghi, Reinh.

25/4 1899. Breisund, 100 m. (11).

Cottus scorpius, LIN.

Sverholt (1894); 25/4 1896, Napstrommen, 40 m. Cottocottus macrocephalus, COLLETT.

7/4 1899, The Lyngen Fiord II, 250 m. (1).

Aegus capthurhinaeus, LIN.

23/4 1898, Breisund, 100 m. (1).

Chirolophis galericulatus, LIN.

2/4 1900, The Skjerstad Fiord X, 10—30 m. (several specimens). At the mouth of the Misvær Fiord, we got the dredging bag full of Lithothamnium, in whose openings a multitude of animals were hidden, there were opalinures, asterides, worms, molluscs, crabs etc.

Among these stone algae which are generally called „ruggel“ by the Norwegian fishermen, many specimens of Chirolophis galericulatus were found. Some of „ruggel“ were left lying on the deck during the night. The next morning, I broke up one of the lumps, and a living specimen of Chirolophis came into view, it had — so to say — spent a night on „dry land“. When at rest, this fish bends the back part of its body sideways. Lampeius bauomiformis, Warbl.

31/3 1900. The Beier Fiord, 50 m. (1).

Ammochichus lugens, LIN.


Cryptobiospis linearis, Dér. & KOB.

10/3 1899. The Trodd Fiord in Lofoten, several specimens from the stomach of Gadas collaris. The cod was 40 cm. in length. Pleuron ees angioglossus, LIN.

15/4 1899. Stonesund, 50—80 m. (3).

Pleuronectes platessa, LIN.

10/4 1899. Steine in Ho (Vesteraalen), several large specimens, with stomach and intestines full of shells (Peeten) and Echinoderma. There were also Polycheata, Eupagurus pabescens, Portunus holatus etc.

Platysethychthys hypoglossoides, Warbl.

20/4 1896. Balstad, from the stomach of cod.

Drepanosetra platessoides, O. FAR.

31/3 1900. The Beier Fiord, 50—150 m. (several specimens).

Gadas acutifrons, LIN.

3/4 1897. Reine, one specimen (28 cm.) from the stomach of cod.

I have written something about the food of the haddock in my paper: — „Contribution to the Study of Hydrography and Biology on the Coast of Norway“. p. 17.

Gadas collaris, LIN.

At several places we caught cod and examined the contents of their stomachs, we also bought some for the same purpose. On
39/1 1899, we examined some cod which had been caught at Steno in Ro. Some were of a reddish colour, others were paler and resembled ocean-cod ("skrei").

The roe was not fully developed.

In the stomachs were found Polychaeta, Helicea corvulatis etc.

A single specimen had Lernaea hirudinacea on one of its gills.

On 30/1 1899 we bought in the Jokel Fiord 10 cod which had been fished by line in the fiord. Shape and colour were those of the ocean-cod ("skrei"), in a few of the larger females the roe was very loose. Schizopods and Amphipods were found in the stomachs.

I have also referred to the food of the cod in the paper quoted above, p. 14.

*Gadus circaus*, LIN.

In the beginning of February, 1897, I took part in a fishing expedition with nets for "skrei" (*Gadus circaus*). Cf. my paper referred to above, p. 17.

*Mallotus melas*, LIN.

Towards the end of April 1897, I went with a fisherman to fish with nets near Rost. Among the rest, we also caught large specimens of *Mallotus*. As a rule the stomach hung like a balloon out of its mouth, but in one instance, bones of *Gadus eglesias* could be identified.

*Bromius bromius*, ASC.

In the stomach of *Bromius*, which was caught near Rost in April 1897, *Lithodes maja* was often found.

*Lygodus surii*, COLLETT.

*Ophiothrix ventricosa*, Or. F. MULL.

On 25/1 1899, dead specimens were found drifting in the Tromsöfjord (between Rolfsø and Ingerø). Both males and females were found, and on examination it was seen that they had spawned. It is said that it is quite usual to find dead capelin floating in Finnmark in the spring, and many theories have been started to offer an explanation for this. Some think that the death of the capelin is to be accounted for by the coldness of the water; others suppose that it must be attributed to unsuitable food etc.

But none of the theories advanced seem very satisfactory.

*Clupea harengus*, LIN.

15/1 1896, Henningsvær, from the stomach of cod.

Herring catches are made in many of the fiords in Nordland in the winter, so as to provide for the codfishery in Lofoten.

The supply of the so-called baiting herring ("agnsalb") is conveyed by small steamers. On 16/1 1897 I went on board one of these steamers (S.N. "Svolvaer") from Svolvaer in Lofoten to the Ljer Fjord in Helgelands, where a quantity of herrings had been caught. On 17/1 I examined the plankton at the bottom of the fjord at the place where the catch had been made. It was not very rich. On the surface, I got a few specimens of *Oithona similis*, as well as nauplii of *Copepoda*. In a sample from 0—25 m. were found the following:

- *Col. finmarchicus* r
- *Eucalan us elongatus* r
- *Acartis fusiformis* r
- *Microcalanus atlanticus* r
- *Melictona hungi* r
- *Nanpili of Copepoda* +

Temperature and salinity were found to be distributed as follows:

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Temperature (°C)</th>
<th>Salinity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.5</td>
<td>33.94</td>
</tr>
<tr>
<td>10</td>
<td>3.8</td>
<td>33.73</td>
</tr>
<tr>
<td>Bottom</td>
<td>3.8</td>
<td>33.73</td>
</tr>
</tbody>
</table>

The herrings were rather meagre. I made some measurements, and found that the smallest were 15 cm. in length, the largest 20 cm., the usual length was 16, 17, 18 cm. (The measurement was made from the tip of the snout to the commencement of the division of the tail fin). Indications of roe and milt were present in the largest specimens. The stomachs were empty, but most of them had a white mass in the intestine.

One of the fiords which almost always in winter supplies Lofoten with "agnsalb" is the Kvenangen Fjord. My observations in this fjord (17/1 and 19/1 1899), testify great uniformity in temperature and salinity during the winter.

This probably has much to do with the fact that plankton *Copepoda* may be found right up to the surface of the water. At any rate, I observed quantities of *Calanus finmarchicus* in a sample from 0—5 m. on 25/1 1899.

As the food of the herring can thus rise so far up, it is explicable that the herring itself follows it, and comes so far up in the water that it can be reached by the tackle employed.

*Anguilla vulgaris*, Trækt.

25/1 1900. The Salted Fjord I, 15—20 m. (juveniles).

*Myxine glutinosa*, LIN.

During the cod fishery at Sunniva in Vesteralen, in the beginning of February 1897, I noticed that large numbers of fish were destroyed by this destructive animal. In some cases the robbers had not had a chance of escape, but were found under the skin of the sucked out cod.
B. Bottom Samples.

a. Foraminifera.

Mr. Hans Klee, Tromsø, determ.

At some places, we took bottom samples, and when the tow
net reached the bottom, we also obtained a combination of bottom
and plankton.

These samples were sent to Mr. Ed. Thum, Leipzig, and he
sorted out the Foraminifera and the Diatoms and made excel-
 lent preparations. Mr. Hans Klee and Mr. E. Jorgensen have
classified the species thus prepared.

In the following pages, I give the list of the Foraminifera
from Mr. Klee's Manuscript.

With regard to the synonyms, I beg reference to the works
of the author himself. 1

11/ 1899, Moskenstrømmen. 0—150 m.
Bottom sample and plankton.

Hyperammina ramosa, Hyperammina rubrodentis, Crithiona
diyxomea, Helophryraea bulboides, Valvulina comm., Anomalina
cornua, Raphax scurpinus, Trochammina robertsoni, Trochammina
nikols, Webbia eborace, Verruculina polytricha, Textularia agglu-
 tanas, Bulimina pygula, Bulimina marginata, Virgulinia schrei-
berriana, Vugicinia angusta, Cassidulina brevispi, Nodosaria
lumge, Globoquadrina bulboides, Truncaulina lobatula, Truncatulina
refugens, Anomalina crocea, Operculina ammoneides, Naisirina
umbilicatula, Naisirina variegata.

17/ 1899, Stamsund.
Bottom sample.

Halophryraea crassa, Halophryraea glomerata, Trochammina
robertsoni, Valvulina canina, Valvulina fusca, Trochammina
nula, Bulimina elliptica, Bulimina pyrula, Bulimina marginata,
Bulimina punctata, Bulimina dilatata, Virgulinia squamosa, Virgulinia
discorbinata, Sogrina discorbinata, Cassidulina crassa, Cassidulina
lumge, Lagena striata, Lagena corrobo, Lagena squamosa, Lagena
marginata, Globigerina bulboides, Pollenia sphenoides, Truncatulina
lobatula, Discorbinia obtusa, Operculina ammoneides, Naisirina
stellata, Naisirina variegata, Triloculina triconnecta, Quinquesculina
semalbanum.

21/ 1899, Hola (Svolvær), 0—150 m.
Bottom sample and plankton.

Halophryraea truncated, Trochammina robertsoni, Bulimina
marginata, Bulimina pyrula, Bulimina marginata, Bulimina pun-
tata, Bulimina dilatata, Virgulinia squamosa, Virgulinia discorbinata,
Sogrina discorbinata, Cassidulina crassa, Cassidulina lumi
gata, Lagena striata, Lagena squamosa, Lagena marginata,
Globigerina bulboides, Pollenia sphenoides, Truncatulina
lobatula, Discorbinia obtusa, Operculina ammoneides, Naisirina
stellata, Naisirina variegata, Triloculina triconnecta, Quinquesculina
semalbanum.

21/ 1899, Hola (Svolvær), 0—150 m.
Bottom sample and plankton.

Raphax scurpinus, Halophryreus glomerata, Trochammina
robertsoni, Valvulina canina, Valvulina fusca, Trochammina
nula, Bulimina elliptica, Bulimina pyrula, Bulimina marginata,
Bulimina punctata, Bulimina dilatata, Virgulinia squamosa, Virgulinia
discorbinata, Sogrina discorbinata, Cassidulina crassa, Cassidulina
lumge, Lagena striata, Lagena squamosa, Lagena marginata,
Globigerina bulboides, Pollenia sphenoides, Truncatulina
lobatula, Discorbinia obtusa, Operculina ammoneides, Naisirina
stellata, Naisirina variegata, Triloculina triconnecta, Quinquesculina
semalbanum.

21/ 1899, Lillsund (Ostnesfjord), 0—35 m.
Bottom sample and plankton.

Trochammina sp., Spirapheca biporina, Urigerina angulosa,
Cassidulina crassa, Cassidulina lumi, Valvulina lumi, Valvulina
fusca, Pollenia squamosa, Nodosaria commonis, Nodosaria
colmohora, Lagena marginata, Lagena beczae, Lagena squamosa,
Cassidulina crassa, Cassidulina lumi, Nodosaria commonis, Nodosaria
colmohora, Pollenia sphenoides, Truncatulina lobatula, Discorbinia
obtusa, Operculina ammoneides, Naisirina variegata, Triloculina
stellata, Naisirina variegata, Triloculina triconnecta, Quinquesculina
semalbanum.

5/ 1899, Raftsund, 250—300 m.

Hyperammina sp., Trochammina robertsoni, Valvulina fusca,
Valvulina canina, Textularia agglutinans, Textularia williamsis,
Bigenerina varia, Bigenerina digitata, Bulimina punctata, Bulimina
marginata, Bulimina elliptica, Bulimina pyrula, Bulimina marginata,
Sogrina discorbinata, Cassidulina crassa, Cassidulina lumi,
Lagena marginata, Lagena squamosa, Lagena beczae, Lagena
squamosa, Lagena marginata, Truncatulina lobatula, Textularia
agglutinans, Nodosaria colmohora, Nodosaria commonis, Nodosaria
colmohora, Lagena marginata, Lagena squamosa, Lagena
beccae, Lagena squamosa, Lagena beczae, Lagena
semalbanum, Naisirina variegata, Triloculina triconnecta, Quinquesculina
semalbanum, Discorbinia obtusa, Operculina ammoneides, Naisirina
variegata, Triloculina triconnecta, Quinquesculina semalbanum, Discorbinia
obtusa, Operculina ammoneides.
Besides these, there were also found at the same place:
Saccamminia sphærica, Eulabidium abysmonium.

7/8 1899, RAftsund, 0—270 m.
Bottom sample and plankton.

Trachominae reticulatae, Textularia cygittula, Eogenerina sarsi, Bolivina eliptoides, Bolivina pyrula, Bolivina marginata, Bolivina costulata, Bolivina subderes, Bolivina punctata, Virgalina sphaeroides, Cassidulina crocea, Cassidulina marina, Polyphaginia compressa, Saccamminia dorothea, Glabigerina bulbilata, Pollenia sphaeroides, Nodosaria ovum, Lagena marginata, Lagena granulata, Lagena striata, Textularia lobata, Discorbina arcaea, Discorbina berthelotiana, Nonionina unguiculata, Operculina incrustata, Quinqueloculina angulosa.

7/8 1899. Ofton I, 300 m.
Eogenerina sarsi (A + B), Bolivina naevicani, Virgalina sphaeroides, Textularia scutella, Bolivina punctata, Bolivina dilatata, Bolivina eliptoides, Bolivina marginata, Urgigerina angulosa, Saccamminia dorothea, Cassidulina builata, Cristallicella rotulata, Nodosaria cropa, Nodosaria ulteria, Lagena marginata, Lagena striata, Lagena crocea, Lagena hexagona, Glabigerina bulbilata, Pollenia sphaeroides, Pollenia quinqueloculata, Saccamminia dorothea, Textularia lobata, Retalia scutata, Discorbina berthelotiana, Ancillayina conradii, Patellina arcata, Nodosaria stelligera, Nonionina unguiculata, Operculina incrustata, Nodosaria ovum, Cassidulina naevica, Quinqueloculina angulosa, Quinqueloculina angulosa.

7/8 1899, Breettes—Skroven, 350—400 m.

I. Hyperammina avium, Rosaphora scolopacea, Halophaginia bilobastum, Valvulina fusca, Wohlena elongata, Bolivina marginata, Urgigerina angulosa, Saccamminia dorothea, Cassidulina builata, Cristallicella rotulata, Polyphaginia compressa, Urgigerina angulosa, Corneospira sp., Lagena agglutinans, Lagena striata, Lagena marginata, Lagena crocea, Gibberigerina bulbilata, Pollenia sphaeroides, Patellina arcata, Discorbina arcaea, Nonionina unguiculata, Nonionina unguiculata, Operculina incrustata, Quinqueloculina angulosa. At the same place were also found:
Saccamminia sphærica, Eulabidium abbysmonium.

7/8 1899, Breettes—Skroven, 350—400 m.

II. Trachominae sp., Bolivina pyrula, Bolivina marginata, Bolivina subderes, Bolivina punctata, Bolivina dilatata, Virgalina sphaeroides, Cassidulina crocea, Cassidulina marina, Polyphaginia compressa, Urgigerina angulosa, Corneospira sp., Lagena agglutinans, Lagena striata, Lagena marginata, Lagena crocea, Gibberigerina bulbilata, Pollenia sphaeroides, Patellina arcata, Discorbina arcaea, Nonionina unguiculata, Nonionina unguiculata, Operculina incrustata, Quinqueloculina angulosa. At the same place were also found:
Saccamminia sphærica, Eulabidium abbysmonium.

1/8 1899, The Kirk Ford I, 100 m.

I. Anomalinina incrustata, Virgalina sphaeroides, Bolivina marginata, Cassidulina builata, Cassidulina conradia, Polyphaginia compressa, Bolivina punctata, Bolivina dilatata, Urgigerina angulosa, Cristallicella rotulata, Nodosaria conradia, Lagena angulosa, Lagena crocea, Gibberigerina bulbilata, Textularia lobata, Discorbina arcaea, Discorbina berthelotiana, Nonionina unguiculata, Quinqueloculina angulosa.

1/8 1899, The Kirk Ford II, 100 m.

II. Halophaginia bilobastum, Halophaginia consanguinea, Textularia cygittula, Bolivina pyrula, Bolivina marginata, Bolivina dilatata, Virgalina sphaeroides, Urgigerina angulosa, Cassidulina builata, Cassidulina crocea, Textularia lobata, Discorbina globulosa, Gibberigerina bulbilata, Nonionina unguiculata, Patellina arcata, Operculina incrustata, Quinqueloculina angulosa.

1/8 1899, The Oosters Ford, 10—20 m.
Rosaphora scolopacea, Halophaginia consanguinea, Halophaginia globulosa, Grobbenia sp., Vouculina polyphaga, Spiroplecton bifurcatus, Bolivina marginata, Cassidulina crocea, Cassidulina builata, Urgigerina angulosa, Polyphaginia compressa, Lagena crocea, Lagena crocea, Lagena angulosa, Textularia lobata, Discorbina globulosa, Retalia builata, Operculina incrustata, Nonionina unguiculata, Patellina arcata, Quinqueloculina angulosa, Gibberigerina bulbilata.

1/8 1899. Moldoreen, near Svolvær, 10 m.
Bolivina dilatata, Virgalina sphaeroides, Lagena sagmoosa, Lagena crocea, Gibberigerina bulbilata, Patellina arcata, Textularia lobata, Retalia builata, Operculina incrustata, Discorbina globulosa, Nonionina unguiculata, Patellina arcata, Quinqueloculina angulosa, Gibberigerina bulbilata.

1899, Svolvær harbour, 10—15 m.
Eogenerina sarsi, Bolivina dilatata, Bolivina pyrula, Bolivina marginata, Cassidulina builata, Urgigerina angulosa, Lagena hexagona, Lagena sagmoosa, Lagena striata, Lagena crocea, Lagena angulosa, Gibberigerina bulbilata, Pollenia sphaeroides, Textularia lobata, Discorbina globulosa, Retalia builata, Operculina incrustata, Quinqueloculina angulosa, Gibberigerina bulbilata.

1/8 1899, Gaukvoer (Vesteraalen), 0—180 m.
Plankton and bottom sample.

Textularia ciliates, Cassidulina builata, Cassidulina crocea, Urgigerina angulosa, Lagena hexagona, Cristallicella rotulata, Gibberigerina bulbilata, Textularia lobata, Textularia reflation, Discorbina globulosa, Nonionina unguiculata, Quinqueloculina angulosa, Bolivina globulosa.

1/8 1899, Stene in Bo (Vesteraalen), 10 m.
Urgigerina angulosa, Cassidulina builata, Textularia lobata, Discorbina arcaea, Nonionina unguiculata, Patellina arcata, Quinqueloculina angulosa, Gibberigerina bulbilata.

Kleek has also classified several species which were not prepared.

7/8 1900, The Oosters Ford.

Textularia lobata, Textularia ciliates, Textularia reflation, Anomalinina conradia, Patellina globulosa.
27/4 1899, Mortand L, 200 m.
Nodosaria salata, Cristellaria rotula, Cristellaria crepidula.

27/4 1899, The Tys Fiord, 500 m.
Polycystina pseudolata on Lophohelia pedifer.

27/4 1899, The Sag Fiord, 200 m.
Saccammina sphacelata.

27/3 1899, The Sea NW of Rost, 700 m.
Rupertia stabiliis.

27/4 1899, Malangen, 380 m.
Astrochiza arenacea, Discorbina globularis.

27/3 1899, Lyngen III, 300 m.
Astrochiza arenacea.

Hammerfest (1894).
Truncatulina lobatula, Truncatulina refugens, Truncatulina angulosa, Discorbina globularis.

Sverholt (1894).
Discorbina globularis, Truncatulina lobatula.

27/4 1899, The Porsanger Fiord, 200 m.
Rhodacrinina abyssorum.

With regard to the distribution of the Thalamophora, Mr. Klier writes: "In taking a survey of the occurrence of Thalamophora in all the ocean-depths investigated by the North Atlantic Expedition we find, in all, three different centres of distribution, viz: —

A. The southern gray clay, which includes the fiords and banks along the Norwegian coast, about as far as to 19° E. Long.; and the gray clay near Iceland.

B. The northern gray clay, to which the fiords and banks along the Norwegian coast east of 19° Long., near Beeren Island and Spitzbergen belong, and the Rhodacrinina clay.

C. The brown clay, which is divided into the Buliminula clay proper and the transition clay."

Klier (l. c. p. 11) gives the following as being the forms which are of most frequent occurrence in the southern gray clay along the coast of Norway:


As characteristic of the northern gray clay, Klier (l. c. p. 12) gives the following forms:

Astrochiza arenacea, Legena apicalata, Palmadina kareni, Globigerina porphyraea.

These are considered to be arctic forms. On the other hand, there are some southern species which are either absent from the field of the northern centre or at any rate are very scarce, and do not attain to their full size, e. g. Buliminula marginata, Uregerina pygmaea and angularis, Quinqueloculina seminulum.

The samples I have collected almost exclusively represent the southern gray clay, of which Thalamophor-fauna they certainly give a very complete illustration.

It is of considerable interest to see that the limit between the northern and southern gray clay on the Norwegian coast is fixed at 19° Long., which lies near Tromsø. Without thinking of this fact, I have, for hydrographical and zoological reasons (cf. Part IV) fixed Malangen as the boundary fiord or rather the transition fiord between the preponderant boreal and the preponderant arctic fauna.

This division is thus confirmed by a study of the deposits.

2) With respect to the chemical condition of the deposits, reference should be made to Schiecken's treatise "On Oceanic Deposits". The Norw. North Atl. Exp. Chemistry. A plate is adjoined giving the distribution of the deposits.
b. Diatoms in Bottom Samples from Lofoten and Vesteraalen.

By E. Jorgensen.

In the following pages an account is given of the diatoms contained in some bottom samples from the following localities in Lofoten and Vesteraalen:

- Moskenstrommen, 0—180 m. (together with plankton).
- Stamsund, 0—150 m. (together with plankton).
- Svolvaer harbour, 10—15 m.
- The Ostnes Fiord, 10—20 m.
- Bretnes—Skroven, 350—400 m.
- Mouth of the Raftsund, 250—300 m.
- Stone in Ba, 10 m.
- Gaukvero, 0—180 m. (together with plankton).

Two of these, the samples from Bretnes—Skroven and from Raftsund, were poor and consisted perhaps only of dead specimens, a good many of which naturally originate from the plankton. The samples from Moskenstrommen, Stamsund and Gaukvero were taken together with plankton.

The working through of bottom samples is a very troublesome and lengthy task, when it is done as it should be. As there was, however, not time enough to investigate the samples in the manner I consider the right one, and as — on the other hand — it was of some importance, to be able rightly to interpret the plankton, to gain a preliminary knowledge of the bottom flora, I have contented myself with the method usually adopted, and have studied the species from the valves in slides. For this purpose the material — together with a richer one from the west coast of Norway — has been prepared as slides by Mr. Thun of Leipzig, in his well-known perfect way.

For this reason, it has not been possible to discern between living (recent) and fossil species.

The species occurring in the plankton are in detail dealt with in another chapter of this work (pp. 90—108). Nevertheless, to avoid arbitrariness, I have not omitted the plankton species, but have in such cases mentioned them as originating from the plankton.

List of the species observed.

I. Centricæ Schütz.

1. Coscinodiscæ.

Coscinodiscæ Emh.

C. nitidus Grev.

Cf. above p. 95.

Somewhat rare: Moskenstrommen r, Stamsund r, Raftsund r, Steine r, Gaukvero r.

Distribution: Western Europe; Balearic Islands, Greenland and Finnmark (Cleve). Warmer coasts of America, Asia and Australia.

C. appollinis Emh. (1841).

Emh. Mikrogeologie pl. 33 A, XXII, f. 1.

var. compacta Rattr. Rec. of Coscin. p. 559.


It differs from the main species (= C. scutillatus Grev.) in having the puncta distinctly smaller towards the margin, more numerous radial rows, the shortened ones being longer than usual. Probably is a separate species.

Rare: Moskenstrommen +, Stamsund r, Svolvaer r, Stone r.

Cos. nitidus A. Schmidt, Nords. Bat. pi. 111, f. 32 does not show the irregular distribution of the puncta that is characteristic of the preceding species. This form occurs in my material together with the one figured l. e., f. 33 and has a similar radiate structure, only much coarser.

Distribution: The species is only known from Svolvaer (west of Berge, Norway). The main species, which has not been found by us, occurs in the antarctic regions.

C. concavus Grev.

Grev. Bat. of Clyde 1851, p. 360, pl. X, f. 17; Emh. Mikrogeol. pl. 21, f. 47; nov. pl. 18, f. 38.

Hardly belongs to the genus Coscinodiscæ. Rattray l. c. p. 170 remarks that the girdle aspect of this species answers to EUndella acuticornis Emh. (cfr. Mikrogeologie pl. 33 A, XXVIII figs. 6, 7; A. Schmidt. Atlas pl. 65, figs. 10—15).

Very rare: Gaukvero r. Diameter 86 μ; 5 areoles on 10 μ; border sharply defined, nearly 3 μ broad.

Distribution: Western Europe; Balearic Islands, Black Sea, Sea of Kara (Cleve). Warmer coasts of America and Asia.

C. leptopus Grev.

Van Heurck Synops. pl. 131, figs. 5—6.

Rare: Raftsund r. Diameter 55 μ; 5 areoles on 10 μ. Remarkable for the minute areoles on the border, like those in the genuine C. linicatus Emh. It differs on the whole from the latter species only in possessing the pseudonucleus.

Coscinodiscæ linicatus Bronn and the variety of Coscinodiscæ linicatus mentioned below have a much finer structure and less regularly straight rows of areoles.

Distribution: Mediterranean, Southern Atlantic, Pacific Ocean, Indian Ocean.

C. linicatus Emh. var.

Cf. above p. 92.

Rare: Stamsund r. Finer structure than in the genuine C. linicatus. Small: 7—8 areoles on 10 μ. Border narrow, striate, 15 str. on 10 μ. Areoles near the border somewhat smaller.

Secondary rows somewhat flexuose.

In the sample from Svolvaer a very similar specimen was found, only with a little finer structure and marginal spines. This
specimen agrees completely with Coscinodiscus polyehora Ehr., but wants the peculiar transverse processes of the latter species.

Such forms, which are perhaps solitary cells of Coscinodiscus, may easily be mistaken for C. rotundata.

**Distribution:** The main species is cosmopolitan, Cleve and Stene mention C. rotundata from several arctic localities: Finnmark, Baren Eiland, Greenland, Spitzbergen, Kara. I should, however, think that the species has been confounded with Coscinodiscus polyehora, at any rate to some extent.

**C. excentrica Ehr.**

Cf. above p. 92.

Frequent: Moskenstroomen r., Stamsund +, Gaukwer +. Derived undoubtedly from the plankton.

**Distribution:** Cosmopolitan.

**C. Kützingii A. Schr.**


As Gruen remarks, this species is intermediate between C. excentrica and the difficult group of C. solabiliis.

Very rare: Raftsund r., Stamsund r.

**Distribution:** North Sea. Arctic and antarctic regions (Ehr.). Not mentioned by Cleve as arctic. Very nearly related forms are found near Greenland (C. adnabatus Os-tr) and Jan Mayen (1890, E. Jorgensen).

**C. Rothii (Ehr.) Grek.**


Belongs to the difficult group of C. solabiliis Ehr., as well as the following species and a good many more, which probably will not bear a more thorough examination.

Structure plainly fasciculate, with numerous fascicles separated by radial lines made conspicuous by the marked inner ends of the beginning of new rows. Small marginal spines in the middle of the fascicle, one in each. Valve almost flat (occasionally undulated according to Gruen). Very rare: Stamsund r., Raftsund r., Brevestes——Skroven r. Probably a plankton form.

**Distribution:** Belgium, Scotland, Caspian Sea. Warmer regions of America and Asia. Southern seas.

**C. Normanii Grek.**

Grek. Quat. Journal, Vol. IV, No. 1859, p. 89, pi. 6, fig. 3. C. normanii: Van Heurk Synopsis, pl. 131, f. C. fasciculatus A. Schr. Novels, Dist, pl. III, figs. 41, 42; Atlas pl. 57, figs. 9, 10.

Very closely related to the preceding species. Differs in having a distinctly convex valve, finer structure (though variable in this respect), more numerous and narrow fascicle and less distinct marginal spines.

It is perhaps not quite certain that this species is identical with C. Normanii Grek.: the name C. fasciculatus A. Schr. (1874) must however be abolished on account of C. fasciculatus O'Meara (1887).

This species seems to me to answer tolerably well to C. petiolata Grun. In specimens with fine structure the fascicle are only seen with difficulty, while the clear, scattered dots mentioned by Gregory i.e., are conspicuous. If this should prove correct, the C. Normanii Grek. is perhaps the same as C. Rothii Grek.

**Distribution:** Western Europe, America. Arctic Sea.

**C. curvatus Grek.**

Cf. above p. 92.

Derived undoubtedly from the plankton.

**Distribution:** American, Africa.

**C. stellars Ross.**

Cf. above p. 92.

Derived undoubtedly from the plankton.

**Distribution:** Arctic regions. North Sea. Borearctic Islands. America and Africa.

**C. concinnus W. Sm.**

Cf. above p. 93.

Derived undoubtedly from the plankton.

**Distribution:** Cosmopolitan.

**C. centralis Ehr. Bate.**

Cf. above p. 93.

Derived probably from the plankton.

**Distribution:** Cosmopolitan.

**C. submollis John.**


Cf. above p. 94.

Probably derived from the plankton.

Rare: Moskenstroomen r., Raftsund r., Gaukwer +. Stark.

**Distribution:** Arctic regions.

**C. borealis Bail.**


Very rare: Raftsund, r. Diameter 135 p. Coarse structure; areoles increasing towards the border, at the centre 3½, near the border 2 on 12 p.; the largest ones only little larger than those at the very margin. Large and very conspicuous "papilae" (papillae),
Border sharply defined, dark, striate. The disc somewhat convex towards the border.

The specimen found only differs from Schmidt's figure in wanting the „central space“ instead of this space, which is, however, not mentioned by Rattray l. c., a large areole was present.

**Distribution:** Pacific Ocean, especially in the northern region (Kamiischakta Sea, Bailey). Cape Wankaremara (Cleve)

- **C. deeresenensis** Grev.
- **C. radiatus** Ehren.

**A. affinis** Grev. in Van Heeck Synops., p. 129, l. 12 (var. actinicus).

Very rare: Brettesnes—Skroven r; Stone r. In structure Coscinodiscus-like, as Grevnow states intermediate between C. corculatus and C. radiatus. Central space circular, conspicuous, only with a few irregularly scattered puncta. Numerous fasciculi (over 20) with interfascicular radii, which are more or less plainly zizag bent, especially towards the centre. Towards the margin the fasciculi are not separated from each other, but form an even radiately structured marginal part. Very small and inconspicuous marginal alvelae. Border narrow, indistinctly striate.

**Distribution:** Cape Wankaremara. Also mentioned from a few places of the North Atlantic and Arctic Seas.

- **A. Ehrenbergi** Ralfs.
- **A. Rafsii** (W. Sm.) Ralfs.

**A. sparsus** (Grev.) Ralfs.

**Distribution:** Western Europe. Greenland (Östfj.); W. Artic Seas.

- **A. crassus** v. H. (Ehren.)

Van Heeck's figure shows interfascicular radii, though not so evident as those of A. Ehrenbergi. Smaller and coarser forms of the latter species is puzzlingly similar to A. crassus. It is on
the whole doubtful, whether these two species always can be distinguished from each other.

A more essential difference than in the structure of the valve is found in the form of the cell (frustule). *A. crassus* has high cells, usually higher than broad, with thick walls, also in the connecting zone; here there is also a conspicuous difference in width between the two valves. *A. Ehr. var. nubantia*, however, forms low cells, broader — often much so — than high, and the two valves have nearly the same diameter.

The valve of *A. crassus* is flat from the centre to some distance from the border, where there is a high and steep marginal zone.

Somewhat rare: Stamsund r, Raftsund r, Gaukværo r, Stene r. Occurs also in the plankton samples.

*Distribution*: Western Europe. After all, it is most probably identical with *Eucoscinodiscus crassus* W. Sm. (cf. Van Heurck l. c. and Traité d. Dist. p. 524).

**Note.** In the sample from Stene, several broken valves with a rather large disc occurred, somewhat similar to *Nanophyceis densifera* Grev. (cf. Van Heurck Traité d. Dist. p. 512, fig. 263), which cannot, however, be referred to the genus *Nanophyceis* Ehr., a doubtful genus including what are probably resting spores of *Chlorococcus* (cf. Schött in Engler and Prantl. Natür. Pflanzenfamil. Theil L. Abh. 1 b. p. 148). Structure rather fine, similar to that of *Coscinodiscus*; valve rather convex, with numerous large, slender, conical spines, as in the figure referred to. Undoubtedly a fossil species.

2. *Melosira*.<ref>

**Coccosina* polyedra* (Gran) Gran.

Cf. above p. 97.

Derived from the plankton.

Very rare: Stamsund r, Gaukværo r.

*Distribution*: Cf. above p. 97. As stated before (p. 196) this species seems also to occur singly, and is then easily mistaken for *Coccosina* *lineata*. At any rate, forms occur in which the peculiar transverse processes at the seminarius are wanting.

**Thalassiosira** cl.

**T. gravida** cl.

Cf. above p. 96.

In bottom samples the strong resting spores (endocysts) of this species occur, though seldom (much more so than would probably be the case, if this species generally „oversummers“ on the bottom).

Rare: Stamsund r, Svolvær r.

*Distribution*: Cf. above p. 96.

**T. decipiens** (Grev.) Jorg.

Cf. above p. 96.

Undoubtedly derived from the plankton.

Rare: Stamsund r, Svolvær r, Gaukværo r +.

*Distribution* of *Coccosina decipiens* Grev.: Caspian Sea. Great Britain and Ireland. West coast of Norway.

**Melosira** Ag.

*M. granulata* (Ehrenb.) Ralfs.

Van Heurck Synopsis p. 290, pl. 87, figs. 10—12.

**Fresh water species.**

Very rare: Gaukværo, rt.

*Distribution*: Frequent in fresh water, especially in Western Europe. Franz Josef’s Land.

*M. Roverana* Raben.

Van Heurck Synopsis p. 199, pl. 89, figs. 1—6.

**Fresh water species.**

Very rare: Ostnæsfjord, rt.

*Distribution*: Common fresh water species. Greenland (Ostrup).

**M. Borrori** Grev.


Very rare: Svolvær, rt (ver. ad hospit. Castle).

*Distribution*: Frequent on the coasts of Europe. Greenland (cl.).

**Paralia sulcata** (Ehrh.) cl.


Comm.: Moskenstrømnen +, Stamsund c, Svolvær c, Raftsund r, +, Bretnesnes—Skroven r, Ostnæsfjord c, Gaukværo c, Stene r.

*Distribution*: Frequent on the coasts of Europe and America. Arctic regions.

**forma coronata** (Ehrh.) Grev.

Van Heurck Synopsis pl. 91, f. 18. *Gallionella coronata* Ehrh., Mikrogeologie pl. 38, XXII, fig. 5.

Rare: Svolvær r, Stene r.

**Cyclotella** Kütz.

**C. striata** (Kütz.) Grev.


Rare: Stamsund r, Raftsund r, Stene r.

*Distribution*: Frequent in brackish water. Western Europe. Baltic Sea. Warmer parts of Asia and Africa.

**C. comata** (Ehrh.) Kütz.


**Fresh water species.**

Very rare: Gaukværo, rt.

*Distribution*: Western Europe.

**Hyalodiscus** Ehrl.

**H. scotti**s (Kütz.) Grev.


Frequent: Stamsund r, Svolvær +, Gaukværo + c, Stene r +.

*Distribution*: Western Europe. Bosphorus. Arctic regions.
H. subtilis Barn.

Perhaps only a form of the preceding species.
Very rare: Stamsund r, Steine f.
Distribution: Belgium, Scotland, Finnmark (Cl.). America, Asia.

H. stelliger Barn.

Frequent: Moskenstrommen +, Stamsund r +, Svolvær r, Raftsund r, Brettevåg + Skroven r, Gaukvær r, Steine r.
Distribution: Western Europe, Virgin Isles, Spitsbergen (uncertain, Cl.).

Podosira hormoides (Mont.) Kütz.
Kütz. Enclit. p. 92, pl. 29, f. 84. A. Schmidt Nords. Dist. pl. 3, f. 49.

Rare: Stamsund r, Svolvær r, Raftsund r.
Distribution: Coasts of the North Sea, Greenland, West coast of South America, Adriatic Sea.

3. Eupodiseae.
Roperia tessellata (Bory) Grun.
Cf. above p. 98.
Undoubtedly derived from the plankton.
Rare: Stamsund f +, Steine rr.
Distribution: Western coasts of Europe and Africa.

Alisus sculptus (W. Sm.) Ralfs.

Common: Moskenstrommen +, Svolvær c. Raftsund r, Brettevåg + Skroven r, Ostnesfjord r, Gaukvær c. Steine c.

Specimens occur which are very similar to A. orbatus Barn. (A. Scum. Atlas pl. 32, figs. 11–15), but connected with A. sculptus by intermediate forms: Gaukvær +, Steine r.
Distribution: Coasts of the North Sea, Western Europe, Mediterranean, America. A. orbatus: Warmer coasts of the Atlantic, Pacific and Indian Oceans.

Eupodiscus argus W. Sm.
W. Sm. Brit. Dist. p. 24. A. Schmidt Atlas, pl. 92, figs. 7–11; pl. 97, figs. 7–11.

Van Heurck Synops. p. 269, pl. 117.

Very rare: Moskenstrommen, f. rr, only one broken valve.
Distribution: Frequent on the coasts of the North Sea and Western Europe. America.

Anlaecodiscus Ehrh.

A. Kittonii Arnott.

Rare: Moskenstrommen +, Raftsund r, Brettevåg + Skroven r, Gaukvær r.

All specimens observed have 4 processes and no, or a very small or inconspicuous „central space“.
It is very remarkable that this tropical species occurs in the lofoten. Very likely fossil. At present I have no opportunity of ascertaining whether the cells have really all been empty.
Distribution: Warmer coasts of the Pacific Ocean, especially frequent on the coasts of California.

A. Johnsonii Arnott.
Arnott in Pritsch. Inf. p. 844. A. Schmidt Atlas pl. 36, figs. 1, 2.

Very rare: Raftsund r, Brettevåg + Skroven r.
Differs from the preceding especially in having a conspicuous central space and processes of a different shape. A. Kittonii is, however, said to vary considerably.
Distribution: Tropical coasts of the Indian and Atlantic Oceans.

4. Asterolampreae.
Actinoptychus Ehrh.
A. amblatus (Barn.) Ralfs.
Cf. above p. 98.

Frequent: Moskenstrommen r +, Svolvær r, Raftsund r, Brettevåg + Skroven r, Steine r.
Distribution: Coasts of Western Europe and the North Sea, Arctic regions, Cape of Good Hope.

A. splendidus (Ehrenb.) Shade.

Very rare: Moskenstrommen r, Gaukvær rr.
Distribution: Coasts of the North Sea and the Baltic (Greifswald).

Asteromphalus heptactis (Ehrenb.) Ralfs.
Cf. above p. 98.

Undoubtedly derived from the plankton.
Very rare: Moskenstrommen rr.
Distribution: Cf. above p. 98.

5. Biddaliphicea.
Biddaliphia Gray. V. H. (including Amphilectus Ehrh., Telescopium Ehrh., Gentians Ehrh.).

B. pallescens Gray.

Rare: Stamsund r, Raftsund r, Brettevåg + Skroven r, Steine r.
Distribution: Frequent on the western and southern coasts of Europe, America, Africa.

B. regina W. Sm.

var.
B. regina A. Scum. Atlas pl. 119, f. 18 (from Borealic Isles).

The 3 median elevated parts of the valve hispid, not smooth as stated by W. Sm. both in his description and figure.

Very rare: Steine, a single valve.
**Distribution**: Balearic Isles. The main species known from the coast of the Isle of Skye.

*B. anira* (Lyeng.) EHRB.

cf. above p. 99.

Probably derived from the plankton.

Frequent: Stamsund +, Svolvær + c, Stene r +.

**Distribution**: cf. above p. 99.

*B. rhombus* (EHRB.) W. SM.

W. SM. Brit. Dist. II, p. 49, pl. 43, f. 329. Denticella r. EHRB.

var. trigona CL. VAN HEURCK Synops. pl. 99, f. 2.

Very rare: Svolvær r.

**Distribution**: Coasts of the North Sea and Western Europe. Finnmark (CLEVE).

*B. turgida* (EHRB.) W. SM.

W. SM. Brit. Dist. II, p. 56, pl. 62, f. 38. VAN HEURCK Synops. pl. 104, figs. 1, 2. Centonaria f. EHRB.

Very rare: Svolvær r.

**Distribution**: Coasts of the North Sea and Western Europe.

*B. smithii* (RALLS) V. H.


Very rare: Moskenstommen r, Svolvær r.

**Distribution**: Coasts of the North Sea and Western Europe. Spitsbergen? (CLEVE).

*B. antediluviana* (EHRB.) V. H.

VAN HEURCK Synops. pl. 109, figs. 4—5. Amphilectus a. EHRB., Mikrogeol. pl. 21, f. 25 a—c.

Rather frequent: Moskenstommen +, Stamsund r, Raftsund r, Gaukvær r, Steine r.

**Distribution**: Common species, cosmopolitan; very rare, however, in arctic regions: Spitsbergen (r, CLEVE).

*B. lata* (GVEY).


Very rare: Raftsund r. Very similar to the figures referred to in Schmidt's Atlas. Side of the tetragon 67 p. Marginal pearls 5 on 10 p; the rows of spines in the corners somewhat radiant. 19 on 10 p.

**Distribution**: Tropical species, according to de Toni (l. c.) only known from Singapore and North Celebes.

*B. favus* (EHRB.) V. H.

VAN HEURCK Synops. pl. 107, figs. 1—4. Triceratium favus EHRB. A. SCHMIDT Atlas, pl. 82, f. 2.

Very rare: Raftsund, r. Side of the triangle 92 p; 2 areoles on 10 p.

**Distribution**: Rather common species, cosmopolitan on tropical and temperate coasts. Spitsbergen (CLEVE, "doubtful as an arctic species").

*B. arctica* (BRIGHTW.)


Very rare: Steine r.

**forma balicena** (EHRB.).


Very rare: Steine r.

**Distribution**: Arctic regions. Vancouver; Cape of Good Hope (De Toni Syll. p. 921).

*R. formosa* (BRIGHTW.)


Very nearly related to the preceding species, from which it differs chiefly in having the centre of the valve irregularly punctate, not areolate, with scattered puncta smaller than the neighbouring areolae.

Very rare: Raftsund r.

**forma balicena**.

Answering to the *forma balicena* of the preceding species.

Very rare: Raftsund r.

*B. alternans* (BAIL.) V. H.


Very rare: Stamsund r.

**Distribution**: Western Europe. West Indies.

*B. punctata* (BRIGHTW.) V. H.


Very rare: Gaukvær, r. Irregularly punctate with puncta very different in size, shape and distance from each other, on an average 5 on 10 p. Side of the triangle 40 p.

**Distribution**: Tropical coasts of America, Africa and Asia. The nearly related *B. scalpta* (Shadb.) V. H., which by De Toni l. c. p. 944 is considered to belong to the same species, occurs in Western Europe, the Skazerek, and the Mediterranean.

*B. nobilis* (WITT.).


A specimen very similar to the figure referred to in Schmidt's Atlas (from Archangel) was found: Gaukvær r; Steine r. Large puncta, irregular in size and shape, intermixed with minute ones. Near the margin, larger areoles. In the centre, a conspicuous inward pointing spine is found. Side of the triangle 56 p.

A nearly related species is *Triceratium Heistergi* GREY., V. H. Synops. pl. 112, figs. 9—11 (from Mors).

**Distribution**: Only known fossil from Simbirk. Perhaps also fossil in my samples (as is probably also the case with some of the other species).
B. Weisell (Gren.)

Trieciramina Weisell in A. SCHUMAT. Atlas pl. 83, f. 2.

A specimen very similar to the figure referred to from Archangel was found: Stone, r.r. (a single specimen). Rather coarse radiating structure of puncta (pearls); about 6 rows on 10 µ. Large circular central space without puncta, only one or two near the periphery. Side of the triangle 57 µ.

Might also belong to the genus Trinmcria. I have not seen a side view of the valve.

Distribution: Only known fossil (Simbirsk, Archangel).

Isthmia Ara.

I. cervis Ehrh.

Eng. Inf. p. 269, pl. 16, f. 6. Van Heurck Synops. pl. 96, figs. 1—3.


Distribution: Coast of Western Europe. Finmark; Spitsbergen (Cleve). West Indies: Honduras.

I. nervosa Kütz.

Kütz. Bacill. p. 137, pl. 19, f. 5. Van Heurck Traité 4, t. 81, pl. 34, f. 891.

Very rare: Raftsund r.


6. Chaetoecereae.

Bacterinastrium varians LAMK.

LAMK. Traité Micro, Soc. 1868, XII, p. 8, pl. 11, figs. 1—6.

Derived from the plankton.

Very rare: Stone r.

Distribution: Neritic plankton species, from the western coasts of Europe. Warmer coasts of the Atlantic, Indian and Pacific Oceans. Rare off the west coast of Norway.

Chaetoeceros Ehrh.

C. atlanticum Cl.

Cf. above p. 100.

Derived from the plankton.

Very rare: Gaukvere r.

C. contortus Schütt.


Thickened horns, most probably belonging to this species, is found now and then in the bottom samples, though seldom. Undoubtedly derived from the plankton.

C. diadema (Ehrh.) Schütt.

The characteristic resting spores of this species (Synecidium diadema Ehrh.) occur rarely:

Stansund r. Svolvaer r. Gaukvere r. Derived from the plankton.

Distribution: Cf. above p. 101. Synedrium diadema Ehrh. also in Peru guano.

Stephanogonia Ehrh.

A specimen very similar to S. actinoptychus (Ehrh.) Grun. in Van Heurck Synops. p. 83, figs. 2—4 was found in the sample from Moskenstrommen.

Neritic. Diameter 70 µ, 15 radii. On the smaller upper disc, a coarse spine seems to be found. In other respects corresponds very well to the figure referred to.

Stephanogonia polygama Ehrh. seems to be a similar form, perhaps the same. Both are possibly resting spores (cfr. Schütt in Euglen and Phæto, Naturf. Plantenz. Th. 1, Abth. 1 b, p. 117).

Distribution: Both species mentioned are known from "North America" (Ehrenberg). The figure mentioned represents a fossil specimen from Nottingham deposit.

Pyxilla baltica Grun.


According to the figure in HENSEN Gter Ber. Komm. Kiels, pl. V, f. 35 c) Pyxilla baltica must be the resting spore (endocyst) of Rhizosolenia setigera Brightw.

Undoubtedly derived from the plankton.

Very rare: Rhizosolenia setigera is a neritic plankton diatom from the coasts of Europe (Western E. Skagorak, Mediterranean, Pacific Ocean, Indian Ocean; north of South America. Pyxilla baltica is known from the Baltic, and fossil from Simbirsk.

II. Pennatæ Schütt.

7. Synedreæ.

Synedra.

a. Eusynedra V. H.

S. atlantis Kütz.


var. tabulata (Kütz.) V. H.


Very rare: Svolvaer r. Ostenfeld r.

Distribution: Frequent on the coasts of Europe. Arctic regions.

S. kamtschatica Grun.

Grun. in Cl. et Gen. Arch. Diss. p. 100, pl. VI.

var. intermedia Grun. 1. c. f. 111.

Very rare: Stensund r.

Distribution: Kamtschatka, Finnmark, Spitsbergen, Greenland, Kara Sea, East Cape.

S. alta (Nitzsck.) Ehrh.

van Heurck Synops. pl. 88, f. 7.

Fresh water species.

Very rare: Svolvaer r.

Distribution: Common fresh water species.
b. Ardissonia (DE Not.) V. H.

S. crystalina (AR) KETZ. KETZ. Brecell, p. 69, f. 1. VAN HEURCK SYNOPSIS, pl. 42, f. 10. DIATOMAE C. AR. CONSP. p. 52.


S. superba KETZ. KETZ. Brecell, p. 69, f. 13. VAN HEURCK SYNOPSIS, pl. 31, f. 39, f. 834.


S. bacilus GRUN. GRUN. Transs. Mus. Soc. 1867, p. 59, f. 52. VAN HEURCK SYNOPSIS, pl. 42, f. 2.

Very rare: Svolvær r. Distribution: Coasts of Scotland and Ireland.

c. Toxarium (BAIL) V. H. GRUN. BAIL. BRIT. FIT. H. p. 57. VAN HEURCK SYNOPSIS, pl. 13, f. 2. TETRAH. ADJACENTIS (BAIL. NORTHERN) BAIL. NOTES ON NEW SP. AND LOC. OF MICR. ORG. p. 15, f. 24—25.


S. Henneydiana GRUN. GRUN. Dist. of Clyde p. 702, pl. XIV, f. 168. VAN HEURCK SYNOPSIS, pl. 42, f. 3.


S. (hyperborica var.?) rostellata GRUN. GRUN. Dist. FROM JOS. LAND p. 54, f. 22, f. 6 a—h.

A specimen very similar to the figure referred to was found: Gaukværo. 35 p. > 3 p. Striae very fine. Distribution: Franz Josef’s Land.

Thalassiosirhus nitzschoides GRUN.


Sceptronectis EHBB.

S. marina (GRUN) GRUN. GRUN. in VAN HEURCK SYNOPSIS, pl. 37, f. 2. MELCHOR BERCOWITZ GRUN. DIST. OF CYLDE p. 497, pl. X, f. 41.


S. kantschatica GRUN.

GRUN. in VAN HEURCK SYNOPSIS, pl. 37, f. 6.

A species very similar to the figure mentioned occurred in the sample from Steine r (several specimens). Usually broader than the preceding, somewhat variable in shape, at the broader end sometimes rounded, sometimes only obtuse. Valve distinctly costate with linear pseudoraphis; costa somewhat radiating, 6—6½ on 10 µ. Length 38—40 µ, breadth 7—8 µ. Also similar to Opephora pacifica GRUN. in V.H. SYNOPSIS, pl. 41, f. 22. Distribution: Kantschatka. Opephora pacifica, perhaps the same species, in the North Pacific.

Rhipheonectis EHBB.


Rare: Stamsund r +. Distribution: Coasts of the North Sea. The Mediterranean. Auckland.

S. Plagiogrammacus.


Frequent: Stamsund r, Svolvær r, Raftsund r, Ostnesfjord r, Gaukværo +, Steine +. Distribution: Coasts of the North Sea and Western Europe. Finnmark; Greenland. South America. Ceylon.

Dimereogramma RALFS.

D. minutus (GRUN) RALFS. RALFS. IN HENNY. INT. p. 790. VAN HEURCK SYNOPSIS, pl. 39, f. 16, 11 a. Denticula minutus GRUN. DIST. OF CYLDE p. 496, pl. X, f. 35.

Somewhat rare: Stamsund r. Svolvær r, Gaukværo r, Steine r +.

var. nana (GRUN) V.H.

VAN HEURCK TROLL p. 396, pl. 19, f. 393. Denticula nana GRUN. 1. c. f. 34.

Rare: Gaukværo r. Seems to be only a smaller form of the preceding species. Distribution: Coasts of Western Europe. The Mediterranean.

D. inflatum (GRUN) RALFS. RALFS. s. CERRIES s. Denticula inflata GRUN. DIST. OF CYLDE p. 496, pl. X, f. 38. VAN HEURCK SYNOPSIS, pl. 36, f. 28.


Glyphadesmis GRUN.

G. Williamsoni (GRUN) GRUN. Cf. above p. 182. Rather frequent: Moskenstroomen r. Stamsund +, Gaukværo r, Steine r.
**Distribution:** Coasts of the North Sea and Western Europe. The Mediterranean.

*G. distans* (Greg.) Ehrb.


Very rare: Stene r; Stamsund r.

**Distribution:** Coasts of Western Europe. Sweden. The Mediterranean.

**9. Eunotia** Ehrb.

Fresh water species.

*E. ovata* Ehrb.

Van Heurck Synops. p. 141, pl. 34, f. 2.

Very rare: Stene r.

**Distribution:** Common fresh water species.

*E. ovata* (W. Sm.) Rabenh.

Van Heurck Synops. p. 142, pl. 34, f. 11.

Very rare: Ostestesfjord r.

**Distribution:** Fresh water species from Western Europe.

*E. pertinax* (Dillw.) Rabenh.

Van Heurck Synops. p. 141, pl. 33, figs. 15—18.

Very rare: Svolvaer r, Gaukvsero r.

**Distribution:** Common fresh water species.

*E. procera* Ehrb.

Van Heurck Synops. p. 143, pl. 34, f. 19.

Very rare: Ostestesfjord r, Stonen r.

**Distribution:** Northern Europe. America.

*E. bidentata* W. Sm.


Very rare: Gaukvsero r; Stamsund r.

**Distribution:** Great Britain and Ireland.

*E. tricrenata* Ehrb.


Very rare: Gaukvsero r; Stonen r.

**Distribution:** Northern Europe. Switzerland. Cayenne.

*Ceratoneis acus* (Ehrh.) Kütz.


Fresh water species.

Very rare: Gaukvsero r.

**Distribution:** Common fresh water species, especially in alpine localities.

**10. Meridionace.**

*Meridion circinare* (Greg.) Ag.

Van Heurck Synops. p. 161, pl. 51, figs. 10—12.

Fresh water species.

Very rare: Svolvaer. Only two cells of a chain.

**Distribution:** Common fresh water species in temperate regions.

### 11. Tabellarioideae.

**Tabellaria flocculosa** ( Roth) Kütz.

Van Heurck Synops. p. 162, pl. 52, figs. 10—12.

Fresh water species.

Rare: Svolvaer r, Gaukvsero r, Stonen r.

**Distribution:** Common fresh water species.

**Striatella unipunctata** (Lyngb.) Ag.

Cf. above p. 103.

Very rare: Gaukvsero r.

**Distribution:** Frequent on the coasts of Europe. Finnmark. The Red Sea. Cape Horn.

**Rhabdonema** Kütz.

*K. minutum* Kütz.


Frequent: Stamsund r, Svolvaer r, Raftsund r, Gaukvsero r, Stonen r.

**Distribution:** Frequent on the coasts of Europe, especially on the western and northern ones. Arctic regions. Cape of Good Hope.

*K. arcuatum* (Lyngb.) Kütz.


Frequent: Svolvaer r, Raftsund r, Gaukvsero r, Stonen r.

**Distribution:** Frequent on the coasts of Europe and North America. Arctic regions.

**R. adriaticum** Kütz.


Rare: Svolvaer r, Raftsund r, Stonen r.

**Distribution:** Frequent on the coasts of Europe and America. Finnmark (cf. Cleve who remarks (Vezzaexp. p. 184) that this species else is wanting in the arctic regions. Africa. Pacific Ocean.

**Grammatophora** Ehrh.

*G. islandica* Ehrh.

Van Heurck Synops. pl. 53, f. 7.

Rare unfrequent: Stamsund r, Svolvaer r, Raftsund r, Brettelesnes—Skroven r, Stonen r.

**Distribution:** Northern and western coasts of Europe. North Pacific. Cape Horn.

*G. serpentina* Ralfs.

Ralfs in Ann. and Mag. XL, pl. IX, f. 5. Van Heurck Synops. pl. 53, figs. 1—3.

Frequent: Moskenstremmen r, Stamsund r, Svolvaer r, Raftsund r, Brettelesnes—Skroven r, Gaukvsero r, Stonen r.

**Distribution:** Frequent on the coasts of Europe. Ceylon. Cape Horn. Antarctic regions.
**G. marina** (Lysoz.) Kütz.

**N. naviculata** (Breb.) Gruen.

**S. candida** (W. Sm.) Gruen.

**S. calicifera** (W. Sm.) Gruen.

**N. macilentua** (W. Sm.) Gruen.

**G. arctica** Cl.
Cl. Dist. Spitsb. 1867, p. 664, pl. 29, f. 1. Van Heurck Synops. pl. 53, 2, f. 3. *G. arctica* Linna. Microgeol. pl. 35 A, XX, figs. 1—2; (non l. c. pl. 18, f. 86 a, b).

**N. coarctata** Gruen.
Gruen. l. c. p. 66. Van Heurck Synops. pl. 57, f. 4.

**N. punctata** (W. Sm.) Gruen.

**G. oceanica** Ehrh.
Ehrh. Microgeol. pl. 19, f. 36 a, pl. 18, f. 87 a.

**Tryblionella constricta** (Greg.) Gruen.

**N. naviculata** (Breb.) Gruen.

**N. marginalata** Gruen.
Gruen. l. c. p. 72.

**N. hungarica** Gruen.

**S. candida** (W. Sm.) Gruen.

**S. coarctata** Gruen.
Gruen. l. c. p. 66. Van Heurck Synops. pl. 57, f. 4.

Several specimens which seem to belong here were found:

**G. oceanica** Ehrh.

**N. macilentua** (W. Sm.) Gruen.

**G. arctica** Cl.

**N. punctata** (W. Sm.) Gruen.

**G. oceanica** Ehrh.

**N. macilentua** (W. Sm.) Gruen.

**G. arctica** Cl.

**N. punctata** (W. Sm.) Gruen.

**G. oceanica** Ehrh.

**N. macilentua** (W. Sm.) Gruen.

**G. arctica** Cl.

**N. punctata** (W. Sm.) Gruen.

**G. oceanica** Ehrh.

**N. macilentua** (W. Sm.) Gruen.

**G. arctica** Cl.

**N. punctata** (W. Sm.) Gruen.

**G. oceanica** Ehrh.

**N. macilentua** (W. Sm.) Gruen.

**G. arctica** Cl.

**N. punctata** (W. Sm.) Gruen.

**G. oceanica** Ehrh.

**N. macilentua** (W. Sm.) Gruen.

**G. arctica** Cl.

**N. punctata** (W. Sm.) Gruen.

**G. oceanica** Ehrh.

**N. macilentua** (W. Sm.) Gruen.

**G. arctica** Cl.

**N. punctata** (W. Sm.) Gruen.

**G. oceanica** Ehrh.

**N. macilentua** (W. Sm.) Gruen.

**G. arctica** Cl.

**N. punctata** (W. Sm.) Gruen.

**G. oceanica** Ehrh.

**N. macilentua** (W. Sm.) Gruen.

**G. arctica** Cl.

**N. punctata** (W. Sm.) Gruen.

**G. oceanica** Ehrh.

**N. macilentua** (W. Sm.) Gruen.

**G. arctica** Cl.

**N. punctata** (W. Sm.) Gruen.

**G. oceanica** Ehrh.

**N. macilentua** (W. Sm.) Gruen.

**G. arctica** Cl.

**N. punctata** (W. Sm.) Gruen.

**G. oceanica** Ehrh.

**N. macilentua** (W. Sm.) Gruen.
d. *Dubia* Grun.

*V. littoreus* Grun. (3)

VAN HEERK SYMPS. pl. 59, f. 21. *H. arenaria* var. *littoralis* Grun. in Cl. et
GREN. AERT. DIST. p. 78.

Very rare: Stamsund r. 113 x long; 7 keel puncta on 10 p. Similar to *N. hybrida*, but is longer and narrower, with more distant keel puncta and more excentric keel. Also Stene, r.r.

*Distribution*: Newcastle. Lyonskil (Sweden).

e. *Bilobata* Grun.

*V. bilobata* W. Sm.


Very rare: Ostnesfjord, r.

*Distribution*: Frequent on the coasts of Europe (the most northern ones excepted). Pacific Ocean.

f. *Hybrida* Grun.

Cf. above p. 03.

Perhaps derived from the plankton.

Very rare: Stamsund r.

*Distribution*: Cf. above p. 03.

N. Mitchelliana Grin.

Cf. above p. 04.

Very rare: Ostnesfjord, r, Stene r.

*Distribution*: North America. Arctic regions.

g. *Insignes* Grin.

*V. insignis* Grin.

GREN. MÉTOP. J. 5, v. 5, p. 30, pl. 1, f. 46.

Not unfrequent: Stamsund r, Ostnesfjord r, Gaukvaero r, Stene r.


var. *notabilis* Grin.

GREN. IN CL. ET GREN. AERT. DIST. p. 84. VAN HEERK SYMPS. pl. 51, f. 5.

Very rare: Gaukvaero r. 476 x long; 9–10 striae on 10 p.

*Distribution*: The Mediterranean.

var. *spatulatiformis* Grin.

VAN HEERK SYMPS. pl. 61, f. 3.

Very rare: Stamsund r.

*Distribution*: The Mediterranean. West Indies.

N. Smithii Rals.

RALS. IN PRITSCH. INT. p. 781. VAN HEERK SYMPS. pl. 61, f. 4.

Not unfrequent: Stamsund +. Stene r.

*Distribution*: Coasts of Western Europe. Adriatic Sea. Finmark (var. marginifera Grin.).

g. *Spatulata* Grin.

N. angulata W. Sm.


*Distribution*: Frequent on the western and northern coasts of Europe. The Mediterranean. Arctic regions. Ceylon. Cape Horn.

N. spatulata Bres.

BRES. IN W. SM. BRIT. DIST. I, p. 40, pl. 31, f. 288. VAN HEERK SYMPS. p. 177, pl. 62, figs. 7–8.

Somewhat rare: Stamsund r, Ostnesfjord, Gaukvaero r.

*Distribution*: Frequent on the western and northern coasts of Europe. The Mediterranean. Arctic regions.

N. distans Grin.

GREN. BRIT. SYMPS. OF CLYDE. p. 350, f. 103. VAN HEERK SYMPS. pl. 62, f. 10.

Rare: Stamsund r (several specimens); Ostnesfjord r.


h. *Sigmastata* Grin.

N. sigma (Kütz.) W. Sm.


*Distribution*: Cosmopolitan.

i. *Lanceolata* Grin.

N. lanceolata W. Sm.


I have two times seen the wavy longitudinal lines, described and illustrated by W. Sm., They were more distinct than the transverse striae.

*Very rare*: Stamsund r. Gaukvaero r. Stene r.

*Distribution*: Frequent on the coasts of Europe, the most northern ones only excepted. Indian Ocean.


N. longissima (Bres) Rals.

Cf. above p. 104.

Very rare: Gaukvaero r.

*Distribution*: Coasts of the North Sea and Western Europe. The Mediterranean. West Indies. Indian Ocean.
13. *Surirellae*.

**Camptocyclus** Ehrh.


Not unfrequent: Moskenstommen r, Stamsund r, Østnesfiord r, Gaukvær r.

*Distribution* (including the nearly related C. *Raftsii* W. Sm.): Frequent on the coasts of Europe. Greenland. Java. Pacific Ocean.


Differs from the preceding species in having a linear (not lanceolate) pseudoraphe. Smaller in size.

Very rare: Stene r. Stamsund r.


Frequent: Raftsund r. Brethesnes—Skroven r. Østnesfiord e. Stene r.

*Distribution*: Scotland. The Skagerak. Arctic regions.


Frequent: Moskenstommen r, Stamsund +, Svolvær r +, Raftsund r. Brethesnes—Skroven r. Østnesfiord + c, Gaukvær + c, Stene r +.

*Distribution*: Frequent on the coasts of Europe. Arctic regions. Indian Ocean.


18 by some authors considered to be a form of *C. *Thuretii* Briët. (cf. De Toni *Syll.* p. 622) by others to belong to *C. decorus* Briët. (cf. *Van Heurck* Traité p. 376).

Very rare: Stene r.


Very rare: Stene r r. Only a broken valve.


**Surirella** Terr.


Very rare: Gaukvær r r.

*Distribution*: Frequent on the coasts of Europe. Spitsbergen.


In fresh and brackish water.

Very rare: Gaukvær r.

*var. orata* (Kütz.) V. H. *Synops.* p. 188, pl. 73, figs. 6—7. *Surirella orata* Kütz. *l. c.* p. 82, pl. 7, figs. 1—4.

Very rare: Gaukvær r.

*Distribution*: Common species.


Rather frequent: Svolvær +, Raftsund r, Gaukvær r, Stene r +.

*var. lata* (W. Sm.) V. H. *Synops.* p. 188, pl. 72, f. 17. *Surirella lata* W. Sm. *Brit. Diat.* I, p. 31, pl. 9, f. 61.

Frequent: Moskenstommen r +, Stamsund r, Svolvær r, Raftsund r. Brethesnes—Skroven r. Østnesfiord r, Gaukvær r, Stene r.

*Distribution*: Frequent on the coasts of Europe. Gulf of Mexico.

14. *Achnanthes* Cl.

**Achnanthes** Bory.


Very rare: Svolvær r.

*Distribution*: Frequent (on algae) on the coasts of Europe. The Canary Isles.

*A. brevipes* Ag. *Ag. L. c.* *Van Heurck* Synops. p. 129, pl. 26, figs. 10—12.

Rare: Stamsund r, Steine r, Østnesfiord r.

*Distribution*: Frequent on the coasts of Europe.

**Euroeconeis** Cl.

Valves coosate, without marginal loculiferous rim. Both valves with narrow axial area, rather similar in structure.


Rare: Stamsund r, Raftsund r, Østnesfiord r, Steine r.


**Heteroneis** Cl. (includes *Discioneis* Cl. L. c. p. 180 and *Achnanthes* Cl. L. c. p. 185).

Valves very dissimilar, without marginal loculiferous rim. Upper valve costate, sometimes only striate, then with broad axial area.
Coste apparently marginal, strong, about 29 in 0.001", giving the appearance of a narrow marginal band of very strong coste. Within this band, however, the valve, on close inspection, is found to be marked with similar but much fainter coste nearly to the median line. The valve appears to be thicker near the margin than in the middle, and this perhaps is the reason why the coste are so strong and conspicuous there. Stene R. c.

It seems to me that there can scarcely be any doubt that *Pinnularia Allmanniana* Greg., is synonymous to *Cocconeis quadrerovus* Grux. Size, shape and structure agree very well in both species. There seems to be a marginal rim which has, however, only faint traces of loculi.

Raré: Stamsund r, Steine r.

*Distribution*: Coasts of the North Sea. Arctic regions. The Mediterranean.

**H. norvegica** (Gréen.)


Upper valve as illustrated l. c. by A. Schirm. Instead of the median line (pseudoraphe), there is often a linear blank space, which sometimes that rarely) is somewhat irregularly widened. The lower valve has a very delicate structure, consisting of close, somewhat radiating striae, in the median part of the valve coarser and more conspicuous, about 15 on 10 p., otherwise very faint, about 29 on 10 p. Raphe Strait, extending to the margin: the inner ends somewhat thickened, separated from each other. A rather broad hyaline border, but no loculiferous rim.

Cl. Synops. Navie. Dist. II, p. 198 mentions that he has found a frustule of *Cocconeis lyrus* with an upper valve like that illustrated by A. Schrm. l. c. (pl. III f. 18. 1, upper figure). I have, however, found a frustule, showing this upper valve, in connection with a lower valve of the structure just described. There must therefore here be some mistake, if there are not two different species, with very similar upper valves.

There is a marginal rim, like a somewhat broad hyaline border, with only faint traces of loculi.

Raré: Stamsund r + (many specimens); Steine r.

*Distribution*: West coast of Norway (Solsvik near Bergen).

**Cocconeis** Ern., l.

Valves ecostate, with a marginal loculiferous rim, dissimilar in structure.

**C. scutellum** Ern.,


According to Cleve exceedingly variable. It seems, however, that he has gone too far when referring so many different forms to this species, as he has done (l. c. pp. 170–171).

Not unfrequent, in different forms which only badly answer to the varieties described: Stamsund r, Solvær +, Ostnesfjord r, Steine r.

*Distribution*: Cosmopolitan.

**C. distans** Greg., A. Schrm.


Small specimens, very well answering to the figures in A. Schrm. l. c. (f. 23 entire frustule) occurred. They had no loculiferous rim, only a hyaline border. Lower valve with very faint and indistinct strip.

There is, however, such a remarkable agreement with a form of *C. scutellum*, most probably the one, mentioned above, which at first was figured by Gregory as *C. distans*, that I do not feel quite sure if not these two forms after all belong together. The only difference seems to be the larger marginal areoles which are wanting in the true *C. distans*.

The variety of *C. scutellum* just mentioned differs remarkably from the common forms. There is a narrow marginal rim, but no loculi. Lower valve with straight raphe, stretching to the margin. Median pores somewhat separated from each other. Axial area indistinct except towards the central node, where it suddenly dilates into a small, round, central one. Striae finely radiating, much curved towards the ends of the valve, most conspicuous near the margin, distinctly punctate, about 14 on 10 p. A narrow striate border with strie somewhat closer and less conspicuous than the marginal strie of the valve, 15–16 one 10 p. 38 > 29 p.

Smaller specimens seem to pass insensibly into such forms, which A. Schrm. has figured l. c.

Very rare: Stamsund r.


**C. lyra** A. Schrm.


As mentioned above I think there must be some mistake, when Cl. mentions having seen a frustule of this species with the upper valve of the species above named *Heteroneis norvegica*. Though I have seen no entire frustule of *C. lyrus*, I should think that A. Schrm.'s illustrations to which I have referred, belong together, which also answers very well to the dimensions. I have repeatedly found this upper valve in connection with a loculiferous rim with 6 loculi on 10 p. The species consequently is no *Disconeis Cl.*, but belongs to *Cocconeis* or *Pleurococcus*.

The remarkable lower valve occurred sparsely in my material, but corresponded in size and shape precisely to the supposed upper valve. Its structure is puzzlingly similar to that of small forms of *Navicula lyrus var. athabasca*. On one side of the valve between the furrows and the margin, there is, however, an indistinct blank line or furrow, parallel to the main furrows, which is absent in the *Navicula* mentioned.

Upper valve with transverse and longitudinal coste, the latter a little closer than the former. Between the coste there is, therefore, a single row of conspicuous areoles.

Raré: Stamsund r (both valves); Steine r (upper valve only).

*Distribution*: West coast of Norway.
**Pleuronoeis** (Cl. L. c. p. 181).
Marginal loculiferous rim. Upper valve costate. Between the costa double rows of small pearly.

**P. costata** (Greg.) Cl. L. c.

Has a broad and well developed loculiferous rim.
Rare: Stamsund r, Ostnesfjord r, Steene r.

**P. pinnata** (Greg.)

Lower valve: The raphe fine, straight, stretching to the ends of the valve, in the middle with valve ends, somewhat separated from each other. Axial area not visible, central one very small, roundish. Striae very faint, not distinctly seen on my specimens.
There is a marginal rim with rudimentary loculi which are less than half developed, but very well visible, 4 on 10 μ. A distinct hyaline border. This species seems on the whole to be closely related to *Pleuronoeis costata* though undoubtedly a separate species.

**Rhoecosphena** Grez.

**K. curvata** (Kütz.) Grez.

In fresh or brackish water. A coarser form (var. marine Van Heurck Synops. pl. 29, f. 4) marine.
Very rare: Svolvær r, Ostnesfjord r.
**Distribution**: Cosmopolitan in fresh and brackish water.

15. *Gomphonemceae*.

**Gomphonema** Ag.

**G. constrictum** Ehrl.
Very rare: Svolvær r.
**Distribution**: Common fresh water species.

**G. exiguum** Kütz.
Kütz. Bacill. p. 84, pl. 30, f. 58.
var. pachycola (Brez.) VH. Synops. pl. 25, figs. 31–32.

Very rare: Steene r.
**Distribution**: West coast of France. Arctic regions.

**G. kantschaticum** Grez.

Very rare: Svolvær, r. Valve 45 × 8 μ, narrow, elavate, with rounded broader end. Axial area narrow, dilated to an oblong central area. Striae little radiating, coarse outside the central area, about 15 on 10 μ, in the middle only 11.
**Distribution**: (Marine). Arctic America and Asia. Iceland.

16. *Naviculceae*.

**Auricula complexa** (Greg.) De T.

Probably derived from the plankton.
Very rare: Ostnesfjord r.
**Distribution**: Cl. above p. 108.

**Tropidoneis** Cl.

**T. maxima** (Greg.) Cl.

Somewhat rare: Stamsund r, Svolvær r, the Ostnesfjord r, Steene r ±, Gaukvær r.
**Distribution**: Coasts of the North Sea and Ireland. The Mediterranean. Finnmark (var. dubia Cl. et Grez.) Indian Ocean.

**T. lepidoptera** (Greg.) Cl.
Cl. l. c. p. 25. *Amphigera lepidoptera* Greg. Dist. of Clyde p. 505, pl. XII, f. 59 a, b+ (non c). Van Heurck Synops. p. 120, pl. 22, figs. 2–3.

Not frequent: Stamsund +, Svolvær r, the Ostnesfjord r, Steene r +, Gaukvær r.

**Donkinia** Raleigh.

**D. recta** (Donk.) Grez.

Very rare: Stamsund, r.

**D. carinata** (Donk.) Raleigh.

Rare: The Ostnesfjord r, Steene r, Gaukvær r.
**Distribution**: Coasts of the North Sea and Ireland. Sea of Kara. Davis Strait. Balaeric Islands.
Plenicosigma W. Sm.

a. Eupleurosignia. Striae in three directions (transverse and oblique).

P. abaeda W. Sm.
W. Sm. Brit. Dist. I, p. 64, pl. 21, f. 291.

var. abaeda var. W. Sm.

Very rare: Stamsund, r. 254 p > 21 p; oblique striae 18 on 10 p, angle more than 60°, transverse striae indistinct. Raphe central, almost straight. Somewhat broader in the middle, with obtuse ends.


P. elongatum W. Sm.

Very rare: The Ostnesfiord r.


P. rigidum W. Sm.

Very rare: Stamsund r, Gaukvsero r.


P. Normanai Ralfs.

Frequent: Stamsund r, Svolvere r, the Ostnesfiord + c, Steen c. Gaukvsero +.


P. strigosum W. Sm.

Very rare: Stamsund r, Svolvere r.


P. formosum W. Sm.

Rare: Stamsund r, Steen r, Gaukvsero r.


P. speciosum W. Sm.

Very rare: Steen r.


b. Gyrosigma (Hass).

P. attenuatum (Kütz.) W. Sm.

var. scalprum Gail. et Turb.

Very rare: The Ostnesfiord r.

Distribution (of the variety): North Sea. brackish and marine.

P. latricum (Breb.) W. Sm.

Very rare: Stamsund r, Stamsund r.

Distribution: Cosmopolitan in warm and temperate regions.

Rhicosigma Grun., Pers.

R. arcticum Cl.

Frequent: Stamsund r, the Ostnesfiord + c, Gaukvsero c.

Distribution: Scotland. West coast of Norway, frequent. Arctic regions.

Sealiotropis Cl.

S. lateriata (Breb.) Cl.

Very rare: Stamsund r, Steen r.


Sealiotropis tumida (Breb.) Ralfs.

Very rare: Gaukvsero r.


Pseudoamphipora Cl.

According to Cleve the following species has 2 chromatophores peculiar in shape and position.

P. stauroptera (Breb.) Cl.

Very rare: Stamsund r, the Ostnesfiord r.

Caloneis Cl.

Valve striate; striae parallel, except at the ends, crossed on each side of the raphe by one or more longitudinal lines. Connecting zone not complex.

C. lacer (W. Sm.) Cl.

var. linearis (Greg.) VI.

Frequent: Stamsund r., Svolvær r., the Ostnesfjord r., Raftsund r., Steine r., Gaukavero r.

Distribution: Cosmopolitan.

var. maxima (Greg.)

Frequent: Stamsund + c, Steine r.

Distribution: Coasts of the North Sea and Western Europe.

var. elongata (Greg.) Cl.

Very rare: Stamsund r.

Distribution: Coasts of the North Sea, Indian Ocean, Colon.

C. consimilis (A. Schrn.) Cl.

Very rare: Stamsund r.

Distribution: North Sea, Balearic Islands.

C. amphibiaena (Bory) Cl.

Very rare: Steine, r.

Distribution: In brackish and fresh water, frequent especially in Northern and Western Europe. Caspian Sea.

C. brevis (Greg.) Cl.

Very rare: Stamsund r, the Ostnesfjord r, Steine r.

Distribution: North Sea. Arctic regions.

C. blanda (A. Schrn.) Cl.

Very rare: Stamsund r, the Ostnesfjord r.

Distribution: Coasts of the North Sea, Black Sea. Indian Ocean. Pacific Ocean.

C. musca (Greg.) Cl.

Very rare: Stamsund r.

Distribution: Coasts of the North Sea. The Mediterranean, Indian and Pacific Oceans. West Indies.

Schiizomena Ag.

S. Grevillei Ag.

Rare: Stamsund r, Svolvær r.

Distribution: Coasts of the North Sea and Western Europe, frequent. Arctic regions. West Indies, California. Kerguelen.

S. crunigerum W. Sm.

Rare: Svolvær, r.

Distribution: Coasts of the North Sea and Western Europe. The Baltic.

Staurnoeis Ehr.

S. salina W. Sm.

Rare: Stamsund r, Steine r.


S. Gregorii Ralfs.

Rare: Stamsund r, Gaukavero r.


S. pharencetron Ehr.

Very rare: Steine, r.

Distribution: Fresh water species, especially frequent in Northern and Western Europe. America, New Zealand.

Navicula Bory.

Valves with small puncta, arranged in parallel transverse striae and also forming straight longitudinal ones, crossing the former at right angles.

N. enopla Kütz.

Very rare: Stamsund r, the Ostnesfjord r.

Distribution: Common fresh water species.


Coarse puncta, arranged in transverse striae (radiate at the ends) but not in straight longitudinal rows.

Very rare: Raftsund r.


N. monilifera CL.


Very rare: The Ostnesfjord r.

*var. heterosticha* CL.

Cl. I. c. *N. granulata* A. Schm. Atlas, pl. 6, figs. 13–16.

Very rare: Raftsund r.


N. latissima GREB.


Frequent: Moskenstrommen r+, Svolvecer r, the Ostnesfjord r. Raftsund r, Steine r+.


N. punctulata W. SM.


Very rare: Stamsund r.


N. fraudulenta A. SCHM.


Rare: Stamsund r+. Many specimens.

*Distribution:* North Sea. Seastadpol.

c. Lincolata Cl. I. c. II, p. 10.

Radiate or parallel striae, transversely lineate.

N. radiosa KÜTZ.


Rare: Steine r.

*Distribution:* Frequent fresh water species, especially in Northern and Western Europe. Asia, Africa, America.

N. peregrina BREC.


Very rare: Gaukværa r.


var. kelvingensis (EMER.) CL.


Very rare: Svolvecer. 141 x long.

*Distribution:* Brackish water. Scotland.

N. digitata-radiata (GREB.) A. SCHM.


Frequent: Stamsund r+, Svolvecer r, the Ostnesfjord r, Steine r.


N. directa W. SM.


Rare: Stamsund r+, the Ostnesfjord r, Steine r.

*Distribution:* Coasts of the North Sea. Arctic regions. Yokohama.

var. remota GREB.


Somewhat rare: Stamsund r+, the Ostnesfjord r. Gaukværa r.


var. subtilis (GREB.) CL.


Rare: Steine r, Gaukværa r.

*Distribution:* Scotland. Arctic regions.

N. immaculata (CL. et GREB.) CL.


Very rare: Steine, r. Very similar to the figure quoted, though wanting the finiter or blank lateral areas. Also very similar to *N. transiens forma minuta* CL. Vega pl. 36, f. 37.

N. frigida GREB.


Probably derived from the plankton.

Rare: Stamsund r+.

*Distribution:* Arctic regions. Cl. above p. 105.

N. cancellata DONK.


Very variable, probably also including *N. valdoci* and *N. norvegica*.

Very frequent: Moskenstrømme r, Stamsund r, Svolvecer r, the Ostnesfjord r, Raftsund r, Steine r, Gaukværa e.c.

VAR. GREGORII (RAFL.) GREG.  

GREG. in CL. and GREN. A R T I C. D I S T . p. 37. 'MICROCOCHLIA GREGORII RALPH IN PEPPER,  
Inf. p. 901. A. SCHM. NORDS. Dist. pl. II, f. 22.  

Very rare: Stamsund r. Gaukvaaro r.  

N. northamazonica DOKS.  
DOEK. M. J. D. 1, p. 9, pl. I, f. 3. A. SCHM. Atlas pl. 47. figs. 19—20.  

Very rare: Stamsund r. Stene r.  
Distribution: North Sea.

N. zostereti GREK. (?)  

Rare: Stamsund r. Stene r. Gaukvaaro r.  

N. fortis (GREK.) DOKS.  

Perhaps only a coarse variety of N. cancellata.  
Very rare: Stene r.  
Distribution: North Sea. Arctic regions (Spitbergen, Finnmark, Greenland).

N. rostellata (GREK.) A. SCHM.  
A. SCHM. NORDS. Dist., expl. pl. II, f. XV. rostellata GREK.?) Pinnularia r. GREK. Brit. of Clyde p. 488, pl. IX, f. 29.  

Very rare: Stene r. Probably the same species as the following one. There does, however, really exist a form answering to Gregory's figure, without a central transverse area.  
Distribution: Coasts of the North Sea.

N. cruciata GREK.  
A. SCHM. Atlas pl. 49, figs. 30—53. NORDS. Dist. pl. II, f. 31 (? rostellata GREK.? )  

Must be reckoned as a variety to the preceding species (or vice versa).  
Very rare: Stamsund r. Gaukvaaro r.  

N. distans (W. & N.) CL.  

Very rare: Raftsund r. Stene r.  
Distribution: North Sea. Arctic regions.

N. compressicavala A. SCHM.  

The peculiar aspect of the ends of the valve is due to the convexity. The valve is boat-shaped with sharp stems, at the bottom of which the terminal nodules are situated. Thus they are rather distant from the very ends.  
Rare: Stamsund r. +.  

N. superimposita A. SCHM.  
A. SCHM. NORDS. Brit. p. 90, pl. II, f. 34; Abers pl. 46, f. 61.  

In many respects answering to the preceding species, though undoubtedly distinct.  
Very rare: Stamsund, r. Several specimens observed.  

N. opima GREK.  

Very rare: Stamsund, r.  

D. LAVISTRIATÆ CL. i. c. p. 66.  
Radiate stripe, not distinctly puncate nor isolate. Valve more or less lanceolate.

N. palpebralis BREED.  
BREED. in W. & N. Brit. Dist. p. 50, pl. 31, f. 27. VAN HEURCK SYNE. p. 96, pl. II, f. 9.  

Rare: Stamsund r. +. Moskenstrommen r. Gaukvaaro r.  

VAR. BARCHAYANA (GREK.) VII.  

Rare: Stamsund, r.  
Distribution: Coasts of the North Sea. The Mediterranean.

VAR. SEMIPLENA (GREK.) CL.  
CL. I, c. p. 70. Pinnularia s. GREK. M. J. D. 1, p. 84, pl. VII, f. 12.  

Rare: Stamsund, r.  

VAR. ANGULOSA (GREK.) VII.  

Rather frequent: Stamsund +, Stene r. Gaukvaaro r. +.  
Distribution: Coasts of the North Sea and Western Europe. The Mediterranean.

VAR. MINOR GREK.  

Rare: Stamsund r. Gaukvaaro r.  

N. praesccta A. SCHM.  
A. SCHM. NORDS. Dist. pl. II, f. 20.  

Recalls the var. semiplena of the preceding species (cf. CL. i. c. p. 70), but has a much finer structure. Striae 15 on 10 p. An obscure line is to be seen between the central area and the margin. Perhaps a species of Galcinia.
Very rare: Stamsund r. 53 p. long.

**Distribution:** West coast of Norway. Bohuslän (Sweden).

**N. lyrata** Ehren.

Ehren 1840. Microgeolog. pl. 19, f. 1.; *Phacopina* p. 92, pl. 18, f. 13.

Not unfrequent: Moskenstroommen +, Stamsund r. Svolvær r. Raftsund r. Steine r. 


**N. Hennebryi** W. Sm.


Very variable.

Frequent: Stamsund c. the Østnesfjord r. Bretestrøm - Svolvær r. Raftsund +, Steine r +.


**N. spectabilis** Grøn.


Frequent: Stamsund + c, Raftsund r. Steine +.


Besides, a fine variety from Stamsund, r. with short marginal stripe between the main ones.

**N. abrupta** (Grøn.) Donk.


Frequent: Moskenstroommen r, Stamsund r. Svolvær r. the Østnesfjord c, Raftsund r. Steine +, Gaukvenr + e.


**N. clavata** Grøn.


Characteristic form, though hardly specifically different from certain varieties of *N. lyra*.

Not unfrequent: Moskenstroommen r, Stamsund r. Svolvær r. the Østnesfjord r. Raftsund r +, Steine r.


**N. lyra** Ehren.


Somewhat rare: Moskenstroommen r, Stamsund r +, Svolvær +, the Østnesfjord r. Steine r.


**var. elliptica** A. Schm.

A. Schm. Nord. Diat. pl. 1, f. 34.

Very frequent: Stamsund c +, Svolvær +, Raftsund c - Svolvær - Kaupstrøm - Svolvær c - Gaukvenr + e.


**var. atlantica** A. Schm.

A. Schm. Nord. Diat. pl. 1, f. 34.

Very characteristic. Recalls sometimes *N. abrupta*, but always easy to distinguish from that species.

Rare: Stamsund r +, Moskenstroommen r.

**Distribution:** Coasts of the North Sea.

**N. forcipata** Grøn.


**N. forcipata** var. Sandnes A. Schm.

A. Schm. Nord. Diat. pl. 1, f. 34.

Very rare: Stamsund r. +, Moskenstroommen r.


**var. versicolor** (Grøn.) Grøn.


A very well marked variety.

Rare: Stamsund +.

**Distribution:** North Sea. The Mediterranean. Sumatra.

**N. pygmaea** Kütz.


It is hardly possible to keep this species distinct from certain varieties of the preceding species (cfr. Cl. I, c. p. 66). Very rare: Stamsund r. Steine r.

**Distribution:** Baltic, water: Coasts of the North Sea. Baltic. Arctic regions. America.

**Pinnularia** Ehren.


Very rare: Raftsund r.

**Distribution:** Fresh water species. Arctic regions. Northern Europe. North America.
P. nobilis Ehrb.  

Rare: Snake r; the Ostnesfjord r.

Distribution: Fresh water species, especially frequent in Northern and Western Europe.

b. Divergentes Cl. l. c. p. 77.

P. laevigata Ehrb.  

Very rare: The Ostnesfjord, r.

Distribution: Fresh water species, frequent especially in Northern and Western Europe. Africa, Asia, Australia, America.

P. dierensis W. Sm.  

Frequent: Stamsund, Raftsund r, the Ostnesfjord r, Stone + c.

Distribution: Fresh water species. Arctic regions. Western Europe, Switzerland, Australia.

P. loricata Ehrb.  

Very rare: Stamsund, r.

Distribution: Frequent fresh water species, especially in arctic and alpine regions: Northern and Western Europe; Switzerland, Asia, Africa, America and Australia.

c. Distantes Cl. l. c. p. 80.

P. bittore (Brek.) W. Sm.  

Frequent: Svolvær r, Raftsund r, the Ostnesfjord r, Stone + c.

Distribution: Fresh water species. Arctic regions. Western Europe, Switzerland, Australia.

d. Marinus Cl. l. c. p. 94.

P. quadrata (A. Schm.) Cl.  

Frequent: Stamsund +, Svolvær r, the Ostnesfjord r, Stone r +, Gaukvaer + c.


P. clavipes (Grev.) Cl.  

Rare: Stamsund r +, Gaukvaer r.

Distribution: Coasts of the North Sea. Sweden, Balicaric Islands.

P. cruciformis Donk.  

Rare: Stamsund r, Svolvær r, Gaukvaer r.

Distribution: Coasts of the North Sea. Finnmark, Baltic, West Indies, Cape Horn, Seychelles.

P. trefurbyana (Donk.) Rasen.  

Rare: Stamsund r, Svolvær r, Stone r.

Distribution: Coasts of the North Sea. Florida, Japan.


The material examined was especially rich in forms of this beautiful genus. For the sake of greater clearness, they are arranged in the two groups Didyma and Elliptice, although these groups by some intermediate forms pass into each other.

a. Elliptice V. H. Synove.

D. hyalina (Donk.) Cl.  

Very rare: Stamsund, r.

Distribution: Coasts of the North Sea. Finnmark.

D. coffeoformis (A. Schm.) Cl.  

Perhaps a variety of the following species. Rare: Stamsund, r +.

Distribution: Coasts of the North Sea. Naples, Macassar Straits.

D. sobollicularis (Greg.) Cl.  
Cl. l. c. p. 81. Navicula sobollicularis var. (Greg.) Brit. of Clyde, p. 157, pl. IX, f. 17.

Somewhat rare: Stamsund +, Svolvær r.


D. eugeniae (A. Schm.)  

This beautiful species is so easily recognizable and seems to be so well distinguished from the following that I prefer to keep them separate instead of referring both to D. contigua, as Cl. (l. c. p. 82) does.

Rare: Stamsund r +, Raftsund r.


D. sejunctata (A. Schm.)  

This species is certainly a Diploneis, not a Caloneis as Cl. l. c. supposes. A. Schm. (Nords.) compares it with D. nilsonii and mentions it (X. eugeniae) another time (Atlas l. c.) as a connecting link between D. nilsonii and D. eugeniae.

Horns of the central nodule not plainly separated. Now and then, the division line is, however, seen. Coaste apparently lanceate; the very faint longitudinal lines form a single row of alveoli between the costae. Sometimes the valves are a little constricted in the middle.

I can find no essential difference between this form and X. eugeniae. The costae in the latter are stated to be 8–9 on 10 μ, in the former 12. The structure of D. sejunctata is, however, somewhat variable, and answers perhaps best to 10 costae on 10 μ.
There is also a remarkable agreement in their occurrence, as both are mentioned from Campeachy Bay.

Very rare: Stamsund +, here in rather large numbers, Distribution of *Navicula borealis* A. Schm.: West coast of Norway (Hylingsen). Campeachy Bay.

Distribution of *Navicula nitescens* var. macrocystis (Sweden). Campeachy Bay.

**D. notabilis** (Grev.) Cl.  

**var. acuta** A. Schm.  

Rare: Stamsund r. Rafisund r. Stene r. Gaukværo r.


**D. fuscus** (Grev.) Cl.  
*Navicula* fuscus A. Schm. Brit. Diat. pl. 7, figs. 2—3 (var. macrocystis  

Cl. I. c. p. 94.

This species is exceedingly variable and includes probably *D. hyperborea* and *D. ordica*. Even the limit towards *D. Smithii* seems not to be reliable.

Frequent: Moskenstrommen r. Stamsund +, Soloæør +, the Ostnessfjord r. Rafisund r. Stene r. Gaukværo +.

**var. Gregoria** Cl. I. c. p. 94.  

Large, beautiful form. Differ from the main species in the same way as *D. major* Cl. from *D. Smithii*. Central nodule elongated; terminal nodules distant from the ends.

Very rare: Stamsund, r.


**D. hyperborea** (Grev.) Cl.  

Furrows swelling round the central nodule.

Rare: Stene r. the Ostnessfjord r. Stamsund r.

Distribution: Bohuslän (Sweden).

**var. eximia** A. Schm.  

Beautiful and characteristic form. Large, conspicuous pearls as in *D. fuscus* var. *Gregoria*.

Rare: Stamsund, r +.

Distribution: West coast of Norway.

**D. Smithii** (Grev.) Cl.  

Exceedingly variable, probably also including *D. major* and *D. borealis*.

Very frequent: Moskenstrommen r. Stamsund c. the Ostnessfjord r. Rafisund r. Stene c. Gaukværo c.


**D. major** Cl.  

Beautiful form, but hardly anything other than a coarse variety of *D. Smithii*. It seems quite impossible to keep it distinct from large forms of the latter species, with coarser structure.

The central nodule is usually broadened, broader than the distance between the horns, while in *D. Smithii* is of equal breadth. The terminal nodules are generally distant from the ends, while they in *D. Smithii* lie close to them. Both these characteristics are, however, unreliable. Thus forms occur, which, on account of the structure and the terminal nodules, should be referred to *D. major* but on account of the form of the central nodule to *D. Smithii*, and vice versa.

Not unfrequent: Moskenstrommen +, Stamsund r +, Stene r.


**D. borealis** (Grev.) Cl.  
*Navicula* borealis var. borealis Grev. Brit. Diat. of Clyde IX. p. 56. f. 1. f. 49.

Furrows swelling round the central nodule.

Frequent: Stamsund c. Stene r. the Ostnessfjord r. Gaukværo r.

My specimens differ somewhat from Grev ow's figure, especially in the central nodule, which is not elongated. The double rows of pearls between the costae are very delicate, but are now and then distinctly seen. Agree very well with the description in Grev ow's first edition.

Distribution: Sweden (Bohuslän). Arctic regions. Java.

**D. litoralis** (Dre) Cl.  

Very rare: Stamsund, r.


**D. nitescens** (Grev.) Cl.  

Somewhat rare: Stamsund +, Stene r. Gaukværo r.


b. *Didyma* VII. Synops.

**D. constrieta** (Grev.) Cl.  


Coarser structure than in the following species, horns of the central nodule more divergent, and obtuse angles in the lateral contour. At a certain focus, a few very indistinct oblique longitudinal costae are sometimes to be seen.

Not unfrequent: Stamsund +, the Ostnessfjord r. Stene r.

D. incertata (Grfr.) Cl.

D. interrupta (Duck.) Cl.
Somewhat rare: Stamsund r. Ostnesfjord r. Raftsund r. Stoner c.

D. lineata (Donk.) Cl.
Rare: Stamsund r. Stoner r. Both forms illustrated by A. Schm. l. c. occur.

D. subcincta (A. Schm.) Cl.
Very variable. Structure coarser, coarser than in the preceding species.
Frequent: Svolvær r +. the Ostnesfjord r +. Raftsund r + c. Stoner + c.

var. media (Grfr.)

Two, or a few, broad, irregular longitudinal costae, anastomosing through oblique ones.

This form is very remarkable. By Cleve it has been referred to D. elongata (cf. under that species) by Grfr.sow as a variety to D. bomboides. Grfr.s has, however, noted the close relationship to D. subcincta. As this species is very variable as regards the development of longitudinal costae, and often shows similar peculiarities as the present variety, I have thought it best to consider the latter a variety of D. subcincta. Although, it is, on the whole, so characteristic that it might very well be regarded as a separate species.
I also think I have seen forms distinctly transitional to X. subcincta. Such forms are, however, rare.
Not unfrequent: Stamsund r +. the Ostnesfjord r +. Raftsund r. Stoner r.
Distribution: Arctic regions.

D. elongata.

Regarding the interpretation of this name Cl. l. c. is not quite clear. His species seems to be = A. Schm. Nords. Dist. pl. I, f. 14; a figure, on which the longitudinal costae are very indistinct. Cl. quotes, however, also A. Schm. l. c. f. 13, a figure which undoubtedly represents another species. A. Schm. himself remarks that these two figures cannot be referred to the same species, but that Grfr.sow considers them to be D. elongata Ehren.

Cleve's species is partly identical with D. bomboides var. media Grfr.sow. (in Cl. et Grfr. Arch. Dist. p. 41, pl. III, f. 54), a form, which, according to Grfr.sow, is an intermediate one between D. bomboides and subcincta. This var. media I have referred to D. subcincta (cf. above). It is hardly essentially different from that form from Franz Jos.'s Land, which Grfr.sow illustrates (Dist. F. J. L. pl. I, f. 39) as Navicula subcincta. In this figure the irregular ramifications of the longitudinal costae is seen, producing two anastomosing ones.

The figures from A. Schm. Atlas (pl. 13, figs. 48—49) referred to by Cl. l. c. represent a species, which I have not seen, and which hardly occurs with us.

D. elongata of Van Heeck's Traité p. 195, pl. 26, f. 732 is a different species, identical with A. Schm. Nords. Dist. pl. I, f. 13. This figure seems, however, to represent a form of D. constrieta. The furns, especially, assert very well to the latter species. Van Heeck who is on the whole conservative on the question of species, also mentions the near relationship between D. elongata and D. incertata, a species which again is very nearly connected with D. constrieta.

When Cleve l. c. remarks that D. elongata by intermediate forms passes into D. splendida, this also shows clearly that his species is different from that of A. Schm. (f. 13) and Van Heeck.

The furns of D. elongata Cl. answer very well to those of D. bomboides, less so to those of D. splendida.
I have, however, never seen specimens where it was doubtful, whether they should be referred to D. elongata Cl. (= bomboides var. media Grfr.sow) or D. bomboides.
D. elongata Ehren. Mikrokrologei. 33, XVII, f. 13 has the shape of D. constrieta, but very narrow furns. D. elongata Ehren. l. c. may be Van Heeck's species (A. Schm. Nords. Dist. pl. I, f. 13); the specimen seems to lie somewhat obliquely, which may have caused the median constriction of the furns.

D. splendida (Grfr.) Cl.

This beautiful species is very similar to D. bomboides, but the furns do not swell in the middle and narrow evenly elliptically off towards the ends. The costa, besides, distinctly cross the furns at the sides of the central nodule (i. e., in the furns are here distinct transverse costae), while these furns else are almost smooth. The median structure of the valve generally is a little earearer, the areoles here somewhat larger.
I have seen no distinct transition between D. splendida and the other species.

Sporadically: The Ostnesfjord r +. Raftsund r. Stoner r +.

D. bomboides (A. Schm.) Cl.

Similar to the preceding species, but the furns swell slightly round the central module, and the structure here is like that of the
other parts of the valve. The notches are also more protracted towards the ends, and not conspicuously crossed by transverse costae at the sides of the central nodule.

Always easy to distinguish from the preceding species.

Frequent: Stamsund + c, Brettesnes—Skroven r +, Raftsund r +, Steine r +.


**D. dolium** (Ehrenk.) Ehrenk.


Not unfrequent: Moskenstrommen r, Svolvær r +, the Ostnesord r, Raftsund r, Steine r.

**Distribution:** Especially in brackish water. Coasts of the North Sea, Arctic regions, Baltic. Black Sea, Caspian Sea. Indian Ocean. Pacific Ocean. Cape Horn. West Indies.

**D. bohane** Ehrenk.


Frequent: Moskenstrommen r +, Stamsund c, Svolvær +, the Ostnesord r, Raftsund r, Steine r, Gaukvsro r +.


**D. chersonensis** (Grun.) Grun.


Not unfrequent: Stamsund +, Svolvær r, Gaukvsro r.


**D. erablo** Ehrenk.


Rather frequent: Moskenstrommen r, Stamsund +, the Ostnesord +, Raftsund r, Steine r, Gaukvsro r +.

**Distribution:** Coasts of the North Sea and Western Europe. The Mediterranean. Red Sea. Indian Ocean. Pacific Ocean. West Indies.

**var. pandura** (Ehrenk.) VII.


Peculiar form with tongue-shaped segments.

Very rare: Gaukvsro, r.


**Fusulina** Ag.

**F. camboides** (Ehrenk.) De Toni.


Very rare: Svolvær r, Brettesnes—Skroven r.

**Distribution:** Fresh water species, rather common.

**Stemaneis inconspicua** (Greg.) Cl.


Frequent: Moskenstrommen r, Stamsund r, Gaukvsro + c.

**Distribution:** Coasts of the North Sea. Bohuslan (Sweden), Balaric Islands. Arctic regions.

**Trachyneis aspera** (Ehrenk.) Cl.


Common: Moskenstrommen r, Stamsund +, Svolvær +, the Ostnesord c, Raftsund r +, Steine c, Gaukvsro +.

**Distribution:** Cosmopolitan.

**Mastogloia** Tow.

**M. exigua** Lewis.


Very rare: Svolvær, r.

**Distribution:** Brackish and marine: Baltic, Belgium. Atlantic coast of America. Bering Island.

**M. smithii** Tow.


Very rare: Svolvær, r.

**Distribution:** In brackish water. Baltic, England, Saxony. Caspian Sea. Australia.

**M. apiculata** W. Sm.


Very rare: Svolvær, r.

**Distribution:** Coasts of the North Sea and Western Europe. The Mediterranean. Black Sea. China.

17. **Cymbella** Hae.

**Cymbella** Ag.

**C. cymbiformis** (Ag.) V. H.


Very rare: Stamsund r, the Ostnesord r.

**Distribution:** Frequent fresh water species, especially from Northern and Western Europe. Arctic regions Asia, Africa, America and Australia.
**Amphora** Greg.


Valves with transverse rows of coarse puncta, forming longitudinal lines, or strong transverse costae, crossed by longitudinal ones. Connecting zone simple.

*A. protus* Greg.

Greg., Distr. of Clyde p. 518, pl. XIII, f. 11 A. Schm. Atlas, pl. 27, f. 3.

Very variable.

Frequent: Stamsund +, Svolvser r, Raftsund r, Stein +, Gaukværo + c.


Perhaps a separate species.

Not uncommon: Stamsund r, Svolvser r, the Ostnesfjord r.


*A. robusta* Greg.

Greg., Distr. of Clyde p. 519, pl. XIII, f. 15.

Not uncommon: Stamsund r, the Ostnesfjord +.


*A. ovalis* Kütz.


Very rare: Stamsund r.

*Distribution*: Fresh or slightly brackish water. Frequent in Northern and Western Europe. Arctic regions.


Connecting zone complex, with more or less numerous longitudinal divisions and transverse strie or costae. Valves with transverse costae, or rows of puncta, on the dorsal side with one or two longitudinal lines.

*A. crassa* Greg.


Rare: Stamsund r, Svolvser r, Stein r.


var. subsilvestris* Petit*

Petit Dist. Cap Horn. p. 120, pl. IV, f. 15 p. A. Schm. Atlas pl. 48, f. 17.

Beautiful form.

Very rare: Stamsund r. 111 × 18 p.; costae 4½ on 10 p., lirate. Strong longitudinal line. The costae answer to the fig. 18 in A. Schm. Atlas, the margin of the ventral side to fig. 17 (these figures thus correspond to different focusing).

A. Graciti Greg.

Greg. in A. Schm. Atlas pl. 25, fig. 10.

Very rare: Stamsund r. 63 × 14 p.; striae 17 on 10 p., crossed on the dorsal side by a blank line. Ends little protracted. Axial area a little constricted in the middle.

Not uncommon: Stamsund r +, Stein +, Gaukværo r.


A. Grevilleana* Greg.


Rare: Stamsund r, Stein r.


A. sulcata* Breé*


Very rare: Stamsund r, the Ostnesfjord r. 15 striae on 10 p., 7½ long. Corresponds exactly to the figures and description in *Gregory* I. c. Also tolerably well answering to *Cleve's* species.

*Distribution*: West coast of Europe. Balearic Islands.

A. Müller* A. Schm.*


Very rare: Stamsund r. Valve 73 × 11 p., with 7½ striae on 10 p., obtuse. The ventral side as illustrated by A. Schm., rather narrow, towards the ends broader, then again narrowing. The raphe is not so distinctly bent as in the figure. On the broader part of the ventral side, inside the marginal strie, there is a band of short striae, as in *A. protus*, separated from the marginal strie by a blank line. Dorsal striae, as in the figure mentioned, crossed by a broad blank, longitudinal line. Another sharp line is seen close to the dorsal margin.

*Distribution*: West coast of Norway (Hvidingso).

A. alata* Ferag.*


Very rare: Stamsund r.


A. bisinodis* Greg.*


Very rare: Stamsund r. 34 p. long. Completely answering to the illustration in *Gregory* I. c.

*Distribution*: Scotland, Balearic Islands.


Connecting zone complex. Raphe close to the ventral margin. Transverse, punctate striae, not crossed by any longitudinal line. Ends of the valve usually rostrate or capitulate.
A. macilentua Greg.  
Greg. Diat. of Clyde p. 510, pl. XII, f. 65, Cl. I, c. p. 121.

Answers best to A. cynodorus Greg. I. c. p. 512, pl. XII, f. 71, which by Cl. I, c. — probably rightly — is considered a variety of A. macilentua. Frustule 48 × 19 μ; with rather narrow connecting zone. 11 striae on 10 μ.

Very rare: Stamsund, r.

Distribution: Coasts of Sweden and Scotland. The Mediterranean. Macassar Straits.

A. canotia Cl.  

Very rare: Stamsund, r.

Similar to an Amphora terebris, with distinctly punctate transverse striae. Valve 80 × 15 μ; its ends a little capitato-rostrate. Striae 7½ on 10 μ.

Distribution: Bohnslau (Sweden). Arctic regions. Indian Ocean.

A. costata W. Sm.  

Rare: Stamsund, r.

Frustule 34 × 16 μ; coarse structure; 9—10 striae on 10 μ; many longitudinal division lines. Ends protracted.


A. terebris H. Ehr.  

Not unfrequent: Stamsund +, the Ostnesfiord r. Gaukvaero r.


d. Oxyamphora Cl. I. c. p. 125.

Complex connecting zone. Valves acute with the raphe close to the ventral margin. No dorsal longitudinal lines. Usually delicate structure of transverse or slightly radiate striae with puncta arranged in unidulating, longitudinal lines. Ventral side usually of still finer structure than the dorsal side. Often a staurus.

A. acuta Greg.  

Not unfrequent: Stamsund r, the Ostnesfiord r, Raftsund r. Gaukvaero r.


A. groenlandica Cl.  
Cl. I. c. p. 128, pl. IV, f. 1.

No staurae.

var.  
Median stria 12 on 10 μ, towards the ends of the valve somewhat closer. Puncta elongated, 10 on 10 μ.

Very rare: Stamsund, r.

Distribution of the main species: Davis' Strait.

A. ostrearia Breb.  

Rare: Stamsund, r. Gaukvaero, r.


A. lavissima Greg.  
Greg. Diat. of Clyde p. 514, pl. XII, figs. 74 a–r. A. schw. Atlas pl. 26, f. 10.

Rare: Stamsund, r +.


var. lavissima (Greg.) Cl.  

Rare: Stamsund r. Stein r.

Distribution: Coasts of the North Sea. Finland. Sea of Kara.

e. Amblyamphora Cl. I. c. p. 199.

Connecting zone complex. Valves obtuse with the raphe diverging dorsally. No longitudinal lines. Fine puncta, arranged in transverse striae. Structure not finer on the ventral part of the valve.

A. obtusa Greg.  

Very rare: Stamsund, r.


A. spectabilis Greg.  

Not unfrequent: Stamsund +, Stein r. Gaukvaero r.


g. Psammonamphora Cl. I. c. p. 132.

Connecting zone simple. Else as Amblyamphora.

A. ocellata Dkov.  

Somewhat rare: Stamsund r, Svalvær r, the Ostnesfiord r +, Gaukvaero +.


h. Cymbamphora Cl. I. c. p. 134.

Connecting zone simple. Valves of rather delicate structure. No longitudinal lines. Raphe close to the ventral margin.

A. angusta Greg. Cl.  
Cl. I. c. p. 135. Greg. Diat. of Clyde p. 510, pl. XII, f. 66 (var. typica Cl.).

Rare: Stamsund, r. Hardly Gregory's species.

var. ventricosa (Ehrenb.) Cl.

Cl. 1, p. 135. Anhau e. G. G. Brit. of Clyde p. 311, pl. XII, f. 68.

Not unfrequent. Moskenstrømmen r. Stamsund r. the Ostnesfjord r. +. Steine r. Gaukvøro +.

Answers completely to Gregory's species, but is very variable.


Epithemia Breel.

E. larvae (Ehrenb.) Kütz.


Fresh water species.

var. Westermannii (Ehrenb.) Grun.


Very rare: Gaukvøro r. Moskenstrømmen r.


E. argus (Ehrenb.) Kütz.


Very rare: Breitnes-Skroven r. Gaukvøro r.

Distribution: Fresh water species; also in brackish water.

Frequent, especially in Northern Europe and in alpine localities.

E. ephes (Ehrenb.) Kütz.


Very rare: Gaukvøro r. Steine r.

Distribution: Common fresh water species.

E. musculus Kütz.


var. constrieta (Ehrenb.) V. H.


Very rare: Svolvær r. Gaukvøro r.

Distribution: Coasts of the North Sea and Western Europe. The Mediterranean.

E. gibberula Kütz.


Rare: Svolvær r.

var. producta Grun.

Van Heurck Synops. pl. 32, figs. 11—13.

Rare: Stamsund, r.

Distribution: Marine. also in brackish and fresh water (eux. producta Grun.), frequent in Europe and America.

Rhopalodia gibba (Ehrenb.) Otto Müller 1895.


var. ventricosa (Kütz.) Grun.


Very rare: Gaukvøro r. the Ostnesfjord r.

Distribution: Common fresh water species.

General remarks on the character of the bottom diatom flora.

The most striking facts regarding the distribution of the diatoms in the foregoing list of bottom species are, that the arctic forms are rare and that the flora, on the whole, has a much more pronounced southern character than would be expected from the geographical situation. This is in sharp contradiction to the character of the diatom flora during the "diatom inflow" of plankton species in spring (cf. above p. 88), when the actual arctic species predominate.

Generally speaking, the bottom flora shows a remarkable agreement with that of the east coast of Scotland. It is especially striking that a great many of the species described by Gregory in Diatoms of the Clyde (1854) are common to these two regions, situated at a rather considerable distance from each other. On the other hand, these species also occur on the west coast of Norway, at any rate most of them. It may, consequently, be concluded that the characteristic western bottom flora of diatoms which inhabit the coasts of the North Sea extend to the north as far as to the Vest-Fjord, probably, however, but little farther.

For the sake of clearness I divide the species found into 6 groups:

I. The actual arctic species, only found in the arctic region.

II. Species with a western and arctic distribution.

III. Species with a very wide distribution, occurring from southern regions right up into the arctic one. Some of these species seem to be cosmopolitan. In Europe, the species belonging to this group are generally found from the Mediterranean to the arctic regions.

IV. Species with a southern and western distribution, generally occurring from the Mediterranean — or still farther to the south — to the coasts of the North Sea.

VI. Species with only southern distribution, not before found so far north as on the coasts of the North Sea.

Most of the species observed belong to group III, and many of these species will probably later on be found to have a still wider distribution than is at present known. For such more or less decidedly cosmopolitan species, a thorough treatise on their varieties and forms is a very important and valuable work, indispensable when one wishes to obtain an accurate knowledge of the distribution of identical and closely related species. Notwithstanding the extensive material consisting of an immense number of facts and observations, often made with the utmost care and accuracy as to details in structure, we are still obliged to acknowledge with regret that our knowledge of the individual variations and real constancy of the various distinguishing characters is very deficient.

These species play an unimportant part with regard to the character of the flora. It is, however, an interesting fact that, apparently, so many species of diatoms are common to most seas of the world. Even if a good many of these widely distributed species, on a more thorough examination, should prove to consist of similar, but separate species, having different areas of distribution, there will still remain a great number of species which, in Europe, occur from the Mediterranean to the Arctic Sea. It must, however, be remembered that the valves of diatoms are almost of eternal
duration and that thus fossil valves will enlarge the apparent area of
distribution of the still living species.

Most of the species of this group III are probably recent
ones, a great number of them being observed alive on the west
coast near Bergen.

Next to group III it is group V, which contains the greatest
number of species. Many of them have a predominating southern
distribution, but occur, more or less frequently, as far north as
the coasts of the North Sea. To this group belong the following (a few
of which might perhaps rightly be reckoned to another group):

Coscinodiscus Rothii,
Biddulphia pelta (a broken
valve, Tromso, C.).
B. rotundula, exceptionally
found as far north as Scotland.
B. paves (once found in Spits-
bergen).
B. alumnata.
B. panulata.
Sagitta spathulata.
S. hastulina.
Rhopalcos nolit.
Dunorocysmos minus.
D. foliosa.
Gephyrocapsa distans.
Grunwolgorapha serpentinia.
Nitzschia panula.
N. acuminata.
N. kalkata.
N. lanceolata var.
Clavulnahis cuxinum.
Savirella festiva.
Arachocystis longipes.
Pleurosigma distans.
P. baltimoriana.
Donkinia erecta.
Pleuroneis rigidum.
P. formosana.
P. speciosa.
P. balticae.
Scatidrotis boletiana.
Caloneis conivalis.
C. blanda.
C. acuminata.

Many of these species were for the first time described and
illustrated in the work by Gregory above mentioned.

All these species have not previously been mentioned from the
arctic zone. To this group should properly also most of these
be reckoned which are previously known from the arctic zone, but
only from the coast of Nordland ("Finnmarken").

Less numerous are the species of a more western European
distribution, group IV. Such species are, however, on the whole
not numerous. Here belong the following species:

Coscinodiscus applanatus var. (west
C. Normanni, C. fusciusculus A.
coast of Norway).

Achnanthes cressus.
Actinocyclus splendidus.
Biddulphia boryana.
Sagitta borealis.
Nitzschia libera.
N. nozumalani (Spitsbergen?).
Cystoseira parvis.
Ceramis fyen (west coast of
Norway).

These species, the first and the last one only excepted, are
common to Great Britain and Norway.

A closely related group is group II, including species with a
predominating western area, though also occurring right up to the
arctic zone. These are the following:

Coscinodiscus Kiihelmii.
Hyalodiscus solens.
Biddulphia tourneii.
B. Smithii.
Nitzschia speculata.
Cyanophora angulata.
Rhizosolenia arctica.
Caloneis baltica.

The genuine arctic species, belonging to group I, are few:

Coscinodiscus borealis.
Actinocyclus alpinus.
Biddulphia arctica.
Sagitta konackhiana.
Nitzschia rosetula.
Grammophora arctica.

All these species, except the last one, are besides very rare.

At last we have the remarkable group VI of only southern
forms, partly only known from regions situated far to the south or
even only from the tropical zone. Their distribution (as it is better
known) extends northwards only as far as the Mediterranean.

To this group belong:

Coscinodiscus leypus var. leypus.
C. nolitifera.
Ascellaria Kiihii.
A. Johnsoniana.
Biddulphia reginae var.
B. leypus.

There may, however, be some doubt as to whether the forms
observed of Biddulphia leypus and Ascellaria Graeffii are identical
with those, which usually occur in southern regions. Moreover, Cosci-
nodiscus leypus, Nitzschia epilaciolpifera, N. cocculata, N. nolitifera
and Biddulphia reginae var. are all very rare and scarce. There remain,
however, Coscinodiscus nolitifera and the two species of Arashodiscus,
all of which occur in comparatively large numbers, and in several
samples. These species are easily recognizable, and have a pro-
nounced tropical area of distribution.

Probably these species are all fossil, but I cannot at present with
certainty decide this. Coscinodiscus nolitifera has most probably
occurred as a planktonic species.

All the species of groups IV, V and VI, a considerable number
of species in all, have not before been known from the arctic zone.
Coccioides nortmanni Grev.
— variable species Epib., = radul. var.
— pseudactis Grev.
— resistantus Epib., = Diploneis var.
— verticillatus Schm.
— radiatus Epib., = Diploneis var.
— rhomboidalis Grev.
— subtile Epib., = Diploneis var.
— truncatus Kütz. = Diploneis s.
— subtilius Grev.
— symphydophorus Grev., = stellaris var.
— angustifolius A. Schm. = Rhomb.

Coccolithus polykentron (Grev.) Kütz.
— strictus (Kütz.) Grev.

Cyclothecella eithula (Hempr.) Kocak.
— cycloformis (A. Gr.) V.H.

Dictyococcidiscus diettes (Grev. = Glyptococcus d.
— fulvus Grev., = Diploneis var.
— minus Grev., = Dimeregramma m.
— atreus Grev., = Dimeregramma min var.
— stauronemus Grev. = PlagGramma var.

Dimeregramma fulvum (Grev.) Ralfs.
— minus (Grev.) Ralfs.

Diplonemal bomboloides (A. Schm.) Grev.
— bomboloides loans (A. Schm.) Grev.
— borealis (Grev.) Grev.
— chersonensis (Grev.) Grev.
— costiformis (A. Schm.) Grev.
— crenata (Grev.) Grev.
— contigua (A. Schm.) var.
— crasso (Grev.) var.
— ciliata (Grev.) var.
— ciliata (A. Schm.) var.
— fusca (Grev.) Grev.
— hyalina (Donk.) Donk.
— hyperborea (Grev.) Grev.
— incurvata (Grev.) Grev.
— intermedia (Kütz.) Grev.
— laevis (Grev.) Grev.
— linearis (Grev.) Grev.
— major Grev.
— nitens Grev.
— nobilis (Grev.) var.
— opaca (A. Schm.) Grev.
— planitia (A. Schm.) Grev.
— splendidula (Grev.) Grev.
— subcincta (A. Schm.) Grev.
— suborbicularis (Grev.) Grev.

Donkmannia coarctata (Donk.) Ralfs.
— coarctata (Donk.) Ralfs.

Endecocysta oceanica Emr.

Epiphilinae argus Köpp.
— gibba Kütz. = Rhipochoea g.
— gibbulae Kütz. et var.
— minuscula (Kütz.) et var.
— transiens (Embr.) Kütz. et var.

Erucocysta pseudomargarita (Grev.) G. var.

Eunolia arcus Emr.
— biscata W. Sm.
— major (W. Sm.) Ralfs.
— perpustilis (Hiller) Ralfs.
— pseudocortis Emr.
— trilobata Emr.

Euopilosa argus W. Sm.
— creata W. Sm. = Actinocyclus c.

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IV. COMBINATION

OF

HYDROGRAPHICAL AND BIOLOGICAL FACTS.
NOTES.

In this section I have given some facts, which it has occurred to me might be of practical interest. It is, however, quite impossible to define clearly between practical and purely scientific marine investigations.
A. The natural Conditions of the Fiords.

One of our historians relates, that in a fragment of an ancient Irish annal it is told, that in the year 872 „one of the two Norwegian kings in Dublin, Ivar, went with a large army from Ireland to Lochlann (Norway) to aid his father who was at war with the king of Lochlann.”

It must be said that the ancient Irish had found a particularly suitable name for the land, which is also in modern tourist language made famous as „the land of fiords“. The Norwegian series of fiords presents many interesting problems to the naturalist too, and a thorough examination of them will undoubtedly serve to throw light on many questions.

If one sets to work to make a thorough scientific investigation of a fiord, the facts obtained may be divided into three principal groups: those concerning the shape and situation of the fiord (topography), or concerning the medium with which the fiord basin is filled (hydrography) or concerning the plants and animals contained in it (biology). The object in view, in case of such an examination, should be to gain the greatest possible insight into the biological phenomena, but in order to attain this end, one will be compelled to study most carefully the topographical and hydrographical conditions of the fiord. As a part of the topography of the fiords one must, I think, consider such things as their geographical position, proportionate size, subdivisions, relative depths, the occurrence of barriers, rocks under water, holms and islands. In addition to these things, the nature of the bottom and the surrounding hills, the geological history of the fiord (e.g. the rise and fall in the shore line etc.), must be taken into consideration as belonging to the topography of a fiord. To the hydrography of the fiords may be reckoned all the facts and qualities concerning the medium which fills their basins, such as salinity, temperature, gas-

icity, transparency, the motions of the water (currents, waves, tides), formation of ice, inflow of rivers or streams etc. Finally, atmospheric conditions must also be taken into consideration as playing an important part in the physical state of a fiord (e.g. temperature, downfall, prevailing winds, atmospheric pressure etc.).

The biology of the fiords will include vegetable and animal life in their waters, at the bottom and in the bottom mud. The plan here suggested for the examination of a fiord must, I think, be taken to be tolerably complete, and I will look upon it as a guide in my future work. I must, however, at once confess that the investigations I have hitherto made in northern Norway do not make it possible to till in very much of the frame work I have set up in the foregoing lines. I will, nevertheless, build up the skeleton in the hope that it may be solidly covered later on.

b. Topographical Notes.

The Geographical survey of the Norwegian coast has given us maps, in which very much of what I call the topography of the fiords is made clear. But the complete mapping out of the northern fiords is not yet finished. A good deal of information about the fiords will also be found in Prof. A. Helland's topographical works, and a description of the ground through which the fiords have dug their way, will be found in „Det nordiske Norges geologi“ (The Geology of Northern Norway) by Dr. H. Røsch. The problem of the fluctuations in the shoreline is treated in detail by Dr. Andreas Hansen.1) In a hydrographical paper concerning the western fiords,2) I have touched upon the effect which changes in the level of the sea have upon these inner parts of the fiords which are connected with the principal fiord by comparatively shallow currents.

As regards these currents, it seems pretty generally to be the case that they have forced their way through moraines, which in many instances cause the comparative confinement. Helland3) mentions examples of this, in Kvænangen, both the „Stor-“ and „Lille strommen“ having forced themselves through old moraines. It is most probable, that the majority of the so-called „stromme“ (currents) in the fiords, run over such moraines.

With respect to the situation of a fiord, it is not only its geographical latitude which is of importance for its vegetable and animal life, a very weighty factor is also its relative position to the prevailing current in the surrounding ocean. Let us make an experiment. We cut a section along the 22nd degree of longitude (E of Greenwich) towards the boundary line of Finland and continue to cut along the boundary to Jacob's river on the south side of the Varanger Fiord. Then we turn this section around the point where the longitudinal line and the shore line of the continent intersect, so that the fiords of Finnmark will lie in a direction which is approximately E—W. These fiords will then undoubtedly undergo a change in their biology, and notwithstanding that they were

1) Leck = lake, fiord.
2) Leibuk og Vesteraalen, Trossos unt.
5) Trossos unt, H. p. 349.
now further north, the change would quite certainly be such that several boreal species would occur there, while some of the arctic ones would die out, or possibly retire into the innermost parts of the fiords. Such a change would take place, because the fiords in this way would have been brought into closer contact with the heat axis of the northwards flowing current.

On the relative depths of the fiords, I have made some remarks in the first part of this work, and reference should also be made to the coast maps. The Finnmark fiords are of rather a different character than those in Nordland and Tromsø and, for they are comparatively shallow. An explanation of this has been given by Dr. Andreas Hansen who writes: — "When the highland cases in Finnmarken, the fiords too acquire another character. They become broader and shallower, less typically formed basins in the loose schist, beds, indeed, for less active and less concentrated glacier-streams, because here, in the low plateau country, there were not originally such deep canions to determine the course of the glaciers, as on the western slope of the mountains." As a general rule it may be said that there is a deep channel in the fiords with a muddy bottom. On either side, there is a bank or edge of land, which in some cases is evenly sloped, but generally has a most uneven surface. It is, nevertheless, in many instances, possible in a definite section to speak of the angle of inclination of the bank of land.

It is clear that, the depth being the same, the side surfaces will increase in proportion to the diminution of the angle of inclination, as will be seen from the figure below, which represents a transverse section through a fiord.

![Fig X](image)

If in the one case, the line of intersection between the side area and the transverse section be s and the angle of inclination \( \alpha \), and in another case the corresponding values be \( s_1 \) and \( \alpha_1 \) we get:

\[
\begin{align*}
\frac{s}{s_1} &= \frac{h}{\sin \alpha} \\
\frac{\alpha_1}{\alpha} &= \frac{h}{\sin \alpha_1} \\
\end{align*}
\]

Are the side surfaces \( (S \) and \( S_1) \) taken to have equally long ground lines, or if one will, shore lines, but with different angles of inclination \( (\alpha \) and \( \alpha_1) \) one gets, according to elementary geometrical law:

\[
\begin{align*}
S : S_1 &= s : s_1 \text{ but hence follows:} \\
S : S_1 &= \sin \alpha_1 : \sin \alpha.
\end{align*}
\]

The side surfaces are thus in inverse proportion to the sines of the angles of inclination.

Eg. \( \alpha = 90^\circ, \alpha_1 = 30^\circ \), and then:

\[
\begin{align*}
S : S_1 &= \frac{1}{2} : 1 \\
S_1 &= 2 S.
\end{align*}
\]

When the angle of inclination is \( 30^\circ \), the side surface will thus be double as large as it is when the land bank is perpendicular.

This little mathematical exposition is valuable in so far as it plainly shows that the space which is available for the distribution of animals depends, to a great extent, upon the angle of inclination of the edge of land. And it gains in interest when it is remembered that experience proves that the edges, both in the ocean and the fiords, teem with animal life.

The presence of islands, holms, rocks etc. in a fiord must also be said to be important factors in the animal life of a fiord. They all tend to increase the extent of the particularly productive areas.

Another important factor in the vegetable and animal life of a given district, is the occurrence of a belt of skerries ("skjergraad"). With respect to navigation, such belts of skerries act as powerful breakwaters. And as such they are biologically too important, and of course the many islands, holms and rocks, with their rich algae vegetation, greatly increase the number of specially productive surfaces.

Mr. M. Foslie of Tromsø has kindly given me some information about the influence of such a "skjergraad" on algae. He writes that where there is none it will, amongst other effects, also be found that the number of species is less. If the coast be an open one, a number of species which require more or less protected spots is as a rule absent. With Mr. Foslie's permission, I quote a part of his letter to me, he writes: — "Those species which are principally found on the open coast, will also generally be found inside the "skjergraad" or in the larger fiords, but usually in the most exposed places, and even there they are not so strong and well developed as on the ocean coast. An illustration may be found in the large Laminarians, *L. hyperborea* and *L. digitata* which are always large and strong in the open sea, but decrease in size and change their shape the further in one finds them. A total absence of some "breakwater" or other often results in the tearing away of large quantities of algae, which the autumn and winter storms drive ashore. I have, for instance, seen immense masses of Laminaria cast in, especially in Berlevåg and Løppen. On the other hand, there are species which are less hardy, and they are smaller on the open coast than in more sheltered places, even if they are found on the coast. They then go further down, where the rush of the waves is less. Therefore, especially along the coast of East Finnmark, there are many places where vegetation seems to be poor and only to consist of a few species, while there is comparatively rich vegetation in fairly sheltered bays."

An exceedingly important factor in the hydrography and biology of the fiords, is their relative position to the prevailing summer and winter winds, and a closer study of these things will probably throw light upon many matters which hitherto have been uncertain.
b. Hydrographical Notes.

In the first part of this work, a number of hydrographical data from the fiords will be found. Now I will mention a few more details, and treat of some things which have not yet been mentioned. First then, some remarks on the influence which the prevailing winds, waves and tidal currents exert on vegetable and animal life in the sea.

In a very interesting paper, Mr. F. W. Hammer has recently explained the importance of the prevailing winds as a geological factor. Mr. Hammer calls attention to the fact that dead-shells are not found in large numbers on the eastern shores of the counties of Norfolk and Suffolk, although there is no want of mol-lusces in the adjacent sea. The reason for this absence of shells is found by Mr. Hammer in the fact that the prevailing winds at present are westerly. On the contrary, the presence of Crag beds on the east coast presupposes a different prevailing wind from that which is now the case.

"Easterly gales might have been prevalent in that part of the North Sea, rather than those from a westerly quarter, as at present." In another paper, Mr. Hammer5 has drawn attention to the tidal currents as a geological factor. He points to the state of things in the Irish Sea, "where an accumulation of dead shells on the Tarbot bank, off the coast of Arran, is caused by the tidal currents which sweep with much velocity through the narrow channel separating Ireland from Scotland." The fact that in some places in Coralline Crag layers of large shells may occur, while at other places smaller shells are predominant, is considered in the light of tidal currents, for Mr. Hammer says: — "Shells are sorted out by currents of varying strength as pebbles in beds of gravel; small specimens would therefore have accumulated in one place, larger ones in another, and comminuted shells, or fine calcareous sand in a third."

Wind and current are of little importance in dynamical geology, on account of their carrying power. But just this characteristic causes these factors also to have an influence, in different ways, upon living creatures. The course of a current offers particularly favourable conditions for the nourishment of plankton-eaters, and a current−faces of animals may be spoken of. It is true that animal life is not profuse where the deposits of material are greatest, but, on the whole, it is correct to say that the bed of a current is profusely supplied with animal life. In a purely theoretical light, the supply of plankton for a given animal must be in proportion to the velocity of the current. It is, at any rate, evident that the motions of the water are of great importance in connection with the supply of nourishment for plankton-eaters.

Dr. Edward Browne6 has drawn attention to the fact that medusae, which are kept in an aquarium where the water is undisturbed, will at first swim quickly about; but in a few hours, it sinks to the bottom, apparently tired out. After an interval of rest, it takes another swim, and again sinks to the bottom. This is repeated until the medusa becomes exhausted; then it stays at the bottom and slowly dies." This unfortunate state of things has been remedied by Dr. E. T. Browne and Dr. E. L. Allen having succeeded in constructing an apparatus by means of which the movements of the water have been skillfully imitated. Mr. Dammen's hatching apparatus is constructed on a similar principle.

With regard to the force of the tidal currents, it will easily be seen that this will depend upon the height of the tide, i.e., the difference between ebb and flow. In the north of Norway, this difference is, on an average, about 2 mtrs., and as a consequence of this, the tidal currents are considerably stronger in the narrow channels and in the smallest parts of the fiords. Based upon material furnished by the Norwegians ("Gradmaalingskommission")1 I will give some figures which show the average difference between high and low tide in succession in 1884 and 1885.

<table>
<thead>
<tr>
<th>Location</th>
<th>1884</th>
<th>1885</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stavanger</td>
<td>0.424 m</td>
<td>0.425 m</td>
</tr>
<tr>
<td>Bergen</td>
<td>0.988 &quot;</td>
<td>0.975 &quot;</td>
</tr>
<tr>
<td>Kabelvag</td>
<td>2.014 &quot;</td>
<td>2.011 &quot;</td>
</tr>
<tr>
<td>Vardo</td>
<td>2.175 &quot;</td>
<td>2.176 &quot;</td>
</tr>
</tbody>
</table>

Generally speaking, it may be said that the tidal wave runs northwards along the coast, and the tidal currents flow into the fiords when the tide rises and outwards when it falls.

In the channels of the "skijerard", it may be taken as a general rule, that the direction of the current is northerly or easterly when the tide rises, westerly or southerly when it falls. But it must be remarked that in many channels the direction of the current changes a little after the water has been at its highest and lowest. In the currents running between the islands of Lofoten (Gimsostrom, Napstrom, Sundstrom etc.) the water at first flows northwards when the sea is at half−high−tide and turns again at half−low−tide. The same is said to be the case in the currents which connect the Skjerstad and Salten Fiords. The best known of these is the so−called "Saltstrom", which surpasses even "Mosken−strommen" in force.

I have attempted, in an article on the two mael streams in Norway, to give an account of their character.7 To explain the change in the direction of currents at half−high and half−low−tide, and have theoretically worked out the following conclusion: — If the inner part of a fiord be connected by a current with the principal fiord, and the direction of this current be changed after high and low tide, the difference between ebb and flow will be less inside than outside the said current.

Thus, the difference between the mael at high and low water should be less in the Skjerstad than in Salten Fiord. I have not as yet had an opportunity of verifying this theoretical conclusion.

Concerning the direction of the surface stream along the coast of Norway, Mons's current map is very instructive.8 The following amusing little story shows that there, in the summer, may be an easterly current along the coast of Finnmarken. Sour's "Tornvärm"9 relates that in the beginning of the eighties S/S "Nordstågen" was in the summer wrecked on Knivskjeledøen, a little west of the North Cape, and very soon sank. A couple of months later, the view of Næsøby had rowed out a little way in

1) "Tidaler−malteringer", p. 124.
2) "Naturværk", p. 265.
3) The North Ocean, pl. XLI.
the Varanger Fiord and suddenly he caught sight of a little box floating in the water. On closer examination, he found, to his great surprise, that his own name and address was written on it.

It had been sent by the „Norstedten“ from Kristiania, and after the wreck of the vessel „the clever little box“ had found its own way to its destination, which is a fanciful expression of the fact that winds and waves had carried it to the inner part of the Varanger Fiord.

Outside the prominent rocks of Finnmarken, the tidal currents are very strong, the direction being easterly when the tide rises, and westerly during its fall.

I have had personal experience too of the strength of tidal currents. In the summer of 1894, in the course of a zoological expedition in Finnmarken, I was out in a little boat on August 14th and had three men with me, I intended to pass Nordkyn going west. We had been sailing a little while, but the wind ceased and we were obliged to try to row; this was exactly opposite Nordkyn. The stream was, however, against us, and it proved to be utterly impossible for us to make any headway. Fortunately the water was so shallow just here that we were able to anchor until the current slackened.

That the tidal currents have a considerable carrying capacity, I have also noticed in Nyenarbstrommen at Bergen, very near the biological station. Not only large mussels but medium-sized specimens of a star-fish (Asteroidea rubens) now and then sail along with this current. So it is not strange that bottom forms, as for instance Foraminifera, are often found in plankton. Currents and winds play also an important part in the fact that plankton is heaped up in quantities at certain special places. A closer study of this subject will undoubtedly throw light on things connected with the catch of plankton-catchers, such as herrings, sprats etc.

Lately, it has become clear to me that the downfall plays an important part in the hydrography and biology of the fiords. My thoughts were first turned in this direction, when I noticed that an increase of salinity occurred in the fiords of northern Norway, from January and throughout the spring. In the fiords in the neighbourhood of Bergen too, I have seen that the surface salinity is greatest in the winter, as the downfall then is the least and there is a portion which does not exert its influence for the time. One would then expect that the greater difference in downfall in the west and north of Norway would be remarkably felt, and this is clearly shown to be the case.

A closer study of the downfall also gives an explanation of the fact that the deeper layers in the Porsanger Fiord have such a low temperature. According to Gran,1 Dr. Hoorn found on the 24th of August 1890 the following conditions in Osterbotten, which is connected by a shallow channel with the rest of the Porsanger Fiord:

\[
\begin{array}{ccc}
| \text{Month} | \text{1899} | \text{1900} | \\
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>February</td>
<td>22</td>
<td>15</td>
</tr>
<tr>
<td>March</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>April</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>May</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>June</td>
<td>62</td>
<td>94</td>
</tr>
<tr>
<td>August</td>
<td>30</td>
<td>66</td>
</tr>
<tr>
<td>September</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>October</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>November</td>
<td>32</td>
<td>67</td>
</tr>
<tr>
<td>December</td>
<td>10</td>
<td>49</td>
</tr>
<tr>
<td>Year</td>
<td>255</td>
<td>409</td>
</tr>
</tbody>
</table>
\end{array}
\]

The annual average downfall for the years 1896—1902 at Olderen at the end of the Porsanger Fiord is reckoned to be 374 mm.2

In the years 1899 and 1900, the downfall for the different months was found to be as follows:3

As a consequence of the slight downfall in the winter, the salinity of the surface layers constantly increases, and in this way there is a tendency to great regularity both in the temperature and salinity of the layers.4 But under these circumstances, the cooling of the surface by means of the vertical current will be felt far down. (Cf. Hydrography, p. 171) and the cold of the arctic winter will, in this way, penetrate down into the deeper layers. When the state of things is like that in Osterbotten, where a shallow channel effects the connection with the fiord, the warm undercurrents cannot penetrate. Then too, the summer downfall is much more effective than that of the winter, so that the mixing on the surface in the summer will serve to prevent the summer heat from penetrating downwards. Taken together, these things will, I think, explain Dr. Hoorn’s surprising statement of (+ 1.02) at a depth of 90 mtr. in Osterbotten, and will also give a clue to the fact that most of the arctic animals are found in the inner parts of the fiords. It should also be remembered that the longer a fiord is, the more will the continental influence be felt.

In western Norway, a different state of things is found in such shut-in basins as Osterbotten. I have studied conditions in the Lyse and the Mo Fiords, both of which belong to districts which form centres for the maximum downfall in Norway. At the station Nedreba, in the Lyse river district, the average fall from 1886—1902 was 2 169 mm.; and at the station Farvevatt, in the Mo river district, it was 2 743 during the same period.

I beg to refer to what I have recently written about these fiords.5 Now I will only mention that while the bottom water in Osterbotten contains degrees of cold from the winter, the bottom

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1) Næbbingtagtebær i Norge, aarg. VIII, 1903, p. 125.
2) Cf. Næbbingtagtebær, aarg. V. VI.
water in the Mo and Lyse Fjords had a temperature corresponding to the average annual atmospheric temperature of the place. Also in the latter fjords, submarine ridges prevent the warm bottom water from penetrating in, and, moreover, the supply of fresh water in the winter is so great that the vertical current is prevented from assuming any large proportions. The transmission of heat downwards takes place principally by conduction. A maximum in the autumn and a minimum in the spring find their way gradually downwards, and finally an average is reached, which corresponds to the annual average atmospheric temperature.¹ The Skjerstad Fjord must probably be classed with the Mo and Lyse Fjords. The bottom water is homotermic (cf. Hydrography, p. 14), the supply of fresh water is sufficient to prevent the winter cold from penetrating down into the depths.

The station Sultjelma, in the Vatnahals river district, had an average fall of 1.097 mm. in the years 1896 – 1902, and the station Grudel, in the Salt river district, during the same period had an annual average of 3.33.² According to Møtt,³ the annual average temperature at Eidsø is +4.1 C. and at Ranel 3.8. On August 17th 1877, the Norwegian North Atlantic Expedition found that the temperature in the Skjerstad Fjord at a depth of about 500 mtrs, was 3.2. On April 4th 1900, I registered at the same depth 3°.15 C. If one now considers these two atmospheric averages, it would seem that 3.2 is a probable value for the annual average temperature of the air in the Skjerstad Fjord.

If we, however, imagine the large basin of the Skjerstad Fjord moved to the inner part of the Persanger Fjord, and with the same connections with the latter as it now has with the Sulen Fiord, we should certainly find that the bottom temperature would be considerably lower than that of the annual average of atmospheric temperature in the inner part of the Persanger Fiord. For, from what has already been said, it will be seen that the supply of fresh water at the latter place is not sufficient to prevent an evening out of its salinity in the winter, thus allowing the winter cold to exert its influence on deeper layers of water.

In some of the lesser fjords adjacent to the Vest Fiord, I have also noticed that the bottom temperature has been lower than the annual average atmospheric temperature, which would imply that somewhat of the winter cold has found its way downwards.

Examples of this fact may be found in Rombaken, Skjomen, the Ogs Fiord etc. Such places excel in many arctic forms. These fjords have already been referred to, and I would call attention to what has been said about them in previous pages and also to PI. 19, where the curves VI, VII, VIII represent the conditions of temperature in Skjomen, the Ogs and Skjerstad Fiords. The curves for Skjomen and the Ogs Fiord are especially characteristic on account of their slight bend, which is a sign of a uniform salinity.

The temperature curves for Translydjet, the Tys Fiord and Oslofjord are such that comparisons may be made. (PL 19, curves I, II, IV, V), all the curves are very much bent in the upper layers, where there is great variation in salinity, but in the layers where there is uniform salinity they become almost a straight line. Curves III and IV, which represent the conditions of temperature in March 1899 in the sea off Rast and in the Tys Fiord, show plainly that a higher temperature prevails in the deeper layers in the fjords than in the corresponding depths in the Norwegian Sea. As I have already stated, the reason for this is to be found in the fact that such fjords as the Tys Fiord are of such a formation as excludes the arctic bottom water from the Norwegian Sea, but gives admittance to the warm Atlantic waters which fill the basins. Then too the fresh water which flows into the fjord from the land, is sufficiently large in quantity from the Boka Fiord to the Vest Fiord to prevent the winter cold from penetrating downwards to any considerable depth.

There is another thing which one might suppose to be, to some extent, dependent upon the variation in downfall, I mean the height of the water on the coasts.

From "Vandstand-observationer", published by "den norske Gradmaalingskomission" I have on pl. 20 drawn some curves, which give the monthly average height of the water at Kabelvaag and Vardo in the years 1882, 1884 and 1885.

The measurements have been made with self-registering instruments at 0, 1, 2, 3 etc. hours after the moon's culmination and from these results the average has been calculated. Taking it for granted that the 9 points have been unaltered, and that the instruments in other respects too have been quite reliable, one must be able, by help of the data thus obtained, to form a wellfounded opinion of the variations in the rise and fall of the water, in the course of the year, on the northern coasts. A chance at the curves (I – VI, PI. 20), will show that there is at any rate one thing which cannot possibly be accidental, the curves show a definite tendency to a minimum in April. Similarly, too, a maximum can be arrived at for the months November – January, while the remaining variations suggest accidental causes.

On the same plate the curves representing the average monthly downfall at Svolvær, which is situated near Kabelvaag and Vardo, are given. Both these curves show a decrease during the first months of the year up to May, in which month the year's minimum downfall is reached. The Svolvær-curve shows a maximum in November, and the Vardo-curve in October. There is this point of resemblance between the water-heights and downfall curves, that they generally show a decrease during the first months of the year, respectively up to April and May, but it cannot at all be said that the decrease in heights is caused solely by the decrease in downfall. Of course the variations in downfall exert some influence on the height of the coast water, but as regards the north of Norway, it will easily be seen on comparing the curves that this influence is by no means sufficient to account for the great differences in height. It should be remembered that 1 cm. is taken as the unit for the height, and 1 mm. for the downfall curves.

At Svolvær, the amplitude of the curve representing the average, monthly downfall is 8.3 cm., the corresponding value at Vardo is 5.3 cm. The observations made of heights have not been so complete that it has been possible to calculate the normal average for each month, but on the basis of the amplitudes of the Kabelvaag and Vardo curves, we get:

<table>
<thead>
<tr>
<th>Amplitude</th>
<th>Amplitude</th>
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<tbody>
<tr>
<td>Kabelvaag 1882 .......... 61 cm. Vardo 1882 .......... 52 cm.</td>
<td></td>
</tr>
<tr>
<td>— 1884 .......... 60 &quot;    — 1884 .......... 35 &quot;</td>
<td></td>
</tr>
<tr>
<td>— 1885 .......... 45 &quot;    — 1885 .......... 47 &quot;</td>
<td></td>
</tr>
</tbody>
</table>

These figures show, with all desirable clearness, that the variations in the course of the year are so considerable, that they
can only in a slight degree be caused by the variations in downfall from one month to another. The principal cause must be looked for in another direction, and one naturally turns one's attention to the distribution of atmospheric pressure, which, as is well known, determines the motions in the air — atmospheric currents. —

Dr. Andreas Hansen has called attention to the fact that the maximum atmospheric pressure in the spring and the minimum height of the water, and the minimum midwinter barometric altitude and the greatest height of the water are, practically speaking, correspondent.

Prof. Mons in his meteorology, has given the atmospheric pressure curves at Stykisholm, in Iceland, and Gjesvær, near the North Cape, and with respect to the course of these curves, he says that, on both sides of the Norwegian Sea, the atmospheric pressure is lowest in the winter and highest in May.

The lowest atmospheric pressure from January—May, we should expect to find somewhere in the Norwegian Sea, and this is seen to be the case from Mons's chart (l. c. p. 173) where a minimum is given at the NE of Iceland. This minimum is maintained, according to Prof. O. Petterson, by the upper layers of water in the Norwegian Sea giving off heat to the atmosphere.

At any rate, it appears to be certain that the distribution of the atmospheric pressure on land and sea during the winter causes such winds as help to sweep the water away from the coasts.

It is probable that the most important causes of the annual fluctuations in the height of the water on the northern coasts may be found in the different distribution of atmospheric pressure in summer and winter and the winds which are dependent upon this.

On pl. 21, I have given the downfall curves for 1899 with crossed lines for the stations at Svolvaer, Skonvær, Tromsø and Alten, and have based them upon „Nedbørragattegaller“ (Observations on Downfall) published by the Norwegian Meteorological Institute. Similarly, the normal curves for the same stations are given in straight lines for a period of observation from 13 to 29 years.

From these curves, it will be seen that, in a single year, there may be great divergence from the normal downfall.

It is evident that the fluctuations in the amount of downfall exert an influence on the temperature and salinity of the sea. By increasing the height of the water in the fiords, the downfall also has some influence in producing currents. In the chapter dealing with the cod fishery in Lofoten, I will try to prove that there is a correspondence between the fishery results and the variations in the distribution of atmospheric pressure, and will, in so doing, use the height of the downfall as a measure of the influence of the winds.

c. Biological Notes.

The problem of the vertical distribution of living beings has occupied many biologists. I will not here treat of it at length, but only mention a few facts.

As far back as 1835, Michael Sars divided our seaweed belt into the following 4 zones: — (1) That of the Botanica, (2) that of the Patella, (3) of the corals, and (4) that of the Littorinar. The greater depths had at that time been so little examined, that Sars could not attempt any division of the life found there. Since 1835, however, this subject has occupied the attention of many, and several divisions have been made. But I will only give here the one I prefer. Dr. Stuxberg has, in his book „Funderbrettatunen i Sibirions Ishaf“, accepted the same division for the animals as F. R. Kjellman for algae. viz. —

(1) The litoral zone.

That part of the bottom, which is laid bare at low water, and which in Norwegian is called „søeren“. 

(2) The sublitoral zone.

From low water mark to the lower limit for algae.

(3) The elitoral zone.

All that is below the lower limit for algae.

2) Kristians 1902.
4) Behaviseres og Efttingesber, p. VI.

According to P. Bone, the dividing line between the sublitoral and eelitoral zones is fixed by Kjellman at a depth of about 40 m. in Bohuslen, and this figure seems to suit the conditions on the southwest coast of Norway too. „On the coasts of Nordland and Finnmark“, says M. Foslie in a letter to me, „alge may generally be found down to 40—50 m., but vegetation mostly occurs to a depth of only about 30 m."

With regard to the vertical distribution of animals, Stuxberg fixes the limit between the sublitoral and eelitoral zones in the Siberian polar waters at 30—40 fathoms, but I think it is best to keep to the algologists' limit, for a large number of animals is found in the seaweed zone. As far as I know, Norwegian algologists have accepted Kjellman's division, and I would suggest that zoologists also should test its practicability for animals too. If it be necessary to have a finer division, Michael Sars's zones should be given a new trial.

As algae vegetation only reaches down to a certain depth, the quantity will to some extent depend upon the inclination of the bottom. On a rock which forms an angle of 30° with the horizon, there will, other things being equal, be much more algae than if the rock were perpendicular. The space between the shore line and the lower algae limit, which may be called the growing area for algae, has a definite proportion to the angle of inclination. Here again the same remarks as on page 220 are applicable, and the same mathematical explanation stands good. It will be found that the growing areas are in inverse proportion to the sines of the angles of inclination.

Notes on the animal life in some of the fiords examined.

In the small fiords surrounding Sandhornøya, a few dredgings were made, and the result was so far satisfactory as to enable us to form an opinion of the character of the animal life in these fiords. Of annelides, the following were noticed: — Harmaothoe major, Lepidonotus crassus, Pholadoe canaliculata, Nephrops eilioides, N. excochla, Omphalorhynchus aculeatus, Leideuria ferruginea, Anisodonta marina, Pomatoceros neglecta, Filograna implicata, Stenopage fossor. In "Gjøven" near Sund farm, several specimens of Echiura pelagica were found.


1) Asterias rubens occurred in monstrous size. One of those we took had thrown its arms around a Cyprina clausa, which was half sucked out.
on the contrary with regard to the warm bottom water, which
is almost independent of continental factors, and which, therefore,
can retain its properties almost unchanged during its course in the
fiords.

And the observations made have shown that the temperature
and salinity of the bottom water in the Vest Fiord differs only
very slightly from that of the fiords on the west coast of Norway.\(^1\)
The similarity in fauna which the zoological examinations have
brought to light are thus quite natural. As the Vest Fiord is the
last of the large fiords which has bottom water with a temperature
of 6—7° C. and a salinity of about 35 pro mille, it is also natural
that it forms the northern limit for many boreal and luminous forms.
Many southern forms are also found in Malangen, but the artie
species are doubtless in the majority there, and this is still more
certainly the case in the Bals Fiord, the Uls Fiord, Lyngen and
Kvamnescon. As Malangen, hydrographically speaking, takes the
position of a kind of transition fiord, I will mention some of the
animal forms we dredged there.

Polyphrya: — Hemiomeis variegata, H. nelson, H. seppiomi,
Lyrophrysamum, Liptothoe fimbriata, Leuconia flavata, Niphon
laeviuscula, N. retula, Leodea nuculae, Carinina quadrata, B.
ganadobita, Eupagurus bresidi, Nereisnudata, Pedilus
larvatus, Trembellides striata, Solbeia procera.

Of Boreophasia, there are two very characteristic boreal species
which have their northern limit in Malangen, namely, Kinebachius
smithi and Damaporhella.

Amphipoda: — Hyale nelson, Scarcars philbi, Hippoephyra
propteryx, Gymnacantha minuta, O. penaeus, Tryphesta brevidens,
Anaspis angularis, Lepidophyes analis, Lophophyes paletata, Har-
pinia nuchali, H. serrata, Ameiurus boreogyps, A. obtusatus, A.
seppiomi, A. amabilius, Hyalophyes larboptus, Stenochereis
koreni, Stenochereis koreniae, Maja boreale, M. bruxel-
septemcostata, Pseudomma lycoreus, P. propinquus, Manosephalides
laurae, M. laeviuscula, M. laeviuscula, M. laevis, M. laeviuscula,
M. laevis, M. laevis, M. laevis, M. laevis, M. laevis, M. laevis,
Haplophyes, H. levis, Haplophyes, H. levis, Haplophyes, H. levis,
Bathyscalina spinospora, Freeidae, Phialonella palearctica, Phialone-
laeviuscula, Carcinus variegatus, Caprella spinosa, Crangon
variegata, Carcinus variegatus, Pseudomma lycoreae, P. propinquus.

Sparrke Schmidt had no possibility to examine the greatest
depth of Malangen, so our dredgings form a suitable supplement
to Schmidt's investigations. We brought to light 18 species of
amphipods, which were new to the Malangen fauna, and most of
these were from the great depth where, as above mentioned,
Schmidt did not make any dredgings. There are several boreal
forms among the amphipods mentioned, but the artie ones are
however, in a small majority. Eupagurus larvatus, which is a
boreal form, has its northern limit in Malangen and Eupagurus larvatus,
which is an artie one, has here its southern limit. Of Canostraca
I found for instance Distylus glossipis, which is a decided artie
form. It was new to Malangen, which is the southern limit for
the species on our coast.

Schizochystis: — Boreogrypus incrust, Boreogrypus articius, B.
trivialis, Pseudohalophilus rosenae, Mysidinae insignis, Mysid
aeule.

Boreogrypus articius has not been found north of Malangen.

Brachiopoda: — Pterophraspsis breviceps, Brachiopoda articulata, P.
propinquus, P. breviceps, Canostraca aloni, Pseudophyllolepis norvegica,
Shibon septemcostata, S. septemcostata var. nucula, Hippolyte spinosa, H.
linnei, H. poli, Eupagurus articius, Eupagurus spiniferus, Leucophaea
spinosa, Lithodes nuchali, Maja nuchali, Maja variegata, Maja
minuta, Maja minuta, Maja major, Maja major, Maja major.

Of these mentioned, both Pseudophyllolepis propinquus and Boreogrypus
have their northern limit. Respecting the fauna of Malangen, I refer to the
mentioned paper by Sparrke Schmidt. With the exception of the amphipods,
I have here only mentioned the forms which I personally observed in
the fiord.

Brachiopods and molluscs have long been considered to be
useful in forming a precise picture of the zoogeographical character
of a given district. I will therefore arrange these animals in a
table, based upon the examinations which have been made by
Sparrke Schmidt's, the Norwegian North Atlantic Expedition
(1), C. W. S. Arendt(2), J. Johan Hørst(3), A. M. Norman(4),
O. S. Sars(5) and myself.

\(^2\) Here I have also included the amphipods which were found in Malan-
### Pelecypoda.

- *Modiolus decussis*, LIN.
- *M. breggii*, GRAY.
- *M. euglypta*, STURP.
- *M. plicatus*, LIN.
- *Dreissena viridis*, MOLL.
- *Crenella decussata*, MONT.
- *Nassa bennisi*, MONT.
- *N. wagneri*, MOLL.
- *L. miliaris*, O. F. MULL.
- *Porcellana lucida*, LIN.
- *T. intermedia*, M. SARS.
- *P. leucostoma*, FARR.
- *P. fragilis*, TOBEL.
- *Yoldia limatula*, SAT.

### Scaphopoda.

- *Teledixia cubalis*, LIN.
- *D. acuta acuta*, STEIN.
- *Splenodentilium citreum*, M. SARS.

### Placophora.

- *Acanthia baujei*, BRAN.
- *Lepidochitona cancellata*, NOW.
- *L. exigua*, MOLL.
- *L. cyrtus*, LIN.
- *T. bavarica*, BRAN.
- *T. vulgata*, LIN.

### Gastropoda.

- *Palina pallida*, LIN.
- *Aceria baltica*, MOLL.
- *Tectona viridis*, FARR.
- *T. cirrata*, MOLL.
- *T. obtusa*, O. F. MULL.
- *Punctatella mackini*, LIN.
- *Sciambria crispata*, FLEM.
- *Melania castelana*, MOLL.
- *Cyclogamma pittsburgh*, VEERE.
- *Marginella kellicottii*, FARR.
- *M. groenlandica*, CHEMN.
- *M. cirrata*, COTTA.
- *M. elisae*, BROWN.
- *M. brevula*, COTTA.
- *M. uncinata*, BROWN.
- *M. orbiculata*, G. O. SARS.
- *Sthemonitis nitida*, MOLL.
- *Tellina colorata*, CHEMN.
- *T. ballichi*, LIN.
- *T. globosa*, GROSS.
- *Solen pellucidus*, FARR.
- *Thecla tumida*, BROWN.
- *Nucula arenacea*, M. SARS.
- *N. obtusa*, LIN.
- *N. obtusa var. glaucina*, G. O. SARS.
- *N. abactata*, G. O. SARS.
- *Parvula granulata*, SAT.
- *Carbula indula*, OLIV.
- *Mya arenaria*, LIN.
- *M. tumida*, LIN.
- *Pangaea multispinosa*, SPRING.
- *Sagittaria arenacea*, LIN.

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*Note: The table above lists various species within the specified taxa, indicating their binomial names and sources.*
## Gastropoda.

<table>
<thead>
<tr>
<th>Mollusca</th>
<th>Mammalia</th>
<th>Caracteres</th>
<th>Funhoz</th>
<th>Kvensangen</th>
<th>East Finnmark</th>
</tr>
</thead>
</table>

- **Ochrida aculeus**, Gould
- **Caguita crenata**, Moll.
- **C. tenaculata**, G. O. Sars
- **Alenaia jeffreysii**, Waller
- **A. joni mayeri**, Price.
- **Rissia pumila**, da Costa
- **P. pumila**, var. intergrade, Adam.
- **B. insculpta**, Jurs.
- **Hecates phalina**, Férée.
- **Jeffreyia globularis**, Jeff.
- **Torniellupopsis acutula**, Stimp.
- **Lorella nuda**, Lov.
- **Cerithiopsis vestita**, Moll.
- **Lootchellia gryon**, Wood.
- **Scutaria groenlandica**, Chern.
- **S. obtusissimula**, S. Wood.
- **Pleolaimia crassa**, Jeff.
- **P. pumila**, Mont.
- **Scolopionida ornata**, Mont.
- **S. insculpta**, H. Harvey
- **Armadulinus insculpta**, Mont.
- **Leptonia caecum**, Stimp.
- **Esticina bilamellata**, Alder.
- **E. stevensoni**, Jeff.
- **Homolobopygia atrata**, Phil.
- **Albicula pulchra**, Férée
- **Taraenius cinctus**, Bero.
- **Menaglia (Terebra) maculata**, G. O. Sars.
- **M. (Terebra) nana**, Lov.
- **Bela pyramidalis**, Stimp.
- **B. pumila**, Buc.
- **B. insculpta**, Moll.
- **B. obtusata**, Moll.
- **B. cincta**, Trosch.
- **B. solida**, Moll.
- **B. incisa**, Moll.
- **B. rugosa**, Trosch.
- **B. exarata**, Moll.
- **B. buscula**, Couthe.
- **B. becula**, Couthe.
- **B. venosa**, Moll.
- **B. bioculata**, var. ablineus, Moll.
- **B. chilensis**, Veer.
- **B. simplex**, Moll.
- **B. sarsi**, Veer.
- **Taphomurex falki**, Lov.
- **Murex variabilis**, Phil.
- **Murex abuloides**, Jeff.
- **Tyrcon truncatus**, Stimp.
- **T. clathratus**, Lin.
- **T. bicornis**, Jenst.
- **Parapollia maxima**, Lin.
- **Atrypia quadricostata**, Gould.
- **Nassarius incognitus**, Stimp.
- **Encinaea oblata**, Lin.
- **B. georgica**, Chern.
- **B. scutata**, Moll.
- **B. involuta**, Veer.
- **B. hiloprimus**, Hancock
- **B. charpentieriana**, Des.
- **Septaria quinqueguttata**, Lin.

## Nudibranchiata.

<table>
<thead>
<tr>
<th>Mollusca</th>
<th>Mammalia</th>
<th>Caracteres</th>
<th>Funhoz</th>
<th>Kvensangen</th>
<th>East Finnmark</th>
</tr>
</thead>
</table>

- **Dopsia adhaerens**, O. F. Mull.
- **Lucellethia bilamellata**, Lin.
- **L. spinosa**, O. F. Mull.
- **Acanthodiscus pilosus**, O. F. Mull.
- **Tripora brevis**, O. F. Mull.
- **Decaloma elongata**, Lin.
- **D. robusta**, Veer.
- **Eudora papillosa**, Lin.
- **E. scabra**, Veer.
- **Cyerce phyllocheius**, Johnst.
- **C. stenophylla**, Veer.
- **Lampadella capitata**, O. F. Mull.

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From these tables, it will be seen that Malangen, Kvenangen and the fiords of East Finnmark for the most part have the same molluscs. It is probable that further investigation would show a still greater similarity than that found in the tables. It may, however, with certainty be affirmed, that there are more boreal forms in Malangen and Kvenangen than in the East Finnmark fiords, in the latter there are, on the other hand, more arctic species. The warm current which flows northwards also exerts some influence in East Finnmark. On March 25, 1899, at the mouth of the Porsanger Fjord, at a depth of 250 mtr., I registered 2.75° C. (p. 8), which proved that a comparatively warm current was seeking to penetrate at the bottom. The temperature at a depth of 200 mtr. was 1.3 and salinity 34.54.

According to Gran, on August 28th 1900, at the mouth of the Porsanger Fjord, the following conditions were registered from „Michael Sars“:
A little farther in the fiord, Linuopis unimbr., which is a boreal form, was taken, according to Friele.

In the Tana and Varanger Fiords, such comparatively high temperatures at the bottom as 2.8 and 3.1 (p. 20) have also been registered. So that one must not expect to find an altogether unmixed arctic fauna in East Finnmark either, although the arctic forms are greatly in the majority. Such species as Peleten ligniformis, Vanea arctica and yellowa, Dendrion callata, Patina pellucida, Gibbula cineraria and tenuis, Natica montaguei etc. must be considered to be decided boreal forms, and yet they have pushed their way up to East Finnmark.

Professor G. O. Sars has found several boreal forms at Hasvik in Soro. This place has not been hydrographically investigated, but I am inclined to think that the deep channel, which penetrates in from the ocean along the island, has comparatively warm water at the bottom. Another stopping place for boreal forms is the Malangen, where the bottom temperature at the greatest depths varies between 4 and 5.5° C., but the Vest Fiord is the most definite limit for marine fauna on the Norwegian coast, a very large number of boreal animal forms being found there, but not further north. It is interesting to be able to connect this fact with the one that the Vest Fiord is the most northerly of the large Norwegian fiords in which ocean water dominates the natural conditions at the depths (t = 6—7°, s = ca. 3.5 °/00). As a general zoogeographical result, it may be stated that, with respect to the large important fiords, which are open to the ocean, the benthic and boreal forms occur as far up as the Vest Fiord in larger numbers than the arctic ones. It is first in the Malangen that the arctic forms are in the majority, and this even more noticeable in the Kvænangen and Porsanger Fiords, the latter having almost unmixed arctic fauna. The inner parts of the fiords and the branch fiords have retained more of the arctic species. For instance, while in the Salten Fiord, the southern forms are in the majority, we find that in the Skjerstad Fiord, which lies farther inland, and in the Beier Fiord which is a little farther south, the arctic animals are more profuse than the southern ones. The Ranel Fiord has not yet been investigated, but it is probable that also there arctic forms will be predominant.

Generally speaking, these facts coincide with the opinion expressed long ago by Prof. G. O. Sars: 1) What I have tried to adduce is the connection between zoogeographical and hydrographical limits.

The northernmost Lophohehia reef, hitherto known.

In his description of Ophioc无声spectabilis, G. O. Sars 2) says: — "I have found this important species at one place only, namely near Bodo, where it is not so very scarce between the corals (Lophohehia prolifera), which are abundant at a depth of from 80—100 fathoms. It is generally so firmly attached to the tangled branches of the corals, by means of its spiky arms, that it is exceedingly difficult to get it loose." On June 19th 1878, the Norw. North Atl. Exp. took two specimens of this echinoderm at st. 255 in the Vest Fiord (66° 12' N., 15° 40' E.). The depth is given as being 624 mtrs., temperature 0.5 and the bottom material, clay.

About the same time, O. spectabilis was found by V. Strom in the outer part of the Trondhjem Fiord. In a paper written in recent years Strom 3) says that this species occurs in large quantities on Lophohehia prolifera in the outer part of the Trondhjem Fiord. According to Gude 4) also Höyel has mentioned the species from the Faeroe Channel (43° fathoms). I do not know if Lophohehia prolifera is found at the latter place, but it is very probable, for M. Sars 5) mentions that it is found off the Shetland Isles, Verhulst 6) too mentions spectabilis as found off Nova Scotia, 1882, 131 fathoms, one specimen. Nothing is said about O. spectabilis having been found together with Lophohehia prolifera, but in another place, Verhulst writes (I. c. p. 536): "L. prolifera B. range. 100 to 300 fathoms, off Nova Scotia: 1060 fathoms, dead, 1884, rare." There is thus probably nothing which makes it unlikely that the ophiuroid in question may have been attached to the coral here mentioned.

When working out my material of echinoderms, Gude 7) mentions that Koehler has given O. spectabilis as being found in the Bay of Biscay, but as Koehler's specimens appear to be somewhat different to Sars' species, Gude raises doubt as to their identity. The following table gives some important data concerning the places where I have found spectabilis.

<table>
<thead>
<tr>
<th>Date</th>
<th>Place</th>
<th>Lat. &amp; Long.</th>
<th>Depth of water between samples</th>
<th>Temp.</th>
<th>Salin.</th>
<th>Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.5°</td>
<td>1896</td>
<td>Transylhet</td>
<td>66° 17' 5.6 N., 15° 29.6 E.</td>
<td>450—530</td>
<td>500</td>
<td>65.2</td>
</tr>
<tr>
<td>31.5°</td>
<td>1896</td>
<td>The</td>
<td>66° 12' 8.2 N., 15° 29.6 E.</td>
<td>500—600</td>
<td>500</td>
<td>65.4</td>
</tr>
<tr>
<td>30.5°</td>
<td>1900</td>
<td>Arno</td>
<td>67° 14' 9.4 N., 15° 28.6 E.</td>
<td>300—400</td>
<td>100</td>
<td>65.35</td>
</tr>
</tbody>
</table>

Arno is situated outside the month of the Salten Fiord near Bodo, and Transylhet is a little farther in than st. 255 of the Norw. North Atl. Exp. in the Vest Fiord, the bottom here is given as being of clay, but there has probably been a hard spot which is accredited for by the presence of Lophohehia, which was the case in Transylhet.

There is thus reason to conclude that O. spectabilis is so closely connected with Lophohehia prolifera as to make the latter almost a necessity for the former. This does not, however, at all imply that where ever Lophohehia occurs, O. spectabilis is also found. This is an interesting instance of one animal's dependence upon another.

1) Oversigt over Trondhjemsforhuds fauna. Beretning fra arbeidskomitéen for Trondhjems biologiske station 1900.
3) "Feodula dystinca" fra Qurter-sperenien, p. 92.

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and it will be interesting to see what other animals exist together with Lophohelia. But first I will mention a few facts about the coral itself. This easily recognized species has been found in several of the fiords on the west coast of Norway up to the Vest Fiord, in rather deep water (about 150—500 m). As far as I know, my specimens have been taken at the most northerly place for this species (Trondheyt, the Tys Fiord I). And I am inclined to think that no living specimens will be found farther north, as the colonies live on our coast under unusually uniform and settled natural conditions, with a temperature of 6—7° C, and a salinity of about 35 %. There is reason for supposing that at VERKELL’s locality "off Nova Scotia" the conditions are similar. At any rate, VERKELL (I. c. p. 506) mentions that off Cape Sable the temperature, at a depth of 65—131 fathoms, varies between 12° and 16° Fhr. (5°.5—8° C). Cf. stations nr. 2063—2071. The bottom at a couple of these stations is given as being coral. It is, therefore, probable that the temperature here too is near 6—7° C at those places where Lophohelia profiera occurs alive. According to VERKELL, only dead specimens were taken at 1600 fathoms, and if it be remembered that in the Norwegian waters the coral in question does not extend beyond the boundary of the ocean water, it tempts me to conclude that the species cannot live at a depth of 1600 fathoms off Nova Scotia, notwithstanding that the fall in temperature is not particularly great. VERKELL (I. c. p. 503) says "The bottom temperatures between 1000 and 2000 fathoms were usually between 37° F. and 39° F., and rarely 46° F." If Lophohelia from 1600 fathoms had existed at this place under present natural conditions, it ought therefore now also to be able to thrive in a temperature of 3—4° C. But the investigations hitherto made in Norway seem to contradict this possibility. A couple of suggestions may be made to account for the occurrence of Lophohelia at such a great depth. The colonies may have been transported from some other locality, so that when the dredgings were made from the "Albatross" they were in a secondary layer, or a fall in the bottom layer may have taken place. There are instances of a rise of the bottom in a couple of places in Norway where Lophohelia has been brought several meters higher than the present water level.

Prof. Michael Sars[1] was the first who discovered Lophohelia profiera at a height of 50 meters above sea level, this was at Drobak in the Kristiania Fiord, he paid great attention to this occurrence and gave a good description of it. Later on, more light has been thrown upon the subject by Prof. W. C. Bremner,[2] who writes in part as follows: — "From the time of the deepest submergence of the Kristiania region, an epibiotic fauna is known, which has lived at a great depth, at least 150 meters. This is the famous dead coral reef at Drobak, south of Kristiania, where the shore, from 60 meters below the sea-level to about 30 meters above it, is covered with the remains of a great reef of Lophohelia profiera." Bremner also shows the height of the reef above the sea-level (30 m.) + the minimum depth of the coral in the present fiords (150 m.) = the minimum depth of the upper marine boundary at Drobak (180 m.) — a proof, that the Lophohelia-reef was formed, partly at any rate, during the deepest submergence of the land at Drobak. A similar argument holds good with regard to the other occurrences at Stenkjer at the end of the Trondhejm Fiord.

Natural conditions at the time when Lophohelia lived at Drobak and Stenkjer cannot have been very different to what they are now in the deep western fiords, and it may from this be concluded that the Gulf Stream, at least from the epibiotic time, filled the channels and basins in the Norwegian fiords with its warm water.

Together with Lophohelia, M. Sars found various other characteristic forms, e. g. Pelexa citrina, P. ovum, Lima excava, Arca nodulosa etc.

These animals very frequently follow Lophohelia in our fiords at the present day, but in no definite state of dependence. Further, the presence of these animals proves that the natural conditions in the depths of the fiords during the epibiotic time could not have been so very dissimilar to the present conditions. But, on the other hand, the deposits in the shallow waters plainly show that in the upper layers of water, quite a different state of things was prevalent to that of the present day.

It is interesting to give a list of the most important animals which have been observed together with Lophohelia at the most northern localities where this species has been found.

30½ 1900, Atmo. 300—400 m.

1½ 1899, Trondheyt, 150—500 m.

2½ 1899, The Tys Fiord I, about 500 m.
A sound at the bottom of our dredging stated a depth of 725 m. and at the end 500 m. We drove along very quickly, however, and our line was hardly long enough, so that we got nothing from the clay at 725 m. It was first at the edge that the trawl began to take in anything, and when we drew it up from a depth of about 500 meters, the net was half full of living and dead branches of Lophohelia, on which was found: —
Paratragia punctulata, D'Orb.

There were also: —

Some of the species mentioned have here their northern limit, e. g. Protathrius simplex, Echinus elegans, Lima excava, Galathodes tridentatus. A wide distribution southwards has for instance Galathodes tridentatus, which, according to MILFORD-EDWARDS and BOURJOT, extends right down to the west coast of Morocco, and Lima excava, of which FRIEL and GREGO write in their account of the Moluccas of the NW. North Atlantic Exp.: — "It is also

known in the deep water between the Hebridies and the Faeroe Isles, in Portugal, the Azores and Senegambia."

From the investigations made by M. and G. O. Sars, as well as V. Storck, we have a tolerably complete knowledge of the fauna of the coral regions in our fiords. Storck has given a concise account of the conditions in the Trondheijmen Fiord, with a map showing the position of the corals, and to this I would beg reference. I will here also emphasize the fact that the characteristic forms on the epiflora Lophelia-reef at Drohak (Pecten cirratus, P. arctesus, Linnaeus carinat. Astrononustamnus, etc.) also at the present time show themselves to be faithful companions. However, I do not think practical boundaries can be drawn between the fauna which are connected with Lophelia and those which are connected with other corals, such as, Paragorgia arborea, Paracorynus plumosus or Didemnum lepidiiferum.

It may, on the other hand, be said that the region of the deep water corals has its definite, decided fauna, which is particularly uniform in all the large Norwegian fiords to which the ocean water has free access, from the Bokn Fiord to the Vest Fiord. There is a coral facies of animals, just as there is a clay facies.

A few words on the fauna in clay.

The deep channels and basins in the fiords (150–200 m. and more), of which clay forms the bottom and into which the ocean water has access, have also their characteristic animal life.

And since the investigations made by G. O. Sars, in the sixties, at the fishing place Skroven and at other places in the Vest Fiord, we know that there are especially interesting forms on the clay-bottom of the fiords. Such as, for instance, Isadella hipparis, Plagothyra arcticata, Rhiizocrinus floslactis, Bussagia carinata, Flustra abyssicola etc. The fauna at Skroven, where I have made a very successful haul with a trawl at a depth of 350–410 m., is very rich. In addition to the forms just mentioned, it was quite usual to find such species as the following, on the clay deposits in the Vest Fiord and those of its arms into which ocean water penetrates at the bottom:—

Eunosta nigra, — Astrononus arcuata, Scoenomenia sphericum, Styrospheora athel. Bathypelagic filiforws, Rhathbunimast plagiopln.

Echinodermata: — Amphilephora norvegica, Plagicentha globulea, Daddlera Andrea, Stichopus tremulus, Bathypelagic natus, Mesothuria interrupta, Cucumaria hispaj, Myriotholus cirratus.

Polychoeta: — Lat VARIABLES, Leathesia filiccras, Leoniouia tetragona, Terbellides Struan.


Ostreacea: — Cypridina norvegica.

Isopoda: — Micronopus lyrus, Eutetoon curvata.

Schiopoda: — Barconopsis tridentis, Penoniana coura.

Decapoda: — Pontophilus norvegicus, Munida rugosa, M. tenella.

Ascidia: — Ascidiella gelatinosa.

The above list gives some of the species which are constantly found on the clay at the bottom of rather deep water. Many of these forms are undoubtedly mud-eaters, more especially is this the case with regard to the above mentioned Holothurioidea. Some of them appear to be dependent upon ocean water (t = 6–7° C, s = about 35 °/o). According to Osterdgen,3 Bathypelagic natus, Mesothuria interrupta, Cucumaria hispaj, and Myriotholus cirratus are not found in Norwegian fiords north farther north than the Vest Fiord. It is characteristic that I took several specimens of Bathypelagic natus and Mesothuria interrupta in the Saltan Fiord where the temperature was 6,65 °C, and the salinity 35,13 °/o, while in the Skjerstad Fiord, which is only a little farther in, where t = 3°, 2 and s = 34 °/o, not a single specimen was to be seen in all the dredging made. Bathypelagic natus occurs in rather large numbers at its northern limit; at the station at the mouth of the Fafden Fiord at a depth of 330 m. 29 individuals of this species were taken, but only 1 Mesothuria. Of clay-bottom molluscs, which have not hitherto been found north of Lofoten, the following may be mentioned:—

Melitina obtusa, Kellicott milliputi, Dentilinum agile, Scyphandria ligularis etc. The deepwater fauna on the mud-bottom is remarkably uniform in the large fiords which are filled with ocean water, from the Bokn Fiord to the Vest Fiord, notwithstanding that the Vest Fiord and its adjacent fiords contain some forms which are wanting in the Bokn Fiord. Further investigations will probably equalize this apparent difference to some extent, for instance, I have latterly found Rhiizocrinus floslactis also in the Bokn Fiord. But it will probably be found that such a species as Plagothyra arcticata cannot be included among the fauna of the Bokn Fiord, this species must, judging from what is up to the present known with regard to its distribution, be considered to be an arctic species, which has been able to exist under the natural conditions determined by the ocean water which penetrates into the fiords. On the whole, one may say that, zoogeographically speaking, the deep water fauna on the clay-bottom of the fiords in question are especially remarkable on account of the large number of forms in them which have a wide distribution southwards. But, north of Lofoten, the fauna on the clay have quite another character. The southern forms disappear, and the northern ones take their place. At my stations in the Lyngen Fiord (Lyngen II and III) at the respective depths of 250 and 320 m. on clay-bottom such forms as the following occurred in large quantities:— Clymenium crispates, Myriotholus rinkii, Pecten quaquaversalus and Astidote, crenulata. Here too were found Syphonodentulium cirratus, Sodaia graenlandica, Bopa cirrata etc. The peculiar arctic Bryozo, Aegyptina disciforme, was also taken here. Dendrotheca gobicola, Bovinum skorupina and many other arctic forms also occurred. At the station Lyngen II, d = 250 m., t = 2°,85 °C, s = 34,47 °/o, and at Lyngen III, d = 320 m., t = 3°,65 °C and s = 34,84 °/o. At both stations in the Lyngen Fiord, several specimens of two actinia species were taken, but none were conserved. If I remember rightly, they were Actinia phyllophora and Boharenus circinatus.

Edredoninae andræi and Eupagurus orcadianus were also found. As I have previously mentioned, there is another character over the fauna in the deep waters of the Malangen Fiord, and if we go as far as to Lyngen and Kvenangen, the difference is even more striking. In the deep waters of Kvenangen where d = 334 m., t = 2°,3 °C, and s = 34,49 °/o, were found, for instance, Myriotholus rinkii, Polychoeta, e.g. Harnotoi variaformis, Nephtys antarctica, X. alicia, Nucula hirsuta, Terbellides striati.

Mollusca: — Pecten quaquaversalus, Area peronitidus, var. septentrionalis, Astidote crenulata, Syphonodentulium cirratus etc.

Amphipoda — Holoxypus fulvocinctus, Idunella cequicornis. The latter has, hitherto, only been taken in the Varanger Fiord.

Notwithstanding that the clay depths both north and south of Lofoten have some forms in common, the Vest Fiord, however, forms a very decided limit for fauna, as has been explained in the foregoing pages. One may also in the fauna of the Norwegian deep waters make a distinction between an arctic and a boreal clay-facies.

Remarks on the fauna of the ocean banks.

I was not able to make many dredgings on the ocean banks in 1899, but I succeeded, however, in getting an idea of their fauna. The station, no. 11, is not far from the ocean banks, at a depth of 150 mts., here Cypalus hungaricus, which is a southern form, was dredged, here this form has its northern limit on our coast. On the banks themselves, it extends, perhaps, a little further northwards. And at the station at Gjøvikoya, 250 m., t = 7°.1 C., s = 34.38 ‰. *Holoxypus fulvocinctus* was taken. This form must be characterized as a boreal one, judging from the places where it has hitherto been found. In the Sea off Ingo (71°.19' N., 23°.10' E.), t = 315 m., t = 3°.15 C., s = 35.24 ‰, an amphipod, *Echinothrix audiberti*, occurred, among other things; this form, according to G. O. Sars has a distribution as far south as the Azores, and was previously only known from the south west coasts of Norway. Taking into consideration the hydrographical conditions on the banks outside Lofoten, Vesteraalen, Tronno and Finnmark, one would expect to find that at any rate some boreal forms would be able to exist there. To get light on this subject, reference can be made to the material collected by the Norwegian North Atlantic Expedition. First I will give a table showing the temperatures at some of the stations in the southern bank district of the Norwegian Sea (Stadt—Shetland—Lofoten). Cf. map of the district of the Norwegian North Atlantic Expedition.

**Bottom temperatures on the southern banks in the Norwegian Sea.**

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>9.</td>
<td>61°.30' N.</td>
<td>377 m.</td>
<td>3°.9 C.</td>
<td>Clay.</td>
</tr>
<tr>
<td>10.</td>
<td>61°.37' E.</td>
<td>402 m.</td>
<td>6°.0</td>
<td>Ooze, Clay.</td>
</tr>
<tr>
<td>92.</td>
<td>61°.6' N.</td>
<td>326 m.</td>
<td>7°.2</td>
<td>Salubrious Clay.</td>
</tr>
<tr>
<td>79.</td>
<td>60°.42' E.</td>
<td>283 m.</td>
<td>6°.9</td>
<td>Salubrious Clay.</td>
</tr>
<tr>
<td>191.</td>
<td>61°.36' N.</td>
<td>408 m.</td>
<td>6°.9</td>
<td>Salubrious Clay.</td>
</tr>
<tr>
<td>147.</td>
<td>60°.4' E.</td>
<td>260 m.</td>
<td>6°.2</td>
<td>Grey Clay.</td>
</tr>
</tbody>
</table>

On these banks, one would expect to find an animal life which differs only slightly from that of the Norwegian fiords (The Boka Fiord — the Vest Fiord), where there are corresponding temperatures. The investigations hitherto made appear to confirm this expectation. I will now give a table showing the bottom temperatures on the northern banks from Lofoten to Eeeren Island.

**Bottom temperatures on the northern banks in the Norwegian Sea.**

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>195.</td>
<td>7°.55' N.</td>
<td>336 m.</td>
<td>29.1 C.</td>
<td>Stones, Clay.</td>
</tr>
<tr>
<td>290.</td>
<td>7°.57' N.</td>
<td>349 m.</td>
<td>3.5</td>
<td>Salubrious Clay.</td>
</tr>
<tr>
<td>325.</td>
<td>7°.55' N.</td>
<td>496 m.</td>
<td>1.5</td>
<td>Clay.</td>
</tr>
<tr>
<td>290.</td>
<td>1°.51' E.</td>
<td>64 m.</td>
<td>1.1</td>
<td>Stones.</td>
</tr>
<tr>
<td>315.</td>
<td>7°.55' N.</td>
<td>329 m.</td>
<td>2.5</td>
<td>Clay.</td>
</tr>
<tr>
<td>326.</td>
<td>7°.50' N.</td>
<td>225 m.</td>
<td>1.6</td>
<td>Clay.</td>
</tr>
</tbody>
</table>

According to FRIELE and GREIM, 14 species of Mollusca were taken at station 195, several of which are widely distributed southwards. Among these may be mentioned:


At the stations previously mentioned in the northern bank district, forms also occurred which have a wide southern distribution. At station 315 (74°.53' N.) a bivalve *Drygozo, Beclacina albi* was taken. I have not on any other occasion noticed this species north of Lofoten. Undoubtedly there are several species which on the banks go farther north than in the fiords, so that it is important to state clearly, when mentioning distribution, whether the species in question occurs in the fiords and the belt of skerries (skjerries) or on the banks.

Zoologically speaking, there remains much to be done with respect to the Norwegian ocean-banks, and a thorough investigation of the edge towards the deep basin of the Norwegian Sea would be highly interesting. For here the transition from boreal to arctic fauna occurs, and that too not spread over several geographical degrees of latitude, but in the space of a few hundred meters.

**Shallow-water shells found at great depths.**

Of late years, there has been a good deal of discussion among Danish and Norwegian authors as to the cause of the occurrence of littoral shells at great depths, especially in the Norwegian Sea. I do not intend to go into the matter, as I do not possess the necessary material to take part in the discussion of it. I would refer those who wish to have a clear account of the various opinions advanced to Dr. A. C. JOHANSEN's1 paper, in which references will also be found to other works dealing with the same subject.


Those who have considered this question seem to have forgotten that also A. E. Verrill has expressed an opinion with reference to transportation by ice.

In 1883, dredgings were made from S S „Albatross“ in the region of the Gulf Stream from off Cape Hatteras to Nova Scotia. In the „Results of the Explorations“ (p. 367) Verrill writes: — „In many instances we have also dredged pebbles and small, rounded boulders of granite and other crystalline rocks from beneath the Gulf Stream in deep water. These, I suppose, have been carried to that region by shore-ice floating off in great quantities from our northern coasts in winter and spring, and melting where the warm Gulf Stream water is encountered. “ From this, it will be seen that Verrill inclined to the opinion that the pebbles found in the deep water were brought thither by floating ice, and if the ice takes along pebbles, there is nothing to hinder for its also taking along shells from the coast.

In the Norwegian bords, it is highly probable that drift-ice causes a transportation of littoral shells out into the deep basins. For instance, Lithotamnium ebulus and obesus found at a depth of 150—180 m. on Riverlakferet, and Gibbula cineraria at a depth of 600 meters in the Oyssund, (in each case the shells were empty) were neither of them in their primary locality. Hans Kleen,1) too, has given a very plausible explanation of the storing of gravel and shells in the snow and ice on the shore, and their conveyance to places farther off when the ice melts in the spring; his explanation is based upon personal observations at Tromsø.

Fauna and Hydrography.

In the foregoing pages, I have tried to prove that there is a close connection between fauna and hydrography. It would from this again appear, that a majority of species of animals have an organisation which can only bear a very slight variation in hydrographical conditions. The number of so-called cosmopolitan species is very small, and it seems to me that the number of those which are mentioned as being widely distributed is also on the decrease. The more exact morphological investigation which is demanded nowadays often results in the dividing of a species into two or more.

And this is the case, not only with bottom forms, but also with reference to plankton.

I will give some instances of what I mean. We have for years heard that Citharus finmarchicus is found in nearly every sea. But G. O. Sars 2) now tells us that under the name C. finmarchicus was hidden another species, C. helgolandicus, Clack, which is specially distributed southwards, while the former has an arctic and boreal distribution. Strictly speaking, Citharus finmarchicus contained three different species, for Citharus hyperboreus was considered to be a variety of C. finmarchicus previous to the publication of Dr. Giesbrecht’s well-known monograph on Copepods. Instead, therefore, of one species distributed over nearly every sea, we now get three species with comparatively limited distribution, C. hyperboreus being arctic, C. finmarchicus boreal and arctic and C. helgolandicus littorane.

Similarly with respect to Eucheta. Instead of the widely distributed Eucheta maxima, we now have, maxima, glacialis and barbata. Examples might easily be multiplied from the Copepods. On the other hand, it is beyond doubt that there are also deep-sea forms of Copepods which have an exceedingly wide distribution. Natural conditions are only subject to very slight changes at the great depths, and this too for extensive stretches. It is also very probable that there are shallow-water forms which are so organized as to be able easily to adapt themselves to changes in natural conditions, and are thus able to exist under very diverse physical conditions, but their number has undoubtedly been over-rated.

In his excellent monograph on northern Annulata, G. M. R. Lütken 3) says:

„I must say that I doubt whether the northern seas really have so many species in common with the Mediterranean as would appear from the lists given in the literature available. “ On account of this doubt, Lütken carefully compared the northern forms and those from the Mediterranean, and came to the conclusion that Acartia oriana and Pseudocalanus krøyeri from the latter sea were different from the northern species bearing the same name. They were given the names A. elongata and P. elongata.

Similarly with respect to Pseudocalanus acutus, P. elongata, etc.

I could give a number of examples from the Bryozoa too, to show how the extent of the distribution of a species diminishes, as the claim for greater exactness in the determination of a species increases. The change which has taken place in the use of the word „species“ with regard to the Bryozoa, has had a similar effect. F. A. Smith, for instance in his work on boreal and arctic Bryozoa, which in other respects is excellent, has used the word „species“ in a very extended sense. He has entered as „forms“ a large number of specimens which are given the rank of „species“ by recent systematical investigators.

As a result, Smith’s species were attributed with a much too extensive geographical distribution.

The distribution of a species is undoubtedly dependent on many other things than the temperature and salinity of the water in which it exists. Currents especially have both a direct and indirect influence. If one considers the conditions on the Norwegian coast, where arctic and boreal fauna meet, the question naturally suggests itself: Is it the arctic or the boreal animals which on our coasts are gaining ground?

To settle whether the movements of a given element of fauna or flora are progressive or retrograde, one can examine the currents in the adjoining sea. On the Norwegian coast, the current which flows in a northerly direction is predominant, and the southern animal forms are carried along with it. On the east coast of North America, the reverse is the case. The duration of the pelagic state is also important with regard to the penetration of the species into new districts. It would therefore seem likely that such species as Mytilus edulis and Mollusca nudibranchia, in which the pelagic state hardly lasts much more than a week, would find it difficult to get over the space between two coasts which are separated by a wide expanse of ocean. Along a length of coast line, however, those and similar species are widely distributed, for, in the course of thousands of years, the many small steps forward amount to a considerable distance.

I do not know very much about the plankton in the more southerly seas, but I have the impression that there is not so much difference there in its quantity and quality at the different times

1) Systematisk geografisk oversigt over de nordiske Annulata. Geogr. Tidsskriften, Vol. IV.
2) Crustacea of Norway, Vol. IV.
of year, as is the case in the northern latitudes.\footnote{Both large and small animals, from the Spitzbergen-reindeer to the plankton-crustaceans, find that winter in the arctic zone is a time when food is scarce.} And if this be a fact, its influence will be seen on the plankton-eating animal world. It is possible that the suitability of the molluscs as zoographical character-forms, depends upon the fact that a great many of them are plankton eaters. The mud-eating worms, for instance, are much less suitable in giving a characteristic of the fauna. Besides, there are species of nudicators with a small geographical distribution. A star-fish, 	extit{Cleioidea crassipes}, whose stomach is almost always full of mud, is very little found beyond the arctic district. In such cases, one is compelled to conclude that the animal has very little power of adaptation.

Further Remarks on Plankton.

In the fiords near Bergen, February is the month in which the plankton is poorest, and there is reason to think that the minimum for the year, for the northern fiords of Norway, also falls in this month. The great change in plankton life occurs at the spring inflow of the diatoms.

In the fiords near Bergen, March is the month when the diatoms begin to show themselves en masse, but at different times, within the limit of this month, from year to year. It is not yet possible definitely to fix the time when the winter state gives way to the spring one in the northern fiords, but it is probable that the spring-diatoms appear in very large quantities somewhat later here than in the south west fiords. Below I give some data concerning the occurrence of diatoms on the northern coasts.

In the Tyś Fiord on \(19/4\) 1899 only a few diatoms were found, but on \(3/4\) they were numerous near Lillo Molla, and this was also the case on \(5/4\) in the same year at Hola near Svolvær.

\(19/4\) 1899. In the harbour at Stene in Bø (Vesteralen) many diatoms, \(0-3 \text{ m.}\)

\(12/4\) 1899. The Malangen Fiord, many diatoms. Whilst there in Malangen, from 12th—14th of April 1899, there was a rich development of diatoms, in Kvenangen on 19th of the same month, winter conditions prevailed. But on \(21/4\), the spring diatoms also had shown themselves in Kvenangen.

\(23/1\) 1899. Tord Fiord harbour, many diatoms.

\(24/1\) 1899. Ingeholv, many diatoms.

\(25/1\) 1899. Repvåg harbour, diatoms.

\(27/1\) 1899. The Persanger Fiord, many diatoms.

\(27/1\) 1899. Malvann, diatoms.

\(1/5\) 1899. Yarda, some chains of diatoms.

\(5/5\) 1899. Hola near Svolvær, few diatoms.

At the place last mentioned (in Lofoten) the first rush of diatoms was over. In place of them, there were multitudes of forms in different stages of development belonging to 	extit{Copepoda}, 	extit{Cirripedia}, 	extit{Annelida} etc.

\(22/4\) 1900. The Ostnes Fiord, \(0-25 \text{ m.}\), development of the spring diatoms.

\(30/4\) 1900. The Vest Fiord, \(0-25 \text{ m.}\), many diatoms.

\(1/5\) 1900. The Skjerstad Fiord, still winter conditions.

\(5/5\) 1900. The Saltten Fiord, many diatoms.

\(9/5\) 1900. The Folden Fiord, still winter conditions.

Previously in this treatise, it has been shown that the Vest Fiord is the most important terminus for a great number of southern bottom forms. It is probably also the case, if one substitutes plankton forms for bottom animals. North of the Vest Fiord such species as 	extit{Phaeocystis globosa}, 	extit{Diel}, and 	extit{Oithonella arctica}, Borek, will hardly be found. In the Norwegian series of fiords, 	extit{Echinus norvegicus}, for instance, is not found north of the Vest Fiord, but I took specimens of 	extit{Cirrostoma articum} in Malangen.

The very large quantities of such 	extit{Phaeocystis} as 	extit{Capilula sosii} and 	extit{Physeplora borealis} along the northern coast and in the northern fiords during the winter of 1899, was an occurrence which merits further mention. Of the forms mentioned, 	extit{Capilula sosii} was exceedingly common. On \(20/4\) I saw in the Jukel Fiord (arm of Kvenangen) a fisherman whose gloves on the inside were stripped red by the remains of this siphonophor which had fastened itself to the fishing lines. The inhabitants looked upon this as being something unusual, which points to the fact that the phenomenon is not of annual occurrence. As the plankton species in question are oceanic, their occurrence in large quantities in the fiords can hardly be explained in any other way than by supposing that there had that year been an unusually strong flow of the current in the upper layers of water in the sea towards the coast and into the fiords. It occurred to me to connect this with the prevailing winds. To be able to form an opinion of the relation between the sea and land winds, we will look at the downfall for the period in question.\footnote{As it is more especially the ocean winds which cause downfall, one must be justified in concluding that, from October 1898 to March 1899, their influence on the coast line in question must have been greater than usual. But this would again result in more than the ordinary quantity of water being driven in from the sea coast, which must be evident in the kind of plankton which occurs. In this connection, it is also interesting to recall that, on the south west coast of Norway (in the spring-herring districts), the fishermen call some 	extit{Salmo salar} **silver** and they look upon their appearance as a sure sign that the herrings will come in shoals to the coast. It is not altogether impossible that scientific investigations will verify this prognostication. At any rate, it appears to be quite reasonable, that the prevailing ocean winds stir up surface currents which drive both herrings and their food towards the coasts.}

<table>
<thead>
<tr>
<th>Date</th>
<th>Bodø Downfall</th>
<th>Trondheim Downfall</th>
<th>Gjøsater Downfall</th>
<th>Vidda Downfall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mm.</td>
<td>mm.</td>
<td>mm.</td>
<td>mm.</td>
</tr>
<tr>
<td>October</td>
<td>108</td>
<td>106</td>
<td>86</td>
<td>72</td>
</tr>
<tr>
<td>November</td>
<td>148</td>
<td>109</td>
<td>181</td>
<td>106</td>
</tr>
<tr>
<td>December</td>
<td>153</td>
<td>87</td>
<td>75</td>
<td>165</td>
</tr>
<tr>
<td>1899</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>January</td>
<td>70</td>
<td>77</td>
<td>58</td>
<td>168</td>
</tr>
<tr>
<td>February</td>
<td>129</td>
<td>61</td>
<td>174</td>
<td>110</td>
</tr>
<tr>
<td>March</td>
<td>96</td>
<td>61</td>
<td>80</td>
<td>95</td>
</tr>
<tr>
<td>Average</td>
<td>117</td>
<td>83.5</td>
<td>109.5</td>
<td>100</td>
</tr>
</tbody>
</table>

\footnote{1. Cf. Nedersjøfartagelsel i Norge, Aarr. IV (1899) og V (1899).}

\footnote{2. From sild (herring) and rek (to drift with the stream).}

\footnote{Cf. M. SARS, Fauna littoralis Norvegiae, Part I, p. 63.}
B. The Investigations considered from a practical Point of View.

The Vest Fiord is one of the most thoroughly investigated of our fiords, speaking in a biological and hydrographical sense. And the reason for this is not difficult to understand. The government has found it necessary to send naturalists to the district in which a cod fishery is carried on, upon the results of which the income of the country shows an important rise or fall, in proportion to the success or failure of the catch. The statistics taken have shown that the catch varies quite considerably from one season to another, and it has been the aim of the investigating naturalists to discover the factors which have an influence on the fate of the fishing. The most important marine animals for us are undeniably cod and herrings, but in addition to these, there are many other fish which are caught in large quantities on the coasts of the counties of Nordland, Trondhejm and Finnmark. I will first mention some invertebrates, which are of economic importance. Then I will deal with the cod fisheries in Lofoten and Finnmark.

a. Some Invertebrates of economic Importance.

The animals may be divided into the following groups: — injurious, indifferent, indirectly useful, directly useful, if account only be taken of their useful or baneful relation to mankind.

A decidedly injurious animal is Mytilus galloprovincialis, which sucks out the fish caught in nets and on lines. Such forms as Ulosus finmarchicus, Boreophyes incrustus, Nyctiphanea norvegica, many worms, molluses etc., may be said to be indirectly useful, as they serve as food for edible fish.

To the directly useful animals, belong first of all those which are eaten by man, then those from which useful products are obtained, and lastly those which are used as bait for the edible fish. Only some of those which are directly useful to man shall be mentioned here.

Arca popillia, Lin.

This polycheet occurs rather numerousy and at many places in muddy beaches, it is dug up by the fishermen and used by them as bait. Similarly too, a fish (Ammodobis tubarois) is taken and also serves as bait.

Pecten islandicus, Mull.

The Trondhejm Fiord is the most southerly place, on our coast, where this mussel occurs of sufficient size and in such quantities as to give it any economic importance. According to V. Strom, it is particularly plentiful on the banks north of Tautra, where it has been dredged for a very long time and has been used as bait. Of late years it has also been taken to Trondhejm and used as food. In the north of Norway, too, this species is a much prized bait, and S. Schneider says that it is eaten by many better-class families at Tromso. The southern limit on our coast for the occurrence of this species, is the Lyse Fiord, not far from Stavanger (59° 3' N.).

Mytilus edulis, Lin.

On our northern coasts, this species is as a rule so small that it is not of much use as bait.

Modiola modiolus, Lin.

At the present time, this is our most important bait-mussell, it is found in large quantities at some places on our northern coasts. It is used as bait on the day fishing lines in Lofoten. The greatest part of the shell-bait which is used in Lofoten is, however, taken from the fiords in the neighbourhood of Bergen and Stavanger. This mussell attains to a considerable size in the western fiords. A specimen from Lonevag (ostero) was, for instance, 17.5 cm. long and 9.5 cm. wide. The shells held about 1/2 liter.

I have measured unusually large specimens from the Sogne Fiord, from 17 to 18.4 cm. In the Oster Fiord, where shells to the value of several thousand kroner have been dredged, I took 100 from a heap at Raknes. The most usual measurement of the shells which were sorted out here to be used as articles of commerce, was 10—15 cm. In the arctic district of our country, M. modiolus does not attain the size of those in the western fiords.

A specimen from Vardo was, however, found to be 11.2 cm. long and 5.3 cm. wide.

It is quite usual to find the tubes of Penetoria trigonella and various forms of Bryozoa and Hydroids on the shells. On one single occasion, I saw in an aquarium Cana paganae crush these shells to eat them.

In the aquariums of the Bergen Biological Station, we have had M. modiolus for many years, and their mortality has been low. Spawning in these aquariums has been observed on 25th August, 1899.

1901 and 1902. From what I have been told by those engaged in dredging shells, I conclude that spawning also takes place in the months of March and April. Spawning time may therefore be supposed to be from March to August. The spawning process itself was seen quite plainly on 24 June 1901. Both eggs and sperm emerged through the anal siphon. The eggs were ejected in the form of narrow, short ribbons which, for the most part, broken up in the water and immediately sank to the bottom. A single female shell expelled so many that a large reddish-yellow mass was formed. Some of the eggs were whirled about in the water and were greedily devoured by shrimps and barnacles; some settled down in empty mussel shells and in the openings of the bumps of *Pomatoceros triqueter*, which covered the living and dead specimens of *M. modiolus*. On closer investigation, it was found that only a small number were fecundated. This was especially so with regard to the reddish-yellow mass above mentioned, these eggs soon began to decompose.

I also succeeded in seeing fecundated eggs at several stages of development. The eggs, which were 0.078–0.09 mm. in diameter, had no special colour. Division was, as in other mussels, complete and unequal. There is reason to suppose that fecundation took place outside the female's body.

While spawning was on, the eggs and the sperm are pressed out through the genital openings, one on either side, then the sperm passes through the innermost branchial passage, close up to the hindermost constrictor and finally enters the cloacal room to be expelled thence into the water through the anal siphon. The reason for the eggs assuming the form of narrow, short ribbons is probably that the genital opening is a column and not a pore. The eggs rushed quite quickly out of the anal siphon, and it is most probable that fecundation did not take place until they were protruded here.

On 2 July 1901, spawning of specimens which had been in the aquarium about a year, was observed. Sperm was so plentiful as to give the tank the appearance of being filled with milk and water. There was at the same time a strong stream of water flowing into the tank and this caused the eggs, for the most part, to whirl about in the water. But as soon as the stream of inflowing water was turned off, the eggs sank to the bottom. The process of division took place rapidly. Already in the evening of the same day (2 July) the eggs were divided into a large number of small balls, and the next morning at 9 o'clock (3 July) they had become larvae, which were wheeling around by the help of cilia and describing tiny circles. They had formed themselves into irregular small lumps, which moved about at the bottom, their movements being quite regular. Three days later (5 July) the specimens were seen to have larval shells and velum. These shells were 0.1 mm. long, their ventral side being curved and the dorsal forming a straight line. The velum could be drawn entirely inside the shells. At this stage, the young *Melidae* possess a considerable power of motion, for they swim quickly about by means of their velum. Instead of being confined to a rotatory motion with very little change of centre, they now moved more in a straight line. When they were six days old, the specimens at the velum stage were seen to have acquired circle-shaped shells, the straight edge which represented the dorsal side having become more curved. The length of the shells was 0.156 mm., width 0.130 mm. The development of these particular specimens was not followed further, but, from analogy with other mussels, we know that the next important stage is the disappearance or alterations of the velum, while the foot now performs the motion, until the little animal finally attaches itself to some object or other. To catch these animals, a shell dredge of a special construction is used, and also a „stikkert“, which is a kind of pincher with three or four claws.

Sometimes too they are taken by divers. They are taken out of their shells after being brought to land. In addition to the shells, the bundles of byssus and the gills are also removed. The remainder is salted in kegs containing 28 liters. If the shells are large, about 400 are enough to fill a keg, but as a rule from 700—800 are necessary. The price is about 9 kroner (10—12) per. keg at first hand, and as the expense of catching them is very slight, mussel fishing may be very profitable.

I have referred somewhat at length to *Mollus modiolus*, as this particular mussel plays an important part as bait in the cod fisheries at Lofoten.

_Cypria islandica_, LIN.

This animal is used as bait in ordinary fishing, but sometimes too in fishing ocean cod.

As for instance in 1896, about the middle of March, at Ballstad fishing station, where it was asserted that there were good results when using this bait.

Besides _Cypria*, which was dredged somewhere in Næstromen, _Arcicola marina* was also used, which was found near the Ballstad station.

_Zerpluma crispata_, LIN.

This peculiar mussel was noticed by me in 1899, alive, in the sand on the beach at the farm Sund, in Gildeskaal; several specimens were dug out and used as bait.

_Ommatostrephes tubarum*, RAF.

„Sprit“ and „akker“ are common names in the north of Norway for this Cephalopod species, which, in the autumn come in to the coast in large quantities and thence into the fiords, where they are taken in thousands to be used as bait during the cod fishing in Lofoten. In the Kvar Fiord in the north of Hinno a considerable catch of cuttle-fish has of late years been made. In many instances, a single family has made an income of kr. 600—800 in the course of a few weeks.

_Pandalus borealis*, KROIVER.

During the investigations in the Skjerstad Fiord in April 1900, several specimens of this species were met with, and in 1903, Nils Hjølme, who was my assistant at the earlier date, made some trials catches with a shrimp trawl, and he succeeded in taking from 10—30 liters each time. So it was that this proved that *P. borealis* occurs in large quantities in this fiord.

This species is now sent to Bergen and Kristiania to be used as food in no small quantities, but in the north of Norway it is more difficult to sell them, so that there is not much prospect of making much profit on them.

Henriksen, has, nevertheless, suggested that a trial should be made in salt them, prepared as bait, for the fisheries in the north. His suggestion might, at any rate, be found useful for such times as there is a scanty supply of other bait.

H. Kler at Tromsø in 1903 made investigations with respect to the occurrence of *P. borealis* in the Bals Fiord, the Tromsø-sund, the Kvalsund and the Kal Fiord.
In the inner part of the Bals Fiord, he fished, on an average, 3 liters pr. hour with a little shrimp trawl, but at the other places mentioned, *P. borealis* only occurred singly. The author mentioned is not sure that it would pay to carry on this kind of fishing, even in the Bals Fiord, under present conditions. The day will, however, doubtless come when it will be found profitable to do so, also in the northern districts where this species is found.

**Casser pegurus, LIN.**

The species is of no importance in the economy of the northern districts, as it occurs very sparsely. Concerning its distribution, it should be noticed that M. Saks mentions having found it at Lofoten. Stærke Schneider has informed me that it does not go so far north as Tromsø. Schneider has also told me that the common crab, *Carcinus maenas*, has its northern limit at Dyrøy and the outer coast of Senjøen. For the present, Lofoten ought, therefore, to be considered to be the northern limit for *C. pegurus*.

**Homarrus grammurus, LIN.**

M. Saks says (f. c. p. 124) that lobster is only rarely found in Lofoten and the Foden Fiord (1871, N.). Later on, it was proved that lobster is found in the Tys Fiord. In 1896 „Nordlands fiskeriforening“, on the suggestion of inspector Dals, decided to use a sum of money on trial fishery. About one hundred lobsters, large and of a good flavour, were caught, but no actual lobster fishery has resulted from this trial. It would indeed be quite unique, if an animal should be found in such large quantities near the boundary limits for its distribution as to make it possible to carry on a profitable catch.

It is, of course, a necessary condition that, to be of any economical importance, a marine animal must occur in comparatively large numbers within a limited area. *Boreocamia amblyon*, for instance, would not doubt be excellent bait, but as it does not occur so close together as *Peten islandicus* or *Cyprina islandica* it is of little practical importance.

A form, which has recently been taken into use, is *Nyctiphanes armigera*, M. Saks. At one place in the Trondjiem Fiord near Verdalsonen a large number of this Schizopod is washed ashore, and in recent years they have been salted and used, with excellent results, as bait for haddock (*Gobius niger*). On our northern coasts, *Boreocamia amblyon* occurs in large numbers, and it is probable that also this form, as well as *Nyctiphanes*, may be used as bait for haddock.

### b. The „Skrei“ Fishery in Lofoten.

The Lofoten fishery is very old. In the latter half of the 9th century Tordal Kveldegson lived at Sandnes in Alstena, and it is said of him, in Egil's historical tales, that he had sent men out fishing „skrei“ at Vaageg (Lofoten) and some were also gone to fish herrings. In the same tale too, it is related that Tordal sent his trustworthy man Tordal gjallande to England with a vessel laden with dried „skrei“, salmon, etc. And wheat, honey, wine and clothes made up the return cargo from England. There are many historical references, in the following centuries, to the fisheries in Lofoten, but I will only here refer to some of them.

The tackle used in the old times took the form of hand-lines, about A. D. 1800 long lines came into use, and about the year 1700 nets appeared upon the scene. At the present day all three are used.

For several centuries the „skrei“ was exclusively prepared as „dried fish“, the head was cut off and entrails taken out and then the fish was hung up to dry. Towards the end of the 17th century some trials were made to prepare „klip“ fish (tor-disk = dried fish = stockfish [commercial], klipisk = salted, dried cod). In a description of Lofoten in 1591, we read that the fish was first salted and then dried on the rocks so that it became „as hard as a piece of wood“. In the same account, it is also mentioned that in the summer when the fish were dried and the oil was squeezed out of their livers, traders came to Lofoten to barter barley, rye, salt, iron, clothes, linen etc. in exchange for the fish and cod liver oil. The primitive preparation of the latter consisted in the collecting of the liver in large cisterns, which were exposed to the direct heat of the sun, the oil was thus melted out and drawn off little by little. About the middle of the 17th century, cod-roe began to be considered as an article of commerce.

Peder von Ahmen, the last of the feudal lords of Nordland, made strenuous efforts to effect the sale of cod-roe, and in 1585 he obtained a license from Frederick III to trade in this article.

About the year 1600, Peder Claussen Fars relates that it was forbidden, under severe penalty, to throw single cod heads into the sea, for fear that fish should eat them to their harm. If one, at that time, wished to be quit the heads of one cod had to string them together and sink them. However, the same writer mentions, some heads were dried to be used as fodder. Now-a-days, the heads and back bones, which are removed when cod is prepared as „klip“fish, are made into guano in factories erected for the purpose. So that not only the flesh of the cod, but also its head, backbone, liver and roe are now made use of. The sperm bags are also sometimes used as fodder, but the rest of the entrails are still thrown into the sea.

The honour of founding the present cod-liver oil industry belongs to a Norwegian pharmaceutical chemist, Peter Moller, he having started the first factory for the preparation of medicinal cod liver oil in 1853.

His son, Dr. F. P. Moller studied the subject also, and he has, in a comprehensive work, explained the scientific basis of the method adopted by his father.

3. Cf. Egil's saga Skillingebrønnen, Reikjavg, 1882, p. 39. „Han havde jo meir i skreydfliski / VIgrein, om annen i skreydfiski.“
From 1859, there are statistical reports of the Lofot fisheries, including remarks on the course of the fishery etc. There is probably no instance of a completely unsuccessful fishing season, it has, however, happened that only very little has been caught and the quality has not always been equally good. The exact statistics show that the variations in quantity have been very considerable. As the prosperity of thousands depends upon the fishing, the inhabitants have tried, in the course of the centuries, to discover different signs upon which to build prognostications, and resource was even had to divination. For instance, Axel Hagemann relates that the fishermen, in Saltbælen, made use of the following device, to be able to foretell the prospects for the Lofot fishing season. On Christmas Eve an outline of the Lofot islands was made on a deep dish, which was then filled with water and put aside to freeze during the night. If there were, the next morning, found to be a good number of air-bubbles formed in the dish, it was said that the coming fishing-season would be a good one. And according to the position of the bubbles, one tried to decide at which places there would be most fish. According to Prof. H. Strom, the fisherfolk in Sondmør adopted a similar method to discover what the cod-fishery, which began directly after Christmas, would be like.

As time went on, scientists began to concern themselves with problems connected with the fisheries. The wonderful progress made in natural history, which is due to Carl Linne, was also seen in an increased interest in the study of the natural causes which are the necessary conditions for the carrying on of various industries. Martin Vahl was a Norwegian who had studied under Linne's guidance, and he in his turn had a pupil, Jens Rathke, who was sent, in 1861, to Northern Norway on account of the fishing which was being carried on there. Rathke's report of this journey has not been printed, as far as I know, but various extracts from it may be found in a topographical-statistical work by A. Helland on the county (am) of Tromsø. It is G. O. Sars who, in our country, actually laid the foundation for fishery investigations, in the years 1861–70, when he made his well-known investigations in Lofoten. In 1874, he also visited Finnmark to examine into certain questions concerning cod fisheries. The Norwegian North Atlantic Expedition 1876–78, also had matters of a practical scientific nature with regard to the fisheries on its programme. From this period, there are a series of valuable "reports" written by Sars, in which a great many fishery phenomena are discussed.

I have previously given an account of the hydrographical investigations which have been made in the Lofot fishery district. In the years 1900–01, Dr. Haart, on S, N, Michael Sars made extensive investigations along the northern coast of Norway. In his preliminary account, Dr. Haart gives many important results, among which may be mentioned the exceedingly interesting fact that the young of the cod is found far out in the Norwegian Sea in the summer, while spawning chiefly takes place on the coast banks, and in a lesser degree in the firths. Haart has given a very instructive chart (l. e. p. 13) showing the distribution of the eggs and young of the "skrei" in the summer of 1900 and 1901. From this it would appear that the movement from land is not the same every year.

During the last twenty years, when the Lofot-fishery season has not been a good one, the usual explanation for this fact has been offered in the circumstance that the temperature of the water has been too low. In the course of time, however, so many measurements of temperature have been made that it must be possible to form a decided opinion on the actual relation between the quantity of fish and the temperature of the water. I have previously dealt with this subject, and will now repeat that at the depths where fish is generally found the temperature is approximately the same year after year; consequently the thermocimeter cannot, as a rule, be taken as a guide. Capt. Gate, too, arrived at a similar conclusion, as a result of measurements of temperature made in the Lofoten fishing waters in the years 1891–92. On a former occasion, I mentioned, among other things, that the fluctuations in the quantity of fish might possibly be accounted for by the variations in the number of sexually fully developed "skrei". I must, however, confess that a more careful consideration of the question makes this supposition much less likely. The investigations made by Haart and Dahl in recent years have made it clear that quantities of cod are found in the summer on the Finnmark banks and in the sea between Norway and Spitzbergen. Of these, the sexually fully-developed individuals in the winter go westwards and southwards to spawn, while the younger ones (holddorsken) stay near the coast of Finnmark. As there is every reason to suppose that, even in the most successful seasons, only a small fraction of the whole number of spawning cod is caught up, it must be concluded that quite extraordinary variations in their number would have to occur if there were to be any noticeable effect on the catch. The natural instinct, whether it be intense or slight in degree, which impels to a change of environment, must be taken to be the same year after year for the same species, and finally, the conclusion is reached that the fluctuations in the quantity of fish must depend upon certain conditions in the medium in which they move. The investigations made up to the present appear entirely to confirm the opinion that it is not the differences in temperature and salinity which determine the yield of fish. The properties of Gadus callarias, which determine this in Lofoten, must certainly be taken to be the same, year in and year out; on the other hand, such things as the number of fishermen, of days when it is possible to put out to sea etc., are subject to variation. But I am convinced that such variations alone are not a sufficient explanation of the fluctuations in the yield of fish. With respect to the number of fishermen, this decreases on account of the fall in the yield, while a prospect of better yield increases the number of fishermen. There must, therefore, be conditions in the sea itself, which contribute in various degrees to increase, or diminish, the effect of the positively active factors, which, in spite of everything, have exerted so much influence as to prevent the Lofot fishery from having at any time been altogether a failure. By the yield of the Lofot fishery is meant, in the Norwegian fishery statistics, the "skrei" (ocean cod) which is caught from the middle of January to the end of April, during which period an official control is exercised, in the district from Gobkilen to Lofotbåden. During the deccennium 1886–95, the average yield was 29,536 millions. The minimum was reached in 1895 with 38,6 millions. For the years 1896–1902, the average yield was 16 millions, the greatest catch was in 1897 (29,8 millions) and the least in 1900 (8,1 millions). The year 1895 forms the turning point, and it is tolerably natural to set the limit here. If
In this clearly defined state of things, there lies an increased possibility of getting at the causes thereof, and I have tried, in various ways, to connect facts, but it was a long time before I succeeded in finding anything which seemed to point to a law. During my work, however, the opinion has gained upon me that the movements in the sea itself have a great effect upon the direction taken by the fish. A. Borek, to whom much is due for his study of the spring-herring fishery, was of the opinion that the herrings went against the stream, but later observers do not agree with him in this matter, and I believe that both herrings and cod must probably, as a general rule, move with the stream. So that a very careful study of the currents in the sea is of great practical import. In recent years, V. Bjørknes, Sandstrøm and Helland-Hansen have developed the analytic apparatus to be used in calculating the movements of the sea, but it would seem that these scientists have taken no account of the wind. In his well known work on the Norwegian Sea, Mohn has, on the contrary, very strongly emphasized the importance of the wind as a cause of currents, and this opinion is shared by many foreign hydrographers. With regard to the mutual dependence of winds and currents upon each other, it may, generally speaking, be said that a constant off-shore wind causes a corresponding current from land, while during a constant sea-wind, the water is forced in towards the coasts. In the spring (March and April) the water on the west coast of Norway is particularly low, the supply of fresh water being slight, but more especially does the continental land-wind blow a quantity of water away from the coasts. At the end of March this year (1904), there was in Bergen continually easterly winds, which were so strong that they kept the tide waves so much at bay as to make the difference between ebb and flow very slight indeed. Similarly, a strong sea-wind in the late autumn is able to keep the water for days at an unusually high level. It is, however, clear, that, during the movements to or from the coast of the surface water, a compensating current must be set in motion in the deep water; it has long been a recognized phenomenon in the fiords, that the surface and under-currents go in contrary directions. If we now take it for granted that both herrings and cod are to a certain extent drawn along by the currents, it naturally follows that one must try to find out whether it be the motions in the surface-layers or the deeper situated compensation-currents which exert a special influence on the direction taken by the fish. Keeping this question to the fore, I have gone through a large number of fishery reports, and it seems from these to be fairly certain that the herrings move coastwards especially in the surface layers, while the "skrei" travels along in the deeper layers. This would imply that herrings are most influenced by the surface-currents, cod by the compensation-currents. In reports on spring-herring fishery, it is, for instance, mentioned that small lots of herring (the so-called "Aater") are often seen drifting along with the stream, and there are many remarks made by skippers about the sea being of a peculiar colour just beyond the spring fishery district, and that this is caused by the large number of herrings which are there present, and this fact denotes that the fish cannot be at any great depth. There is, however, no reason why the herrings should not lower themselves deeper in the water, but as a general rule, I think one may conclude that they move principally in the upper layers. On the other hand, no one has observed schools of "skrei" off the coast, and the first "skrei" of the year is, in fact, usually taken from a depth of 100—150 meters. It must, therefore, be supposed that as cod and herrings, to a certain extent, depend upon contrary current phases, a particularly good spring-herring fishery would prevent a correspondingly good cod fishery in the same district, for a strong tendency of the upper layers towards the coast certainly takes herrings along in the current, but this at the same time causes a compensation current in the deep water, and this current hinders the cod in its passage to the spawning places. It is indeed specially mentioned in reports on spring-herring fishery, that, in really good herring years, cod does not, as a rule, occur in any quantity.

The "skrei" fishery takes place in Lofoten in the months January—April.

Let us have a look at Mohn's Climate tables (Vol. IV), so as to get an idea of the winds prevalent at this time of year. We find that at Skjomvær, from October—April, the prevailing wind is from S. At Andenes station, there is prevalent southerly wind from September—April, and at Frulholmen station from SE in the months of October—March. From this, it would follow that, as a rule, the wind and the surface current go in a contrary direction to that taken by the cod from the northern banks, while the under-currents probably go in the same course as that which the cod has to follow. On looking through the remarks on the weather which are found in the annual reports of the Lofot fishery, I have got the impression that the cold-bringing easterly winds by no means retard the fishing, as has been stated, but that they, on the contrary, assist it. For instance, the following paragraph is found in the chief controller's report on the excellent season 1895—

"Easterly and north-easterly winds were prevalent, with clear skies and frost, north-westerly and westerly winds and snow were not unusual either, but southerly winds and rain were rare." When easterly winds prevail, it is found that the surface temperature on the Lofoten banks falls considerably, and the principal reason for this fact is that the wind sweeps along the cold surface water from the fiords, while the under-currents undoubtedly go in a contrary direction and carry along the cod.

As a result of the foregoing, it is quite natural to conclude that the fluctuations in the Lofot fishery really are due to the distribution of atmospheric pressure, or, in other words, the direction and strength of the winds. As, however, there are many difficulties to be surmounted in studying the changes in the influence of winds, I have chosen another thing, which is greatly affected by them, namely downpour. I take it for granted that the annual downpour must, taken generally, give a measure of the influence of the winds. By noting the changes in downpour from year to year, one must be able to form an opinion of the relation of the sea and land winds to each other; for upon this, according to the theory stated above, depends the success of the fisheries. In the "Observations of the Downpour in Norway" published by the Norwegian meteorological institute, we have an excellent aid in studying the fluctuations in downpour. From this work, I have taken the necessary data to enable me to give the following table, which shows the annual average height of downpour in millimeters, at a series of coast stations, during the years 1896—95 and 1896—1902, as well as the calculated normal height.
the surplus above the normal in 1896—1902 is exceedingly small, in comparison to the difference between the average height of downpour in the series of years mentioned.

If we next investigate the results of the herring fishery in the Skagerak, we find that the Swedish Bohus fishery shows considerable increase in the years 1886—95, with a succeeding decrease up to the present time. In 1886—95 the catch of fish in Eastern Norway was, as a rule, good, and at times very plentiful. In 1893, the culminating point was reached with a catch of 337,000 Hl. But from 1896—1902 the herring fishery in the same district was poor.

It will be found that the winter herring fishery, both in the North Sea and Norwegian Sea off the coast of Norway, had a different result. As will be seen, on reference to the tables, there was a surplus downpour both in 1886—95 and 1896—1902 from Skudeneshavn to Kristiansund and Trondheim, but it was very slight at the two last mentioned places, so that no decided effect can be expected there. On the other hand, on the coast southwards from Aalesund, a considerable surplus during both periods, greatest during the years 1896—1902, will be noticed. These facts harmonize well with the particularly successful spring-herring fisheries from 1896 onwards, the catches in the previous period, 1886—95, being unimportant in comparison. And, as is well known, it is also from 1895 onwards that there has been herring fishery in the Romsdal district.

During the years 1896—1902 then, the downpour on the Skagerak coast was on an average below the normal, and in the spring-herring district considerably above the usual average; at the same time, the spring-herring fishery flourished, and that in the Bohus and East Norwegian districts decreased.

It has long been affirmed that there is an alternation between the winter-herring fishery in the Skagerak and the Norwegian spring-herring fishery, so that when the curve for the latter reaches its maximum, the other is at a minimum, the highest point for the one corresponding to the lowest for the other. As far as can be seen from the historical notices of the fisheries, this interchange would appear to be almost an unbroken rule, which does not, however, prevent the possibility of there being some catch of fish at one and the same time both on the Bohus and the West Norwegian coasts. In the light of my hypothesis, of the definite influence of the pressure of the atmosphere on the fisheries, an explanation may be sought in the fact that the barometric minimum which compels winds and currents to send the herrings into the west coast of Norway, cannot at the same time act similarly on the south Norwegian and Bohus coasts.

From what has now been advanced, it follows that the influences which are favourable to an inflow of herrings along a given stretch of coast will obstruct the passage of the cod landwards.

Let us, therefore, have a look at the results of the cod fishery. That which is carried on in the springherring district (Stavanger and the Bergenhus counties) yielded, during the years 1886—95, about 3 million fish, calculated from the official statistics; for the years 1896—1902, the average was about 1 million.

In the Romsdal district, where big herring fishery has been flourishing since 1895, I have calculated the average yield of cod to be 7.5 millions during the years 1886—95, and about 6.5 millions for the years 1896—1902. Thus, in both these districts, an increase in herrings and a decrease in cod have gone together. On reference to the tables, it will be seen that the stations at Kristi—

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<th>Station</th>
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For the sake of clearness, I have, in the following table only put a + to represent those average values which are greater than the normal ones, and a — for those below the normal ones.
ansund and Trondhjem show, for the years 1896—1902, as com-
pared with 1886—95, an average downpour which is not very
unlike or much above the normal height. During the years
1896—1902 the downpour was below the average at Nordoeine,
Bromno and Sandnesfjorden. So that we should expect to find an
improvement in the cod fishery in the Trondhjem district and on
the coast of Nordland south of the Vest Fjord, and statistics prove
that this was actually the case; for I have calculated, from the
official statistics, that the average yield in 1886—95 was about 2
millions, from 1896—1902 about 3. In the district where the lar-
gest cod fishery is carried on, it is interesting to notice that there
was an unusually high average downpour in the "bad" years 1886—
1902, while the "good" fishing seasons are characterized by very
little downpour. And, as already mentioned, the average yield of
the Lofot fishery in the years 1886—95 was 26.5 millions, but from
1896—1902 only about 16 millions. Thus, there does appear to
be a connection between the downpour, on the one hand, and the
cod and herring fisheries, on the other.

In judging the various fisheries, a much too important part
has hitherto been given to the natural animal instinct, while, on
the other hand, it would be incorrect to attribute all the chief
phenomena connected with the fisheries to purely hydrodynamic
conditions. Especially with regard to the cod, it should be men-
tioned that if everything depended upon the mechanics of the water
layers, one would also expect to find younger individuals than fully
sexually developed ones at the spawning places. Dr. Hoerr has
shown that spawning principally takes place on the banks, less in
the clay channels, so that Gobio elongatus must, undoubtedly, pos-
sess some degree of initiative. But it can hardly be denied that the
currents in the sea exert a very modifying influence on the
movements of the fish. From this point of view, it becomes of
considerable interest to have a clear knowledge of the causes of
these currents. But on this matter, there is no little disagreement.
Some scientists assert that the rotary motion of the earth is
alone necessary to cause the system of currents taken as a whole,
but even if this be so, it can be said that the influence of the
rotary motion of the earth, whether it be great or small, must
at any rate, be constant, and when one is trying to discover the
causes of fluctuations in the fishery-yield, one must especially exa-
nine the variable factors which may be supposed to exert some in-
fluence. And then, I think, the winds must first of all be con-
sidered. As variations in atmospheric pressure cause winds, winds
cause currents and currents, with great probability, exert an
influence on the course of herring and cod, it must certainly be
practical to turn one's attention to the barometrical minima. In the
 foregoing pages, I have considered that the downpour will gener-
ally be influenced both by the situation and the degree of promi-
nence by which they are characterized. In the meantime, it is
interesting to consider these minima direct.

It may now be taken for granted that the great atmospheric
depression, which is called the winter minimum, in the Norwegian Sea
is subject to considerable variations, both with respect to place and
degree. In "The Book on Norway", Einar Haffner describes the
variations in atmospheric pressure in the years 1884 and 1890.
Haffner also gives charts showing the distribution of atmospheric
pressure, respectively in January 1884 and December 1890. The
former shows a low pressure north of Norway, and the result was
that January 1884 was unusually mild. In the chart for December
1890, this northern minimum has disappeared, the lowpressure centre
near Iceland determined the direction of the winds, and in the month
in question the temperature was very low over the whole of the
Scandinavian peninsula. In "Ymer" for 1898 (Nr. 2), Otto
Pettersson has described how the great development of the Gulf
Stream, in the northern part of the Norwegian Sea in the summer of
1907, caused a winter minimum to the N.W. or N. of Norway.
In consequence of this, there was a higher average temperature in
Sweden in January and February 1898, on account of the prevailing
westerly winds. As a whole, several winters from 1896 onwards
have been unusually mild, while the summers have, to some extent,
been cold, at any rate, in the north. There have also been "green"
years in the same period. Another peculiar feature in connec-
tion with these years, is that some arctic mammals have come far
south during the spring and summer (Phoca groenlandica and
Delphinapterus leucas). But of greatest interest is the fact that
there was a much smaller yield of cod than usual, in these years.
If the theory, advanced in the foregoing, is adhered to, with respect
to the dependence of this fishery upon winds and currents, a natu-
ral explanation of the decrease in the Lofot yield will be found in
the fact of the atmospheric winter depression in the Norwegian Sea
having been so marked and so situated as to make the system of
currents, set in motion by the wind, act as an obstacle to the pro-
gress of the fish.

It is possible, too, that this way of looking at things, may
throw new light upon the subject of the changes in the height of
our coast water.

According to Dr. Andresen Hansen, the variations in the height
of coast water have been above and below a settled medium, and
the result, in historical times, has been that the relation between
land and sea on the coasts of the North Sea and the Norwegian
Sea has remained unaltered. It might perhaps be practical to in-
troduce the idea of a medium normal height of water, which would
correspond to the normal height of downpour for a given stretch of
cost. The medium annual height of water, according to And-
resen Hansen falls into groups of years in which it is above, and
years in which it is below the normal height. In 1891—94 he
mentioned a lesser height than usual, but in 1890 at Skagerack a
greater. This answers particularly well to the circumstance that
on the Skagerack coast in the period 1886—95 there was a
surplus downpour, while on the northern coasts the average was
not attained. For, as both downpour and water-level depend upon
the direction and force of winds, they must have a corresponding
course, and the measure of the one may, therefore, serve to judge
of the other. It is also probable that just as the water on the
Skagerack coast and the west coast of Norway may be in different
phases, as proved by Hansen, so may there also be places, on the
long stretch of coast from Skudeneshavn to Varo, where the water
is higher than the normal height, while at others, it is lower. There
is reason to suppose that, in the years 1896—1902, the medium
water-level was lower than usual on the coast of Helgoland,
and probably also on the coasts of the Trondhjem district, for the table
shows that the downpour was below average.

If events should prove that my opinion, concerning the in-
fuence of atmospheric pressure upon the yield from the fisheries,

is well founded, it is at the same time settled that an increased interest will be attached to the question of the causes of, and laws governing, atmospheric pressure. But this is an exceedingly difficult problem, for, as an English scientist, F. W. HARMS1, says: — "It seems impossible in these questions to distinguish between cause and effect. Temperature, pressure, winds and ocean currents act and react upon each other as links in an endless chain."

It is evident that, if the connection referred to really does exist, an important advance in weather prognostication will also be of some weight with regard to the prediction of the fisheries. And it would then be a reasonable supposition that an investigation of the distribution and degree of heat of the Gulf Stream in the Norwegian Sea, in December, for instance, would provide material which would make it possible to get an idea of the prospects for the subsequent Lofoten fishery. Similarly, it may be supposed that, if the fluctuations in the fisheries were given a place in the group of phenomena, which vary during the so-called "Bratukner Periods," a helpful plan of the rise and fall which occur in the fisheries might be obtained, by means of the historical-statistical method.

One is tempted to conclude with regard to the Lofoten fisheries that as the years 1856-93 were unusually favourable, it is not likely that the present marked poor yield of cod can last much longer, a change for the better must soon occur. It is, however, a fact that the changes in climate hardly occur with the regularity which the word "period" demands. In the last edition of his Meteorology, Motyv writes (p. 302): — "Beyond the daily and the yearly period in the course of the meteorological elements, we know no other period in the weather changes. One day, the one year, is not like the same day, another year, one month, the one year, is not like the same month another year; there is, indeed, a variation from one year to another in the weather, which seems quite irregular."

But on the other hand, the circumstance that bad years, — as well as good years, — both on land and at sea are inclined to follow each other, would seem to modify the supposition that there is an interchangeableness tightening and slackening in the play of forces. At any rate it will be exceedingly interesting to follow the working out of the problem: — Are there periods of years which are characterized by great downfall, high medium water-level, good winter herring fishery, less good cod fishery, colder summers, with sometimes "green" years for the farmer; and are there periods of years when there is little downfall, low medium water-level, good cod fishery, less good herring fishery, dry and warm summers, with sometimes "dry" years for the farmer?

With regard to the special problem here being dealt with, what has already been said will, I hope, make it clear that there seems to be an agreement between the yield of the cod and herring fisheries and the winds, for whose influence the downfall has been used as a measure. To this method may be objected that the cod and herring fisheries are carried on in certain months, while the calculations of the downfall are made for the whole year. But it should be noticed that these months, in which these fisheries are carried on, are the richest in the year in downfall. Consequently, there will hardly be any real difference in results on account of the method here adopted. It might, however, perhaps be found that the agreement between the winds and the yield would be greater, even in details, if the downfall for the months September—December were taken in conjunction with the downfall in the months of January—April in the succeeding year. Any very detailed agreement must not, however, be expected, as the catch for a single year is only an unreliable measure of the actual quantity of fish present."

The observations of downfall are of comparatively recent date in our country, consequently they can only be used as a measure of the effect of the winds, during recent years. But there are other things which give hints as to the conditions previously. During the last period of years in which there was a surplus downfall, a storm flood occurred in Lofoten and caused much damage. Richard Hansen writes about this, as follows: — "During the week, 19th-26th January (1901) a violent storm of wind from southwest to northeast raged; and on the 22nd, there was such high water that it was unparalleled in the memory of the oldest inhabitants, and much damage was done by this unusually high flood all along the Lofoten district." 2 novembre This kind of damaging flood will probably only occur in years with great downfall and high average water-level, so that the mention of such a flood makes it possible to draw conclusions with regard to the weather and matters connected with it. When, for instance, Absalon Pedersen, in his diary3 mentions that on November 1st 1570 a very great and high flood occurred, whose equal no one in Bergen remembered and which did great damage to flour, malt and fish, one might from this circumstance conclude that herring catch was made during these years. From Christmas 1570 to February 1571 there was according to the same writer, severe frost, and the herring fishery that year was a failure, but the next year (1572) herring were caught in the beginning of February, and in the years preceding 1570 in February herrings were regularly to be had in the Bergen market. From several sources, we find that the years 1749-50 were "bad" ones or "green" years. Professor Hans-Strøm, in his well-known description of Sandmor, mentions that spring-herring fishery was started there about 1740, "that is to say about the same time as the general failure of crops occurred in Norway." And at another place, in the same work, he says that the summer is generally short and warm, but "from 1740 the summer here has generally been cold and damp with thick fogs, which have continually come in from the sea and brought a cold northerly, or westerly, wind in its wake." Here we have a clear combination of bad weather and inflow of spring-herrings, and this is not the only example of its kind. The first "green years" mentioned in our history occurred during the reign of Harald Grav-field (961-970), and were exceedingly bad. Skjørr relates that "the country people were almost entirely without grain and fish." At Helgeland, there was great hunger and want. Øivind Skalde-1


2) Same.


spiller, who lived at Tjotta, wrote about the common minory, and he too was a great sufferer during the bad years. One spring, there was an inflow of herrings to some outlying places, and Orvin- rowed thither to buy some. Smørre further writes that "the first winter (1760—1761) that Haakon Jarl ruled in Norway, herrings came around the whole country." We see, that, at this time too, bad years and inflow of herrings were coincident, and I am, moreover, inclined to conclude that, as there was such hunger and want at Holgeland, the cod fishery had not been successful. Smørre indeed says that there was a want of fish. We know that, about a hundred years previously, the Lofot fishery had been so good that a man at Holgeland had been able to export stock fish to England.

Right back in the olden days, there are sources of information which hint at considerable variations in the yield of the Lofot fishery. And at the present day, we have certain proofs that rather great fluctuations do indeed occur.

To confirm which, I will, finally, give a few features of the history of the Lofot fishery in the 19th century. At the commencement of the century in question, there were many bad years for the farmer, 1812 being one of the worst. From an account written at the time, it will be seen that the Lofot fishery had so fallen off that it was feared that it would altogether fail, and the reason for this was not sought in natural circumstances, but in the increasing use of nets during the fishing season.

About ten years later, there appears to be an improvement in the fishery. The clergyman in Saltalen, S. C. Sommerfeldt writes that, in the year 1823, there was a particularly good Lofot fishing season, and the yield was calculated to be 13,923,000 fish, divided among 2788 boats. For the succeeding years the following figures are given by Jens Krafft for Lofoten and Vesteraalen.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Boats</th>
<th>No. of Fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1825</td>
<td>2580</td>
<td>115,041,804</td>
</tr>
<tr>
<td>1826</td>
<td>2700</td>
<td>128,217,04</td>
</tr>
<tr>
<td>1827</td>
<td>2916</td>
<td>158,962,20</td>
</tr>
</tbody>
</table>

It was interesting to note that during the years 1861—74, there was a big-herring period in Nordland. At the same time, the average water-level is mentioned as being higher than normal, and the yield of cod must be reckoned as not very good. The next period shows an improvement in the yield, and the best seasons are reached in the years 1880—95. This agrees beautifully with a low average water-level in Nordland in the years 1891—94, and a downfall less than usual in the same decade. On the contrary, as already mentioned, the Lofot fishery has of late years not been very good, while there has been a surplus downfall.

c. Some Remarks on the Cod-fishery in Finmark.

The catch of spawning cod (skrei) in Finmark is not very important, at any rate at the present time. Spawning takes place, however, every year and Brevik and Hasvik in Nordland are important stations during the winter-fishery in Finmark. A. F. Bremer mentions that, about 1830, there was a very good catch of "skrei" in the fjords of West Finmark, in particular in the Alten Fiord. But in 1838 a change occurred, and from that year the fishery in the fjords was poor, and the reason Bremer states, was that the considerable inflow of Ommastrephes leucops (akker) and herrings began just that year. Bremer, and others, again mention that from 1830—40 the "loddefisjery" was very poor. It is mentioned as a general rule that the winter cod fishery in Finmark is always better in those years when the "boltefis" (capelan) occurs only in small numbers. The spring cod-fishery, which depends upon the capelans being followed on its spawning travels by young individuals of Gadus callarias, is very much more important than the winter fishery (skrei-fishery), therefore the absence of capelan is a serious matter for the Finmark fishers economically speaking. It would therefore be of great economical importance to get a thorough knowledge of the capelan's life. In one of his latest works, Prof. Collett has collected what is up to the present known about this fish. I beg to refer to this account, from which it will be seen that "during the inflow, the capelan often travels in compact shoals in the surface layers." Sometimes, spawning occurs at a depth of a few meters, but generally deeper down (70—90 m.).

3) Beskrivelse over Kongeriget Norge, 6 Del, p. 373, Kristiania, 1835.
4) En gennem Finmarkens Betydningerne o. s. v. Hammerfest, 1881.
5) By this expression is meant the cod fishery which is carried on at the time when Mallogus callarias, M. m. (bolte) spawns.
6) 1825— 2734 — 139,193,80.
7) 1829 — 3027 — 140,762,90.

These figures, according to J. M. Schwengardt are too low, as the fishers were supposed to have given too low numbers, on account of tithes to be paid. As, however, the yield from Vesteraalen is also included in these figures, the yield for Lofoten alone can hardly be said to be more than 10 millions.

From 1859, there are complete reports of the Lofot yield.

A graphic illustration of the millions caught from 1859—1903 gives a particularly irregular picture, suggesting a panorama of Jotunheim, with a Goldhefner for the maximum year.

It is evident that the catch of a single year may, to some extent, be affected by more or less accidental factors, whose influence must be supposed to be disregarded when an average for a period of years is to be given, e. g. a decennium.

The result would then be: —

1861—75 . . . . 18.4 million fish
1876—86 . . . . 24.5 . . . . .
1886—96 . . . . 26.5 . . . . .
1906—1903 . . . . 15.4 . . . . .

These figures are supposed to be comparable.

It is interesting to note that during the years 1861—74, there was a big-herring period in Nordland. At the same time, the average water-level is mentioned as being higher than normal, and the yield of cod must be reckoned as not very good. The next period shows an improvement in the yield, and the best seasons are reached in the years 1880—95. This agrees beautifully with a low average water-level in Nordland in the years 1891—94, and a downfall less than usual in the same decade. On the contrary, as already mentioned, the Lofot fishery has of late years not been very good, while there has been a surplus downfall.

1) Lofoten alone.
2) Norges Statistik, p. 96, Kristiania, 1810.
3) According to Sommersfeldt (loc. cit.), the yield from Vesteraalen in 1823 was 591,750 fish.
At any rate it would seem to be worth while to pay attention to those mechanical factors which may be supposed to exert an influence on the yield from the fisheries.

It is possible that it will be found that the large catches of herrings on the coast in the months of October—December, and to some extent also January, may be accounted for by the fact that meteorological conditions in these months cause a strong flow of water to the coasts, which is also evident from there being a maximum height of water in the autumn. And with regard to the spawning herring (vaarsild) and the spawning cod (skrei), I think I have found as a result of historical and statistical investigations, that, as a rule, a good herring fishery and a good “skrei”-fishery will not occur on the same stretch of coast, simultaneously. At the period these fisheries are carried on (January—April), there is a sinking tendency in the water towards the spring minimum, and it seems reasonable, that just as the relation between ocean and land winds at this time exerts an influence on the medium water-level, by regulating the currents in the coast water, so will its effect on the currents also, to some extent, further or hinder the inflow of cod and herrings. There can be no doubt that biological and physical factors play an important part in the fisheries. The former may be taken to be constant, while, at any rate, some, of the physical ones are variable.

If one takes it for granted that the ocean-currents have an important influence on the course of the fish towards land, the difficulty meets one that scientists are not agreed as to which of the causes of currents one should give most weight. Can it, however, be proved that there is a connection between the periodical changes in the yield of the fisheries and the fields, one will be compelled to suppose that there is a common cause at the bottom, and we have thus come to the conclusion that this must be the variations in atmospheric pressure. But we get no further, and will hardly be able to do so, until meteorologists have solved the problem of the laws governing the rise and changes in barometrical minima.

As far as practical marine investigations are concerned, the following famous words of Laplace may well be used:—

"Ce que nous savons est peu de chose, ce que nous ignorons est immense."
PLATE I.

Map showing the northern part of Norway. The curves are isohyets and represent downfall in mm. for the year 1899 (blue) and 1900 (green).
Oversigtskart over Det nordlige Norge.
PLATE II.

Fig. 1—12. *Pleuronectes robustus*, Dahl. Skroven (Vestfjord). 0—300 m., 1/2 1899.

1. Anterior antenna, right side, 83/4.
2. First joints of anterior antenna, left side, 83/4.
8. 2. pair of natatory legs, 83/4.
9. 3. pair of natatory legs, 83/4.
12. 5. pair of natatory legs, 83/4.
   Spine of the last segment of cephalothorax, 83/4.
   Spine of the last segment of cephalothorax, 83/4.
1. Flustra carhocea, Ellis & Sol., Mehavn, 1894, 1/4.

2. Flustra secundifera, Pallas, Breisund (Finmarken), 1/4.


5. Flustra barkei, Busk, Arno (West Fiord), 300—400 m., 1/4.


7. Flustra abyssoidea, M. Sars, on a little stone, Balstad, 150 m., 1/4.

8. Bugula muricata, J. J. Sars, the typical form, from the „skjærgaard“ outside Bergen, 1/4.

9. Schizoporella sinuosa, Busk, Svolvær, 50—70 m., aperture of the zooecium, 3/4.

10. Schizoporella sinuosa, Busk, Digenaulen, 100—150 m., operculum, 3/4.


17. Escharopis rosacea, Busk, Moskenströmen, 1/4.


21—24. Collepora nobilis, LORREN.


23. An operculum of a colony from the Jokel Fiord III, 100 m., 3/4.


26—29. Collepora centricora, LORREN.

26. Colony from Breisund (Finmarken), 30—40 m., 1/4.

27. An operculum of the same colony, 3/4.


32. Idmonea atlantica, FORR., Hustadviken, outside Romsdals amt, 1/4.

33. Harnacia rhombica, POSTER, the Porsanger Fiord, 200 m., 1/4.

34. Donaxia stellata, GODF., the Malangen Fiord, 100—200 m., 3/4—7/4.

35. Alexoporella disciformis, SMITT, the Lyngen Fiord III, the border a little ruptured, 3/4—7/4.


PLATE IV.

Fig. 1—2. *Physophora borealis*. M. Sars, Moskenstrommen, 0 m., 1/3 1899.
3—5. *Eschara moskenesis*. n. sp. Moskenstrommen II. 150 m.
11. Oral aperture, the condyles are seen, 3/4.
16. Ooecium with the upper part of the zooecium, 3/4.
23. The under side of the front wall of the zooecium, showing the avicularian chamber (a. c) and the lateral channels (c h), 3/4.
32—35. *Eschara norlandica*. n. sp. The Kvenang Fiord, 90 m.
33. Oral aperture of the zooecium, c. condyles, r. opercular rib, 3/4.
PLATE V.

Fig. 1—2. Schizoporella stormi, n. sp., The North Cape (1894).

1. Zooecia, $^{5/4}_i$. The avicularia are not quite correct, as the mandibles are more pointed than in the figure.

2. Operculum, o. r, opercular rib, $^{3/4}_i$.

3—4. Schizoporella kerinseni, n. sp., Kvaenangen II, 90 m.

3. Zooecia, $^{5/4}_i$.

4. Operculum with the proximal margin of the oral aperture, $^{3/4}_i$.


5. Zooecia, $^{27/4}_i$.

6. Operculum, $^{3/4}_i$.

7. Mandible, $^{206/4}_i$.

8—11. Rhynphostomella scabta, Farr., The Porsanger Fjord, 70 m.

8. Zooecium, $^{52/4}_i$.

9. Ooecium, $^{42/4}_i$.

10. The back side of the zoarium, $^{52/4}_i$.

11. Mandible, $^{43/4}_i$.

12—13. Schizoporella hexagona, n. sp., Kvaenangen II, 90 m.

12. Zooecia, $^{52/4}_i$.

13. Operculum, $^{43/4}_i$.

14—15. Rhynphostomella plicata, Smitt, Nordkyn (1894).

14. Ooecium with the upper part of the zooecium, $^{42/4}_i$. The two small denticles, one on each side of the large one, are not illustrated.

15. Mandible, $^{43/4}_i$.


16. Ooecium and oral aperture, $^{43/4}_i$.

17. Part of the frontal wall of the zooecium, $^{42/4}_i$.

18—20. Rhynphostomella contigua, Smitt. The Ostnes Fjord, 50—70 m.

18. Zooecium, $^{52/4}_i$.

19. Operculum, $^{32/4}_i$.

20. Mandible, $^{25/4}_i$.


21. Ooecium, $^{52/4}_i$.

22. Oral denticle, $^{33/4}_i$.

23—25. Schizoporella unicornis, Johnst., Gla (Rost).

23. Zooecia, $^{52/4}_i$.

24. Operculum, $^{32/4}_i$.

25. Mandible, $^{43/4}_i$.

26. Schizoporella lineata, Hass., Bognastronmen (Bergen), 30—50 m., operculum, $^{42/4}_i$.

27. Schizoporella unicornis, Johnst., The Hjelte Fjord (Bergen), operculum, $^{43/4}_i$.

28—31. Phylochaeta peristomata, n. sp., Jokel Fjord II, 80 m.

28. Zooecium with marginal pores, p. a. c, pores to the avicularian chamber, $^{32/4}_i$.

29. Zooecia, s, shield beneath the oral aperture, $^{42/4}_i$.

30. Mandible, $^{206/4}_i$.

31. Oral denticle, $^{33/4}_i$.


33—34. Schizoporella lineata, Nordg., Nordkyn (1894).

33. Operculum, $^{43/4}_i$.

34. Oral aperture, $^{33/4}_i$.

35. Smittina trispinosa, Johnst., Balstad (Loofoten), operculum, $^{43/4}_i$. 