MEDDELELSER OM GRØNLAND
UDGIVNE AF
KOMMISSIONEN FOR VIDENSKABELIGE UNDERSØGELSER I GRØNLAND
Bd. 104 · Nr. 13

THE SCORESBY SOUND COMMITTEE'S 2ND EAST GREENLAND EXPEDITION IN 1932 TO KING CHRISTIAN IX's LAND
Leader: Ejnar Mikkelsen

ECHINODERMS

BY

S. G. HEDING

WITH 28 FIGURES AND 3 MAPS IN THE TEXT
AND 2 PLATES

KØBENHAVN
C. A. REITZELS FORLAG
BIANCO LUNOS BOGTRYKKERI A/S
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During the summer of 1932, the Scoresby Sound Committee's 2nd East Greenland Expedition made a number of dredgings at Kangerdlugsuak and the Mikis Fjord at 68° N and 31° to 32° W. In spite of the rather few hauls the results were very valuable. Not only was the locality hitherto unexplored, but being situated in an area, where pronounced cold-water forms and warm-water forms was to be supposed to meet, the marine examinations of the Expedition was supposed to be of great value from a zoogeographical point of view. Also from a systematic point of view the collection turned out to be very valuable, as several new or little known species were contained in the collections braught home. Unfortunately, the very interesting locality Mikis Fjord was only examined by few hauls, for as is seen from the specimens caught there, Mikis Fjord differs rather much from the localities at Kangerdlugsuak, in being more pronouncedly arctic. As a matter of fact the marine results of the Scoresby Sound Expedition are, in any case as regards the *Echinodermata* a very interesting and valuable contribution to our knowledge of the East Greenland Fauna. I am highly indepted to Dr. DEGERBÖL, the Zoologist of the Expedition, for having placed this rich material of Echinoderms at my disposal, for examation and discription.

As MORTENSEN in 1932 summed up our knowledge of Greenland Echinoderms he recorded 44 species from East Greenland:

Crinoidea.
Heliometra glacialis (Leach).
Poliometra prolixa (Sladen).

Asteroidea.
Ctenodiscus crispatus (Retzius).
Bathybiaster vexillifer W. TH.
Pontaster tenuispinus (Düb. & Kor.).
Ceramaster granularis (O. Fr. Müll.)

Poraniomorpha tumida (Stuxb.).
— *bidens* (Mrtsn).
Pteraster militaris (O. Fr. Müller).
— *pulvillus* M. Sars.
— *obscurus* (Perrier).
Hymenaster pellucidus W. Th.
Korethraster hispidus W. Th.
Henricia sanguinolenta (O. Fr. Müller).
Odinia semicoronata Perrier.
Lophaster furcifer (Düb. & Kor.).
Solaster papposus (L.).
— *glacialis* Dan & Kor.
— *squamatus* Døderlein.
Pedicellaster typicus M. Sars.
Stephanasterias albula (Stimps).
Urasterias Lincki (M. & Tr.).
Icasterias panopla (Stuxb.)
Leptasterias groenlandica (Steenstrup).
— *mülleri* (M. Sars).

Ophiuroidea.

Gorgonocephalus arcticus Leach
— *eucnemis* (M. & Tr.)
Ophiomyxa serpentaria Lym.
Ophioscolex glacialis M. & Tr.
Ophiacantha anomala G. O. Sars.
— *bidentata* (Retz.).
Amphiura Sundevalli (M. & Tr.).
Ophiopus arcticus Ljungm.
Ophiactis abyssicola (M. Sars).
Ophiura Sarsi Lütken.
— *robusta* Ayres.
Ophiocten sericeum (Forbes).
Ophiopleura borealis Dan & Kor.

Echinoidea.

Strongylocentrotus droebachiensis (O. Fr. Müller).

Holothurioidea.

Myriotrochus Rinkii Steenstrup.
Eupyrgus scaber Lütken.
Trochostoma thomsonii Dan & Kor.
Cucumaria frondosa v. japonica Semper.
Thyonidium pellucidum (Flem.).

Apparently, *Pteraster militaris* and *Pt. pulvillus* are lacking in MORTENSEN's list, but as MORTENSEN himself has previously described these two species from East Greenland, the omission in the list must be due to a misprint. The collections of the MIKKELSEN-Expedition comprised 19 different species of Echinoderms, which is nearly half of all the species known from East-Greenland, and leaving the pronounced deepsea species, included in MORTENSEN's list, out of consideration, the collection at hand include more than half of them. The species collected by the Expedition are as follows:

Crinoidea.

Heliometra glacialis (Leach).
Poliometra prolixa (Sladen).

Asteroidea.

Ctenodiscus crispatus (Retzius).
Pteraster militaris (O. Fr. Müller).
— *pulvillus* M. Sars.
Henricia eschrichtii var. *laevior* Michailovskij.
Lophaster furcifer (Düben & Koren).
Crossaster papposus (L).
Solaster syrtensis Verrill.
Stephanasterias albula (Stimps.).
Leptasterias floccosa var. ***crassa*** var. nov.
— ***degerbölli*** n. sp.

Ophiuroidea.

Ophioscolex glacialis Müller & Troschel.
Ophiacantha bidentata (Retzius).
Ophiura robusta Ayres.
Ophiocten sericeum (Forbes).

Echinoidea.

Strongylocentrotus droebachiensis (O. Fr. Müller).

Holothurioidea.

Myriotrochus Rinkii Steenstrup.
Trochostoma arctica v. Marenzeller.

The examination of this material showed not only the interesting new species *Leptasterias degerbölli*, but also that some of the species hitherto recorded from East-Greenland does not occur there, and are in part replaced by other forms. *Henricia sanguinolenta* which is often

recorded from Arctic Waters turned out to be not *sanguinolenta*, but a variety of *Henricia eschrichtii* (Müller & Troschel) described as forma *laevior* by MICHAILOVSKIJ, who regarded it as a variety of *sanguinolenta*. Further, neither *Leptasterias mülleri* (M. SARS) nor *Leptasterias groenlandica* STEENSTRUP can be regarded as East Greenland species. The specimens previously referred to these two species are *Leptasterias floccosa* (Levinsen) or the new variety v. *crassa*. Also the records of *Solaster glacialis* DAN. & KOR. from East Greenland are wrong, as this species has not been found hitherto, but has been mistaken for *Solaster syrtensis* VERRILL. Also the presence of certain specimens of *Ophiocoma arctica* MÜLLER & TROSCHEL and some intergrades between this species and *Ophiactis bidentata* (RETZIUS), which clearly shows that these two species are exceedingly closely related, and most reasonably synonyms, is very interesting.

Thus the list of Echinoderms from East Greenland, given by MORTENSEN has to be amended, and as the collections of the Zoological Museum of Copenhagen contain some specimens of *Ankyroderma affinis* DAN & KOREN, described by MORTENSEN in 1910 as *Molpadia blakei* var. *groenlandica*. (For a careful revision of the North Atlantic and Arctic Molpadids cf. my paper on the "Ingolf" Molpadids, which will appear in the winter 1934—35) and the specimens of *Henricia scabrior* Michailovskij, described by MORTENSEN in 1903, these two species may be added to the complete list of Echinoderms known. The list will then be as follows:

Crinoidea.

Heliometra glacialis (Leach).
Poliometra prolixa (Sladen).

Asteroidea.

Ctenodiscus crispatus (Retzius).
Bathybiaster vexillifer W. Th.
Pontaster tenuispinus (Düb. & Kor.).
Ceramaster granularis (O. Fr. Müller).
Poraniomorpha tumida Stuxberg.
— *bidens* Mrtsn.
Pteraster militaris (O. Fr. Müller).
— *pulvillus* M. Sars.
— *obscurus* (Perrier).
Hymenaster pellucidus W. Th.
Korethraster hispidus W. Th.
Henricia eschrichtii v. laevior Michailovskij.
— *scabrior* Michailovskij.

Odinia semicoronata Perrier.
Lophaster furcifer (Düb. & Kor.).
Crossaster papposus (L.).
— *squamatus* Döderlein.
Solaster syrtensis Verrill.
Pedicellaster typicus M. Sars.
Stephanasterias albula (Stimps.)
Urasterias Lincki (M. & Tr.).
Icasterias ponopla (Stuxb.).
Leptasterias floccosa (Levinsen).
— — var. *crassa* n. var.
— *degerbölli* n. sp.

Ophiuroidea.

Gorgonocephalus arcticus Leach.
— *eucnemis* (M. & Tr.)
Ophiomyxa serpentaria Lym.
Ophioscolex glacialis M. & Tr.
Ophiacantha anomala G. O. Sars.
— *bidentata* (Retz.)
Amphiura Sundevalli (M. & Tr.)
Ophiopus arcticus Ljungm.
Ophiactis abyssicola (M. Sars.).
Ophiura Sarsi Lütken.
— *robusta* Ayres (Forbes).
Ophiocten sericeum.
Ophiopleura borealis Dan. & Kor.

Echinoidea.

Strongylocentrotus droebachiensis (O. Fr. Müller).

Holothurioidea.

Myriotrochus Rinkii Steenstrup.
Eupyrgus scaber Lütken.
Ankyroderma affinis forma *groenlandica* (Mrtsn.).
Trochostoma arctica (v. Marenz.).
— *thomsonii* Dan & Kor.
Cucumaria frondosa v. *japonica* Semper.
Thyonidium pellucidum (Flem.).

When comparing the list of specimens from Kangerdlugsuak with Mortensen's list of the destribution of the Greenland Echinoderms, it appears that almost one half of the specimens are cold-water forms

and the rest warm-water forms. A few may be indifferent e. g. *Strongylocentrotus*. The East Greenland *Henricia* was previously regarded as a warm-water form, but after it has turned out to be a separate form, we may regard it as an arctic form of *eschrichtii*. The two forms of *Leptasterias*, *floccosa* Levinsen and var. *crassa* n. v. show the presence of a cold-water *Leptasterias* as well as a warm-water *Leptasterias*, north and south of Kangerdlugsuak. As to the new species of *Leptasterias*, *degerbölli*, nothing can be stated with certainty, as it is for the present known with certainty only from Kangerdlugssuak. A few very young specimens of *Leptasterias* (apparently *degerbölli*) in the Zool. Mus. of Copenhagen, collected at Angmagssalik (Tassiusak) and Rosenvinge Bay (Scoresby Sound), however, indicates that *degerbölli* may have a wider distribution.

I. CRINOIDEA

Heliometra glacialis (Leach).

Antedon Eschrichtii: Duncan & Sladen. Mem. Echinoderms of the Arctic Sea to the west of Greenland pag. 73, Pl. VI, figs. 1—4.
— — : Mortensen 1903. Echinoderms from East Greenland pag. 65—67.
— — : Døderlein 1905. Arktische Crinoiden, pag. 397.
— — : Grieg 1907. Echinod. II Norw. Arctic Exped. "Fram", pag. 5 Pl. X fig. 1.
Heliometra glacialis: Mortensen 1910. Echinoderms of North East Greenland pag. 241 Pl. X fig. 1.
— — : Mortensen 1913. Echinodermer (consp. Faun. Groenl.) pag. 371.
— *Eschrichtii*: v. Hofsten 1915. Echinodermen des Eisfjords pag. 9.
— *glacialis*: A. H. Clark 1923. Crinoidea of the Ingolf Exped. pag. 6.
— — : Grieg 1928. Echinod. Siberian Ocean "Maud" Exped. pag. 4.
— — : Mortensen 1932. Echinoderms from the "Godthaab" Exp. pag. 5.

Kangerdlugsuak	St. 1	2	specimens
—	St. 12, $^{12}/_{8}$ 32. 80—100 m	5	—
—	$^{20}/_{8}$ 32	1	—

The specimens are nicely preserved. They are seen away from the small specimen from $^{20}/_{8}$ all large with the arms measuring ca. 20 cm.

Poliometra prolixa (Sladen).

Antedon prolixa Duncan & Sladen 1881. Mem. Echinoderms from the Arctic Sea to the west of Greenland pag. 77. Pl. VI figs. 7—10.
— — Mortensen 1903 Echinoderms from East Greenland pag. 65 Pl. I figs. 1—3.
— — Døderlein 1905. Arktische Crinoiden pag. 401.
Hathrometra prolixa Mortensen 1910. Echinoderms of North East Greenland pag. 242. Pl. VIII—IX; Pl. X fig. 2; Pl. XI fig. 1—6 and Pl. XII fig. 1—5 and 7.
— — Mortensen 1913. Echinodermer (consp. Faun. Groenl.) pag. 372.
Poliometra prolixa A. H. Clark 1923. Crinoidea of the "Ingolf" Expedition pag. 8.

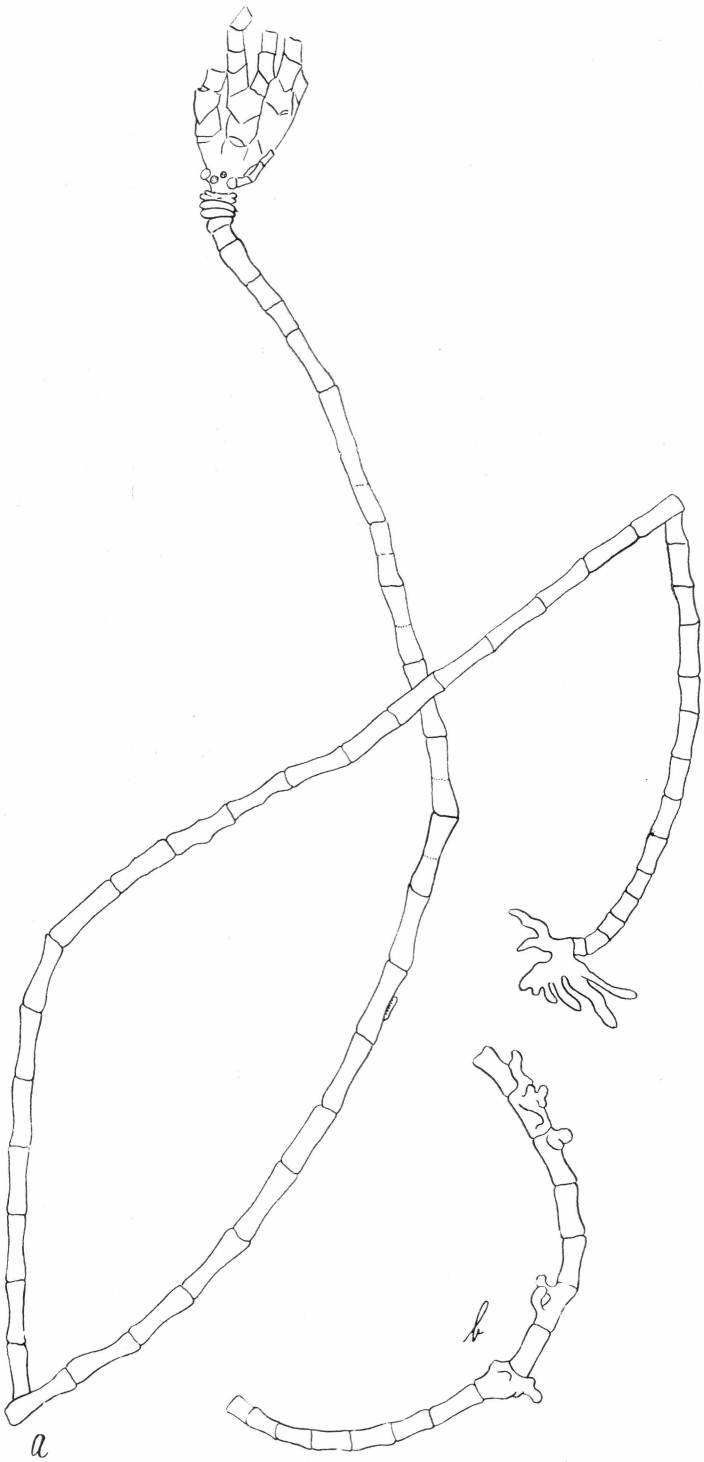


Fig. 1. *Poliometra prolixa* (Sladen). Pentacrinoids. *a.* a complete specimen with arms broken off. *b.* a fragment of a column with hapteres. $^{9}/_{1}$.

Kangerdlugsuak	$^{20}/_{8}$ 32. 175 m.....	2	specimens
—	$^{20}/_{8}$ 32. 450 m.....	4	—
Mikisfjord	$^{25}/_{8}$ 32. 175 m.....	17	—

Besides the specimens mentioned, which, are all typical and well developed, the examination of some bottom-material from Kangerdlugsuak $^{20}/_{8}$ 32. 175 m, consisting for the greater part of Polyzoa, revealed some large pentacrinoids, obviously belonging to this species. This is interesting, as very young larvae of *P. prolixa* are previously described from East-Greenland by MORTENSEN. The specimens at hand, two calyx

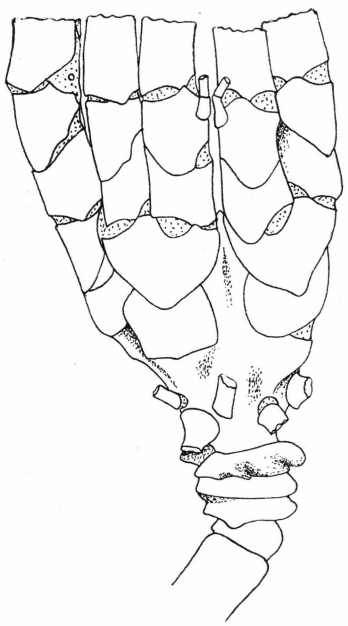


Fig. 2. *Poliometra prolixa* (Sladen). Calyx of the pentacrinoid Fig. 1a, enlarged, showing the traces of the cirri and pinnulae broken off.

and some fragments, are not fastened to Crinoids, like those found by MORTENSEN but to Polyzoa, and they further represent two more developed stages than those described by MORTENSEN. Unfortunately, the specimens cannot be thoroughly examined and described, as they were for a few months kept in spirit which proved to be acetic, for which reason they are seriously attacked by the acid. It is thus only possible to give a few remarks and to reproduce figures taken from the notes and drawings made when the specimens were found.

The most striking feature of these pentacrinoids is their size. Unfortunately, the largest is a fragment only, but the smallest, which in the size of calyx and of the arms is no more than two thirds of the largest,

measures 48 mm. The stem consists of 57—58 columnals, of which those closest to the calyx are discoidal, but already the sixth or seventh is normal. The actual number of columnals cannot be made out, as several of the columnals close to the calyx are formed by a stem syzygy. The end of the distal columnal extends to a rather large digitate mass, which expands over the surface of the object of attachment. The calyx is well developed with a few cirri, which are however broken off. On the proximal part of the off-broken arms, there are a few remains of some off-broken pinulae. A columnar-fragment found on a Polyzoa, shows that this species does not only cling to the object of attachment by the expanded distal columnal, but like *Hathrometra sarsi* it may develop processes from the other columnals and by means of these cling to Polyzoa-Hydroids or Crinoid-cirri.

The larger specimen (Pl. 1) has rather many cirri and a number of small pinnulae. The intestinal cone is comparatively large and supplied with a well developed anal tube.

Besides, there are some fragments of columns, some of which obviously belong to the large calyx, but as they are of little interest only, as we do not known whether they are basal or distal fragments, they are neither figured nor described.

II. ASTEROIDEA

Ctenodiscus crispatus (Retzius).

Ctenodiscus corniculatus DUNCAN & SLADEN 1881. Memoir on the Echinodermata of the Arctic Sea to the west of Greenland pag. 49 Pl. III figs. 17—20.

— *crispatus* LUDWIG 1900. Arktische Seesterne pag. 450—452.

— *corniculatus* MICHAILOVSKIJ 1903. Echinodermen der Russischen Expedition nach Spitzbergen pag. 28.

— *crispatus* KALISCHEWSKIJ 1907. Zur Kenntniss der Echinodermenfauna des Sibirischen Eismeeres pag. 24 Pl. I figs. 7—8 and Pl. II figs. 2—4.

— — MORTENSEN 1911. Report on the Echinoderms of North-East Greenland pag. 255—257 Pl. XIV figs. 4,6 and Pl. XVI figs. 4—5.

— — FISHER 1911. Asteroidea of the North Pacific etc. I pag. 31. Pl. III fig. 1—4 and Pl. IV fig. 1—6.

— — VERRILL 1914. Monograph of the shallow-water Starfishes of the North Pacific Coast etc. pag. 330. Pl. V figs. 6—8 and Pl. XLIX fig. 5.

— — MORTENSEN 1932. Echinoderms of the "Godthaab" Expedition pag. 6—7.

Mikisfjord, $^{25}/_{8}$ 32. 175 m, Mudd. ..... 4 specimens

One of the specimens at hand has but four arms. These are rather slender and thus differ characteristically from those of the other specimens. The three normal specimens are very alike, and as our knowledge of the local forms of this variable species is very slight and as far as the East-Greenland specimens are concerned, based on an abnormal specimen (cf. Mortensen 1911) a short discription of the specimens at hand is needed.

The arms are rather short, having R = 1,8r. The marginal spines are well developed and in the distal end of the rays often double (one specimen has even three spines on some of the supero-marginal plates).

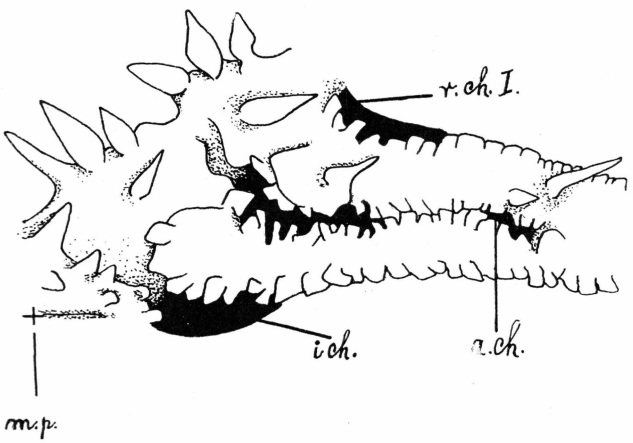


Fig. 3. *Ctenodiscus crispatus* (Retzius). Additional channel between 1st and 2nd adambulacral plates. a.ch. additional channel, i.ch. interradial channel, mp. Mouth-plate, r.ch. I. 1st radial channel.

The adambulacral plates have four large spines on their edge and 1—4 solid spines on their plane. In the arrangement of the ventral channels the two specimens (the largest and the fourarmed one) differ from the normal mode, in having a short channel running from the interval between the 1st and 2nd adambulacral plate. This channel, however, does not extend farther than half the way to the marginals, and thus it is not in connection with any cribriforme organ (cf. Fig. 3). In spite of the fact that this short channel is apparently an abnormal feature, it is regularly developed in the two said specimens.

The mouth-plates are rather varying, even in the single specimen.

The paxillae are of medium size and supplied with 10—15 spinelets, of which one (seldom two) is placed on the tabulum. Only the spines from the area around the central cone and the madrepore-plate are without any tabular-spinelet. The madreporite measures 2 mm in diameter in all the specimens (it is lacking in the fourarmed one). The radiating muscles pointed out by Mortensen in 1911 are very solid

in the specimens at hand, and easily visible even in dried specimens, on the other hand the abnormal character of the superomarginal plates, figured by MORTENSEN does not exist in these specimens, which are all quite normal in this respect.

Measurements of the specimens at hand.

Specimen	R	r	R:r	Number of supero-marginal plates	Width of ray at base	Number of furrow-spines	Width of madreporic plate
Nr. 1.....	35	19	1,8	13	19	4	2 mm
Nr. 2.....	32	17	1,8	13	20	4	2 mm
Nr. 3.....	30	16	1,8	13	17	4	2 mm
Nr. 4*).....	30	13	2,3	13	13	4	lacking

*) Specimen with four rays.

Pteraster militaris (O. Fr. Müller).

Pteraster militaris DÜBEN & KOREN 1844 Öfvers. Skand. Ech. pag. 246. P. VII figs. 11—13.
— — LÜTKEN 1857. Grønlands Echinodermata pag. 43.
— — SARS 1861. Norges Echinodermer pag. 48—62. Pl. III figs. 8—9, Pls. IV—VI.
— — DUNCAN & SLADEN 1881. Memoir on the Echinodermata of the arctic sea etc. pag. 46. Pl. III figs. 13—16.
— — DANIELSSEN & KOREN 1884. Asteroidea of the "Norske Nordhavs Exp." pag. 70. Pl. XIII figs. 18—19.
— — LUDWIG 1900. Arktische Seesterne pag. 469.
— — MORTENSEN 1903. Echinoderms from East Greenland pag. 77. Pl. II figs. 4—5.
— — MORTENSEN 1911. Report on the Echinoderms of North-East Greenland pag. 260. Pl. XVI fig. 2 and Pl. XVII fig. 1 and 11.
— — FISHER 1911. Asteroidea of the North Pacific I pag. 346. Pl. 98 figs. 1—2.
— — v. HOFSTEN 1915. Die Echinodermen des Eisfjords pag. 46.

Kangerdlugsuak, St. 3. $^{11}/_{8}$ 32 70 m, Stones .... 2 specimens

The two specimens at hand are rather small having R = 14 & 7 mm. R:r is 2,0 in both specimens. They are quite normal in general appearance,

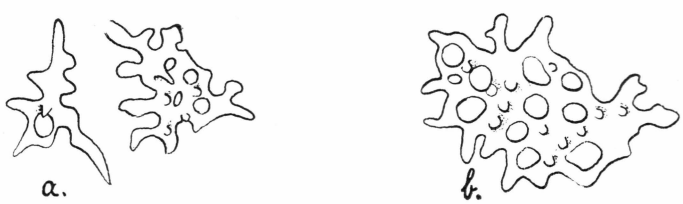


Fig. 4. *Pteraster militaris* (O. FR. M.). Calcareous deposits from smaller specimen (a) and larger specimen (b) 220/1.

only the little specimen is rather spiny on account of comparatively long spines of the paxillae. As MORTENSEN in 1911 did not find any spicules in his specimen from East-Greenland a figure of the spicules of the specimens at hand is given here. As it is seen of the figures (Fig. 4) the spicules of the small specimen are not so large and well developed as those of the larger specimen. In other respects they quite agree with the spicules of West-Greenland specimens drawn by MORTENSEN in 1911 (Pl. XVII fig. 1 and 2).

Pteraster militaris is widely distributed all over the Arctic Sea and is also found in the Scandinavian Seas as well as in the Sea West and East of North America down to Washington and Cap Cod. In 1932 (The "Godthaab" Echinoderms) MORTENSEN does not record it from East Greenland, but as he has previously described it there from, this may be a misprint.

Pteraster pulvillus M. Sars.

Pteraster pulvillus M. SARS 1861. Oversigt over Norges Echinodermer pag. 62—75. Pl. VI figs. 14—18 and Pl. VII—VIII.
— — LUDWIG 1900. Arktische Seesterne pag. 470.
— — MORTENSEN 1911. Report on the Echinoderms of North-East Greenland pag. 261. Pl. XIV fig. 3 and Pl. XVI fig. 3.
— — FISHER 1911. Asteroidea of the North Pacific I pag. 358 Pl. 102 figs. 2—4.
— — MORTENSEN 1913. Echinodermer (Consp. Faun. Groenl.) pag. 337.

Kangerdlugsuak St. 2, $^{10}/_{8}$ 32. 100 m; Wire, Gravel 1 specimen.

The well preserved specimen at hand measures in R, 18 mm and has a proportion of R and r = 2,6.

Pteraster pulvillus is not as widely distributed as *Pteraster militaris*, though it may be regarded as circumpolar. It is found on both the West-Coast and the East-Coast of Greenland, in the latter place at Cap Bismarck (MORTENSEN 1911). The absence of this species at East-Greenland in MORTENSEN's table of the distribution of the Greenland Echinoderms (MORTENSEN 1932) may be due to a misprint.

Korethraster hispidus Wyv. Th.

Korethraster hispidus WYVILLE THOMSON 1873. Depths of the Sea pag. 119—120.
— DANIELSSEN & KOREN 1884. Asteroidea of the Norwegian North-Atlantic Expedition pag. 95—100. Pl. XII figs. 1—14.
— — MORTENSEN 1913. Echinodermer (Consp. Faun. Groenl.) pag. 336.
— — DJAKONOV 1933. Les Echinodermes des Mers Arctiques pag. 51.

Mikis Fjord, $^{25}/_{8}$ 32. 175 m..... 1 specimen

It is interesting that this pronounced cold-water-seastar is found in the Mikis Fjord. The single specimen at hand has R = 10 mm and R:r = 3,3.

It is previously recorded from East-Greenland (66°16′ N—25°20′ W, 287 fth.). The Distribution is from the cold area of the Faroe-Channel to East-Greenland — Jan-Mayen — Spitzbergen — Novaja-Semlja.

Genus: *Henricia*.

The genus *Henricia* is represented by five small specimens in the collections of the MIKKELSEN-Expedition, specimens so alike that there cannot be any doubt that they belong to the same species. Apparently, they are *Henricia sanguinolenta* (O. Fr. Müller), which agrees with the fact that this species is recorded several times from East-Greenland (cf. Mortensen 1903 pag. 72, 1910 pag. 258, 1913 pag. 340 and 1932 pag. 15). A close examination and especially the comparison with good specimens of *sanguinolenta* from the Norwegian coast (The Trondheimfjord and the waters off Bergen), however, shows that they cannot simply be referred to that species. The question therefore arises whether these East-Greenland specimens are referable to one of the rather numerous synonyms of *sanguinolenta*, or whether they should be regarded as a new form, this being then a separate species or only a variety of *sanguinolenta*. The literature on *Henricia* and in some degree the comparison with specimens from the zoological museum of Copenhagen clearly show that the specimens at hand cannot be referred to any of the known species other than *sanguinolenta* and its synonyms. The forms referred to *sanguinolenta*, either as synonyms or as varieties, which should be taken into consideration in this connection are *eschrichtii* Müller & Troschel, *curta* Norman, *laevior* Michailovskij and *scabrior* Michailovskij, but our knowledge of these forms and their relation to *sanguinolenta* as well as our knowledge of the systematic characters within the genus *Henricia* is for the present very incomplete.

The only recent study of the classification of the genus *Henricia* is FISCHERS fine Monograph on the North Pacific Asteroidea (Asteroidea of the North Pacific and adjacent waters Part I pag. 266—305.) This work, however, only deals with the North Pacific forms, for which reason it does not threw much light on those from the Atlantic and the European Arctic. It would be natural to suppose that so eminent a study of the different Pacific variations and forms of *Henricia sanguinolenta* as that of FISHER, afforded a good basis for a revision of those from the Atlantic. This is, however, not the case. Even FISHER himself is uncertain

as to the classification of these specimens, stating that his results cannot be regarded as more than provisional as he must regard each apparently valid species as a center of variation, variations which may often intergrade and perhaps hybridize. As regards the variation of *sanguinolenta*, the question is much more serious. Here FISHER has used some Scandinavian specimens for his studies, but has not been aware that he did not possess really typical specimens. Like other localities the Scandinavian seas do contain different forms of *Henricia* which are previously united under the name *sanguinolenta*, and as they may often vary considerably, and have now and then been regarded as different species, it is important to be quite certain that the specimens used as the centre for a cyclus of variation, is in fact the real *sanguinolenta*. Unfortunately, the type-specimen of *sanguinolenta* does not exist, and O. FR. MÜLLER's description is surprisingly brief, being only: "*A. sanguinolenta* stellata supra sanguinea radiis apice albis", but this brief description clearly shows that the real *sanguinolenta* is the deep red form found rather commonly at the Norwegian coast. The study of a number of such red specimens, shows that besides other features they are characterized by having very distinct and well developed marginals arranged in regular rows (cf. fig. 9). This proves the specimens regarded as typical *sanguinolenta* by FISHER to be not of this type, as he states (pag. 272) the "marginal plates (are) typically indistinct and small, or not distinguishable from the other plates". Due to the authority of FISHER, MORTENSEN has further adopted this view, and characterises in his "Handbook of the Echinoderms of the British Isles" *sanguinolenta* in stating that contrary to the other European species of *Henricia* it has no marginals.

For the purpose of classifying the specimens of *Henricia* at hand, the present author has thus been obliged to embark on a revision of the European forms related to sanguinolenta, and to base this revision not on literature but on the extensive collections of these forms kept in the zoological museum of Copenhagen. In his Monograph of the Asteroidea from the N. Pacific, FISHER states that "probably no better collection exists, at least for a region of similar extent. To this I wish to remark that from FISHER's lists of specimens examined it appears that he had 70 specimens of *sanguinolenta* and 254 specimens of *eschrichtii*, all together about 350 specimens of the *sanguinolenta*-group. In the collections of the zoological Museum of Copenhagen there are about 175 specimens of Greenland *eschrichtii* and ca. 200 specimens of various other forms of *sanguinolenta* from Scandinavian and North Atlantic localities and a little more than 100 specimens of *Henricia* similar to *sanguinolenta* from European Arctic and East Greenland localities, i. e. a collection quite as extensive as that of FISHER.

The study of these numerous specimens has given the surprising

result that the variation of the *sanguinolenta*-group of *Henricia* is not at all so *baffling* in the Atlantic as it is in the North Pacific, and that the forms *sanguinolenta* O. Fr. Müller, *eschrichtii* Müller & Troschel, *curta* Norman, *laevior* Michailovskij and *scabrior* Michailovskij are different forms. Besides these there are some few less distinct forms from south-Scandinavia and Iceland, forms which mainly may be regarded as varieties of these named here, and which on account of their distribution, do not concern us in this connection.

As to the characters useable for separating the different forms of the sanguinolenta-group, it is mainly the mode of spinulation and the shape of the skeleton which afford the best features. Further the proportion of the length of the rays and the diameter of disk, expressed in R:r may be of some classificatory value, though the different authors hold rather deviatory views as to this. FISHER uses it often as a main-character, e. g. for separating *eschrichtii* from *sanguinolenta* in stating that R:r is 5—7 in *sanguinolenta* and 1,4—3,6 in *eschrichtii*. Contrary to this, LÜTKEN states that the size of R:r increases with the size of the specimens (Oversigt over Grønlands Echinodermer pag. 33 below). For this reason I have measured a number of specimens, especially the typical *sanguinolenta* and *eschrichtii*, the forms dealt with by FISHER and LÜTKEN. These measurements are in Fig. 5 arranged diagrammatically for showing how distinctly the real *sanguinolenta* differs from the other forms. From this figure it appears that even rather small specimens of *sanguinolenta* has R:r larger than large specimens of the other forms. Further it is evident that specimens from Iceland as well as from the Faroes have R:r of very nearly the same size as *eschrichtii* (judged from other features these specimens are in fact *eschrichtii*) and that the specimens of *curta* represent a separate group which is, however, placed so closely to the other specimens (of *eschrichtii*) that the two groups may easily be mixed up. From fig. 5 it also appears that there is a certain correlation between the size of specimens and the value of R:r, though this is so faint that it cannot disturbe the differences between the groups. Thus LÜTKEN is right in some degree, which is not the case with MICHAILOVSKIJ, who states that his specimens of *Henricia* has "(eine) von der Grösse unabhängigen Proportion r:R (von 1:3,5—1:5,45).

Further MICHAILOVSKIJ's measurements are of no value, as he has not distinguished between his two forms *laevior* and *scabrior*, which have a rather different value of R:r, *laevior* a small 3—4 and *scabrior* a larger 4,5—6.

The variation in the mode of spinulation within the *sanguinolenta*-group of *Henricia* is apparently rather puzzling, but when comparing a large number of specimens there appear to be some few main-forms which correspond nicely with different forms of the skeleton. Firstly

we may distinguish between two modes of spinulation which may be named the bristly and the spiny one. When the specimens are bristly there are a rather high number (8—30[40]) of small spines in each pseudo-paxilla, and these spines usually have their tips supplied with a corona of minute spinules, as is the case in *laevior* Michailovskij from

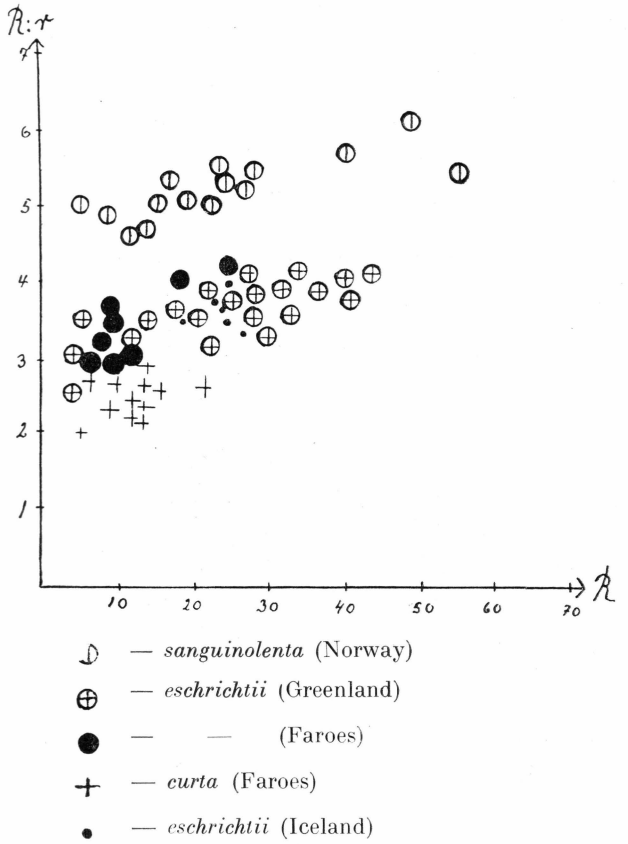


Fig. 5. Diagram of the relative size of the rays in correlation to the real length of the rays. It is seen from the figure that H. *sanguinolenta* from Norway in small and in large specimens have relatively longer arms than have the specimens of *eschrichtii* and *curta*, and that *curta* has pronouncedly the shortest arms. Differences which are strong enough for separating the species. Further shows the place of the various specimens of *eschrichtii* that these are more closely related and though intermediate between *curta* and *sanguinolenta*, clearly separated from these two forms.

East-Greenland. Spiny specimens are such which have but a few (1—3) spines in each pseudo-paxilla, spines which are relatively smooth and pointed at the tip, and further covered by a rather thick coat of skin. Specimens with spiny paxillae are e. g. those of *scabrior* Michai-

lovskij. There seems to be some intermediate forms of spinulation, especially in the Scandinavian seas, but they are only specimens of either the one or the other *sort* which have so small spines that these are nearly alike. That the two mentioned forms of spinulation are not two different developmental stages of the same feature is seen from the fact that the bristly specimens have always well developed marginals, and the spiny ones have no or at any rate irregularly developed marginals; further the arrangement of the adambulacral spines is different in the two groups of specimens. In the Scandinavian Seas the real *sanguinolenta* is a bristly form and the yellow "*sanguinolenta*" is a spiny form. Consequently, the two forms cannot be referred to the same species as usually done, but must be regarded as independent species, perhaps belonging to different genera or subgenera.

Of the systematic forms concerning us here forma *scabrior* Michailovskij is a valid species distinctly different from all the other in having spiny pseudo-paxillae and no marginals. All the other forms are more alike in having bristly pseudo-paxillae. Of these the two forms *sanguinolenta* and *curta* differ from *eschrichtii* and *laevior* in having a very high and a very low value of R:r. Further, these two forms have each a very characteristic shape of skeleton. The two Greenland forms *eschrichtii* and *laevior* are much alike in many characters. They have quite the same size of R:r, and their skeleton appears to be formed in the same way, the one (of *eschrichtii*) being but more reticulate than the other. On the other hand the two forms differ so much, in the arrangement and the shape of the adambulacral-spines, and perhaps in the shape of the skeleton too, that they cannot simply be regarded as identical.

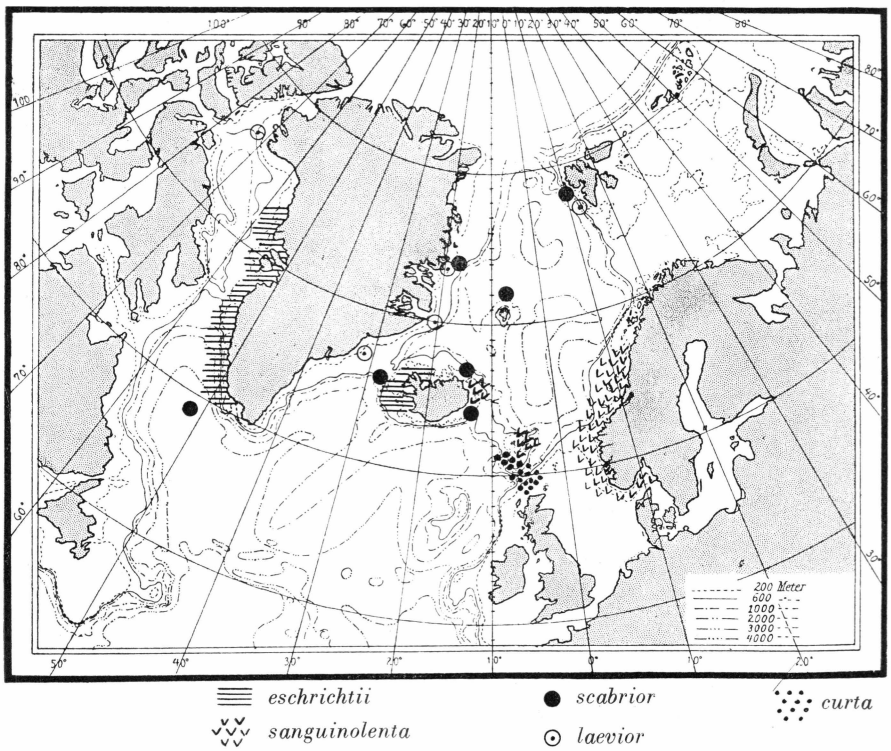
Whether these four forms are to be regarded as valid species or merely as varieties of the one *sanguinolenta* is of course a matter of taste. Different they are at any rate, and as there appears to exist variations of some of them or all of them, it is preferred for the present to name them by specific names. A reason for not collecting them as varieties of *sanguinolenta* is the existence of a form of *sanguinolenta* and a form of *eschrichtii* at Iceland, two forms which are distinctly different. Only the two forms *laevior* and *eschrichtii* are obviously so closely related that there cannot be much doubt that *laevior* must be regarded as a variety or cold-water form of *eschrichtii*. By the skeleton and the adambulacral-spines they can normally be separated, but intergrades exist which cannot with certainty be referred to any of them. Whether these intergrades are hybrids, or they are only deviating forms of one or the other of the two named forms cannot of course be ascertained without biological studies, studies which are probably impossible to undertake. Minute examinations of more material, especially from the deep waters of the Davis-Strait and Baffin-Bay

as well as from the Danmark Strait may perhaps throw some light on this problem.

As to the distribution of the different forms described above it is not possible for the present to point out any geographical limits, for which reason only the certain localities are given in the North Atlantic and the corresponding part of the Arctic. *Henricia scabrior* Michailovskij is originally reported from East-Greenland (MORTENSEN 1903) and Spitzbergen (MICHAILOVSKIJ 1903). Further it is also recorded from some of the "Godthaab" Stations (MORTENSEN 1832), and from the material at hand it appears that it occurs rather commonly on both sides of Greenland as well as at the eastern shore of Iceland and Jan-Mayen. Further a form of it, and most reasonably a separate species, is commonly met with in the Scandinavian seas where it is recorded as the yellow *sanguinolenta*. The appearance of these scabrior-forms are often so different in spite of there uniformity that one may suppose that a close study of them would result in the establishment of at least two species, an arctic (*scabrior*) and a boreal one, and of one to two varieties of each of these species, but that is a matter of future and it does not concern us in this connection. *Henricia sanguinolenta* (O. Fr. Müller) was previously recorded from numerous localities, but of these we may for the present only regard the Scandinavian seas and Iceland as certain. *Henricia eschrichtii* (Müller & Troschel) is common at the West Greenland coast, at East Iceland—North Iceland and the Faroes. Whether it is really the same form as described by FISHER from the Bering Sea is rather doubtful as we have no reasons for regarding it as an arctic species. *Henricia escrichtii laevior* (Michailovskij) which may be regarded as the arctic form of *eschrichtii* is known from Spitzbergen (Michailovskij 1903), East Greenland (Mortensen 1903) and contained in the material at hand from the Danmark Strait and the Smith-sound. *Henricia curta* (Norman) is apparently a very local form from the Shetland and the Faroes, but as it is also found in the deep water between the Shetland and the Faroes it may have a wider distribution than this.

Key to the species mentioned.

1. Pseudopaxillae spiny (cf. pag. 19) with one (to four) spines. Each spine smooth and clothed with a rather solid skin, on account of which in wet specimens it is more like a papilla than a spine. Normally but one row of spines on the ambulacra. Marginal plates either totally absent or irregularly developed, never in two to three well formed rows..... *scabrior*
   Pseudopapillae bristly with numerous (8—30[40]) small spiny spines, each of which are un-clothed with skin. More than one



Map 1.

row of spines on adambulacrals. Marginals well developed in two to more regular rows 2

2. Rays long and slender (R:r = ca. 5—6). Dorsal skeleton reticulate (not scaled). Adambulacrals with 3—4 rows of spines; those towards the furrow much larger than the others. . *sanguinolenta*
Rays not so slender (R:r = ca. 3—4). Dorsal skeleton scaly or partly scaly and partly reticulate..... 3
Rays short (R:r smaller than 3). Dorsal skeleton consists of very thick and solid granules, irregularly arranged..... *curta*

3. Adambulacral plates with two (three) rows of spines. Those towards the furrow much larger than the others, and normally forming a keel between the tube-feet. Dorsal skeleton more or less reticulate..... *eschrichtii*
Adambulacral plates with a "brush" of short spines. No distinct difference between the inner and the outer spines, the outer though a little thicker than the others, forming no keel. Dorsal skeleton scaly ..... var. *laevior*

Henricia eschrichtii laevior (Michailovskij).

Cribrella sanguinolenta Mortensen 1903. Echinoderms from East Greenland pag. 72. P. II figs. 7—9.
— — forma *laevior*. Michailovskij 1903. Echinodermen der Russischen Expedition nach Spitzbergen pag. 478—480.
— — forma *laevior* Michailovskij 1904. Die Echinodermen der zoologischen Ausbeute des Eisbrechers "Jermak" vom Sommer 1901, pags. 166—167.
— — Mortensen 1911. Report on the Echinoderms of North-East Greenland pag. 258—260.
Henricia sanguinolenta v. Hofsten 1915. Die Echinodermen des Eisfjords pag. 51—56.
— — Mortensen 1932. Echinoderms of the "Godthaab" Expedition pag. 15.

Kangerdlugsuak:

St. 2, $^{10}/_{8}$ 32. (100 m wire) Gravel.	2 specimens	R = 29 mm	= 3,6 r
		R = 15 mm	= 3,3 r
St. 3, $^{11}/_{8}$ 32. 70 m Stones.....	2	— R = 16 mm	= 4,0 r
		R = 15 mm	= 3,7 r
St. 5, $^{11}/_{8}$ 32. 50 m.....	1	— R = 17 mm	= 3,4 r

Diagnosis: Rays five, short and rather tumid. In transverse-section nearly circular. In general appearance this form resembles a brown or, at any rate, very dark *eschrichtii*. Skeleton usually forming a totally imbricate (scaly) coat with only some few pores for the papulae with but one, seldom two papulae in each. Marginals distinct, often gradually transforming into the imbricate (scaly) covering of the dorsal side of the rays. Carinals not developed. Pseudopapillae bristly with about 15—20 spines in each. Adambulacrals with 25—30 spines of very nearly the same length. One very small furrow-spine.

Description: This form is in general appearance very characteristic, due to the short and tumid rays and the very dense coat of pseudopaxillae, interrupted only by some few and small pores for the papulae. Ventrally it differs rather characteristically from *eschrichtii*, to which it is most closely related, as the spines along the adambulacral furrow (not the furrow-spines in it) are not so much longer than the other adambulacral spines as to form a distinct ridge along the furrow.

Contrary to the rather short rays the disk is well developed, and the proportion of disk and ray is low (R:r = 3—4).

The skeleton is very characteristic as the dorsolateral-plates are imbricate with their antero-dorsal side free. This is also the case with the superomarginal and inferomarginal plates, whereas the ventrolateral plates have their postero-ventral side free. Real carinals are absent, but along the dorsal side of each ray there is an area covered

with more or less irregular plates the larger of which are always imbricate with their posterior, i. e. their "terminal" side covered (Fig. 6.2-4). The marginal and ventrolateral plates are always well developed. Usually there is only one very regularly formed row of ventrolateral plates

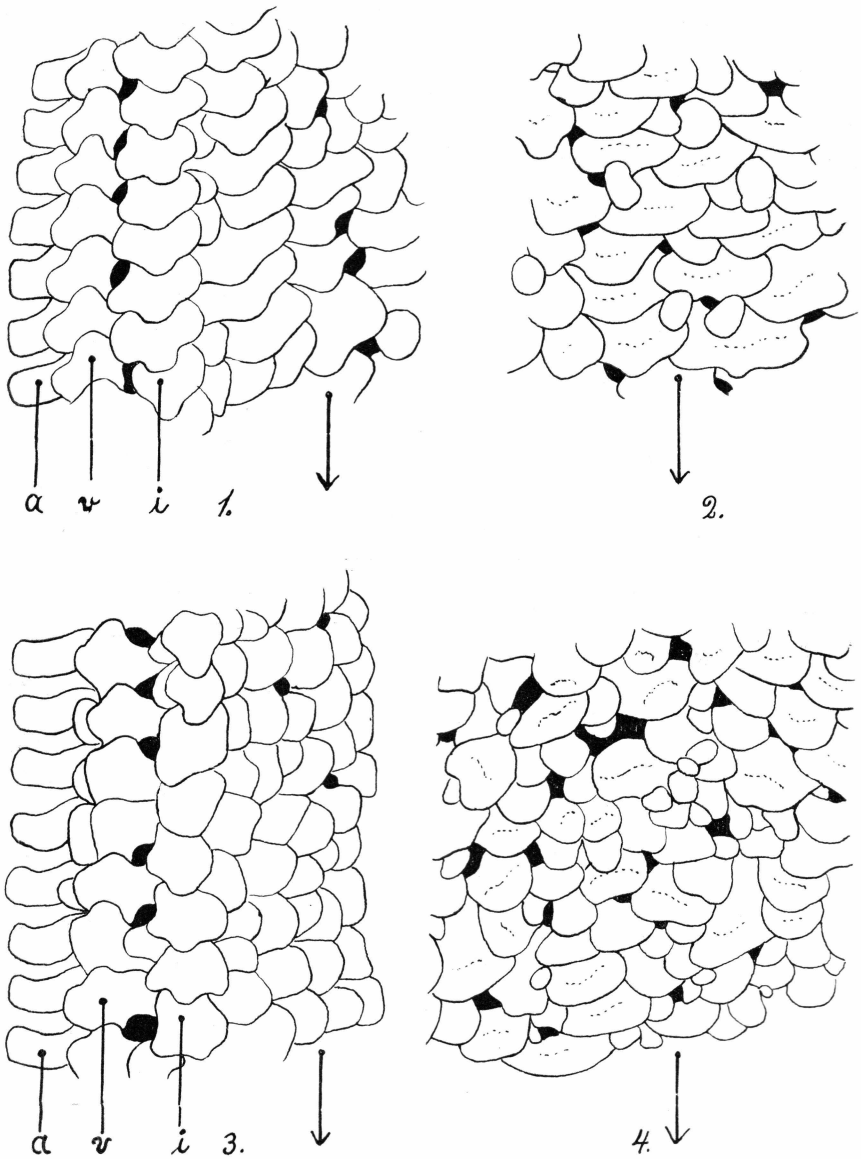


Fig. 6. *Henricia eschrichtii* v. *laevior* (Michailovskij) 1. lateral armplates of a small specimen close to the base of the ray. 2. dorsal armplates from a corresponding place on the arm of the same specimen. 3—4 figures corresponding to 1 and 2 from a larger specimen. a. adambulacrals. v. ventrolaterals. i. inferomarginals. The arrow is pointing towards the disk.

(Fig. 6.1), but in the larger specimens there may be some traces of a second row (Fig. 6.3). Between the ventrolateral plates and the inferomarginal plates there is a row of papulae. These are rather regularly arranged one for every one or every second ventro lateral plate. Between infero- and superomarginals as well as between superomarginals and the ventral rows of dorsolateral plates there are no papulae. The inferomarginal and superomarginal plates are usually very regularly arranged, but irregularities may occur and there is often a more or less well developed row of small plates between them (fig. 6.3). The dorsolateral plates are normally very regular, they are imbricate (fig. 6.2) and with excedingly few papulae. Papulae are normally lacking between the marginal plates and the ventral rows of dorsolateral plates. The

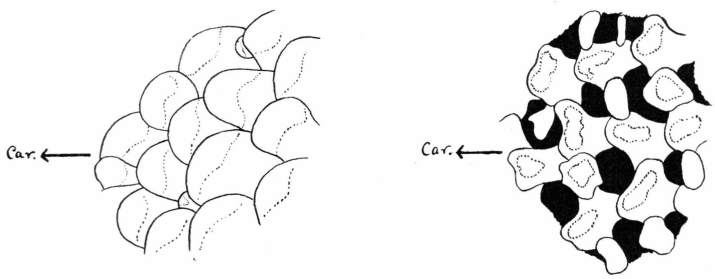


Fig. 7. Henricia eschrichtii v. laevior (Michailovskij) (a) and H. sanguinolenta (O. Fr. M.). Dorsolaterals showing typical differences.

spines are normally placed on a rather thick transverse ridge on the free end of the imbricate plates, where they form rather large pseudopaxillae. Further there may also occur some few spines on some of the small plates which are found lying above the imbricating plates of the dorsal side. Due to the imbrication of the plates and the large ridges forming the base of the pseudopaxillae, the spinulation of the specimens is very charachteristic. Dorsally the spines are covering the rays rather uniformly only interrupted by the small openings of the papulae, and on the marginal and ventrolateral plates the spines are placed in both longitudinal and transversal rows.

The spines (Fig. 13.15-17) are rather small on the dorsal side (about 250 μ), and supplied with a little crown of four to six equally long spinules. Those on the adambulacral plates are of varying size, those towards the ventrolateral plates being about 500 μ long and those at the furrow about 800 μ, they are gradually increasing in size as well as they are also gradually changing from a spine rather like a dorsal spine into one of quite different appearance.

The variety *laevior* is rather closely related to *Henricia eschrichtii* (Mll. & Tr.) but differs considerably from it in the shape of the skeleton

and the adambulacral-spines. Further the shape of the dorsal arm-spines of the two forms is somewhat different. The two forms may however often be much alike, and there are intergrades especially in specimens from the rather deep waters. The main forms, the shallow-water forms from East-Greenland and West-Greenland are however so different that they must be separated. Due to the distribution, *laevior* may be regarded as a cold-water-form of *eschrichtii*, but before we take this for granted, specimens of *Henricia* from the deep water around Greenland should be thoroughly examined.

Distribution: *Henricia eschrichtii laevior* (Michailovskij) appears to be widely distributed in the Arctic, as the greater part of the recorded specimens of *H. sanguinolenta* from there, may be regarded as *laevior*. That the specimens described by FISHER as *Henricia sanguinolenta eschrichtii* (Müller & Troschel) are not *laevior* is evident from the figures given by FISHER (Asteroidea of North Pacific etc. pag. 276 Pl. 67 and Pl. 68).

[The following four species, *eschrichtii*, *sanguinolenta*, *curta* and *scabrior* were not collected by the Mikkelsen-Expedition, but as they as well as the East-Greenland *laevior* were hitherto collected as *sanguinolenta* and no real description exists, a brief description as well as a few figures are so strongly needed, that an establishment of *laevior* as a separate form is nearly impossible without a supplementary description of them.]

Henricia eschrichtii eschrichtii (Müller & Troschel).

Echinaster eschrichtii MÜLLER & TROSCHEL 1842. System der Asteriden pag. 25.
Cribrella sanguinolenta LÜTKEN 1857. Oversigt over Grønlands Echinodermata pag. 31—35.
— *oculata* DUNCAN & SLADEN 1881. Memoir on the Echinodermata of the Arctic Sea to the west of Greenland pag. 32—34. Pl. II figs. 18—21.
— *sanguinolenta part.* LUDWIG 1900. Arktische Seesterne pag. 472—476.
Henricia sanguinolenta eschrichtii FISHER 1911. Asteroidea of the North Pacific etc. pag. 276—279. Pl. 67 figs. 1—3 and Pl. 68 figs. 1—2.

Diagnosis: Rays five, short and tumid. R = 3—4 r. Skeleton with regular imbricate ventrolateral and marginal plates. Ventral rows of dorsolateral plates imbricate, the other reticulate. Carinals not distinguishable from surrounding plates. Papulae between inferomarginal and superomarginal plates as well as between superomarginal plates and dorsolateral plates. Normally but one (two) papula in each papular-area. Pseudopaxillae bristly with 8—20 spines in each. Adambulacrals with few (about 10) spines which as stated by MÜLLER & TROSCHEL (Op. cit. pag. 25) are "meisthentheils in 2 Reihen, welche gegen die Furche keilförmig in eine dickere grössere Papille endigen".

Discussion: This species is very characteristic and differs from *sanguinolenta* rather definitely, for which reason I cannot follow FISHER in regarding it as merely a forma of that species. Further it is not quite certain that FISHERS specimens of *eschrichtii* are in reality the same form as that from Greenland. The absence of this species in the arctic water North of America, is by Fisher regarded to be due the abcence of collections in this area. As, however, we have every reason for regarding *eschrichtii* as a rather boreal species with the coldwaterform *laevior* (Michailovskij), it is not reasonable to await the appearance of a true *eschrichtii* in the Behring Sea. As a matter of fact FISHER did not have any

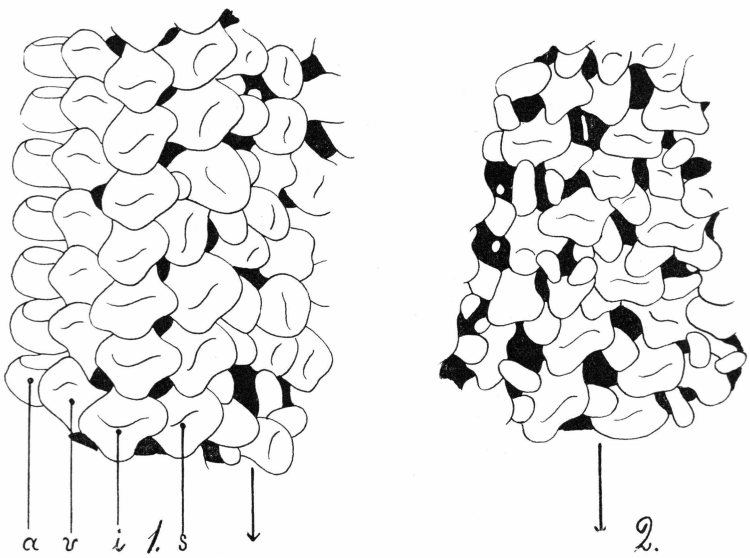


Fig. 8. Henricia eschrichtii (M. & Tr.). Lateral (1) and dorsal (2) armplates. a. adambulacrals; v. ventrolateral; i. inferomarginals; s. superomarginals. The arrow is pointing towards the disk.

true *eschrichtii*, so his determination of the Behring specimens is made on basis of MÜLLER & TROCHEL's description. Certainly FISHER's specimens agree very well with this description, but as this is also the case with the Greenland specimens, and the type-specimen of *eschrichtii* was from Greenland, we may at any rate regard the Greenland specimens as the true *eschrichtii*. One would naturally suppose that the Behring-specimens in FISHER's collections not being the supposed boreal *eschrichtii* were to be referred to the coldwater-form *laevior*. This is not the case. The comparison of the specimens of *lævior* with FISHER's figures definitely shows that these two forms are distinctly different. Probably FISHER's specimens may be regarded as a variety of *eschrichtii*. The distribution of *eschrichtii* and *laevior* apparently is opposed to this

view, but if we consider not *eschrichtii* but *laevior* the mainform, *eschrichtii* and the Behring specimens form two rather similar offshoots of this species.

Distribution: *Henricia eschrichtii* is a typical West-Greenland species, being rather common along the greater part of the West-coast. It is not known from the Smith-sound, where it appears to be replaced by *laevior*. Besides at Greenland *eschrichtii* is found at Iceland and the Faroes. The specimens there may, in minute characters, deviate somewhat from those from Greenland, but the deviations are so small and uncertain that they cannot be regarded as being of much classificatory value.

Henricia sanguinolenta (O. Fr. Müller).

Asterias sanguinolenta O. FR. MÜLLER 1776. Zoologiae Danicae Prodromus pag. 234.
Cribrella sanguinolenta part. LUDWIG 1900. Arktische Seesterne pag. 472.
? *Henricia sanguinolenta* FISHER 1911. Asteroidea of the North Pacific etc. pag. 271.
— — *part.* MORTENSEN 1927. Handbook of the Echinoderms of the British Isles pag. 118—120.

Diagnosis: Rays five, long and slender. R = about 5—7r. Skeleton with very regular ventrolateral plates and inferomarginal plates. Superomarginal plates rather indistinct. Dorsolateral plates and carinal plates alike and reticulate. Real carinal plates indistinguishable. Spines small, united into small pseudo-paxillae each with about 8—10 spines dorsally and 10—15 spines ventrally. Intervals between pseudo-paxillae rather marked, due to the reticulation of the sceleton. Papular areae with one (to three) papulae. Papulae between ventrolateral plates and inferomarginal plates as well as between inferomarginal plates and superomarginal plates. Adambulacrals with about 12 spines of which the three towards the furrow are distinctly longer than the others (Fig. 12.4). Dorsal spines spiny (Fig. 13.1-3). Colour deep red, usually white at the tip of the rays.

Discussion: *Henricia sanguinolenta* is usually said to occur in two forms, a red and a yellow. The examination of the rather large material of these two forms at hand, as well as the comparison with the arctic specimens of *Henricia* definitely show that the two forms are specifically if not generically different. Whether the yellow form from the Scandinavian seas should be regarded as a new species, or it may be referred to SLADEN's form *cylindrella* (cf. SLADEN: *Asteroidea* dredged during the cruise of H. M. S. "Triton" pag. 160) is a matter of future resarch. The Pacific specimens described by FISHER as *sanguinolenta* are evidently not this species. FISHER's description of the lacking of marginals shows that he is at any rate not quite cognizant of the systematic characters of the true *sanguinolenta*.

Distribution: Owing to the mixing up of so different forms and species under the name *sanguinolenta*, our knowledge of the actual distribution of this species is very poor. It occurs rather commonly at the Norwegian coast, and the present Author possesses some specimens

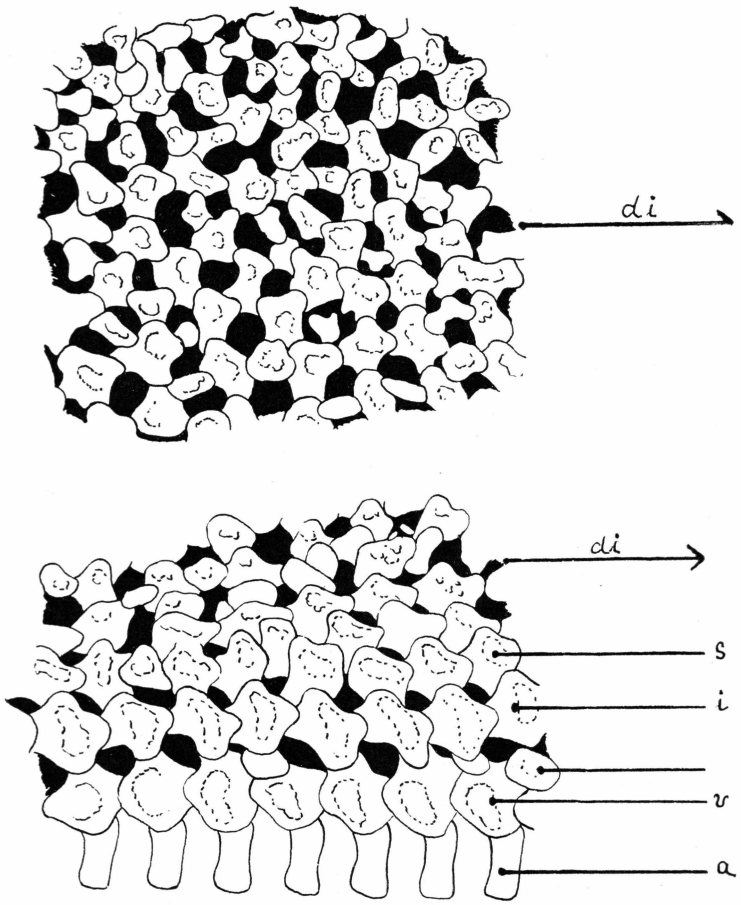


Fig. 9. *Henricia sanguinolenta* (O. Fr. M.). dorsal sceleton (above) and lateral sceleton (below). a. adambulacrals; v. ventrolaterals; i. inferomarginals; 2. superomarginals; di. direction towards disk.

from the Faroes. Further the collection of the Zoological Museum of Copenhagen includes some specimens from Iceland, which may be referred to *sanguinolenta* though they are obviously a deviating form of it.

Henricia curta (Norman).

Cribrella sanguinolenta var. *curta* Norman 1868. On the Shetland Crustacea etc. pag. 313.

Henricia sanguinolenta var. *curta* MORTENSEN 1927. British Echinoderms pag. 119.
— — — — LIEBERKIND 1929. Echinoderma [Zoology of the Faroes] pag. 5.

Diagnosis: Rays five, short. R. = ca. 2r. Ventrolateral plates and superomarginal plates rather small, but regular and well developed. Inferomarginal plates unusually large. Between inferomarginal and superomarginal plates there is in the proximal third of the rays a third row of regularly developed and arranged plates. Distinct carinal plates abcent. Dorsolateral and carinal plates tranformed into granules, ar-

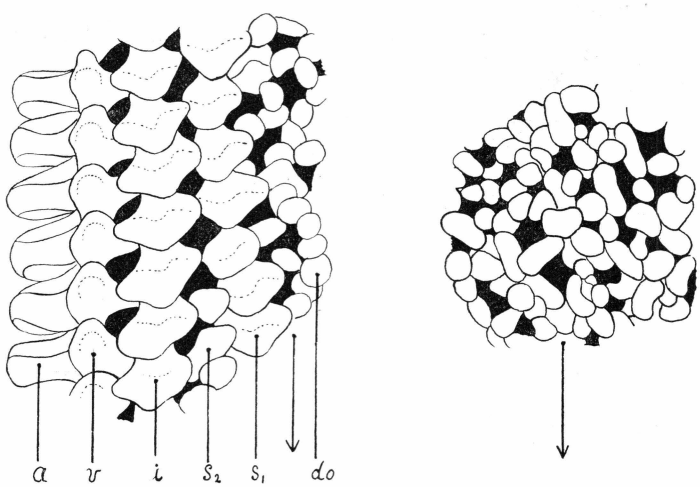


Fig. 10. *Henricia curta* Norman. Lateral (to the left) and dorsal (to the right) skeleton. a. adambulacrals; v. ventrolaterals; i. inferomarginals; s_1. superomarginals of 1st order; s_2. superomarginals of 2nd order; do. dorsolaterals. Arrow pointing towards the disk.

ranged so densely as to form a solid covering of the dorsal side of the rays. Papula-area small and only with one papulae. Papulae also between the marginal plates, though they may lack here in the proximal part of the rays. Pseudopaxillae bristly and very densely arranged, so as to cover the whole ray with a nearly uniform coat of spines, only interrupted by the small but very distinct papula-areae. Each pseudopaxilla with three to ten rather long-spined spines. Adambulacrals with ca. 7 rather solid spines of which those the closest to the furrow are the largest. Colour yellow.

Discussion: There can be no doubt that *curta* is a valid species. LIEBERKIND in 1929 had little doubt that it was a distinct form, and MORTENSEN too in 1925 was inclined to suppose that it was different from *sanguinolenta*. Further MORTENSEN has told me that when preparing

the "Godthaab"-record, he came to the conclusion that *curta* was a separate species.

Distribution: *Henricia curta* is only recorded from the Shetlands and the Faroes, and thus appears to be a very local form. Perhaps more collections may give a somewhat larger distribution.

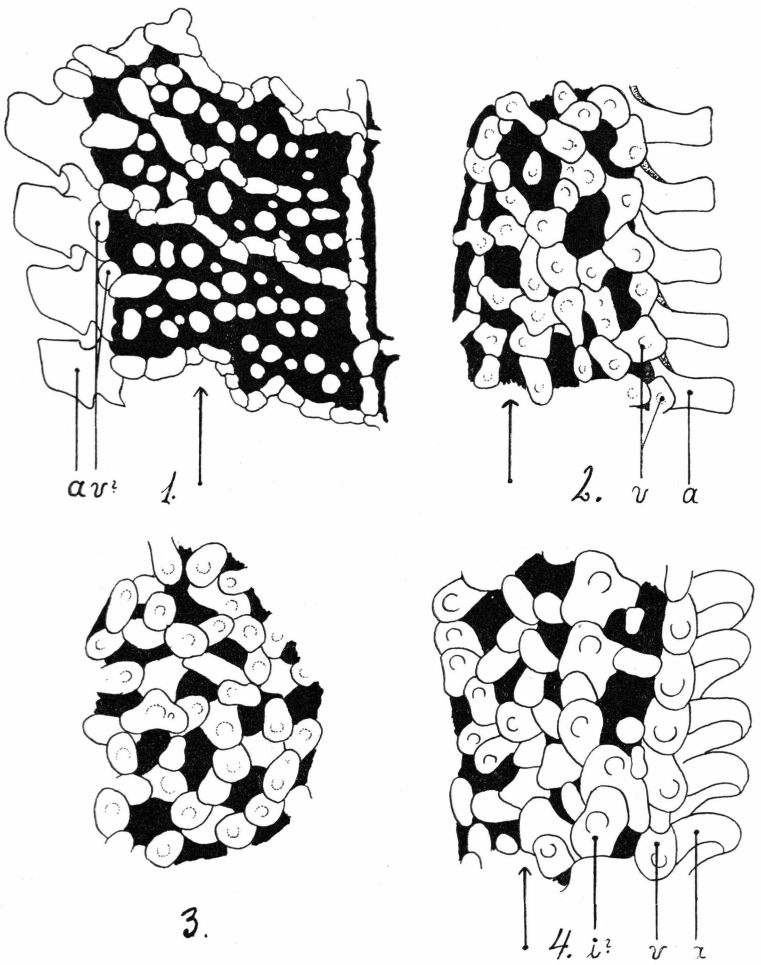


Fig. 11. *Henricia? scabrior* Michailovskij. Skeleton of a specimen from East-Greenland (Danmark Exp. St. 72a) (1), from off Julianehaab ("Godthaab" St. 188) (2) and from "West-Greenland" (3—4). The arrow is pointing towards the disk. a. adambulacrals; v. ventrolaterals; i. inferomarginals. Fig. 3 carinal area.

Henricia scabrior (Michailovskij).

Cribrella sanguinolenta? Mortensen 1903. Echinoderms from East Greenland pag. 72—73. Pl. II figs. 7—9.

— — forma *scabrior* Michailovskij 1903. Echinodermen der Russischen Expedition nach Spitzbergen pag. 478—480.

Cribrella sanguinolenta? forma *scabrior* MICHAILOVSKIJ 1904. Echinodermen der zoologischen Ausbeute des Eisbrechers "Jermak" vom Sommer 1901, pag. 166—167.

— — forma *scabrior* MORTENSEN 1911. Report on the Echinoderms of North-East Greenland pag. 258—260.

Henricia sanguinolenta f. *scabrior* v. HOFSTEN 1915. Die Echinodermen des Eisfjords pag. 51—56.

— — f. *scabrior* MORTENSEN 1932. Echinoderms of the "Godthaab" Expedition pag. 15.

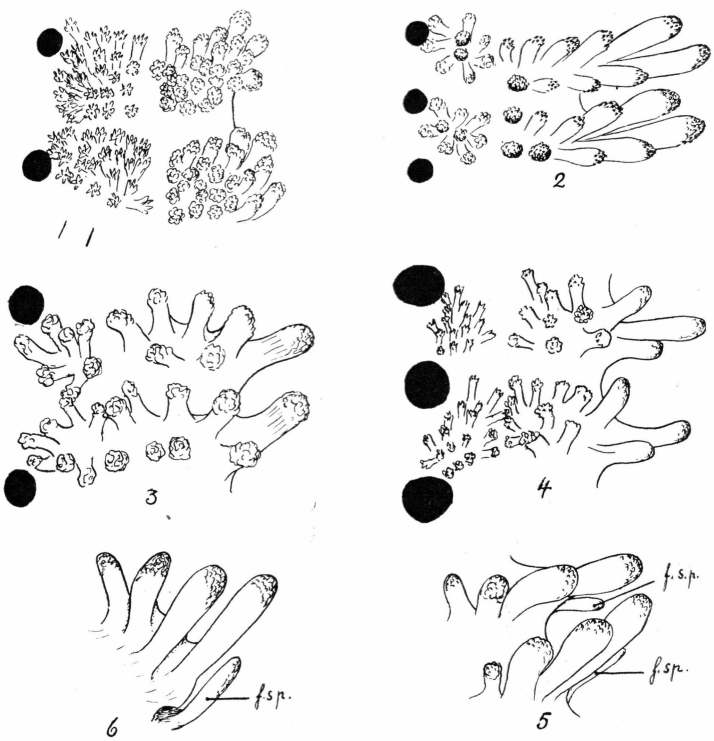


Fig. 12. Adambulacral spinulation of *Henricia eschrichtii v. laevior* (1), *H. erchrichtii* (2), *H. curta* (3), *H. sanguinolenta* (4) and *H. scabrior* (5—6). 6. the spines of a single adambulacral plate lateral view. f. sp. Furrow spines. The black spots are the papula-areae.

Diagnosis: Rays five, of medial length. R. = about 4r. Sceleton without carinal plates, marginal plates and ventrolateral plates. Dorsolateral plates forming large irregular meshes including 3—5 papulae and a number of small granules each with a spine. Spines slender and distended with or without fine spinules which are never forming a "crown" as in other species. Spines on adambulacral plates usually in one row and often united by a web. Spines always covered by a thick skin which (in wet specimens) makes them look papilliform.

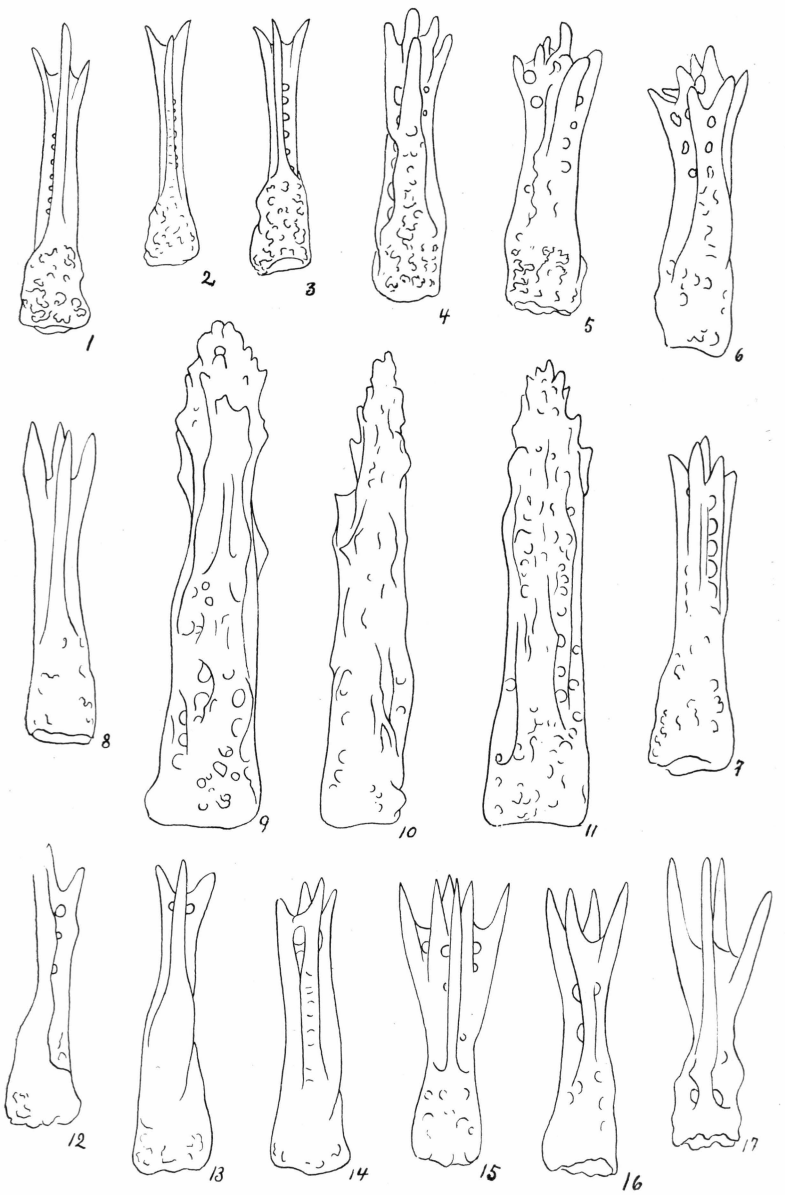


Fig. 13. Dorsal (carinal) armspines of *H. sanguinolenta* (1—3), *H. curta* (4—6), *H. eschrichtii* Expl. II (7—8), *H. scabrior* (9—11), *H. eschrichtii* Expl. I (12—14), H. eschr. v. lævior (15—17).

Discussion: The specimens of this species at hand (from East-Greenland) are so characteristically different from all the species of *Henricia* previously described that it would be the most reasonable to establish a new genus or at any rate a subgenus with them as the genotype. As there may, however, be quite a number of species belonging to this

supposed genus, when the large material from the "Ingolf" Expedition as well as from other Danish collections in the Atlantic are to be described, it seems rather unpractical to establish such a genus before the species concerned have been investigated and described. In the Arctic Area, dealt with here, there appears to be two different forms, the real *scabrior* and a form from Jan Mayen. This latter form deviates from *scabrior* in having the spines collected in pseudopaxillae and in having several rows of spines on the adambulacrals, an appearance which rather agrees with a large yellow specimen of *Henricia* collected in Denmark at Hanstholm. The appearance of these two forms are in fact so alike that there seems to be reasons for uniting them. This is, however, a matter for future studies. In this connection only the distinct difference of *scabrior* from *laevior* and related forms are to be made clear.

Lophaster furcifer (Düben & Koren).

Lophaster furcifer DUNCAN & SLADEN 1881. Memoir on the Echinodermata of the Arctic Sea to the West of Greenland pag. 40. Pl. III fig. 5—8.
— — LUDWIG 1900 Arktische Seesterne pag. 467.
— — MORTENSEN 1913. Echinodermer (Consp. Faun. Groenl) pag. 335.
— — v. HOFSTEN 1915. Die Echinodermen des Eisfjords pag. 43.
— — MORTENSEN 1932. Echinoderms of the Godthaab Exp. pag. 16.
— — DJAKONOW 1933. Echinodermes des Mers Arctiques pag. 52.

Mikis Fjord $^{25}/_{8}$ 32. 175 m ..... 1 specimen

The specimen at hand is small having R = 9 mm and R:r = 3.

Lophaster furcifer is recorded from several localities on the East-Greenland coast (cf. MORTENSEN 1913) and from some few localities at West-Greenland. The »Godthaab" Expedition found it at several stations from 75°—78° N. L.

Crossaster papposus (Linn.)

Crossaster papposus DUNCAN & SLADEN 1881. Memoir on the Echinodermata of the arctic Sea to the West of Greenland pag. 36. Pl. III figs. 1—4.
— — LUDVIG 1900. Arktische Seesterne pag. 460.
Solaster papposus DÖDERLEIN 1900. Die Echinodermen der "Olga"-Expedition pag. 205.
— — GRIEG 1906. Echinodermen v. "Michard Sars" 1900—1903 gesammelt.
— — FISHER 1911. Asteroidea of the North Pacific I pag. 325. Pl. 94 fig. 1—6.
— — MORTENSEN 1913. Echinodermer (consp. Faun. Groenl.) pag. 333.
— — VERRILL 1914. Starfishes of the North Pacific Coast pag. 259 Pl. V fig. 2, Pl. VIII figs. 1—2, Pl. IX fig. 4 and Pl. XLIX fig. 4.
— — v. HOFSTEN 1915. Die Echinodermen des Eisfjords pag. 29.
— — MORTENSEN 1932. Echinoderms of the "Godthaab" Exp. pag. 17.
— — DJAKONOW 1933. Echinodermes des Mers Arctiques pag. 52.

Kangerdlugsuak $/_8$ 32 ..... 1 specimen
— St. 18, $^{14}/_8$ 32. 10 m Sand ..... 2 —
— $^{21}/_8$ 32. 450 m ..... 1 —
Mikis Fjord $^{25}/_8$ 32. 175 m Mudd ..... 1 —

The specimens at hand are easily referred to *Crossaster papposus*, but their general appearance differs rather markedly from that of normal Scandinavian *papposus* in being more "haired" as the spinelets of the paxillae are exceedingly long. Whether this is a systematic character is not quite certain, but it is used by Döderlein (Op. cit. pag. 207) for establishing his variety *anglica*. As far as can be seen the variety *anglica* as well as the arctic forms may be regarded as real varieties of the true

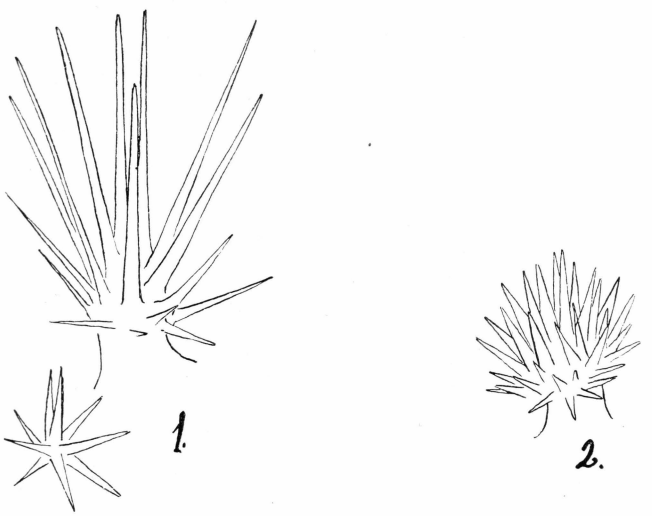


Fig. 14. Pxillae of *Crossaster papposus*. 1. specimen from Kangerdlugsuak; 2. specimen from Denmark (Lille Bælt) [forma *anglica* Döderlein].

papposus, but the clearing up of this problem is so difficult that it cannot be done in this place.

The arctic form of *Crossaster papposus* appears to be circumpolar, and at both the Atlantic and the Pacific coasts there are some boreal forms more or less closely related. This distribution rather strikingly agrees with that of the different forms of *Leptasterias* and *Henricia*.

Measurements of the specimens at hand.

Specimen	N. of rays	R	r	R:r
Nr. 1	10	55	21	2,6
Nr. 2	10	34	17	2,0
Nr. 3	10	25	10	2,5
Nr. 4	8	15	6	2,5
Nr. 5	10	13	5	2,6

Solaster syrtensis Verrill.

Solaster syrstensis VERRILL 1894. Proceed. Un. States National Museum (Nr. 1000), Vol. 17 pag. 271.
— — DÖDERLEIN 1900. Die Echinodermen der Olga-Expedition pag. 210. Pl. VII fig. 2—3.
— *glacialis* GRIEG 1906. Echinodermen v. "Michael Sars" 1900—1903 gesammelt pag. 66.
— — MORTENSEN 1910. Echinodermen from North East Greenland pag. 261.
— — MORTENSEN 1913. Echinodermer (Consp. Faun. Groenl.) pag. 335.
— — MORTENSEN 1932. Echinoderms from the "Godthaab" Exp. pag. 17.

Kangerdlugsuak St. 6, $^{11}/_{8}$ 32. 25 m..... 1 specimen

The specimen at hand is very interesting in being rather small, having R = 17 mm, being thus the smallest specimen known of this species and distinctly smaller than the type of *solaster glacialis* DANIELSSEN & KOREN. In his paper on the "Michael Sars" echinoderms GRIEG states that *syrstensis* is but a synonym of *glacialis* and that the differences between the two forms are due to the small size of the type of *glacialis*. As in spite of its small size the present specimen agrees nicely with DÖDERLEIN's specimens of *syrtensis* and differs definetely from the type of *glacialis* it is not possible to follow Grieg in regarding these two forms as synonyms.

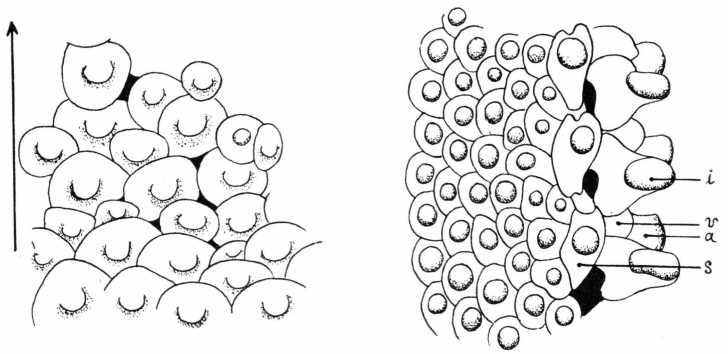


Fig. 15. *Solaster syrtensis*. Lateral skeleton (to the right) and dorsal skeleton (to the left) from the edge of the disk. The arrow is placed in the interradial line and is pointing towards the centrum of the disk. a. adambulacral; v. ventrolateral; i. inferomarginal; s. superomarginal.

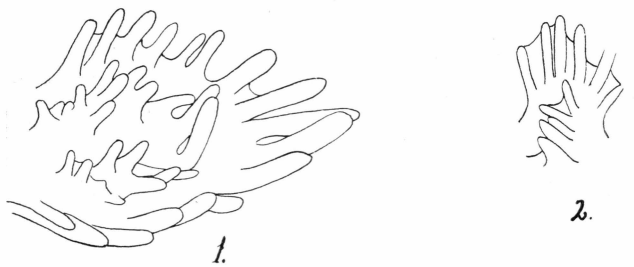


Fig 16. *Solaster syrtensis*. 1. mouthplate; 2. adambulacral plate with spines.

The difference between the two species is convincing by a direct comparison.

Specimen from Kangerdlugsuak	Typespecimen of Solaster glacialis D & K
Size of R — 17 mm	Size of R — 25—30 mm (cf. Grieg Op. cit. pag. 68).
Number of rays nine.	Number of rays seven.
Proportion of disk and rays, R: r = 2,4.	Proportion of disk and rays, R: r = 3,0.
The abactinal paxillae placed very densely and forming no regular longitudinal rows on the rays.	The abactinal paxillae placed with intervals of 1 mm, and forming distinct longitudinal rows on the rays.
Paxillae with 7—20 spinelets, of which 1—3 are placed in the centre.	Paxillae with 6 (acc. to Grieg 3—12) spinelets, of which 1 is placed in the centre.
Papulae exceedingly few, nearly lacking on the rays.	Papulae regularly arranged, only lacking in the most exterior end of the rays.
On their exterior convex margin the oral plates have 10 (6—10) teeth on each side. On the medial part there are two rows of spinelets, each containing 10—11 spinelets (Fig. 16).	On their exterior convex margin the oral plates have 10 teeth (6+4) on each side. On the medial part there are two rows of spinelets each containing 3—4.
Dorsal skeleton consists of imbricate scales (Fig. 15) each with a large tubercle for the paxillae. The scales are so large that they do not form any reticulation, only now and then they allow a papula to protrude in the angles between them. Skeleton of rays nearly without pores for papulae.	Dorsal skeleton consists of calcareous ossicles, which are largest on the disk and have several short projections which laminate with the projections of the adjoining calcareous ossicles, thus forming a calcareous reticulation. Skeleton of the rays with larger meshes than that of the disk.
The interbrachial space of the actinal surface is set with well developed paxillae and without spines.	The interbrachial space of the actinal surface is set with a few irregularly placed spines.

As it appears from the table above the little specimen of syrtensis at hand differs definitely from the type of glacialis. Whether the two species are absolutely different is not certain, as some specimens from the "Godthaab" Expedition, determined by MORTENSEN as *glacialis* have the skeleton formed as described by DANIELSSEN & KOREN, and, due to that, also numerous regularly arranged papulae. That these specimens may nevertheless be referred to *syrtensis* appears from the numerous paxillae in the ventro-interradial spaces. A close examination may however show that *syrtensis* is not so homogeneous a species as we may be inclined to suppose for the present.

Distribution. *Solaster syrtensis* was first found at Cape Cod and New-Scottland, and by DÖDERLEIN at the localities: 76°58′ N. 13°20′ E.,

74°55′ N 17°30′ E., 75°23′ N. 17°45′ E., 76°27′ N. 21°24′ E. A specimen determined by LEVINSEN as *Solaster endeca* is present from the Kara Sea (Dijmphna), and the species is recorded from Greenland by MORTENSEN (as *glacialis*) from: Cap Bismarck East Greenland and from 75°35′ N 65°41′ W., 76°36′ N. 68°54′ W. and 77°05′ N 71°13′ W.

Stephanasterias albula (Stimpson).

Stichaster albulus DUNCAN & SLADEN 1881. Mem. in the Echinodermata of the Arctic Sea to the west of Greenland pag. 29. Pl. II figs. 13—17.
— — LUDWIG 1900. Arktische Seesterne pag. 479.
— — GRIEG 1907. Echinodermata from the 2de Norw. Arct. Exp. in "Fram", pag. 10.
— — MORTENSEN 1910. Echinoderms of North East Greenland pag. 267. Pl. XIII figs. 1—6, Pl. XIV fig. 8, Pl. XV figs. 8—10 and Pl. XVII fig. 12.
— — MORTENSEN 1913. Echinodermer (Consp. Faun. Groenl.) pag. 342.
Stephanasterias albula VERRILL 1914. Starfisches of the North Pacific Coast pag. 147.
Stichaster albulus v. HOFSTEN 1915. Die Echinodermen des Eisfjords pag. 56.
Stephanasterias albula FISHER 1930. Asteroidea of North Pacific pag. 157. Pl. 70 figs 1—5, Pl. 71 fig. 1 a—g and Pl. 72 fig. 5.
— — MORTENSEN 1932. Echinoderms of the "Godthaab" Exp. pag. 19.
— — DJAKONOW 1933. Echinodermes des Mers Arctiques pag. 62.

Kangerdlugsuak St. 3, $^{11}/_{8}$ 32. 70 m.. 1 specimen R = 5 mm
— $^{20}/_{8}$ 32. 175 m. 1 — R = 13 mm

Distribution: *Stephanasterias albula* (Stimpson) is one of the most common Echinoderms at the West Greenland Coast and it is also recorded from different localities in the East-Greenland Sea (cf. MORTENSEN 1913). It is further distributed over the European Arctic, and according to FISHER in the Arctic area of the North Pacific. This record is however according to MORTENSEN (1932 pag. 19) not to be trusted, as there are reasons for believing that FISHER's specimens named *Stephanasterias albula* are not that species but another form. [cfr. Note p. 68]

Genus *Leptasterias* Verrill.

Subgenus *Leptasterias* Verrill.

Pl. II; fig. 1—13.

VERRIL 1866. On the Polyps and Echinoderms of New England pag. 350.
FISHER 1930. Asteroidea of the North Pacific Coast.
DJAKONOW 1930. Zur Frage der Artberechtigung der *Mülleri-Groenlandica*-Gruppe der Asteridengattung *Leptasterias* etc.

Genotype: *Asteracanthion mülleri* Sars.

In the collection at hand there are 10 well preserved specimens of *Leptasterias* from Kangerdlugsuak. The two of them obviously differ so much from the others that they cannot be regarded as the same

species but must be described as a new one, *degerbölli* n. sp. The eight specimens are in many features so like *Leptasterias floccosa* Levinsen, that there is little doubt that they may be referred to that species, which was previously recorded from East-Greenland by MORTENSEN, though a number of differences from *floccosa* show that in these specimens we have a separate southern variety of *floccosa*, var. *crassa* n. v.

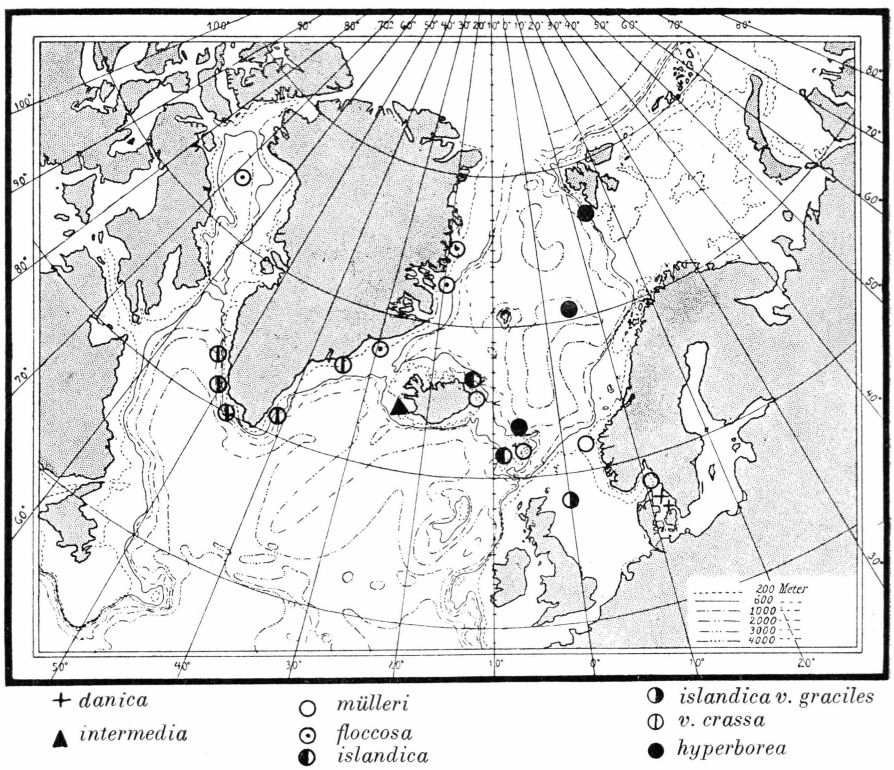
In his monograph on the Asteroidea of the North Pacific FISHER refers *floccosa* to *hyperborea* with a ? which agrees with the fact that when briefly described, the two forms may in spite of their difference, appear to be rather alike. In determining the specimens at hand the problem arises, whether *floccosa* Levinsen should be regarded as a form of *hyperborea*, or a form of *mülleri*, and how the deviating specimens at hand are to be classified. In order to prove this, I compared both (the two forms from East Greenland) with the type of *hyperborea* and with the type of *mülleri*. This comparison yielded the surprising result that the type-specimen of *mülleri*, which belongs to the Zoological Museum of Copenhagen, is not at all the same form as that which is usually named *mülleri*, and further that the two types were so different that DJAKONOW is wrong in regarding *hyperborea* as a variety of *mülleri*. Before it was possible to ascertaine anything as to the East Greenland specimens at hand, a careful examination of a number of Atlantic *Leptasterias* and their different characters was necessary. For such an examination the Zoological Museum in Copenhagen possessed an excellent material from the North Atlantic and the Arctic Sea. Further on a visit to Bergen and Reykjavik I had an opportunity of examining the collections of *Leptasterias* kept in these two museums, and on board the Danish Exploring Steamer "Dana" I was able to examine a number of living *Leptasterias* from Iceland, the Faroes and the North Sea.

The result of these studies was that the mülleri-group of *Leptasterias* must be divided into a number of distinct forms, the greater part of which aught to be regarded as independent species. That they are species and not merely varieties of a single species, is evident not only from their very characteristic differences, but also from the fact that most of them have one to two varieties or forms, forms which only in a single case resemble intergrades (between *hyperborea* and *mülleri*). These species are the following:

Leptasterias mülleri (Sars)
— — forma *nobilis* f. n.
— *islandica* (Levinsen)
— — var. *gracilis* n. var.
— *danica* (Levinsen)

Leptasterias floccosa (Levinsen)
— — var. *crassa* n. var.
— *degerbölli* sp. n.
— *hyperborea* (Danielssen & Koren)
— — forma *carinata* f. n.
— — forma *floccosoides* f. n.
— — forma *intermedia* f. n.

The characters useable for separating these different forms are mainly the general shape of the specimens (short and broad rays — long



Map 2.

and narrow rays — long and gradually tapering rays), the shape and arrangement of the spines (terete — cylindrical — subcapitate — capitate spines irregularly arranged or arranged in regular rows) and the shape of the skeleton, especially of the dorsolateral plates. Further the feature that the adambulacrals are monacanthid or diplacanthid may in spite of rather irregular varying fluctuations be regarded as a character of some value to the classification.

The specimens at hand from Kangerdlugsuak may then be regarded as *Leptasterias floccosa* var. *crassa* n. var. and *Leptasterias degerbölli*

n. sp., but before describing them a short diagnosis of the other named forms will be necessary.

As to the distribution of these different forms of *Leptasterias* (cf. Map 2), *danica* is not known from other localities than the Kattegat and the southern part of Skagerrak, but it may be supposed to occur also in the southern North Sea. *Mülleri* is distributed along the Norwegian Coast down to the Zool. Station, Kristineberg in Sweden, and is rather common at Iceland and the Faröes. The variety *intermedia* is common in the Faxa Flöj at Iceland and is found at the southern part of West-Greenland. *Islandica* is found at Iceland and is common at the Faroes but is not recorded from other localities. The variety *gracilis* is from the North Sea (Northern part.) *Floccosa* is a Greenland species which is common at East Greenland in shallow waters, and at West-Greenland in rather deep water. The new species *degerbölli* is only known from the type-locality Kangerdlugsuak, but may be regarded to have a wider distribution. *Hyperborea* is hitherto regarded as a cold-water form, which cannot be right, as it is only reported with certainty from, Spitzbergen — the Bear Island and the Faroes, localities which have all a positive temperature.

Leptasterias mülleri (Sars).

Asteracanthion mülleri M. Sars 1844. Über die Entwickelung der Seesterne.
— — M. Sars 1846. Fauna littoralis Norwegiae I pag. 56—58. P. VIII fig. 38—43.
Leptasterias mülleri Verrill 1866. On the Polyps and Echinoderms of New England p. 350.
Asterias mülleri Ludvig 1900. Arktische Seesterne pag. 481.
Leptasterias mülleri Fisher 1930. Asteroidea of North Pacific etc. pag. 208.
— — Djakonow 1930. Zur Frage der Artberechtigung der *mülleri-groenlandica*-Gruppe der Asteridengattung *Leptasterias*.
Leptast. mülleri mülleri Djakonow 1933. Echinodermes des Mers Arctiques pag. 66.

Rays five, short and robust with nearly parallel sides and blunt ends. Spines on disk and carinal-plates of nearly the same size and shape as those of marginals, being short and cylindrical or faintly tapering. The carinal spines are arranged in a zig-zag row. Besides there are on each side of the rays four regular rows of spines, dorsolateral — superomarginal — inferomarginal and ventrolateral, all of very nearly the same size. The general appearance of the spines is rather characteristic; as each spine is like a little cone on the top of the thick bundle of pedicellaria, which is surrounding them. The adambulacral spines are rather faint compared with the other spines of the rays. They are normally monacanthid though specimens may occur with some few diplacanthid adambulacrals. Straight pedicellariae are rather scarce though a few may usually be found in the angles of the rays. Small straight pedicellariae

are found in the furrow. Crossed pedicellariae are very abundant on the dorsal and lateral spines, where in dried specimens they surround the base of the spine. On the adambulacral spines there are but a few crossed pedicellariae arranged in a little cluster close to the top of the spine.

The skeleton (Fig. 18.1 & 3) consists of regular rows of marginal plates (ventero-lateral, inferomarginal and superomarginal). These are well developed, rather robust each with four short prolongations and a tubercle for the insertion of the spines. Besides there is a second row of ventrolaterals

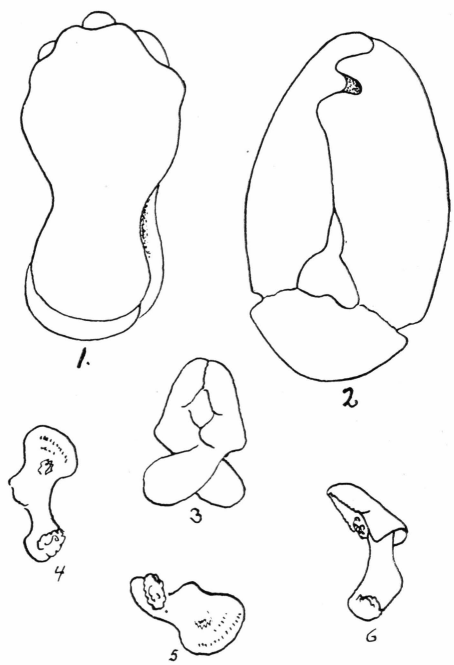


Fig. 17. *Leptasterias mülleri.* (Typespecimen). Straight pedicellaria (1—2). crossed pedicellaria (3—6).

in the proximal half of the arm, but these do not carry spines. The adambulacrals have no tubercles for the insertion of the adambulacral-spines, which at their base have a slit for the insertion, but in the place where the spine is inserted the plate is a little thicker. Like the marginal plates the dorsolateral plates are well developed with short processes and a tubercle for the spine-inseration. They are arranged in a rather regular row and are fastened to the superomarginals and the carinals either by their short prolongations, or by small accessory plates, which may often have a small spine.

The disk is usually set off from the rays. The madreporite is well formed and without any spines. Nor is there any circle of spines around it.

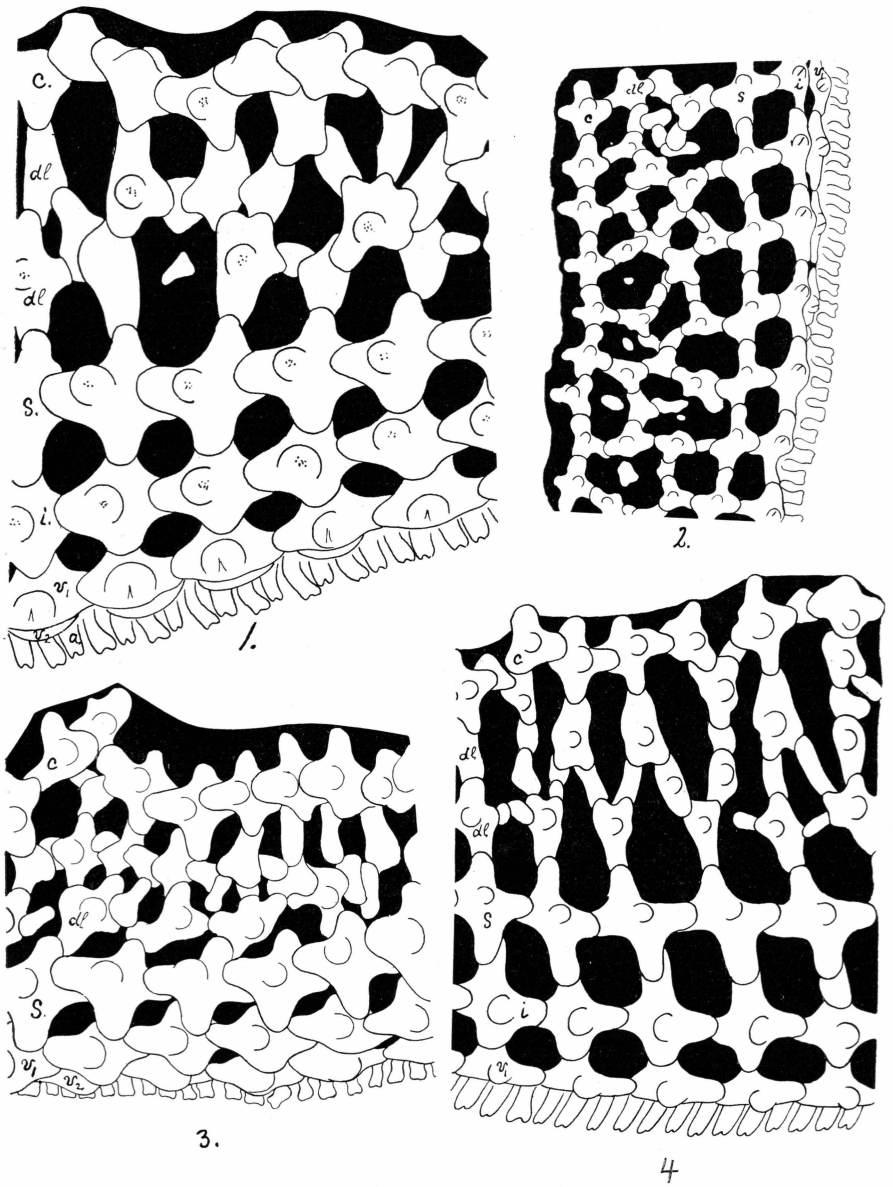


Fig. 18. Skeleton of *Leptasterias mülleri* f. nobilis (typespecimen) (1), *L. degerbølli* (typespecimen) (2), L. *mülleri* (typespecimen) (3), *L. danica* (neotype) (4). a. adambulacrals; v_1 ventrolaterals of 1st order, v_2 ventrolaterals of 2nd order; i. inferomarginals; s. superomarginals; dl. dorsolaterals; c. carinals. In 3 the disk is placed to the left of the figure, in the other figures the disk is close to the broadest part of the figure.

The size of well developed specimens is not large, as the length of the rays is normally 20—30 mm.

Due to its small size and robust apearance with the regularly ar-

ranged rather terete spines *Leptasterias mülleri* (M. Sars) is an easily recognizable species. It is found at the Norwegian coast down to the Kristineberg Zoological Station in Sweden and is one of the most common sea-stars at Iceland[1]). There are further some few specimens from the Faroes in the collection at hand.

Leptasterias hyperborea varietas *intermedia* n. var.

The variety *intermedia* differs from *mülleri* in having more slender and gradually tapering rays and small irregularly arranged dorsal spines, and most probably it should be regarded as an independent species.

The marginal spines are solid and cylindrical and arranged in regular rows, but the dorsolateral and carinal spines are small forming a rather even spinulation in the dorsal area of the rays. The adambulacral spines are slightly smaller than the marginals. They are normally rather constantly monacanthid, but now and then an arm may have a number of adambulacrals which are alternating monacanthid and diplacanthid. The straight pedicellariae are as in *mülleri* few and mostly confined to the angles between the rays. The crossed pedicellariae are rather scarce, as there are but 2—6 at each dorsal spine and a small circle with up to ten pedicellariae around the marginal spines. On the adambulacral spines there are as in *mülleri* 12—14 in a cluster on the side of the spine.

According to the arrangement of the spines the shape of the skeleton is rather characteristically differing from that of the skeleton of *mülleri*. The marginal plates are strongly developed, and may often afford some very characteristic high sides to the rays. Besides, the second ventrolateral row is well developed and supplied with normal spines and part of the ray is provided with a third row of ventromarginal plates, which may now and then bear a little spine. The carinals are faintly developed and rather difficult to distinguish from the dorsolateral plates, which are not regularly arranged as in *mülleri*. The size of this form is slightly larger than that of *mülleri* as in normal specimens the rays are about 40—45 mm long. In living specimens the colour is a bluish purple on the dorsal side down to the superomarginal spines. The sides and the ventral side are of a pale bluish white.

In the general appearance as well as in the features of the skeleton this form is the closest related to *hyperborea*, there are however some specimens of *mülleri* from Bergen which resemble it so much that one may be inclined to suppose that *intermedia*, is perhaps as well a variety of *mülleri* as of *hyperborea*. The fact that the Iceland-form of *mülleri* var. *nobilis* differs so distinctly from *intermedia* however speaks against such a supposition.

Var. *intermedia* is from the Faxa Floi, the type-locality, destributed

[1]) The robust form from Iceland aught to be regarded as a separate variety var. ***nobilis*** n. v.

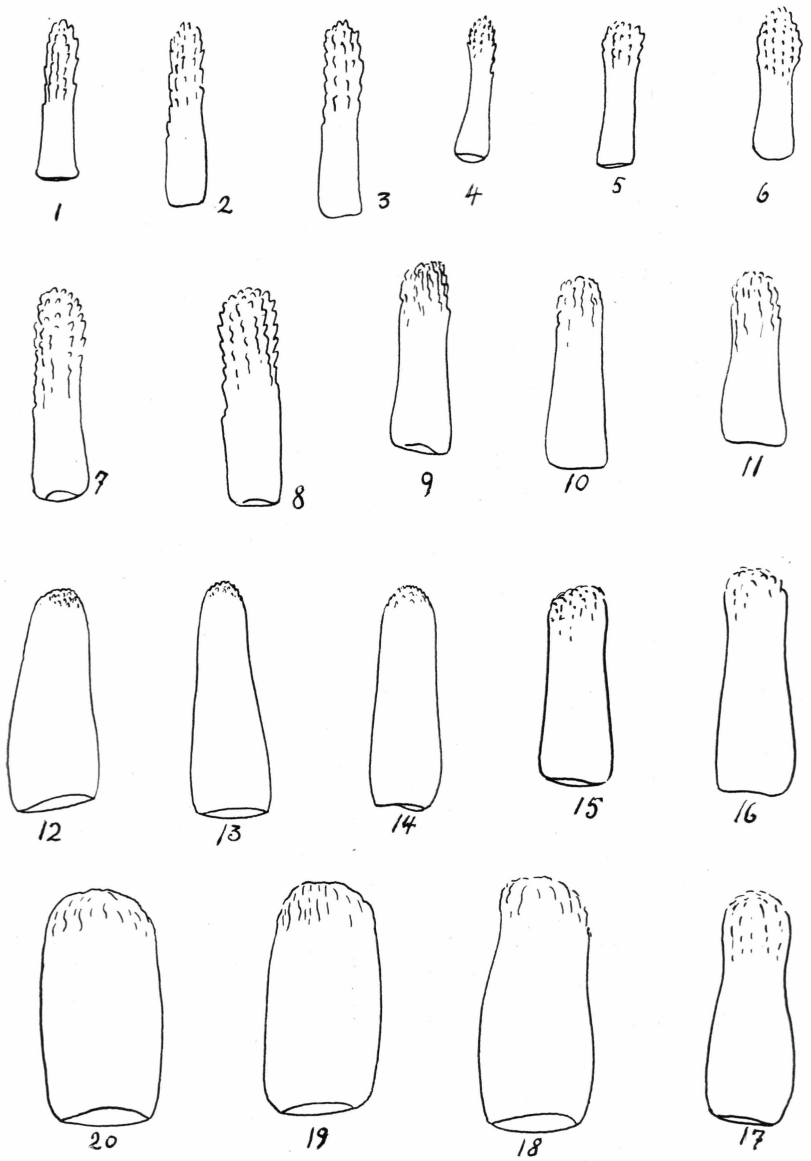


Fig. 19. Carinal spines of *L. degerbölli* (1—3), *L. floccosa* (4—6), *L. floccosa* v. *crassa* (7—8), *L. danica* (9—11), *L. mülleri* (type) (12—14), *L. hyperborea* v. *floccosoides* (15—17), *L. mülleri f. nobilis* (18—20).

to West-Greenland, where it is found in the same areas as *floccosa* var. *crassa*. *Intermedia* and *crassa* are most easily separated in *intermedia* being more spiny on the side of the rays, in other characters they may be rather alike.

Type-Locality 64°08′ N. 22° 22′ W. 45 m (ca. 50 specimens).

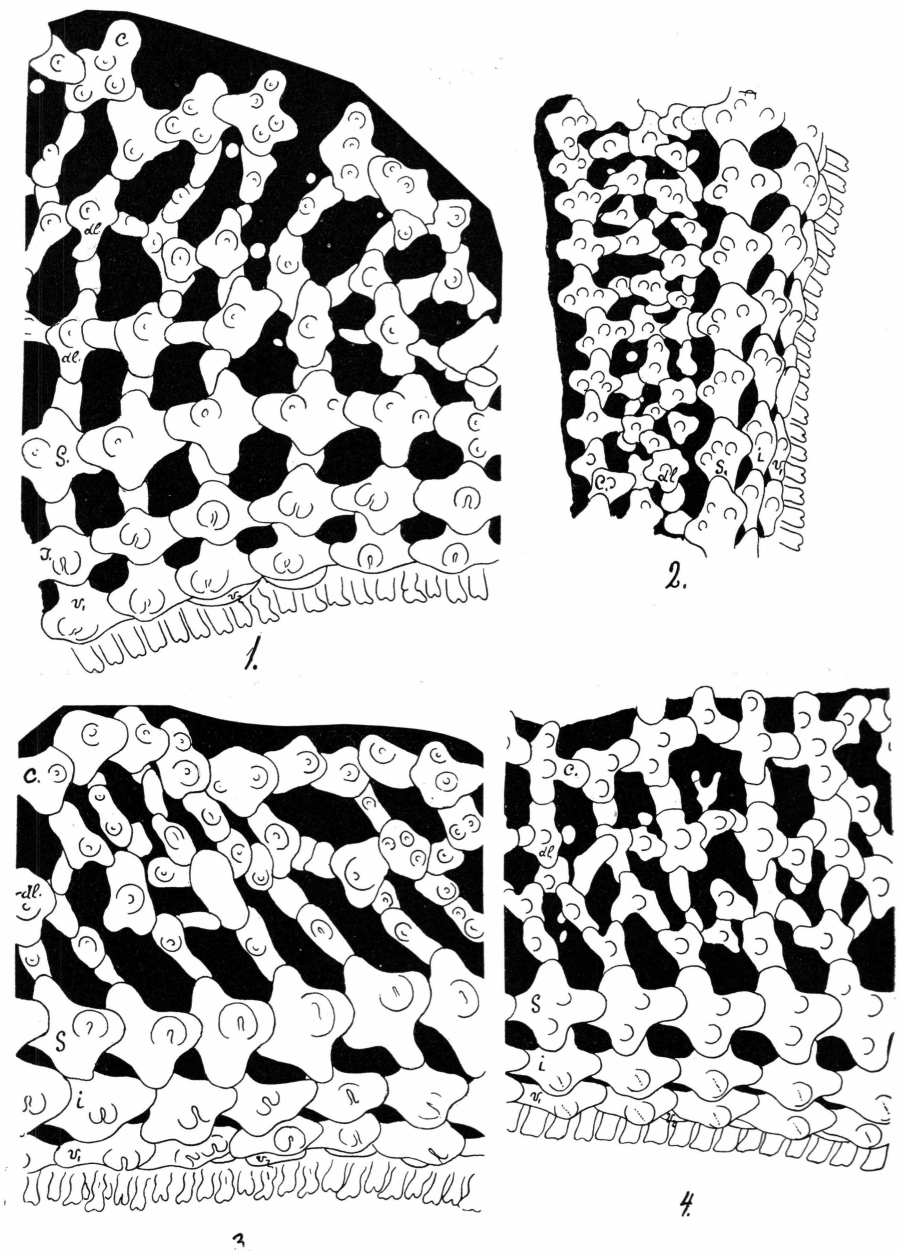


Fig. 20. Skeleton of *Leptasterias islandica* (from the Faroes) (1), from Iceland (the Type) (3), of *Leptasterias floccosa* (Type) (2) and of *L. floccosa* v. *crassa* (4) [type]. c. carinals; dl. dorsolaterals; S. superomarginals; i. inferomarginals; v_1—v_2. ventrolaterals of 1st and 2nd order.

Leptasterias islandica (Levinsen).

Asterias mülleri var. *islandica* LEVINSEN 1887. Karahavets Echinodermata pag. 393.

This species has even shorter rays than *mülleri* as R:r = about 3, but as the rays are more gradually tapering, the appearance is not so robust as that of *mülleri*. The spines are almost of the same lenght all over the body, and are on the dorsal side of the rays and the disk rather uniformly scattered, seldom with a faint longitudinal arrangement in the carinal area. They are thick and short, and more or less capitate, often bulbshaped or even transformed into a thick disk on a short stem.

Straight pedicellariae apparently absent. Crossed pedicellariae exceedingly scarce, only one to three at the base of each of the dorsal spines, 2—3 on each adambulacral spine and a circle or a cluster of 5—8 pedicellariae on the ventromarginal and inferomarginal spines.

The skeleton consists of very large superomarginal and inferomarginal plates, small but regularly developed ventrolateral plates, and large dorsolateral and carinal plates irregularly scattered over the dorsal side. The very large superomarginal and inferomarginal plates afford the side of the rays two rows of large regular square papulareae each with three papulae. The ventrolateral plates are placed close to the adambulacral plates, and a second row of ventrolateral plates does not occur, only now and then there may be one or two plates between the ventrolateral plates and the adambulacrals (i. e. the rudiments of a second row) but these are very narrow and not supplied with spines. Of the other plates, the ventrolaterals and marginals have one large tubercle each for the inseration of a spine. Some of the dorsolateral plates and the carinals, however, have two or three such tubercles. This explains the fact that the surface of these specimens is rather densely spined in spite of the rather open-meshed skeleton. Most of the specimens at hand are regularly monacanthid, but diplacanthid adambulacrals may naturally be found now and then, and LEVINSEN states that this feature is somewhat varying.

Leptasterias islandica is a very characteristic species, which cannot be confounded with other Atlantic species of the Genus. In the thick an capitate spines as well in the short arms it bears a rather close resemblance to *Leptasterias arctica* Murdoch, but cannot however be referred to that species. Not only is the exceedingly different locality, the Faroes and the Bering See, opposed to this view, but FISHER's many fine fotographs of the different forms of arctica and its forma *beringensis*, also definitely show that we have to deal with two different species. In this I definitely disagree with DJAKONOW, who states (Op. cit. pag. 35 below) that "Diese dickstacheligen Exemplare sind auffallend der aus dem Beringmeer bekannten *Leptasterias arctica* Murdoch ähnlich. Ich halte

es für sehr wahrscheinlich, dass es wircklick diese Art oder wenigstens eine Localform derselben ist". If in the Zoological systematics we want to obtain more than a catalogue of various morphological forms ("species" in the old sense) i. e. want to find out how the different morphological forms are phyllogenitically related and how they vary on account of different geographical and ecological conditions, I consider it very dangerous not only to unite apparently related forms before they are so well known that there is no doubt about their identity, but I also deem it dangerous to unite such two forms as *arctica* and *islandica* the destribution of which is so different, and as to which no connecting forms are known.

Leptasterias islandica Levinsen is represented in a small number from Iceland, and in a larger number from the Faroes. Whether this really

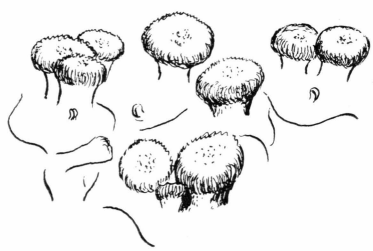


Fig. 21. Dorsal armspines of *L. islandica* (type).

indicate that it is more common at the Faroes than at Iceland is not certain, as the larger number of specimens from the Faroes at hand dates from the recent systematic Zoological examination of the Faroes.

varietas *gracilis*.

On board the exploringsteamer "Dana" in the Summer 1933 I got a specimen of *Leptasterias* from 57°23′ N 3°26′ W., 61 m. The specimen was alive pure white with a faint tinge of red on the disk. The arms are rather long as R:r = about 7. The spines are large and subcapitate and on the dorsal side of the rays irregularly placed. The marginal spines are long and pointed and all the spines are supplied with a circle of crossed pedicellariae. The adambulacrals are all monacanthid and with a little cluster of pedicellariae.

The skeleton consists of very regular ventrolaterals, inferomarginals and superomarginals, leaving but small papulaarea, irregularly scattered dorsolaterals and very regularly arranged carinals and adjoining pieces of dorsolaterals.

The general appearance of this specimen is in all characters, except the dorsal spines, like a slender *islandica*. In the arrangement of the carinals and in having the adambulacral spines pronounced monacanthid,

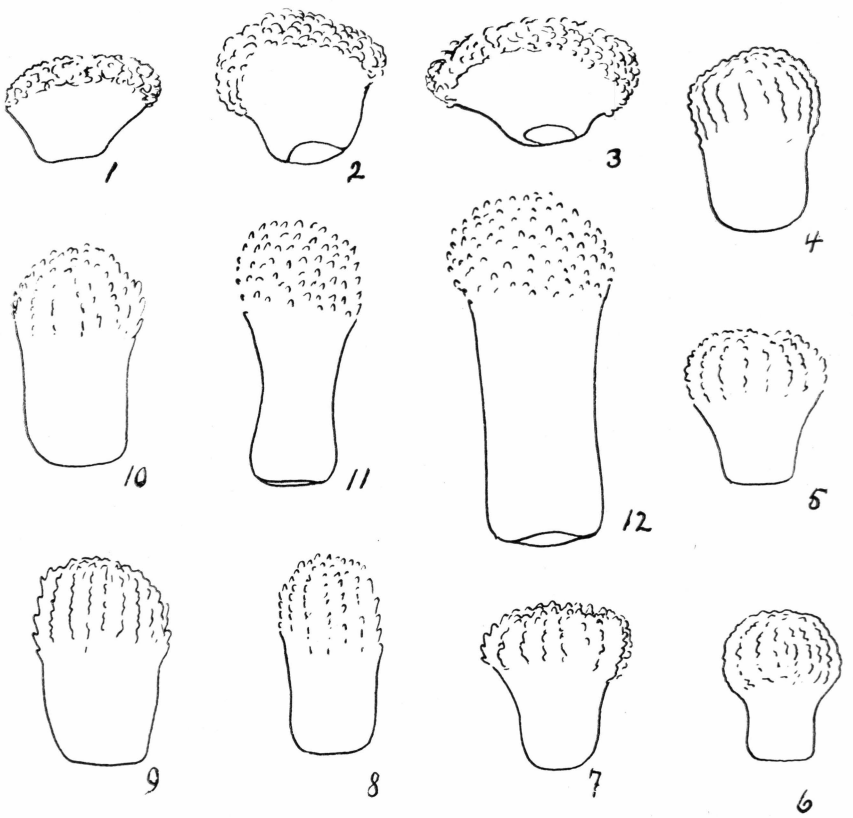


Fig. 22. Dorsal armspines of *L. islandica* (type) (1—4), of specimen from the Faroes (5—7), of *L. isl. v. gracilis* (8—10), of *L. hyperborea* (11—12).

the specimen at hand resembles a specimen of *danica* Levinsen, but the capitate dorsal-spines are opposed to this. Most reasonably the specimen at hand is a hybrid, but as this is so difficult to decide, I prefer to describe it as a variety of *islandica*.

Leptasterias danica (Levinsen).

Asterias mülleri var. *danica* Levinsen 1887. Kara-Havets Echinodermata pag. 393.

Rays five, long and elegant. They are slightly swollen at the base, but soon strongly tapering (R = 6r). The spines are tiny and suplied with a circle of crossed pedicellariae. There is a rather regular carinal row and three lateral rows. Dorsolaterally there are further two irregular rows of spines. The adambulacral plates are pronouncedly monacanthid. The adambulacral spines are long and thin and supplied with a cluster of 3—8 crossed pedicellariae. Straight pedicellariae not found.

The skeleton has well developed inferomarginal plates and superomarginal plates forming large square papulaareae with normally but one

papula in each. The ventrolateral plates are small, but supplied with equally strong spines as the other plates. The dorsolateral plates are very characteristically arranged, forming small figures of Y. The carinals are distinct but arranged in zig-zag.

The colour is faintly red.

There seems to be no doubt that *Leptasterias danica* is a good species, which differs distinctly from its closest neighbours *mülleri* and *islandica*. It is apparently most closely related with degerbölli but the different distribution is against any closer relation between the two species, if we have not to deal with a relict form of *degerbölli* from the southern Kattegat.

Leptasterias hyperborea Danielssen & Koren.

Asterias hyperborea DANIELSSEN & KOREN 1882. Fra den norske Nordhavs Exp. V pag. 269.
— — DANIELSSEN & KOREN 1884. The Norwegian North Atlantic Exp. pag. 10—14. Pl. III figs. 1—7.
— — DÖDERLEIN 1900. Die Echinodermen der Olga-Expedition pag. 198. Pl. IV fig. 2, Pl. V fig. 4—5.
— — LUDWIG 1900. Arktische Seesterne pag. 484.
— — v. HOFSTEN 1915. Echinodermen des Eisfjords pag. 62.
Leptasterias hyperborea FISHER 1930. Asteoridea of the North Pacific pag. 207.
— *mülleri f. hyperborea* DJAKONOW 1930. Zur Frage der Artberechtigung der *mülleri--groenlandica*-Gruppe der Asteridengattung *Leptasterias*.
— — — DJAKONOW 1933. Echinodermes des Mers Arctiques pag. 67.

Rays five, rather long (R:r = about 6,5) and supplied with a coat of irregularly scattered robust spines without any longitudinally arrangement on the dorsal side. The spines are cylindrical, thick and solid with blunt ends. At their base they are surrounded by a circle of crossed pedicellariae. The ventral spines are somewhat larger than those on the dorsal side, and usually a little curved and often flattened at the ends. The adambulacral spines are placed very regularly alternating one and two, and in such a way that when there are two spines the one towards the furrow is but a very thin one in spite of being of the same length as the other. Superficially seen there are therefore not two rows of spines on the adambulacrals, but one row with regularly arranged thin spines, i. e. superficially seen the species may erroneously be considered monacanthid. Each of the adambulacral spines has a cluster of crossed pedicellarians. Large straight pedicellariae are rather common even on the dorsal side of the distal end of the rays.

The skeleton is very solid even in small specimens. It has regularly developed and arranged superomarginal plates, inferomarginal plates and ventrolateral plates of I—II—III order, those of the III order,

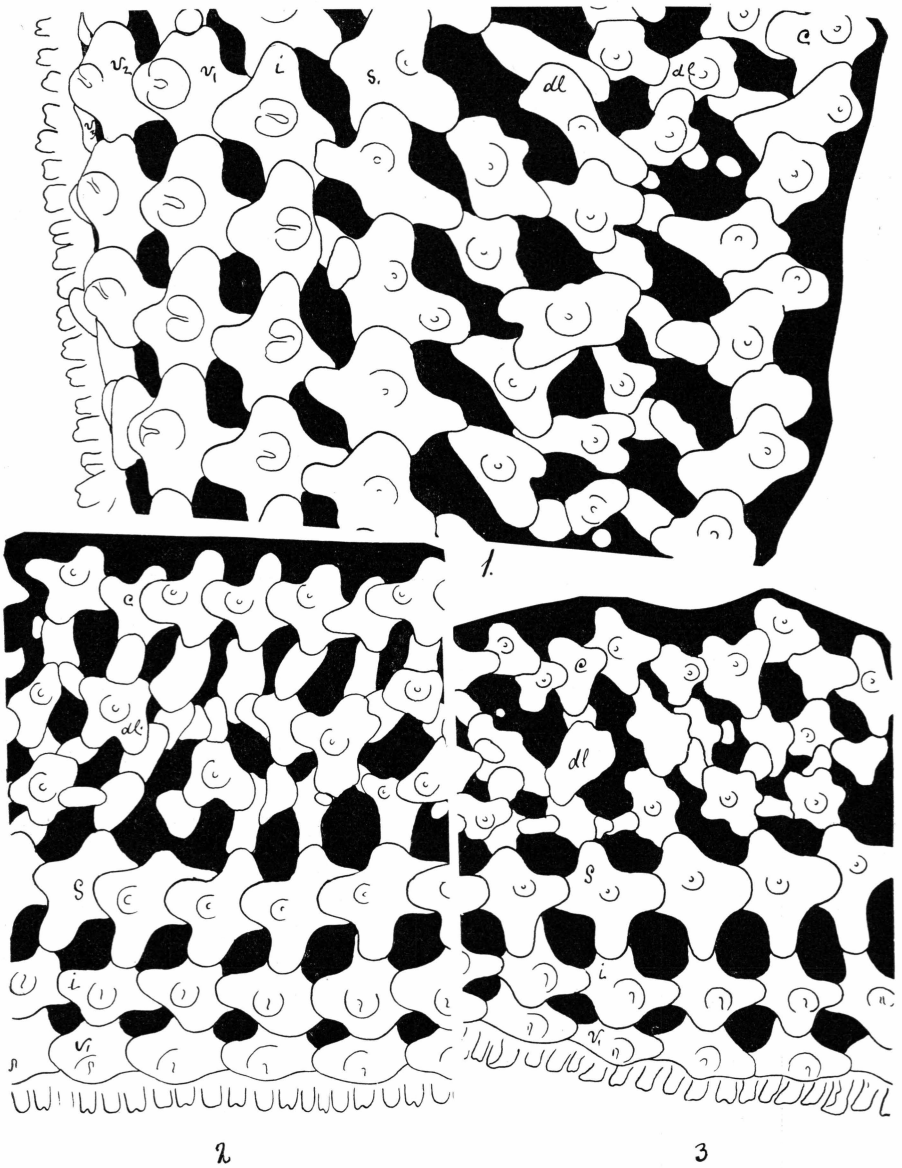


Fig. 23. Skeleton of *L. hyperborea* (1), *L. islandica v. gracilis* (2) and *L. hyperborea* v. *floccosoides* (3). c. carinals; dl. dorsolaterals; s. superomarginals; i inferomarginals; v_1—v_3. ventrolaterals of 1st, 2nd, 3d order.

however, normally without spines. The dorsolateral sceleton consist of two irregular rows of large cross-shaped plates supplied with tubercles for the inseration of spines, and a number of irregularly arranged plates normally without spine-tubercles. The carinal plates are well developed and rather regularly arranged in a row.

This large species, by far the largest of all European and Arctic *Leptasterias*-species is of an exceedingly characteristical appearance, and may solely on account hereof be easily distinguished from all the other forms, only very small and young specimens may be rather like young *mülleri*, confusion of well developed specimens of the two species is impossible. The reason why DJAKONOW in 1930 could not distinguish with certainty between the two species, was that he did not know the real *mülleri*, as he had not seen the typespecimens of it. Therefore he regarded deviating specimens of *hyperborea* as *mülleri* and very reasonably could not find certain differences between the two species. In spite of the very characteristic appearance of *hyperborea* and its common occurence in the rather deep water North of the Faröes, this species is rather seldom found. I quite agree with v. HOFSTEN that true *hyperborea* were only found with certainty a few times. The different localities of *hyperborea* mentioned by DJAKONOW are not certain, as he confounded this form with *mülleri* and most reasonably also with specimens very probably belonging to *islandica* var. *gracilis*. In the collections of the zoological Museum of Bergen there are, besides the typespecimen, only a few fragments of *hyperborea*. In the Summer 1933 I had the luck to get a rather large material of good *hyperborea* from the Faröes and am thus able to give some measurements of this species, based on good specimens. These are rather valuable, as LUDWIG (Op. cit. pag. 484) has given some measurements of Römer-Schaudinn's specimens from Spitzbergen, and

Measurements of specimens from 62°13′ N. 6°21′ W. 78. m.

R	r	R:r	W_1*)	W_2*)	$W_1 : W_2$	Number of inferomarginal-spines
78	10	7,8	13	12	1,0	35
76	10	7,6	14	9	1,5	41
73	10	7,3	13	7	1,9	36
72	12	6,0	15	9	1,6	36
69	10	6,9	16	8	2,0	38
64	10	6,4	15	8	1,9	28
62	10	6,2	17	8	2,1	31
60	10	6,0	15	8	1,9	25
55	10	5,5	12	7	1,7	24
52	10	5,2	16	8	2,0	28
52	9	5,7	12	10	1,2	24
51	9	5,6	12	7	1,7	28
45	7	6,4	10	6	1,6	22
44	7	6,3	10	7	1,4	27
40	6	6,6	11	9	1,2	28

*) W_1 and W_2 are the diameter of the rays in $^1/_5$ and $^4/_5$ of the length of ray from the base of rays. $W_1 : W_2$ gives the shape of the ray.

thereby showed that the proportion of R and r is correlating with the size of R. Further Ludwig's specimens are for the greater part only small and those at hand are all rather large.

It is seen from this table that the proportion of disk and Rays (R:r) is correlating with the length of rays, as showed by Ludwig, but the surprising constancy of r in the larger specimens gives a value of R:r higher than that found by Ludwig (R = 95, R:r = 6,33).

Distribution: True specimens of *hyperborea* are hitherto only recorded from Spitzbergen (Römer—Schaudinn & v. Hofsten), Bear Island (Norwegian North Atlantic Expedition and Olga-Expedition) and the Faroes (Mortensen [unpublished] and Heding). In all these localities *hyperborea* is found in water with positive temperature and therefore I do not se any reason for naming it a cold water form as done by various authors.

forma *floccosoides* f. n.

In the collections of the Zoological Museum of Copenhagen there are seven specimens of *Leptasterias*, which may undoubtedly be referred to *Leptaterias hyperborea*, but in spite of this they differ so much from the typical specimens of this species, that it is preferred, at any rate for the present, to regard them as a variety. In general appearance they resemble *Leptasterias floccosa*, in having a "dotted" appearance, due to the small and thin dorsal spines and the large clusters of pedicellarians, an appearance which is rather different from that of the typical *hyperborea*. As in *hyperborea* the dorsal spines are scattered over the rays, without any longitudinal arrangement. Large straight pedicellariae are common, there are usually one large and a pair of smaller ones in the angles between the rays, and large ones may be found along the ventrolateral armplates.

The dorsal skeleton quite agrees with that of *hyperborea*, but there is but one row of ventrolateral plates and these are not well developed, and the inferomarginal plates are placed so close to them that the papular areas between the two rows of plates is very small.

These specimens (from E. to S. of the south-end of Nolsø, 80 fths.) very much resemble the little specimen of *hyperborea* figured by Döderlein in the "Olga"-Echinoderms (op. cit. pl. V fig. 4) and most reasonably they all represent the same form. Döderlein regards his specimen as a young specimen of *hyperborea*, which agrees with the fact that his typical specimens were both very large. The comparison of these specimens with the good specimens at hand shows that they cannot be regarded as identical, at any rate not on basis of the material known of *hyperborea*. The largest specimen at hand has R = 45 mm.

Leptasterias floccosa var. *crassa* n. var.

Asterias mülleri v. floccosa MORTENSEN 1903. Echinoderms from East-Greenland pag. 68.

Kangerdlugsuak	St. 18, $^{14}/_{8}$ 32. 10 m.....	1	specimen
—	St. 24, $^{18}/_{8}$ 32. 20 m.....	1	—
—	St. 26, $^{18}/_{8}$ 32. 11—15 m.....	1	—
—	St. 27, $^{18}/_{8}$ 32. 25 m.....	3	—
—	$/_{8}$ 32.	2	—

The specimens at hand vary in size from R = 13 mm to R = 36 mm, thus attaining a slightly larger size than the type-specimens of *floccosa*, which at a size of R = about 25 mm have youngs around their mouth. The larger specimens are very characteristic in their general appearance, and do not resemble other forms of *Leptasterias*. They have rather small, at any rate very thin spines, and owing to their pedicellarians and thick skin at the base the spines afford, the "dotted" appearance, mentioned by LEVINSEN. LEVINSEN, who did not use the microscope for examinations as those of the general appearance of a seastar, supposed that the "dotted" appearance of *floccosa* was due to a large number of pedicellariae, which is not correct. Not only the variety at hand, but also LEVINSENS typespecimens of *floccosa* have but few pedicellariae around the dorsal spines, but the pedicellariae as well as the base of the spines, are supplied with a rather thick skin, which give the specimens their characteristic appearance.

The spines are very thin and of varying length, being however relatively longer than the spines of *floccosa*. As in *floccosa* they are not arranged in rows on the dorsal side of the rays, but scattered evenly, though more sparsely. On the carinal plates, and now and then also on some of the other plates, there are more than one spine, the secondary spines being always smaller than the primary ones. The large primary spines are placed on the central tubercle of the carinals, and supplied with a circle of 6—10 pedicellariae. The smaller secondary spines are placed on tubercles on the lateral wings of the carinals, and have only two to three pedicellariae.

This feature, to have more than one spine on the skeleton-plates, appearantly places these two forms, *floccosa* and var. *crassa*, closer to *groenlandica* than to any of the other species, except *islandica*; and may ultimately prove to be a character of no little value, for the classification of the species of *Leptasterias*, though we are not able for the present to see how much stress should be laid on this.

The marginal spines are a little larger than the dorsal spines, and the ventrolateral ones are usually a little curved, and flattened at the

tip. The adambulacrals are rather regularly alternating monacanthid and diplacanthid, though abnormalities are common.

The crossed pedicellariae are placed on the spines, in preserved specimens at the base of the spines, but not in any large number. Large straight pedicellariae are very common and may be found all over the surface. In comparison with the spines they are very large, being often of the same length as the secondary carinal spines.

The skeleton consists of a rather open meshwork composed of well developed carinal plates, rather irregularly scattered, not always imbricating dorsolateral plates, large regular superomarginal plates and rather large threearmed inferomarginal plates. Ventrolateral plates are well developed, forming narrow plates with large tubercles. The carinals and some of the other large plates may have 1—3 tubercles, a feature which is however not so common as in *floccosa*.

In spite of LEVINSEN's statement: " E Groenlandica exemplaria numerosa vidi", there is in the Zoological Museum of Copenhagen only a single glass with specimens of *floccosa*, being so old that LEVINSEN may have seen them. This glass contains 14 specimens from the Davis-Strait (100 fths.), and as there are but these in the Museum and Dr. MORTENSEN further maintains that they have been determined by LEVINSEN himself, there can be no doubt that they are to be regarded as the typespecimens of *floccosa*; a single typespecimen does not exist. As further LEVINSEN's diagnosis of this hitherto problematic species is very brief and without figures, it is preferred to give a short description of the type-specimens illustrated by a few figures, the figured specimen then to be considered the type.

The typespecimens of *floccosa* are rather small, measuring but 22—25 mm in R. Their maturity is ascertainable, as some of them are carrying youngs in the cavity between the raised armes. The rays are short and thick. The spines are small and slender. Dorsal and lateral spines rather alike, the latter being only somewhat longer than the first. The spines are not arranged in rows, and the fact that they are evenly scattered over the rays is attributable to the arrangement of more than one spine on each skeleton plate.

The crossed pedicellariae are not so abundant as stated by LEVINSEN, as there are but 3—8 on each spine. The spines of the disk are devoid of crossed pedicellariae. Straight pedicellariae are rather scarce, and distinctly smaller than those of var. *crassa*. The skeleton consists of a regular row of large carinals and superomarginals, some irregularly arranged dorsolaterals and two narrow rows, inferomarginals and ventro-

laterals. All the larger plates have 2—3 tubercles, and this is even the case with the ventrolaterals.

It is obvious that the two forms dealt with here, *floccosa* and var. *crassa*, cannot be referred to the same systematic form, as the differences, in the general appearance as well as in many minute characters are too great. Nor can they be regarded as different species, which is seen from the strong resemblance in the spinulation, a resemblance which unites these two forms and places them both rather closely to *groenlandica*.

The distribution of *floccosa* and v. *crassa* appears to be rather interesting (Map 2 p. 40) as *floccosa* was taken in the Baffin Bay and at the Northern part of East-Greenland, and v. *crassa* was taken from Kangerdlugsuak and round the southern end of Greenland. This distribution bears a rather striking resemblance to that of *Henricia eschrichtii* and *H. eschr.* v. *laevior*, as also to that of other specimens, which range from the East-Coast round the North-Coast to the northern part of the Bafin-Bay.

Leptasterias degerbölli n. sp.

Kangerdlugsuak St. 26 $^{18}/_{8}$ 32 11—15 m..... 2 specimens

Diagnosis: Size small to medium. Rays five, slender, gradually tapering, bluntly pointed. With of ray close to base 5,5 mm, at the middle of the ray 3,5 mm and close to the end 2 mm. R = 27 mm, r = 4 mm, R:r = about 7. Rays not swollen at base, well arched with curved lateral face. Spines small, dorsally rather equal in diameter, striate, usually noncapitate or slightly subcapitate. Dorsal spines with 1—2 (3) crossed pedicellariae arranged at the base of the spines, lateral spines (i. e. inferomarginal and superomarginal spines) surrounded by a circle of 6—8 crossed pedicellariae. Carinal spines in a rather straight line, superomarginal, inferomarginal and ventrolateral series of spines regular. Intermarginal spines almost quite lacking. Adambulacrals nearly pure monacanthid. Ungulate straight pedicellarians apparently totally lacking. Skeleton rather fine with large papular areae, each with 1—2 papulae. There are two regular rows of large square papulaareae along each row of superomarginal plates and along the carinal plates, a feature which gives the specimen a rather characteristic appearance. Inferomarginal plates threearmed and placed close to the narrow ventrolateral plates. All real plates, carinals — 2 rows of dorsolaterals — marginals and ventrolaterals have one large tubercle for spine-inseration and no more.

Discussion: The general appearance of this specimen is so characteristic, that it cannot be confounded with any of the other species of

Leptasterias. The two only species which resembles it in some degree are *Leptasterias hylodes* Fisher and *Leptasterias danica* (Levinsen), but the differences are so strong that it cannot be referred to any of them even if the very different localities were not taken into consideration.

It differs distinctly from *floccosa* in being pronouncedly monacanthid, in having but one spine on each plate and in the general appearance. The second specimen which is found at the same station is so small that it cannot be determined with certainty. However as, it differs from specimens of the same size from Kangerdlugsuak, there is some reason for believing it to be the same as *degerbölli*, though it differs from it in some faint features, probably on account the minute size (R = 11 mm).

III. OPHIUROIDEA

Ophioscolex glacialis Müller & Troschel.

Ophioscolex glacialis Müller & Troschel 1842. System der Asteriden pag. 109.
— — Sars 1861. Norges Echinodermer pag. 7.
— — Grieg 1900. Ophiuriden der Arktis pag. 268.
— — Mortensen 1903. Echinoderms from East Greenland pag. 86. Pl. II fig. 10.
— — Mortensen 1910. Echinoderms of North East Greenland pag. 274.
— — Mortensen 1913. Echinodermer (Consp. Faun. Groenl.) pag. 361.
— — v. Hofsten 1915. Echinodermen des Eisfjords pag. 117.
— — Mortensen 1920. Notes on some Scandinavian Echinoderms pag. 46—48.
— — Mortensen 1927. Handbook of British Echinoderms pag. 169.
— — Mortensen 1932. Echinoderms of the "Godthaab" Exp. pag. 25.
— — Mortensen 1933. Ophiuroidea of the Danish Ingolf Exp. pag. 14. Pl. II fig. 2—3.

Mikis Fjord. $^{25}/_{8}$ 32, 175 m Mud..... 3 specimens

The specimens at hand are rather large, with a diameter of 15—20 mm. In general appearance they agree rather well with the typical forms of *Ophioscolex glacialis*, but the dentation of the yaws is very different from e. g. the figure in British Echinoderms (fig. 95a pag. 170), as well as from the figures in the "Ingolf" *Ophiuroidea* (fig. 4a-c pag. 16). As the specimens at hand are further, rather varying in this feature, the mode of dentation cannot be regarded as a specific character of high importance. The figures (fig. 24) show the dentation in specimens with a disk-diameter of 15 mm and 18 mm.

Ophioscolex glacialis is distributed in the North Atlantic from the

Faroe-Channel to East Greenland-Jan Mayen-Spitzbergen and the Kara Sea. As to the distribution in Greenland waters cf. MORTENSEN 1913.

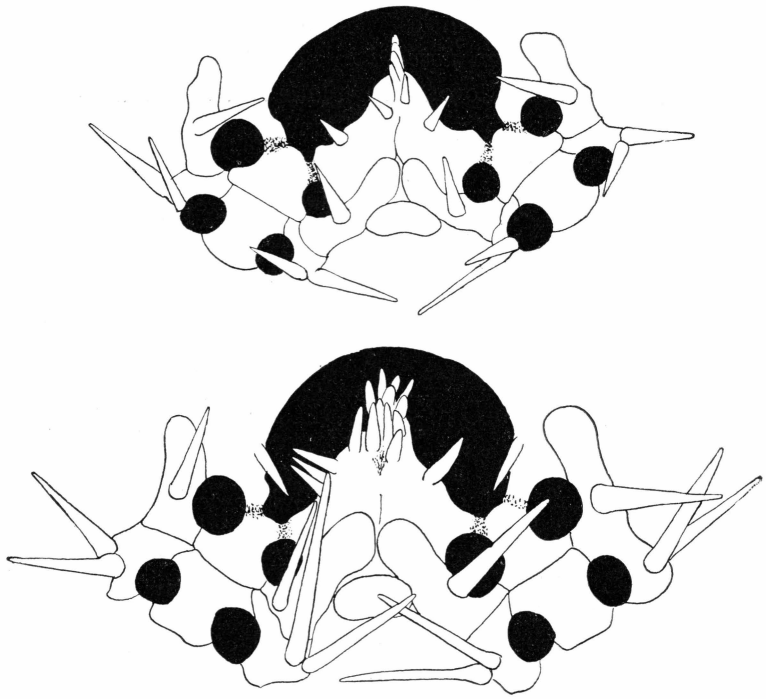


Fig. 24. *Ophioscolex glacialis* from Mikifjord. Varying dentation of the mouth-plates.

Ophiacantha bidentata (Retzius).

Asterias bidentata RETZIUS 1805. Diss. sistens species cognitas Asteriarum pag. 33.
Ophiocoma bidentata MÜLLER & TROSCHEL 1842. System der Asteriden pag. 99.
Ophiacantha bidentata MORTENSEN 1903. Eschinoderms from East Greenland pag. 86.
— — MORTENSEN 1910. Echinoderms of North East Greenland pag. 274.
— — MORTENSEN 1913. Echinodermer (Consp. Faun. Groenl.) pag. 358.
— — v. HOFSTEN 1915. Echinodermen des Eisfjords pag. 109.
— — GRIEG 1924. Molluscs, Brachiopods and Echinoderms from Novaja Semlja pag. 22.
— — MORTENSEN 1927. Handbook of British Echinoderms pag. 196.
— — MORTENSEN 1932. Echinoderms of the Godthaab Exp. pag. 26.
— — MORTENSEN 1933. Ophiuroidea of the Ingolf Exp. pag. 20—22.

Kangerdlugsuak	St. 1, $^{10}/_{8}$ 32. 80 m.....	1	specimens
—	St. 3, $^{11}/_{8}$ 32. 70 m.....	3	—
—	St. 7, $^{11}/_{8}$ 32. 20—40 m.....	1	—
—	St. 11, $^{12}/_{8}$ 32. 20—25 m.....	*2	—

Kangerdlugsuak	St. 12,	$^{12}/_{8}$ 32.	80—100 m.....	*1 specimen
—	St. 18,	$^{14}/_{8}$ 32.	10 m.....	4 —
—	St. 24,	$^{18}/_{8}$ 32.	20 m.....	1 —
—	St. 26,	$^{18}/_{8}$ 32.	11—15 m.....	1 —
—	St. 27,	$^{18}/_{8}$ 32.	25 m.....	1 —
—		$^{20}/_{8}$ 32.	175 m.....	*1 —
Mikis Fjord		$^{25}/_{8}$ 32.	175 m.....	several —

The greater part of the specimens at hand are quite typical *Ophiacantha bidentata*, but the four specimens from Kangerdlugsuak St. 11 and 12 and from Kangerdlugsuak $^{20}/_{8}$ differ very characteristically from most of them, in having two large tentacle-scales at the first Armpore (cf.

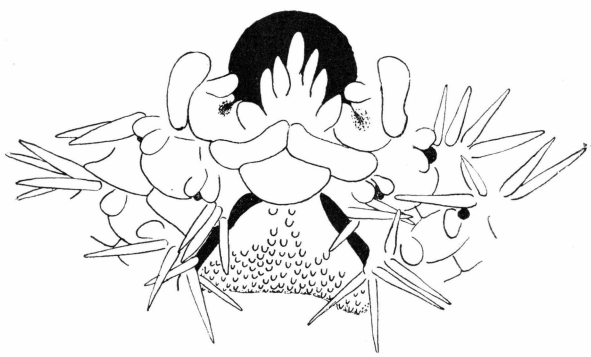


Fig. 25. Ophiacantha bidentata f. glacialis.

fig. 25). owing to this character there is no doubt that these specimens are the same as *Ophiocoma arctica* Müller & Troschel (Syst. Ast. pag. 103). Whether this species should be regarded as good, or it may be regarded as a synonyme of bidendata is not quite certain. Lütken (Grønlands Echinodermata pag. 53) regards it as a synonym of *Ophiacantha spinolosa* and most other Authors refer them to *bidentata*. The presence at Kangerdlugsuak of these four specimens of true *arctica* is apparently in favour of regarding it as a valid species. On the other hand, its occurrence among so many good *bidentata*, specimens with which it agrees in all characters other than the paired 1st tentaclescales, is in favour of uniting the two forms. Further the fact that a pair of the *bidendata*-specimens have abnormal tentacle-scales (the one has 2 scales at one of the first armpores, 1 at the other 9, and the other specimen has 2 at one, 3 at one, and one at the eight armpores shows that the number of tentacle-scales in the arctic specimens is variable, and that there can be little doubt that *Ophinocoma arctica* should be regarded as synonym with *bidentata*.

In "Handbook of British Echinoderms" Mortensen states as a characteristic feature for this species that it is known to be phosphorescent. It may be stated that in the summer 1933 the present

author caught some specimens of *Ophiacantha abyssicola* at the Faroes at a depth of 1300 m, specimens which were very strongly phosphorescent, a feature which may be more prevalent within this genus and thus it cannot perhaps be regarded as being of systematic value.

Ophiacantha bidentata is a circumpolar species, which is very common at both sides of Greenland. A careful list of Greenland localities was given by MORTENSEN in 1913 (Op. cit. pag. 359). [cfr. Notes p. 68]

Ophiura robusta (Ayres).

Ophiolepis robusta AYRES 1851. Proc. Bost. Soc. Nat. Hist. IV pag. 134.
Ophioglypha robusta LYMAN 1865. Oph. and Astroph. Ill. Cat. Mus. C. Indl. I pag. 45.
— — DUNCAN & SLADEN 1881. Mem. Echinoderms of the Arctic Sea to the West of Greenland pag. 62. Pl. IV fig. 5—7.
— — MORTENSEN 1903. Echinoderms from East Greenland pag. 83.
— — MORTENSEN 1910. Echinoderms of North East Greenland p. 271 Pl. XVI fig. 1.
Ophiura robusta MORTENSEN 1913. Echinodermer (Consp. Faun. Groenl.) pag. 349.
— — v. HOFSTEN 1915. Echinodermen des Eisfjords pag. 78.
— — MORTENSEN 1927. Handbook of British Echinoderms pag. 242.
— — MORTENSEN 1932. Echinoderms of the Godthaab Exp. pag. 32.
— — MORTENSEN 1933. Ophiuroidea of the Ingolf Expedition pag. 78.

Kangerdlugsuak St. 14, $^{14}/_{8}$ 32. 50 m..... 1 specimens
Mikis Fjord $^{25}/_{8}$ 32. 175 m... several —

The specimens at hand are all characteristic *Ophiura robusta*. It is surprising that this species is only found at one of the many Kangerdlugsuak-Stations, and there only in a single specimen, and that it can be collected in rather large quantities in Mikis Fjord. For the present our knowledge of the live-modies of *robusta* is not sufficient to explain this, but before long G. THORSON will publish some extensive studies on the biology of the North East Greenland bottom-invertebrata, in which also the specimens at hand will be discussed.

Ophiura robusta is widely distributed in the North Atlantic and the Arctic, and is rather common at Greenland. A list of all the localities known from Greenland was given by MORTENSEN in 1913 (op. cit. pag. 349). [cfr. further Notes p. 68]

Ophiocten seriseum (Forbes).

Ophiura sericea FORBES 1852. Sutherlands Voyage II p. CCXV.
Ophiocten sericeum DUNCAN & SLADEN 1881. Mem. Ech. Arct. W. of Greenland pag. 65. Pl. IV fig. 8—10 & 14.
— — GRIEG 1893. Ophiuroidea. Norwegian North Atlantic Exp. pag. 9.
— — GRIEG 1900. Ophiuren d. Arktis pag. 264.
— — MORTENSEN 1903. Echinoderms from East Greenland pag. 84.
— — MORTENSEN 1913. Echinodermer (Consp. Faun. Groenl. pag. 351.
— — v. HOFSTEN 1915. Echinodermen des Eisfjords pag. 88.
— — MORTENSEN 1927. Handbook of British Echinoderms pag. 247.
— — MORTENSEN 1932. Echinoderms of the Godthaab Exp. pag. 34.
— — MORTENSEN 1933. Ophiuroidea of the Ingolf Esp. pag. 96.

Kangerdlugsuak	St. 1, $^{10}/_{8}$ 32. 80 m.....	1	specimens
—	St. 12, $^{12}/_{8}$ 32. 80—100 m Stones	23	—
—	St. 14, $^{14}/_{8}$ 32. 50 m.....	2	—
—	St. 18, $^{14}/_{8}$ 32. 10 m.....	2	—
—	St. 19, $^{16}/_{8}$ 32. 10—20 m	2	—
—	$^{20}/_{8}$ 32. 175 m Mud. ...	5	—
—	$^{21}/_{8}$ 32. 450 m.....	2	—
Mikis Fjord	$^{25}/_{8}$ 32. 175 m.....	3	—

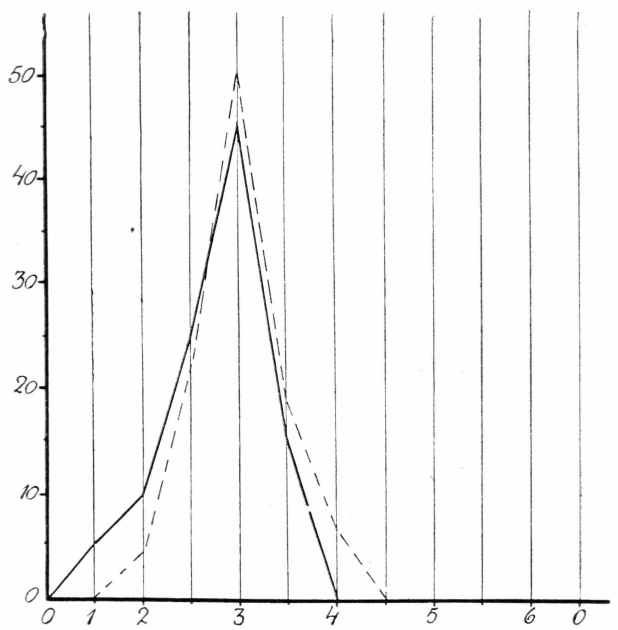


Fig. 26. Curves showing the stages of maturity of *Ophiocten sericeum* (Forbes) in Kangerdlugssuak (unbroken curve) at 50—1000 m, Aug. 12.—20., 1932, 20 ♀♀, and in the Solitærbugt, Ella Island (stipled curve), 27—41 m, Sept. 20.—22, 1931. 51♀♀. It is seen from the curves that already in August the specimens from oft Kangerdlugssuak have reached the same stage of maturity as the specimens from Ella-Island do not reach before the last third of September. The causes (different temperature in the two Summers 1931 og 32 or different ecological conditions) have not been found as yet.

Ophiocten sericeum appears to be widely destributed in the Area explored by the Mikkelsen Expedition, though it is not common in any of the stations. The specimens at hand have been examined by G. Thorson for the purpose of stating the degree of ripenes of the gonads, and the interesting result has been obtained that the breeding-curve (cf. fig. 26) nearly totally coincides with the breeding-curve of the huge material from Ella Island North East Greenland, examined by Thorson, only with the exception that the Kangerdlugsuak specimens have

their annual cyclus displaced a month. For a closer discussion of this as well for a beautifull study of the development of this species, cf. THORSEN 1934. [cfr. Notes p. 68]

IV. ECHINOIDEA

Strongylocentrotus droebachienses (O. Fr. Müller).

Strongylocentrotus droebachiensis		DUNCAN & SLADEN 1881. Mem. of the Echinoderms of the Arctic Sea to the West of Greenland pag. 19 Pl. Fig. 1—3.
—	—	MORTENSEN 1903. Echinoidea of the Ingolf Exp. pag. 162.
—	—	MORTENSEN 1903. Echinoderms of East Greenland pag. 88.
—	—	DÖDERLEIN 1905. Arktische Seeigel pag. 380.
—	—	GRIEG 1907. Echinod. II Norw. Arct. Exp. "Fram" pag. 23.
—	—	MORTENSEN 1910. Echinoderms of North-East Greenland pag. 275.
—	—	MORTENSEN 1913. Echinodermer (Consp. Faun. Groenl.) pag. 365.
—	—	v. HOFSTEN 1915. Echinodermen des Eisfjords pag. 135.
—	—	MORTENSEN 1927. Handbook of British Echinoderms pag. 313.
—	—	GRIEG 1928. Echinod. Siberian Ocean "Maud". Exp. pag. 12.
—	—	MORTENSEN 1928. Echinoderms of the Godthaab Exp. pag. 37.

Kangerdlugsuak	St.	5, $^{11}/_{8}$ 32. 50 m	1 specimen
—	St.	16—17, $^{14}/_{8}$ 32. 60—100 m	2 —
—	St.	18, $^{14}/_{8}$ 32. 10m	6 —

The specimens at hand are all very characteristic and differ from normal Scandinavian specimens in having the globiferous pedicellariae much larger. In the common Scandinavian *Strongylotus droebachiensis*, the globiferous pedicellariae may fairly well be seen with the unarmed eye, but they are not very conspicuous. In the specimens at hand they are so dominating that the specimens look as if they were covered with fisheggs. These pedicellariae measure about 1,5 mm in diameter, and differ from those of Scandinavian specimens in their "fat" appearance. An examination of the spicules shows that they are also slightly different. In Scandinavian specimens there are some, often many, but now and then very few C-shaped hooks arranged in a band along each valve. In the specimens at hand there are numerous hooks scattered all over the surface of the "head". Further the valves are not only a little larger, owing

to the larger size of the pedicellariae, but in their shape they also differ slightly from typical specimens. Whether the specimens at hand should be regarded as a variety or a characteristic cold-water form of *droebachiensis* may be a matter of future research. The present author is of the opinion that they at any rate not merely may be referred to *droebachiensis*, and that most reasonably they will turn out to be a variety.

As to the distribution of *Str. droebachiensis* in arctic Seas, reference may be made to Mortensen 1903—1913—1932. It is a common littoral-sublittoral form around Greenland, and it is even taken at the North Coast. It is circumpolar and has a rather extensive boreal distribution. [cfr. Notes p. 68]

V. HOLOTHURIOIDEA

Myriotrochus rinkii Steenstrup.

Myriotrochus rinkii Steenstrup 1851. En ny Form af de lungeløse og fodløse Søpølsers Gruppe. Videnskabelige Medd. Dansk Naturh. Foren. pag. 55. Pl. III fig. 7—10.

Chiridota brevis Huxley 1852. Appendix 10 Vol. II of Sutherland's: Journal of Penny's Voyage in Baffin's Bay and Barrows Strait pag. CCXI.

Myriotrochus rinkii Lütken 1857. Grønlands Echinodermata. Videnskabelige Medd. Dansk Naturh. Foren. pag. 22.

— — Théel 1877. Note sur quelques Holothuries des Mers de la Nouvelle Zemble. Nov. Act. Reg. Soc. Sci. Ser. III vol. ext. ord. XVII pag. 3, Pl. I.

— — Ludwig 1900. Arktische und subarktische Holethurien. Fauna Arctica Bd. I pag. 160.

— — Østergren 1902. The Holothurioidea of Northern Norway. Bergens Museums Aarbog pag. 14—18.

— — H. L. Clark 1908. The Apodous Holothurians. Smithsonian Contrib. to knowledge Bd. XXXV pag. 28.

— — Mortensen 1910. Report on the Echinoderms of North-East Greenland. Medd. om Grønland Bd. XLV pag. 277.

— — A. H. Clark 1920. Echinoderms, Rep. Canadian Arctic Expedition 1913—18 pag. 5c.

— — Heding 1931. Über die Synaptiden des Zoologischen Museums zu Hamburg. Zool. Jahrbuch Abt. Syst. Bd. 61 Heft 5—6 pag. 694.

— — Mortensen 1932. Echinoderms of the Godthåb Expedition. Medd. om Grønland Bd. 79 Nr. 2 pag. 40.

— — Djakonow 1933. Les Echinodermes des Mers Arctiques pag. 159.

Ravnsfjord $^{29}/_{7}$ 1932	1	specimens
Kangerdlugsuak St. 1a, $^{18}/_{8}$ 32. 65 m	1	—
— St. 2, $^{10}/_{8}$ 32. 100 m wire gravel.	1	—

Kangerdlugsuak	St. 11, $^{12}/_{8}$ 32. 20—25 m.....	1	specimens
—	St. 12, $^{12}/_{8}$ 32. 80—100 m.....	1	—
—	St. 19, $^{15}/_{8}$ 32. 10—20 m.....	1	—
—	St. 22, $^{18}/_{8}$ 32. 25 m.....	1	—
—	St. 26, $^{18}/_{8}$ 32. 10—15 m Stone with Algae.....	7	—
—	St. 27, $^{18}/_{8}$ 32. 25 m.....	1	—
—	St. .. $^{21}/_{8}$ 32. 450 m wire	1	—
Angmagsalik	$^{8}/_{9}$ 1932. 20 m.....	5	—

The present more or less well preserved specimens are all very characteristic specimens of *Myriotrochus rinkii* Steenstrup. This species was originally found at the West-Coast of Greenland, but appears to be more common at the East-Coast, and as a rule it is more commonly found, the more arctic the localities examined are. Probably the species is circumpolar, and nobody has hitherto been able to prove any real difference between specimens from different localities. Certainly I have described a new rinkii-like Myriotrochus from the Kara-Sea (not yet published) and this may in some cases have been mistaken for a true *rinkii*, but as true *rinkii* are also living in the Kara-Sea, this does not militate against the view that *rinkii* is circumpolar. In "The Holothurioidea of Northern Norway" ØSTERGREN has shown that the size of the wheels and the relative number of their spokes and teeth is varying in accordance with the more or less arctic localities, but the examination of the specimens at hand has shown that we cannot use ØSTERGREN's measurements with certainty, as he has not taken the variation within the single specimen into consideration. The specimens at hand, i. e. the more well preserved specimens show that the degree of variation from the anterior end to the posterior end is greater than the variation shown by ØSTERGREN for specimens from true arctic localities and more boreal waters. Certainly this does not prove that ØSTERGREN's view is wrong it only shows that a closer study of a larger material is needed to give certain results; and that meassurements are at any rate of no value when no remarks are given as to the place in the body-wall of the meassured wheel.

As to the biology of this species A. H. CLARK has stated that it is viviparous (Report of the Canadian Arctic Expedition 1913—18, vol. VIII, Prt. C pag. 6) and G. THORSON has told me that during his biological studies at the North-East-Greenland he has seen specimens with young embryos. On the other hand none of the nearly thousand specimens examined by me during the last years have had embryos, only more or less ripe eggs or spermea.

The specimen at hand are all examined for *Entocolax*, but none of them had this interesting parasite, but the examination for the purpose

of finding parasites gave the result, that in some of the best preserved specimens there was a new unknown organ. This is placed in the anterior end of the dorsal mesentery and by rather solid canals connected with the female genital organs (cf. fig. 27). The real function of this organ, cannot be made out on basis of the material at hand, as it is only present in two specimens, i. e. so well developed that its presense can be ascertained with certainty. As it appears to be developed in correlation to the development of the eggs in the Uterus, it may be supposed to be an

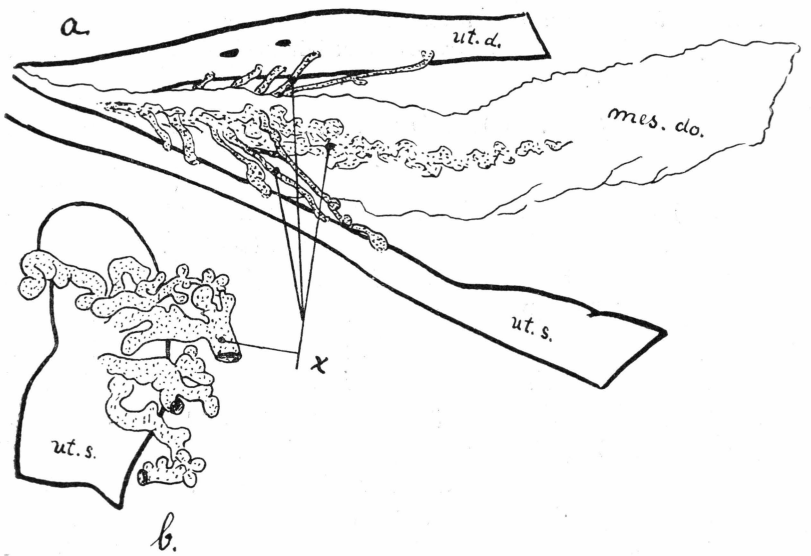


Fig. 27. Myriotrochus rinkii. A, anterior part of uteri (ut. d — ut. s) and dorsal mesenterium (mes. do.) showing the new puzzling organ (x) and C, a part of uterus in an older specimen with the organ.

accessory genital organ, but better and richer material is necessary for the solution of this problem.

It was interesting to see that the specimens from Kangerdlugssuak were supplied with a surprisingly large number of abnormal wheels, either too small wheels or quite large ones.

In order to compare these specimens with specimens from other localities, a table of the average size of the wheels and their relative number of teeth-spokes is given below.

		Diameter	S:T
St. 22	anterior	184 μ	73 %
	posterior	215 μ	64 %
St. 11	anterior	244 μ	74 %
	posterior	275 μ	64 %
Angmass. I	posterior	271 μ	73 %

Trochostoma arcticum (v. Marenzeller).

Haplodactyla arctica v. MARENZELLER 1877. Die Coelenteraten, Echinodermen und Würmer der k. k. öst-hung. Nordpol Expedition pag. 29. Pl. IV fig. 1.

Trochostoma arcticum DANIELSSEN & KOREN. The norwegian North Atlantic Expedition pag. 65.

— *boreale* LUDWIG 1900. Fauna arctica.

— — MORTENSEN 1903. Echinoderms from East Greenland pag. 89.

Molpadia arctica CLARK 1908. The Apodous Holothurians pag. 169.

— — MORTENSEN 1910. Report on the Echinoderms of North-East Greenland pag. 284—85.

Trochostoma arcticum HÈROUARD 1923. Holothuries provenant des Campagnes des Yachts Princesse-Alice et Hirondelle II 1898—1915. Pl. VIII fig. 1.

Mikis Fjord $^{25}/_{8}$ 32. 130 m Dynd. ..... 5 Expl.

Unfortunately these nicely preserved specimens (the four are quite uncontracted) are preserved in an acid formaldehyde-solution, where the calcareous deposits have been strongly attacked. In most of the specimens there are only weak traces of deposits, but there are a few which show their shape (Fig. 28). They are all open three to nine-armed rods, only very few have two arms coalescing so as to form a real plate. The spires are all dissolved. *Trochostoma arcticum* was hitherto found at East-greenland in two localities only (Flemming Inlet 180 faths. 3 spec. and off Angmagsalik 140 faths. 1 spec.) and also these specimens, which have been described by Mortensen are attacked by acid. This is rather unfortunate as this species appears to vary rather much, and perhaps includes two forms, one from East Greenland and one from the Kara-Sea.

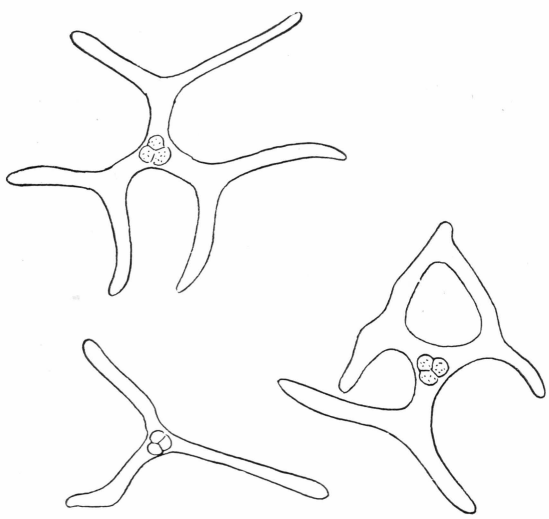
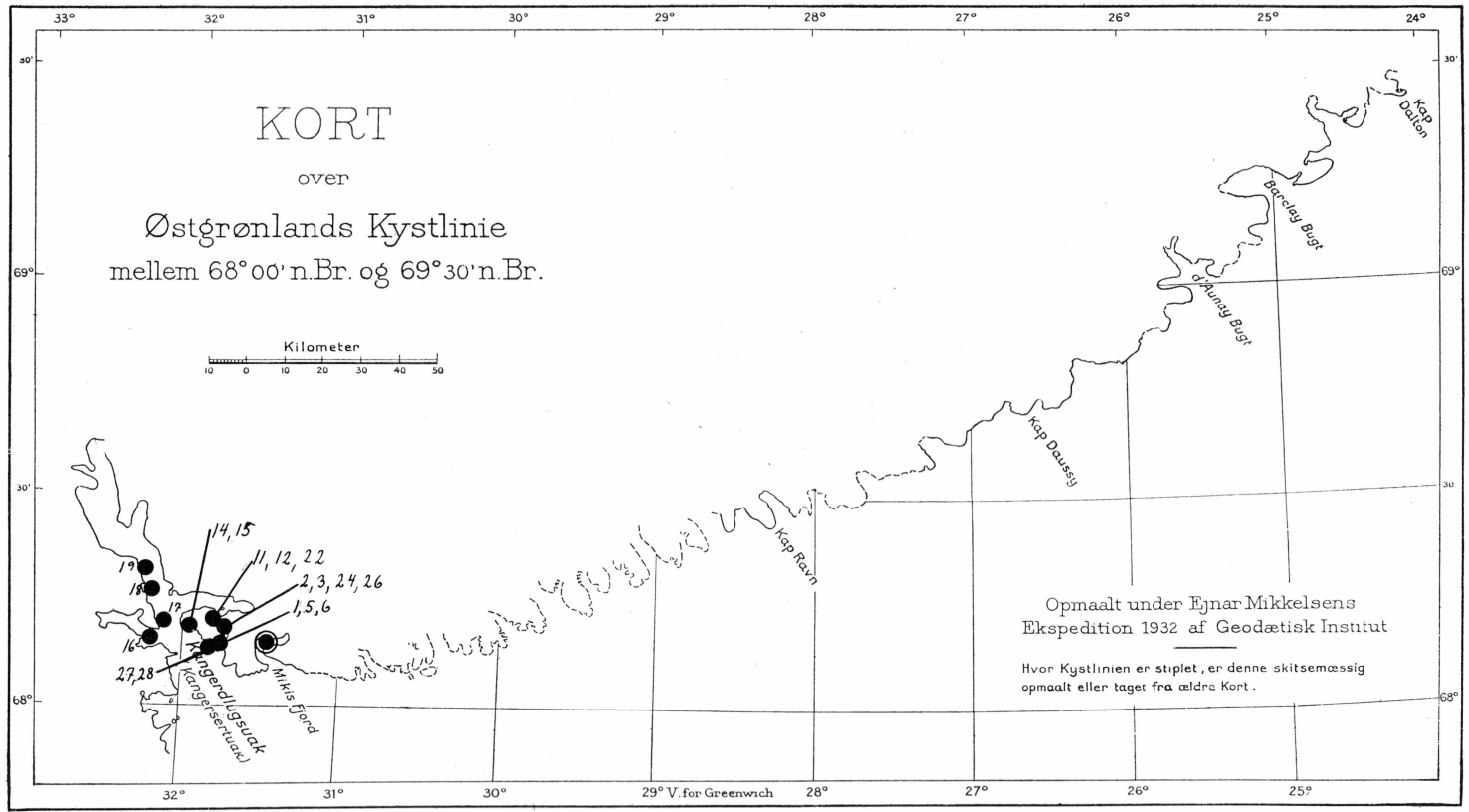


Fig. 28. Trochostoma arcticum. Deposits from medial part of body-wall.



Geodætisk Institut 1933.

Map. 3.

At any rate the species may be difficult to separate clearly from *Tr. thomsonii* Dan & Kor. and *Tr. boreale* (Sars), as the absence of red deposits is not so reliable a character as supposed by CLARK in 1908. Small specimens of *thomsonii*, apparently not of *boreale*, may almost entirely lack red deposits, and now and then a few quite minute ones are found in true specimens of *arctica*. Certainly there can be little doubt that the three said species are different forms, species or races? but extensive studies of a good material is needed before we can distinguisk, clearly between them.

Note.

After this paper has been delivered to the press, the following papers dealing with the biology of the fauna of East-Greenland has appeared:

R. SPÄRCK: Contributions to the animal ecology of the Franz Josef Fjord and Adjacent East-Greenland Waters I—II. Medd. Grønl. Bd. 100, Nr. 1.

G. THORSON: Investigations on shallow water animal communities in the Franz Josef Fjord (East-Greenland) and adjacent Waters. Medd. Grønland. Bd. 100, Nr. 2.

— Contributions to the animal ecology of the Scoresby Sound Fjord Complex (East Greenland). Medd. Grønl. Bd. 100, Nr. 3.

— On the reproduction and larval stages of the Brittle-Stars *Ophiocten sericeum* (Forbes) and *Ophiura robusta* Agres in East-Greenland. (Medd. Grønl. Bd. 100, Nr. 4.

From these papers it appears that *Ophiocten sericeum* is characteristic for the two deapest parts of the *Macoma-calcarea* community, being taken in 30 and 44 specimens pr. □ m. Further that *Stephanasterias albula* — *Strongylocentrotus droebachiensis* — *Ophiura robusta* are characteristic for the *Fucus*-epifauna in Franz Joseph Fjord in depths from $3^1/_2$—30 m, and that *Ophiacanta bidentata* is characteristic for the Fucus-epifauna in Amdrup Harbour and in the outer part of Scoresby Sound.

Færdig fra Trykkeriet den 25. Februar 1935.

EXPLANATION OF PLATES

Plate 1.

Poliometra prolixa (Sladen).

Fragment of nearly developed Pentacrinoid c. $^{20}/_{1}$.

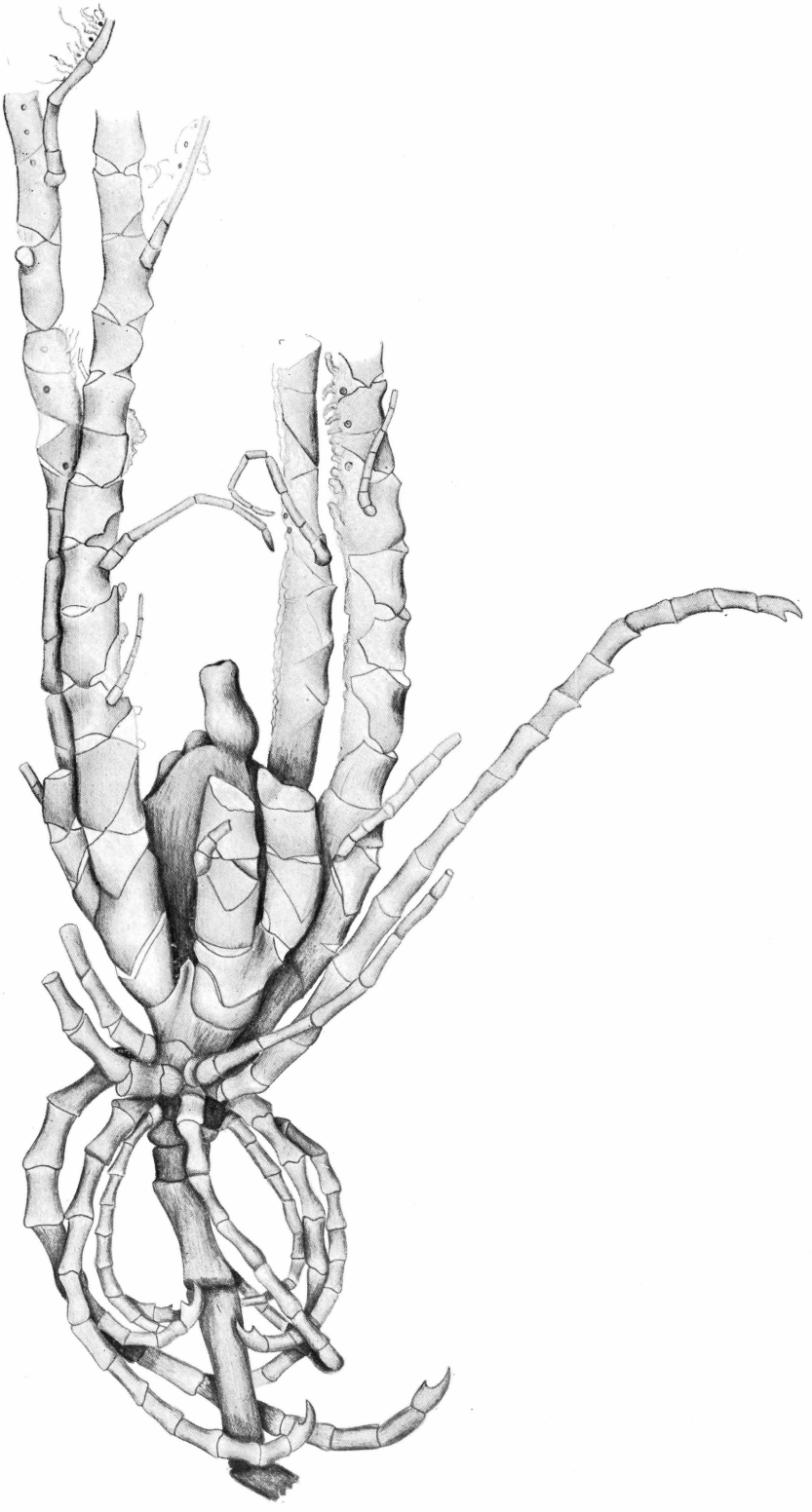
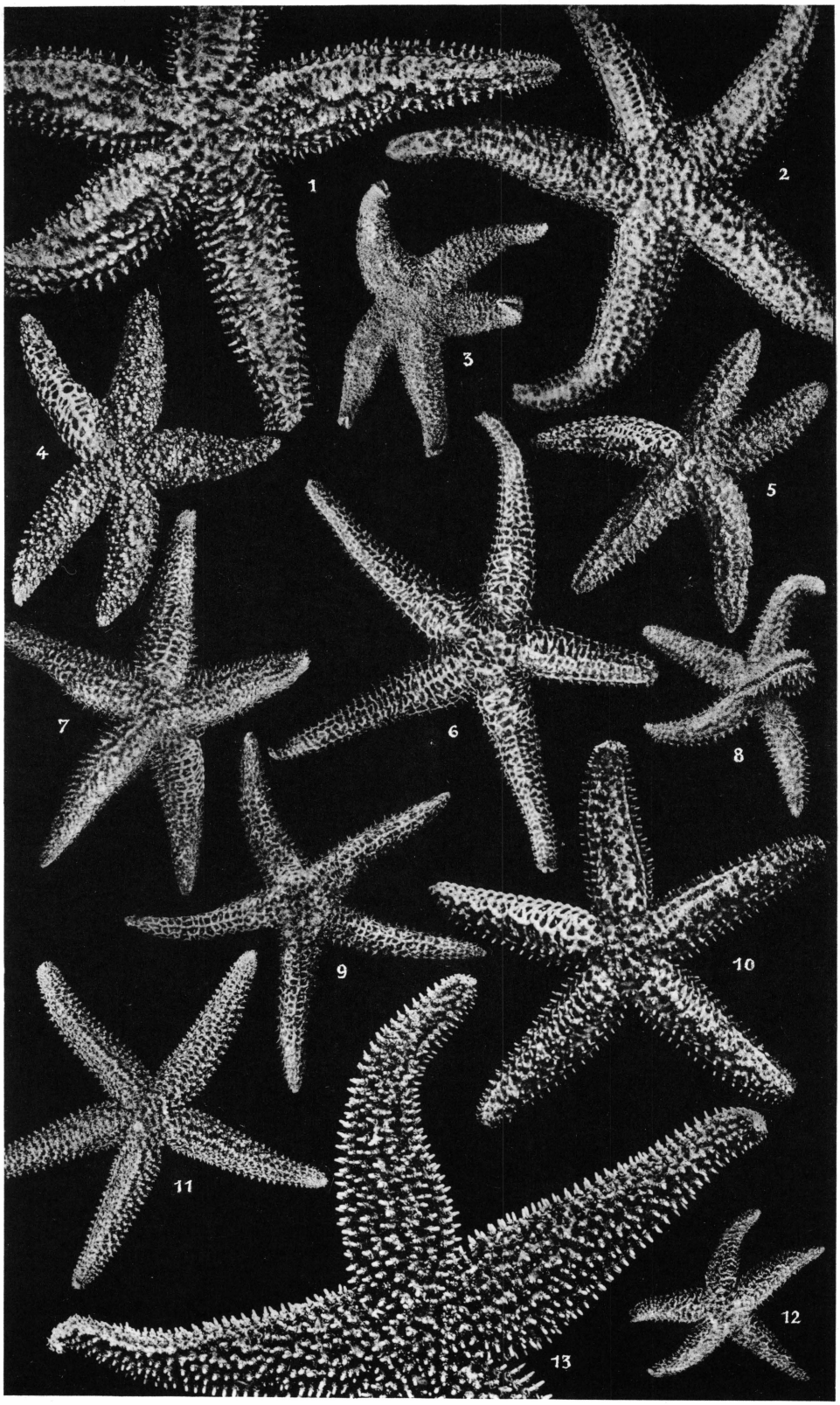


Plate 2.

Fig. 1. *Leptasterias hyperborea* forma *carinata* f. n. Type specimen.
— 2. — *islandica* var. *gracilis* v. n. Type specimen.
— 3. — *flocossa* (Levinsen). Type specimen.
— 4. — *islandica* (Levinsen). Type specimen.
— 5. — mülleri (Sars). Type specimen.
— 6. — *danica* (Levinsen). Neotype.
— 7. — *floccosa* var. *crassa* v. n. Type specimen.
— 8. — hyperborea forma *floccosoides* f. n. Type specimen.
— 9. — *degerbölli* n. sp. Type specimen.
— 10. — *mülleri* forma *nobilis* f. n. Type specimen.
— 11. — *hyperborea* forma *intermedia* f. n. Type specimen.
— 12. — *groenlandica* (Steenstrup) Type specimen.
— 13. — *hyperborea* (Danielssen & Koren). Specimen from Svinö.

All figures in natural size.



Pacht & Crones Eftf. Fototypi.