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DE DANSKE NÛGSSUAQ EKSPEDITIONER 1938 OG 1939
UNDER LEDELSE AF ALFRED ROSENKRANTZ

CONTRIBUTIONS TO THE QUATERNARY GEOLOGY OF NORTHERN WEST GREENLAND ESPECIALLY THE RAISED MARINE DEPOSITS

BY

DAN LAURSEN

WITH A CONTRIBUTION ON FORAMINIFERA
BY
K. DREYER JØRGENSEN

WITH 32 FIGURES IN THE TEXT AND 7 PLATES

KØBENHAVN
C. A. REITZELS FORLAG
BIANCO LUNOS BOGTRYKKERI A/S
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PREFACE

The present publication is principally based upon the observations and collections made by the second "Danish Nûgssuaq Expedition", 1939. However, the Mineralogical Museum of Copenhagen contains from of old a large collection of marine Quaternary shells from Northern West Greenland, brought home at various times by various collectors. Some of these collections have never been published, and therefore it has been considered expedient to profit by the opportunity here given to do this. Also, in the course of years a number of works dealing with the Quaternary formations have appeared, without any attempt having been made to comprise the scattered observations into a collected whole. An attempt of this kind will likewise be made in the following.

Besides the material already mentioned, Dr. V. NORDMANN, State Geologist, possessed large and valuable collections from the region round Gieseckes Sø (ɔ: G. Lake) in the Egedesminde district. This material had not been worked up, and therefore Dr. NORDMANN handed it over to me, for which I owe him a great debt of gratitude, as it enabled me to extend this work to cover the whole of the stretch of coast between 67°—73° lat. N in Northern West Greenland.

It has not been possible for me to perform this task without assistance and advice from various quarters.

First of all I wish to express my most sincere thanks to Professor ALFRED ROSENKRANTZ, the leader of "The Danish Nûgssuaq Expeditions" 1938—39, who gave me the opportunity to take part in the expedition of 1939, where he assigned to me the task of dealing with the Quaternary formation, and both then and afterwards, while I was working up the material, he has followed my work with the greatest interest.

I also wish to thank the other members of the expedition for good comradeship and assistance, more particularly KNUD DREYER JØRGENSEN, M. sc., who helped me in the field with measurings and collections, and the Greenlanders OVE KRUSE and ANDREAS TOBIASSEN, both from Qaersut, JØRGEN BRØNLUND from Qutdligssat, and JONAS JENSEN from Sarqaq, who all assisted me at various times.

A special debt of gratitude I owe to Professor AD. S. JENSEN for valuable advice and instruction, as well as for the great interest which he has always taken in my work. Further, I am greatly indebted to Professor JENSEN for permission to use his first-hand and revised determinations of the old material preserved at the Mineralogical Museum of Copenhagen.

For the determination of the material brought home, it has been a great help to me that I have been able to confer with various specialists of the Zoological Museum of Copenhagen. I beg to express my cordial thanks to Dr. TH. MORTENSEN for help rendered towards the determination of *Echinodermata*, to Dr. K. H. STEPHENSEN (*Crustacea*), to Dr. M. DEGERBØL (*Vertebrata*) and to Dr. G. THORSON (*Gastropoda Prosobranchiata*).

I am further indebted to Dr. V. NORDMANN for assistance rendered towards the determination of certain molluscs, and to Dr. VEDEL TÅNING for identifying the otoliths found.

My acknowledgments are likewise due to the director of the Administration of Greenland, Mr. K. OLDENDOW, for supplying me with certain biographical data.

In conclusion I wish to thank Professor O. B. BØGGILD and Professor A. NOE-NYGAARD, the former and the present director of the Mineralogical Museum of Copenhagen, for permission to study in and make use of the collections of the museum.

Mrs. ASLAUG MIKKELSEN M. A. has undertaken the translation. The photographs of plate 6 were carried out by Mr. CHR. HALKIER, and the drawings have been performed by Miss EVA LA COUR.

INTRODUCTION

The southern boundary of the area to be dealt with in the present publication is Nordre Strømfjord and its southern ramification, whereas its northern boundary is Melville Bugt (ɔ: M. Bay); but it must be stated at once there are no observations of any importance farther north than the Umanak district.

In this area collections and measurings have been undertaken by a number of expeditions and individuals. The greater part of the collections are now to be found in the Mineralogical Museum of Copenhagen, where the present author has had the opportunity to examine them.

The earliest investigations and collections date from the mineralogist KARL LUDVIG GIESECKE, who in the years 1807—1813 visited a number of localities in North Greenland. GIESECKE was apparently not very much interested in the Quaternary formation; at any rate there is only a single shell from that age in his collections, and the notes in his diary (83) on this subject are also very meagre. The specimen mentioned above is a *Balanus balanus* DA COSTA; on the label attached to this GIESECKE has made the following note: "Lepas im aufgeschwemtem Mergellande Aukpadlartok. Feskeo Lande[1]) Westküste". According to the diary published by K. J. V. STEENSTRUP (83) the locality is Fortune Bay, about 10 km west of Godhavn.

Although GIESECKE traversed the coasts of the Umanak Fjord and investigated them very carefully, he had apparently not been ashore at Pâtorfik on the north coast of the Nûgssuaq peninsula, and consequently he could not have seen the considerable deposits of shells found there. On the other hand, he writes about the stretch of coast at the base of Slibestensfjæld (ɔ: S. Mountain): "Hier ist die erste und einzige Stelle, wo ich Versteinerungen der *Venus Islandica* und *Mya truncata*, und zwar in eben beschriebenem rötlichem Sandsteine fand" (83, p. 343). This passage is very remarkable, seeing that GIESECKE evidently takes it for granted that the two said pelecypods belong to the sandstone of Slibe-

[1]) = Diskoeilande, Feskeo Lande being due to a later misscript.

stensfjæld. The latter is, however, of Cretaceous age, and so the presence of the said pelecypods is entirely excluded. The shells and sand have here rather been exposed to a recent cementation with an iron compound, which phenomenon is known from elsewhere. The said fossils are not to be found in the collections of the Mineralogical Museum, so that it has been impossible to examine the problem in detail.

When GIESECKE gives so little information on the Quaternary deposits, it undoubtedly has some bearing upon the fact that he was first and foremost a mineralogist.

The collections of the Mineralogical Museum contain a fairly large material collected by Dr. H. J. RINK. The year given on the labels (1881) is, however, not the year when the collections were made. At that time RINK was director of the Royal Greenland "Trade", which position he relinquished in 1882, and although in 1881 he undertook a voyage of inspection to Greenland, it is hardly likely that he made geological collections on this occasion. The records of the museum only show that the material in question was entered there in 1881, and there is consequently every reason to suppose that it was collected by RINK on his journey in 1848—1851.

In his work from 1852 (71) RINK renders an account of his investigations in North Greenland on the expedition mentioned above. He does not distinguish between glacial and marine formations and is i. a. of the opinion that glacial striae, gravel and pebbles are due to the agency of the sea. According to RINK the sea has extended as far as 2000 ft. (= 625 m) above the present level. The shell-bearing layers, however, he only records up to a level of 100 ft. (= 30 m) above sea level.

RINK describes the marine formations in Disko Bugt (ɔ: D. Bay) and on the Nûgssuaq peninsula, laying particular emphasis on the consolidated beds at Pátorfik, from which he brought home a number of shells. Although he mentions that there are species among them which have not been found recently in Greenland, he does not reflect on the causes of this.

A very large collection of shells was brought together in 1869 by S. F. KRARUP SMITH, Inspector of North Greenland within the period 1867—1882. The locality given is: "Omenak between Patorfik and Sarfarfik". The determination of this material, like that of the remaining collection found at the Mineralogical Museum, was undertaken years ago by Professor AD. S. JENSEN.

Nearly all the shells belonging to the collection of KRARUP SMITH can be clearly proved to have been taken in consolidated sand about 250 m east of the debouch of the Pátorfik river into the Umanak Fjord in a cleft in the coast, which by the present author is called Mellemkløft (ɔ: middle cleft). For that matter this locality is the one generally

thought of, when Pátorfik is mentioned as the finding place, as appears from the very fact that the fossils have been taken in the consolidated sand, which does not occur in other localities of the entire Pátorfik area. The collection has not formerly been mentioned in detail, nor has the list of fossils been published until now.

A. E. NORDENSKIÖLD, who in 1870 traversed Northwest Greenland and among other places visited Pátorfik, Sarpiussat, Tasiussarssuaq and Lerbugt (ɔ: clay bay) at Claushavn, distinguishes sharply between the glacial and the marine deposits and renders an exhaustive account of his observations (57). Like RINK he mentions that the shell-bearing beds are identified at a height of at least 100 ft. (30 m) above sea level. NORDENSKIÖLD also makes particular mention of the Pátorfik beds. When, however, he mentions that the shells are found in basalt sand, which may be consolidated into basalt tuff, this mode of designation is very unfortunate. It is true that there is a good deal of basaltic material in the deposits, which is not to be wondered at, as most of the rivers debouching into the Umanak Fjord spring from the plateau basalt or the immediate vicinity of the latter, but it is apt to lead to misconceptions, when the depositions for this reason are designated as basalt tuff.

Among the shells found *Mya arenaria* is mentioned, but this does not cause NORDENSKIÖLD to reflect on the changes of climate. AD. S. JENSEN, however, points out that the said specimen must be *Mya truncata forma ovata* (24, p. 144).

On the other hand, NORDENSKIÖLD realized that epirogenetic movements are taking place in Greenland, and he mentions a number of observations on changes of level, which have taken place during the early half of the 19th century.

In the collections of the Mineralogical Museum there is a single specimen of *Cardium ciliatum* FABR., collected 1872 at Pátorfik by CASPAR EDUARD BOYE, who at that time was trading manager of Umanak.

The most comprehensive of the earlier investigations undertaken within this area are those of Dr. K. J. V. STEENSTRUP, who in 1871 travelled in North Greenland together with NORDENSKIÖLD; in 1872 he visited Disko and the Nûgssuaq peninsula; in 1878—80 he traversed the region round the Umanak Fjord, and in 1898 he finally again visited Disko.

Although the part of STEENSTRUP's work, which is of any importance in this connection, only amounts to a few pages (81, 82), one constantly wonders at the great amount of details observed and the accuracy of his measurings. Besides collecting many shells STEENSTRUP has i. a. undertaken a great number of examinations of raised alluvial beaches and their altitudes.

At Ungôrsivik, at the mouth of the Disko Fjord, he proved the existence of two different horizons of raised sea-bottom, an older one, characterized by *Saxicava arctica*, which reaches a height of about 20 ft. (about 6 m), and a younger one, characterized by *Mytilus edulis*. At Pátorfik the marine clay attracts his attention. He compares it with the Danish boulder clay and emphasizes the peculiar fact that this till is identical with the basalt tuff of NORDENSKIÖLD. When, however, STEENSTRUP states (81, p. 234) that the fossils do not normally belong to these beds, this is undoubtedly due to the insufficient knowledge of these deposits prevailing at that time, and he clearly does not realize that it is here a case of delta deposits and not of till.

STEENSTRUP realizes that an alteration of the coast line showing a submergence of the land is taking place at the present time, and in view of subsequent observations he has undertaken levellings of a series of points, which work was continued by the Nûgssuaq-Expedition.

STEENSTRUP draws no conclusions from his shell material as to changes in the climate.

In 1875 the Norwegian scientist AMUND HELLAND undertook various investigations between Egedesminde and the Kangerdlugssuaq fjord in the Umanak district. HELLAND particularly investigated the glaciers and their velocities and demonstrated the exceptionally great velocity of the Jakobshavn glacier. He further studied the distribution of the formerly larger extent of the ice cover by means of glacial striae, erratics and the formation of lakes and fjords. HELLAND touches little on the formation of terraces. He is of the opinion that the sea formerly only extended up to 30 m above the present sea level. From a terrace at Claushavn a find of marine shells is listed, which species were determined by Professor G. O. SARS. Moreover, finds of concretions containing shells are mentioned from the same locality. This marine terrace shows that the submergence which can be recognized at present has been preceded by an upheaval of the land. In connection with the studies of the glaciers HELLAND points out that terraces in the interiors of neighbouring fjords may be of different heights, although this does not necessarily signify a different upheaval of the country, seeing that the glaciers, which in the icefjords prevent the formation of terraces, may recede earlier from one fjord than from another.

In 1879 Docent A. KORNERUP traversed part of the Holsteinsborg and Egedesminde districts by means of a women's boat (umiaq) (42). Shell-bearing beds were only found on the banks of the Nagsugtôq River in Nordre Strømfjord, but he observed and measured a number of marine terraces. Also regarding the larger extent of the ice investigations have been made, and as the result of the latter KORNERUP states (42, p. 193) that the country round Nordre Strømfjord and north of this, as far as

the Arfersiorfik fjord, has been completely covered with ice, as appears from the extensive moraine covers, glacial striae and roches moutonnées.

In 1888 the physician SØREN HANSEN undertook antropological investigations as far as Disko and Umanak. Among other places he visited Ikorfat on the northern coast of the Nûgssuaq peninsula and brought home a number of shells from an elevated beach.

In the Mineralogical Museum there is a small collection brought home in 1890 by Dr. N. HARTZ from Orpigsôq (Orpigssuit) in the interior part of Disko Bugt.

In 1897 Dr. HELGI PJETURSSON (PJETURSS) visited the regions round Disko Bugt and i. a. undertook the collection of fossil shells and the measuring of terraces; the glacial deposits were also studied. PJETURSSON is of the opinion (65, p. 340) that the upheaval of the country had begun, before the ice had retreated to its present position. This view is more particularly substantiated by conditions in Blæsedalen at Godhavn (65, pp. 301—303), where the terminal moraine is situated at an altitude of about 80 m above sea level. On the outer side of the moraine there is no sign of its having been washed over by the sea, although there are raised beaches at Flakkerhuk at an altitude of 98 m and at Skansen in 88.9 m above sea level (STEENSTRUP 81, p. 231).

At the same time F. FRODA (FRODE PETERSEN) undertook a series of glaciological measurings in the Holsteinsborg and Egedesminde districts. Further, some points were determined for subsequent use by means of investigations of the dislocation of the coast line (65, p. 346).

In 1902 and 1903—04 Dr. M. C. ENGEL undertook measurings in the regions round Disko Bugt. Among other localities ENGEL visited Orpigsôq (Orpigssuit) and brought home some shells (14).

These shells were determined by AD. S. JENSEN, who pointed out that the collection comprised *Zirphæa crispata*, and that this bivalve is a boreal species which no longer lives off the coasts of Greenland; from this he drew the conclusion that the deposit containing *Zirphæa* has been laid down during a postglacial period, when the climate was warmer than nowadays, »at least as mild as that which we find at present at the eastern Canada and at West-Finmark«. (27, pp. 295—297).

In 1906 (28) Professor AD. S. JENSEN and Dr. P. HARDER investigated the marine deposits at Disko Bugt; by means of these investigations it has been possible to prove that, immediately after the retreat of the ice, high-arctic conditions have prevailed, *Portlandia arctica* having been found in the oldest deposits. Above these there are beds with *Balanus hammeri*, which testify to a rise of temperature, followed by a decline of temperature, *Portlandia arctica* immigrating once more. Then follow beds showing a new rise of temperature, which reaches a temperature maximum, *Zirphæa crispata* being found in the youngest beds.

In 1909 Docent J. P. J. RAVN and Dr. A. HEIM visited the Umanak Fjord. HEIM briefly mentions the diluvial formations (20, p. 224 pp.) without, however, contributing anything new.

In 1911 Dr. V. NORDMANN (59) traversed Nordre Strømfjord and penetrated as far as Gieseckes Sø. As the material of shells collected had not been examined, Dr. NORDMANN kindly placed it at the disposal of the present author, so that the material will be published here together with the other finds from Northern West Greenland.

In 1923 F. FRODA within the area in question undertook glaciological observations and measurings regarding the epirogenetic movement of Greenland (16).

In 1925 the first "Hessian Greenland-Expedition", under the leadership of H. K. E. KRUEGER, traversed Disko Bugt and the Umanak Fjord. KLUTE briefly summarises the geographical results of the expedition (43, p. 111), and KRUEGER mentions the diluvial and alluvial formations in the area traversed (44, pp. 130 et seq.). Neither of these works, however, add anything essentially new.

While mapping the island of Disko in 1933 V. JENSEN-AARIS, Stabsofficiant, found a peculiar conical elevation on the river plain in Stordalen, presumably a mud volcano (cf. Medd. o. Grønl. vol. 135, No. 6). It was composed of thrown-up marine deposits, from which a number of shells were brought home and identified by Dr. V. NORDMANN.

In the course of the Nûgssuaq Expedition 1938 J. TROELSEN, M.sc. collected some shells at Pâtorfik; they have been included in the material brought home in 1939 and treated together with the latter.

In a paper published in 1942, Professor AD. S. JENSEN deals with some material, which was collected and brought home from a journey in 1916 by O. BENDIXEN, then Royal Inspector of South Greenland (33). One of the localities mentioned is in Nordre Strømfjord, and is thus within the area covered by the present work.

DESCRIPTION OF LOCALITIES

The area investigated by the Nûgssuaq Expedition extends from the Svartenhuk peninsula to the island of Disko.

The description of localities naturally falls into three parts, viz.: the Svartenhuk peninsula, the Nûgssuaq peninsula and the Disko island.

1. Svartenhuk.

The coast section at the mouth of the Kugssineq River.

The Kugssineq River debouches on the south coast of Svartenhuk in the bay between Pângnâgigsoq and Igdlerussat. Along the eastern coast of the bay, in the flat country round the outlet of the Tasiussaq River, terraces were observed at various altitudes. To the west of the outlet of Kugssineq a section was observed in the coast, this section being already mentioned by STEENSTRUP (81, p. 228), who also gives a list of shells found there (81, p. 235), however, without entering into a more detailed description.

The coast section is hardly 400 m long and up to 18 m high (fig. 1). The most easterly part of the cliff consists of very coarse material, viz. gravel and sand, the beds showing a dip towards the river. Only fragments of crushed shells are found there. Farther west towards Pângnâgigsoq there is lowest down a bed of clay with areas of closely packed pebbles of the size of hens' eggs. Higher up the clay becomes free from stones. In the clay scattered shells are found, and at the top there is a shell horizon which, however, only contains two species viz. *Saxicava arctica* (L.) and *Mya truncata* (L.). Towards the west the marine alluvial beds are seen to overlie the basalt, which superstratification is visible over a distance of about 200 m.

The following shells were found:

In the upper shell horizon:

Mya truncata (L.)
Saxicava arctica (L.)

In the clay:

Portlandia arctica (GRAY)
Astarte montagui (DILL.)

Astarte montagui (DILL.) *var. striata* (LEACH) SARS
Astarte montagui (DILL.) *var. warhami* HANC.
Astarte elliptica (BROWN)
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Mya truncata (L.) *var. uddevallensis* HANC.

The shells collected show that the clay has been deposited under high-arctic conditions, and in this connection the presence of *Portlandia arctica* (GRAY) is of decisive importance. As to the climatic conditions prevailing during the deposition of the upper sand beds, it can only be said that it has probably been arctic, which appears from the thickness of the shells.

The Kugssineq Valley.

The marine deposits in this valley appear in terraces, the heights of which are 40 m above sea level. However, it is probable that the thickness of the beds has been greater in former times, as the river has eroded a good deal. At an altitude of about 75 m there were terraces on both sides of the valley. It could not be said with certainty whether they were old lateral moraines or marine terraces, but the latter is the more likely supposition.

In the deposits in the valley the following shells were found at an altitude of 40 m:

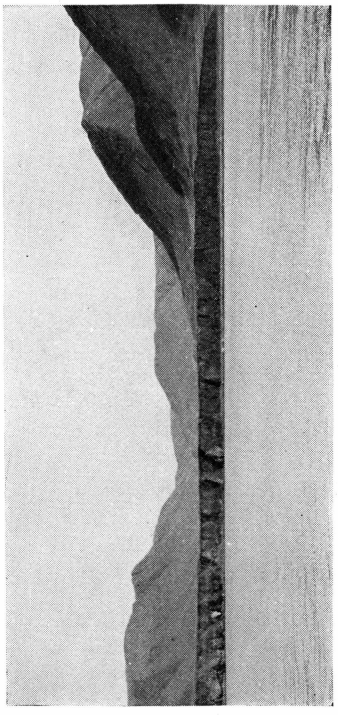
Astarte borealis (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)

Astarte borealis was found in great quantities and unbroken specimens. It is hardly possible to say anything decisive of the climatic conditions at the time when the beds were deposited; but it need not have been essentially different from that of the present time.

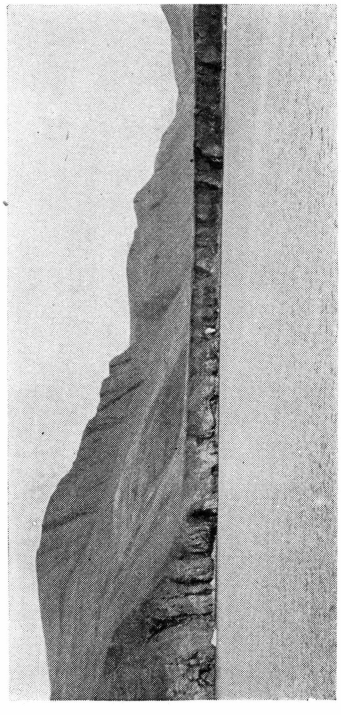
2. The Nûgssuaq Peninsula.

The most exhaustive investigations were undertaken in the Nûgssuaq peninsula, more particularly on the northern coast, where several localities are well known from of old. Thus Pâtorfik and Sarfarfik are, as stated above, already mentioned by RINK, NORDENSKIÖLD, STEENSTRUP and WHITE & SCHUCHERT. These localities will also be described here, having been made the subject of new, thorough investigations.

The basis of the investigations on the north coast was Pâtorfik, from where the area in an eastern direction as far as Kûk was investi-



A. ROSENKRANTZ phot. 11/8 1939.



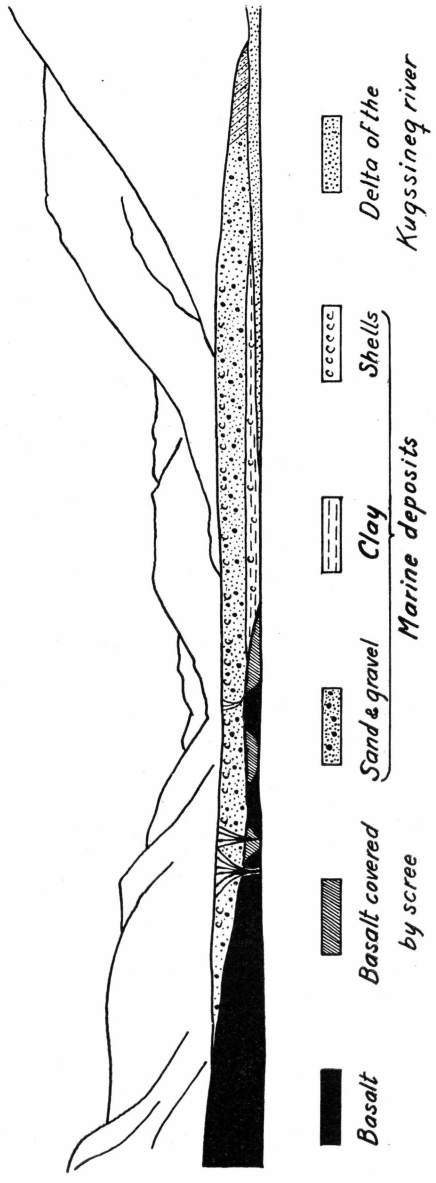
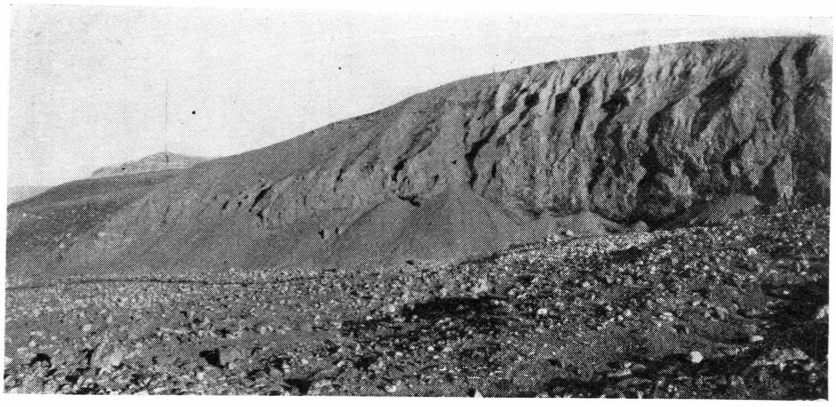


Fig. 1. The coast cliff at the mouth of the Kugssineq River, Svartenhuk.



Author phot. $^{26}/_{6}$ 1939.

Fig. 2. Elvklinten at Pátorfik. For explanation see fig. 3.

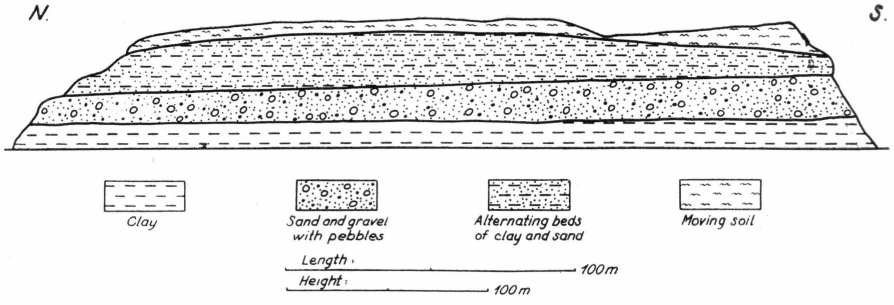


Fig. 3. Section of Elvklinten at the Pátorfik river near its debouch into the Umanak Fjord.

gated; the investigated localities will in the following be described in succession from east towards west.

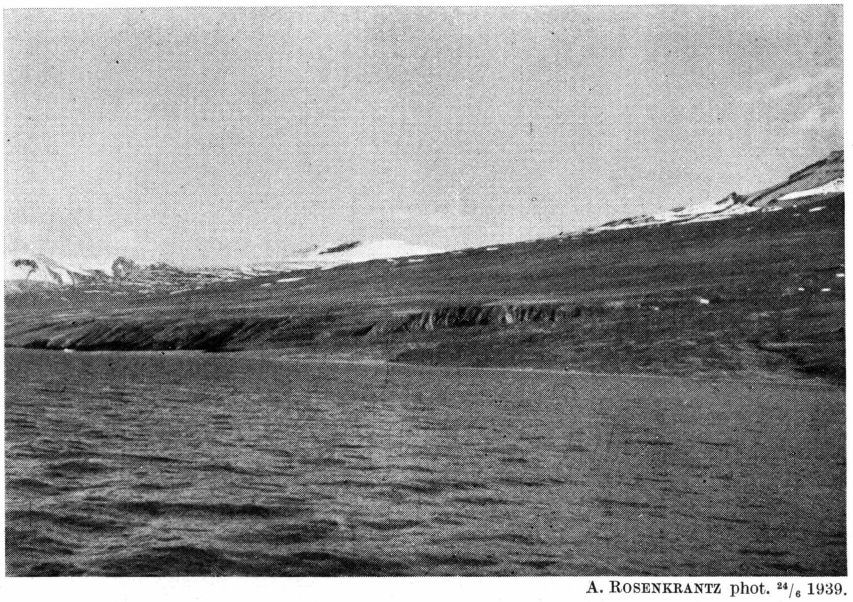
Kûk.

At its mouth this river has cut through the flat terraces, which extend about 300 m inland from the coast. Farthest down there was clay, superposed by sand with small and large blocks. On the uppermost of these terraces the upper layers at any rate must be defined as delta formations. The height of this raised delta was 15 m.

Further, three more terraces were observed, but no shells in clay or sand were found.

Pátorfik.

This locality, familiar from of old, derives its name from the river, which takes its rise from below the steep wall of Qilertínguit and debouches into the Umanak Fjord about 14 km west-northwest of the



A. ROSENKRANTZ phot. $^{24}/_{6}$ 1939.

Fig. 4. The Pátorfik delta. Behind it Elvklinten and the terraces between Pátorfik and Qaersuarssuk kangigdleq. Particularly prominent are the terraces of 90 m and 220 m above sea level.

Umanak settlement. As this locality has long ago been described as the best finding place of Quaternary, marine fossils, it was made the principal field of investigation, and in this place a levelling of the terraces was undertaken, which will be mentioned later on (p. 90).

The cliff at the Pátorfik River extends from the beach and about 300 m inland along the eastern banks of the river, but is only accessible along the first 200 m.

The Pátorfik cliff.

As appears from the drawing of the section (fig. 3) and the photographs (figs. 2, 4) of the cliff region at the mouth of the river, there is farthest down a bed of brecciated clay of a thickness of 7 m. In this bed a number of well-preserved shells were found. Above this there was an 8 m thick bed of sand and gravel with boulders, which were highly disintegrated, this bed being in its turn superposed by a layer of fine gravel, about 2 m thick, which contained great quantities of closely packed shells (fig. 5). The layer of sand was superposed by a layer, 8 m thick, of interchanging clay and basalt sand with shells. At the top there was a layer of moving soil, the thickness of which varies between 1 and 2 m.

A detailed measuring of the basalt sand beds was made, as is shown on fig. 6. Each of the sand beds begins from below, with an accumulation

of pebbles of the size of hens' eggs and fists. In the clay shells of *Saxicava arctica* (L.) were found. From these conditions it would seem that the beds have been deposited in the sea off a delta, and the stratification expresses a duration extending over a number of years (varves). The

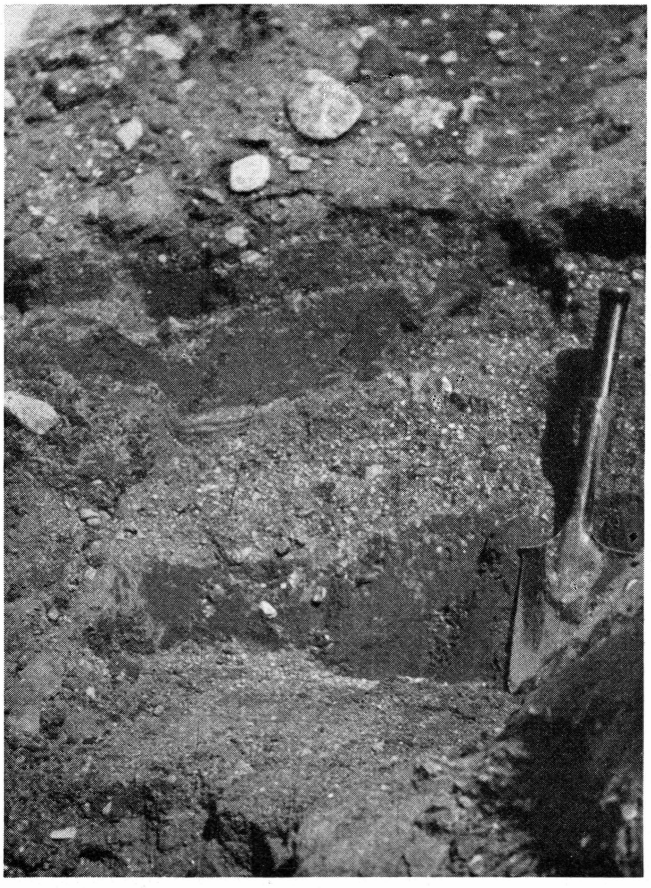


Fig. 5. Accumulation of shells in a sand bed 42 m above sea level in the Pátorfik cliff. The length of the spade 50 cm.

accumulations of pebbles and boulders would thus seem to represent the spring flood in the river, and according to the lesser amount of water during the summer, the finer sand settles, and finally towards autumn and winter the clay is deposited. In the course of the autumn and winter *Saxicava arctica* (L.) has drifted across the delta deposits, presumably fixed on sea weed. That there are no shells in the sand and gravel beds is due to the fact that the current in the river has been stronger than the tidal currents and has transported sea weed and shells farther out in the fjord. The fact that it is a species, which lives attached to

things floating in the sea, and that no other species occur, points in the same direction.

The following shells were found:

In the brecciated clay bed, altitude 24 m above sea level:

Leda pernula MÜLL.
Astarte borealis (CHEMN.)
Astarte elliptica (BROWN)
Cardium ciliatum FABR.

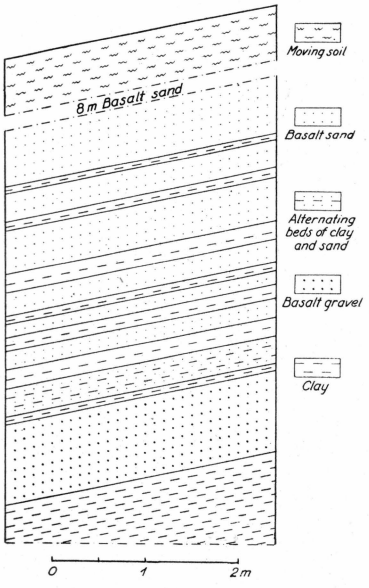


Fig. 6. Sketch showing interchanging beds of clay and basalt sand. The Pátorfik cliff.

Cyrtodaria siliqua (SPGL.)
Panopœa norvegica SPGL.
Mya truncata (L.)
Neptunea despecta L. *var. carinata* LAM.

Sand bed. Altitude: 39 m above sea level, collected by J. TROELSEN 1938:

Leda pernula (MÜLL.)
Astarte borealis (CHEMN.)
Astarte sulcata (DA COSTA)
Astarte elliptica (BROWN)
Cardium ciliatum FABR.
Serripes groenlandicum (CHEMN.)
Mya truncata (L.)
Bela nobilis (MØLL.)
Admete viridula (FABR.)

Sand bed. Altitude: 42 m:

Pecten islandicus MÜLL.
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Mya truncata (L.) *var. uddevallensis* HANC.
Natica-bored shells of *Macoma*
Serpula sp.

Interchanging beds of clay and basalt sand. Altitude: 50 m. From the clay beds:

Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)

Lying loose in the scree at the base of the cliff:

Pecten islandicus MÜLL.
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Mya truncata (L.) *var. uddevallensis* HANC.
Natica clausa BROD. & SOW.

Elvskrænten (ɔ: the river slope).

In continuation of the Pátorfik cliff, a little more than 300 m in along the river bed, there is a slope which, however, did not show accessible sections in the marine beds along the whole distance. About 200 m from the coast an excellent section was observed, in the layers of which many shells were found. In the section there was farthest down a bed of clay, almost free from stones. This was overlain by a bed of brecciated clay with larger stones, above which a cross-bedded layer of sand, and on top of that a layer of pebbles, which were deposited in distinct beds.

The following shells were collected in the clay free from stones. Altitude: 25—30 m:

Nucula tenuis (MONT.) *var. expansa* REEVE
Leda pernula (MÜLL.)
Leda minuta (MÜLL.)
Portlandia lenticula (MØLLER)
Pecten islandicus MÜLL.
Astarte borealis (CHEMN.)
Astarte montagui (DILL.)
Astarte montagui (DILL.) *var. striata* LEACH
Astarte elliptica (BROWN)
Astarte crenata (GRAY)
Cardium ciliatum MÜLL.
Serripes groenlandicum (CHEMN.)

Macoma calcarea (CHEMN.)
Cyrtodaria siliqua (SPGL.)
Saxicava arctica (L.)
Mya truncata (L.)
Alvania jan-mayeni (FRIELE)
Alvania wywille-thomsoni (FRIELE) *var. pátorfikensis n. v.*
Turritella erosa (COUTH.)
Amaura candida MØLLER
Natica clausa BROD. & SOW.
Trophon truncatus (STRØM)
Buccinum hydrophanum HANC. *var. texturata* POSS.
Bela nobilis (MØLLER) *var. scalaris* MØLLER
Bela exarata (MØLLER)
Bela harpularia (COUTH.)
Bela trevelyana (TURT.)
Bryozoa sp.

The coast between Pátorfik and Sarfarfik.

Between Pátorfik and Sarfarfik there is a coast cliff, which in its entire extent was subjected to detailed investigations (plate 1). Regularly at every 50 m the height of the coast section was measured; further, measurements were taken, where it was considered necessary for the purpose, viz. in all localities with exposed alluvial formations. In plate 1 is seen the result of this measuring. Along the entire distance the beds were investigated for the purpose of finding shells, and in a number of places such were found. These localities will be described in the following.

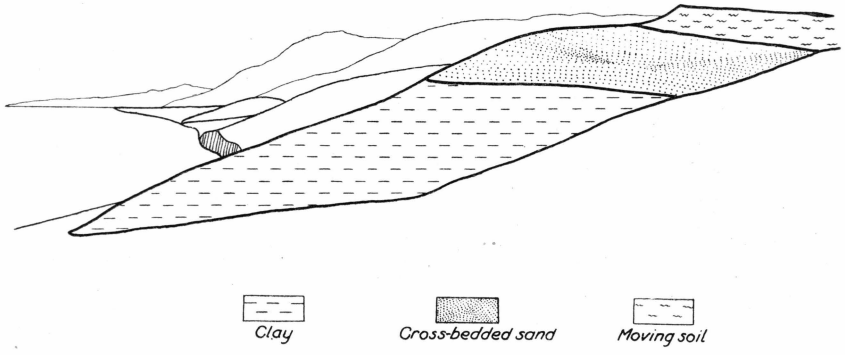


Fig. 7. Section in the eastern side of Kløft II about 110 m east of the mouth of the Pátorfik River.

Kløft II (Plate 1). (Figs. 7, 8, 9).

About 110 m east of the mouth of the Pátorfik River there is in a small wet-weather rill a good, exposed section, which shows about 3 m of Cretaceous sandstone, overlain by 27 m clay with shells. Above this

there were cross-bedded, shell-bearing sand beds, about 10 m in thickness. The section terminates with 10 m of moving soil.

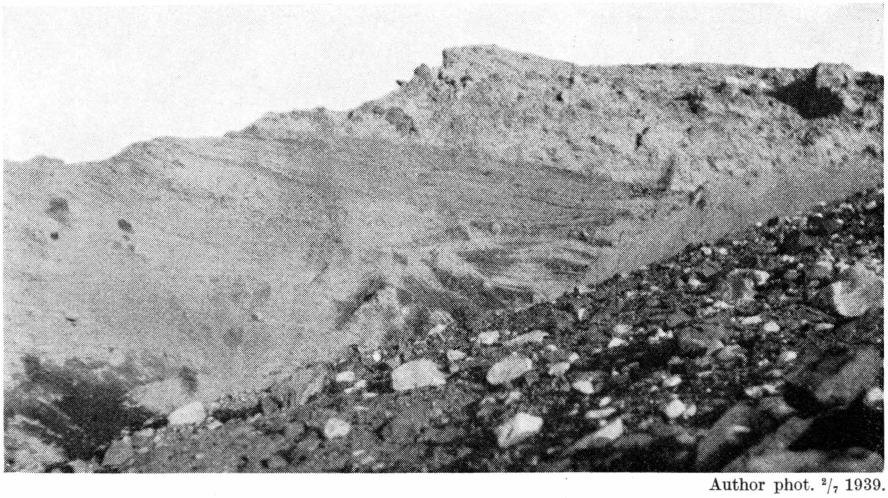
The shells found are the following:

Clay bed. Altitude: 5.5—32.5 m:

Leda pernula (MÜLL.)
Pecten islandicus MÜLL.
Astarte borealis (CHEMN.)
Astarte montagui (DILL.)
Astarte elliptica (BROWN.)
Cardium ciliatum FABR.
Serripes groenlandicum (CHEMN.)
Macoma calcarea (CHEMN.)
Cyrtodaria siliqua (SPGL.)
Panopaea norvegica (SPGL.)
Saxicava arctica (L.)
Trophon truncatus (STRØM)
Neptunea despecta (L.)
Buccinum hydrophanum HANC.

Sand bed. Altitude: 32.5—42.5 m:

Nucula tenuis (MONT.) *var. expansa* REEVE
Leda pernula (MÜLL.)
Leda minuta (MÜLL.)
Portlandia lenticula (MØLLER).
Pecten islandicus MÜLL.
Mytilus edulis L.
Astarte borealis (CHEMN.)
Astarte montagui (DILL.)
Astarte sulcata (DA COSTA)
Astarte elliptica (BROWN)
Astarte crenata (GRAY)
Axinopsis orbiculata G. O. SARS
Thyasira flexuosa (MONT.)
Cardium ciliatum FABR.
Serripes groenlandicum (CHEMN.)
Macoma calcarea (CHEMN.)
Cyrtodaria siliqua (SPGL.)
Saxicava arctica (L.)
Mya truncata (L.)
Mya truncata (L.) *var. ovata* JENSEN
Thracia sp.
Lepeta coeca (MÜLL.)
Littorina saxatilis (OLIVI) *var. groenlandica* MØLLER
Alvania wywille-thomsoni (FRIELE) *var. pátorfikensis n. v.*
Turritella erosa (COUTH.)
Amaura candida MØLLER
Lunatia pallida (BROD. & SOW.)
Natica clausa BROD. & SOW.
Trophon clathratus (L.)
Neptunea despecta (L.)



Author phot. $^{2}/_{7}$ 1939.

Fig. 8. Kløft II. Cross-bedded, shell-bearing sand bed in the upper part of the section.

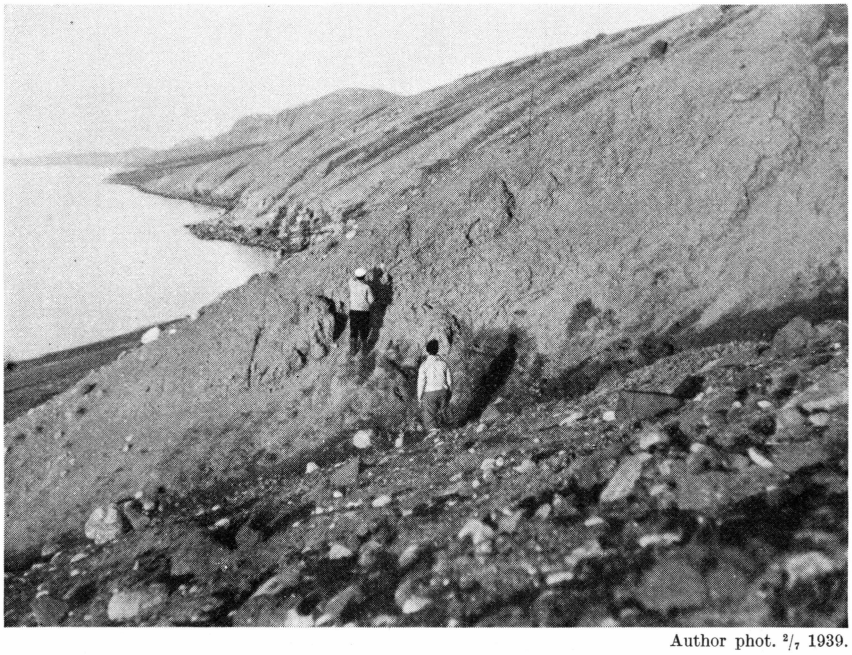


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Fig. 9. Kløft II. Shell-bearing clay in the lower part of the section.

Bela nobilis (Møll.)
Bela exarata (Møll.)
Bela harpularia (Couth.)
Bela violacea (Migh.)
Bela tenuicosta (M. Sars)
Bela decussata (Couth.) *var. livida* Møll.

Utriculus (*Retusa*) *pertenuis* (MIGH.)
Balanus balanus DA COSTA
Balanus hammeri (ASCAN.) BROWN
Balanus crenatus BRUG.
Hyas sp. I
Hyas sp. II
Bryozoa sp.

The shells in the clay bed show that the layer has been deposited under arctic, possibly subarctic to boreal conditions, which would appear from the presence of *Panopaea norvegica* (SPGL.). AD. S. JENSEN (31, pp. 28 et seq.) is of the opinion that, if concluding from the now known distribution of *Panopaea norvegica* (SPGL.), it should be regarded as a boreal form. But as the species lives buried in the sea-bottom, there is a possibility that it may nevertheless live in the arctic seas, even though it would be difficult to take it with the dredge.

In the sand bed we find several species, which clearly show that a change of climate must have taken place at the time, when the bed was deposited. *Astarte sulcata* (DA COSTA) and *Balanus hammeri* (ASCAN.) BROWN are boreal forms, and the presence of *Mytilus edulis* L. points in the same direction. *Mytilus edulis* L., it is true, also occurs nowadays in the Umanak Fjord and other Greenland waters, but as it has not been found at all in the subjacent beds, it is to be supposed that it has immigrated at the time, when the sand was deposited owing to a rise of temperature.

From about 250 m to about 350 m east of Pátorfik there is above the Cretaceous sandstone 15 m clay with fossils, superposed by about 15 m stratified sand with shells. The shells in the clay were so crushed and disintegrated that it was impossible to determine them. From about 400 m east of Pátorfik the sandstone was succeeded by scree, which in its turn was overlain by 25 m stratified clay and sand without shells.

Mellemkløft. (Plate 1).

About 325 m east of Kløft II melting water and rainwater has cut a small cleft into the softer beds of the cliff. In this locality, which is called Mellemkløft, there was no distinct stratification. The cliff here is 64 m high. At a height of 60 m above sea level there was a consolidated sand bed, hardly 1 m thick, and immediately above this sandstone bed there were beds of sand. It is the above-mentioned consolidated sand bed, which in the literature has been termed the sandstone bed with "the famous Pátorfik fossils". It is the opinion of the present author that it is here a case of a purely local occurrence, due to cementation. Nowhere else a similar formation has been met with in the marine beds. In the unconsolidated sand shells were also found.

Consolidated bed:

Nucula tenuis (MONT.) *var. expansa* REEVE
Pecten islandicus MÜLL.
Cardium ciliatum FABR.
Serripes groenlandicum (CHEMN.)
Macoma calcarea (CHEMN.)
Cyrtodaria siliqua (SPGL.)
Saxicava arctica (L.)
Mya truncata (L.)
Acmaea (*Tectura*) *rubella* (FABR.)
Lepeta coeca (MÜLL.)
Natica sp.
Trophon clathratus (L.)
Buccinum undatum L.
Buccinum hydrophanum HANC.
Bela violacea (MIGH.)
Cylicna alba (BROWN)
Balanus balanus (L.) DA COSTA
Balanus crenatus BRUG.
Strongylocentrotus drobachiensis (MÜLLER)
Ophiura sarsii LTK.
Ophiura robusta AYRES?
Ophiura sp.

Sand bed:

Pecten islandicus MÜLL.
Mytilus edulis L.
Astarte elliptica (BROWN.)
Axinopsis orbiculata G. O. SARS
Cardium ciliatum FABR.
Serripes groenlandicum (CHEMN.)
Macoma calcarea (CHEMN.)
Cyrtodaria siliqua (SPGL.)
Mya truncata (L.)
Acmaea (*Tectura*) *rubella* (FABR.)
Natica clausa BROD. & SOW.
Trophon clathratus (L.)
Trophon truncatus (STRØM)
Sipho togatus (MØRCH)
Balanus balanus (L.) DA COSTA
Balanus hammeri (ASCAN.) BROWN
Hyas (*araneus* L.?)
Rangifer tarandus L.
Phoca groenlandica O. FABR.
Uria uria (PALL.)

The beds in this locality must, it seems, be identified with the sand bed in Kløft II; in particular attention must be called to the occurrence of *Balanus hammeri* and *Mytilus edulis.*

Kløft III.

500 m east of Pâtorfik a similar cleft was found. At an altitude of about 60 m above sea level there were sand beds without stratification, but containing shells. The sides of the cleft were covered with scree, and the bottom was filled with large blocks.

The following shells were found:

Sand bed. Altitude: about 60 m:

Pecten islandicus MÜLL.
Mytilus edulis L.
Cardium ciliatum FABR.
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Sipho sp.
Balanus balanus (L.) DA COSTA
Balanus crenatus BRUG.

This bed must have been deposited at the same time as the sand bed in Mellemkløft, and also the climatic conditions must have been the same, viz. subarctic-boreal.

Sections between Kløft III and Kûgtsiaq.

Between 670 and 700 m east of Pâtorfik a small section was visible about 40 m above sea level and consisting of stratified sand and gravel. In the gravel were found a few shells of *Saxicava arctica* (L.)

A similar section was found 875 m east of Pâtorfik. However, no shells were found in these beds.

1650 m east of Pâtorfik a section was found, the lower part of which consisted of arenaceous clay, superposed by 1 m clay. The only shells found in the clay were:

Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)

which indicate an arctic climate.

About 1850 m east of Pâtorfik a small river debouches into the fjord. On the western side of the latter alluvial formations were found exposed in the lower part of the cliff. Farther down there was a 2 m thick layer of arenaceous clay without shells, and above them 1 m clay with some shell fragments. Farther up the cliff was covered with scree.

On the eastern side of the river a section was found, the lower part of which consists of 3 m clay, superposed by stratified beds of sand and clay with shells. The upper part of the cliff was covered with scree and vegetation.

Sand bed. Altitude: 5 m:

Cardium ciliatum FABR.
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)

During the deposition of the beds the climate must have been arctic.

1900 m east of Pátorfik, in a small outcrop, there was farthest down 3 m arenaceous clay; then 2 m clay overlain by sand, in which there were shells 30 m and 40 m above sea level.

Sand bed. Altitude: 30 m:

Astarte borealis (CHEMN.)
Astarte montagui (DILL.) *var. striata* (LEACH) SARS
Astarte montagui (DILL.) *var. warhami* HANC.
Astarte elliptica (BROWN)
Cardium ciliatum FABR.
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Sipho (*Siphonorbis*) *ebur* (MØRCH)

Sand bed. Altitude: 40 m:

Phoca foetida O. FABR.
Phoca groenlandica O. FABR.

The forms found testify to an arctic climate.

2050 m east of Pátorfik, due east of a small river, a small section was found. The lower layer consisted of 2 m screes, superposed by 3 m stratified clay and basalt sand with shells. Farther up the section was covered by screes. 50 m farther east the lowermost beds were exposed and they proved to consist of stratified layers of clay and sand containing shells.

Clay and sand beds. Altitude: 5 m:

Pecten islandicus MÜLL.
Astarte borealis (CHEMN.)
Astarte elliptica (BROWN)
Cardium ciliatum FABR.
Macoma calcarea (CHEMN.)
Cyrtodaria siliqua (SPGL.)
Saxicava arctica (L.)
Mya truncata (L.)
Balanus balanus (L.) DA COSTA

The climate has been arctic at the time of deposition.

2300 m east of Pátorfik a section showed farthest down 5 m sand free from shells and superposed by 10 m of stratified beds of clay and sand with indeterminable shell fragments.

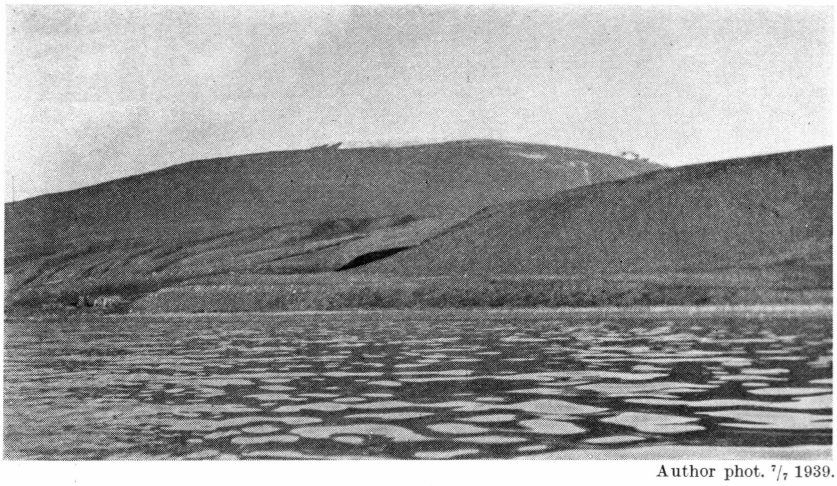

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Fig. 10. The mouth of the Kûgtsiaq River seen to the left at the hunting hut. To the right of this the 8 m terrace dipping towards west is seen. The raised beach at a height of 35 m and the terrace at 45 m are clearly seen to the right of the river cutting.

Kûgtsiaq.

Sedimentary beds again appeared 5250 m east of Pátorfik at the outlet of the small Kûgtsiaq River. The area round the mouth of Kûgtsiaq showed some interesting phenomena (fig. 10). Right down at the coast there was a terrace, which due west of the river attained an altitude of 8 m. A short distance farther back from the coast a new terrace rose to an altitude of 25 m; at an altitude of 35 m there was a smaller raised beach, and finally at an altitude of 45 m a well developed terrace. The two terraces farthest down had a slight western dip. Probably they are both old delta deposits which now, owing to the upheaval, have been cut through by the river. The terrace at 25 m could be found on the eastern side of Kûgtsiaq, and in the slopes there were a number of shells. The raised beach at 35 m must be regarded as a river terrace, there being no traces of it outside the river system. The terrace at 45 m was the old sea bottom. Unfortunately the cutting was covered with screes, and it was not possible to see any stratification. A number of shells were collected.

Bed of screes. Altitude: 40 m:

Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Shells of *Macoma calcarea* (CHEMN.) bored by *Natica*

The climate possibly arctic at the time when these shells were imbedded.

Sarfarfik.

The cliff at the mouth of the Sarfarfik River (fig. 11) rises to a height of up to 60 m. Farthest down in the cliff a 40 m thick bed of stratified clay with a few pebbles is visible. Above this there is at the coast a sand bed of 10 m, superposed by a couple of metres of moving soil. Farther into the river valley the bottom layer merges into a sand bed, superposed by an 8 m thick clay bed. On top of this layer there is some 10 metres with moving soil. The number of shells found in these deposits is very small.

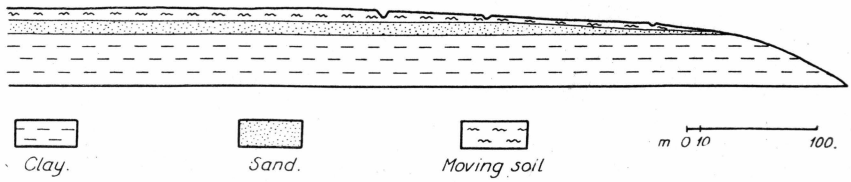


Fig. 11. Section of the cliff on the western bank of the Sarfarfik River.

Clay bed. Altitude: 30 m:

Saxicava arctica (L.)
Mya truncata (L.)

An arctic climate must undoubtedly have prevailed, while these beds were being deposited.

Vibekes Elv (ɔ: V. River).

During the ascension along the rivers between Pátorfik and Sarfarfik it was possible, up to an altitude of 230 m above sea level, to observe alluvial sediments. As a rule the upper metres were covered with scree or vegetation. At Vibekes Elv there was, however, a fresh slide in the eastern bank of the river, at an altitude of 190 m above sea level. The section showed brecciated clay at the bottom, superposed by arenaceous clay. The beds of the section were frozen, so that it was necessary to excavate the shells found in the clay.

Clay bed. Altitude: 190 m:

Pecten groenlandicus Sow. *var. major* Collin
Astarte elliptica (Brown.)
Cardium ciliatum Fabr.
Serripes groenlandicum (Chemn.)
Saxicava arctica (L.)

The presence of *Pecten groenlandicus* Sow. *var. major* Collin shows that the beds were deposited under high-arctic conditions.

Lillebæk (ɔ: small brook).

Between Qaersuarssuk kangigdleq[1]) and Kûgtsiaq a small brook debouches, in the banks of which there were also alluvial beds. At an altitude of 200 m above sea level there was a very small section showing shell bearing clay beds.

Clay bed. Altitude: 200 m:

Pecten islandicus MÜLL.
Cardium ciliatum FABR.
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)

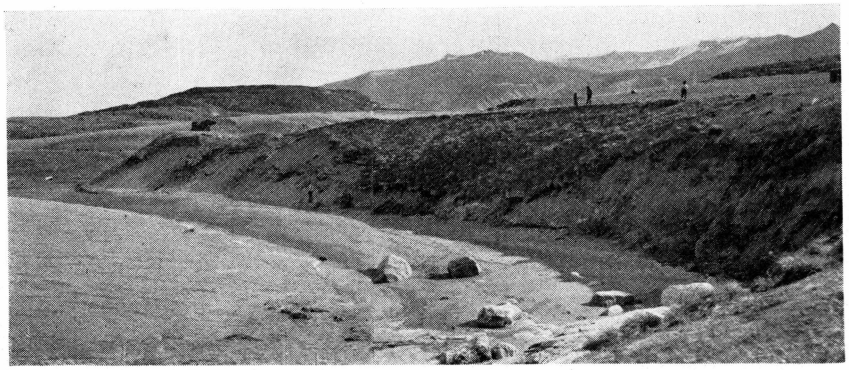
Even though in this locality there were no species characterizing high-arctic conditions, the altitude makes it probable to suppose that the beds at Lillebæk were deposited under the same conditions as the high-arctic layers at Vibekes Elv.

Qaersuarssuk kitdleq.

The now abandoned Qaersuarssuk coal mine is situated about 8.5 km west of the outpost of Qaersut. The place, from which the coals were shipped, lies east of the mine and is bounded by a low gneiss hill. East of and in continuation of the latter there is a long cliff composed of alluvial beds. The cliff is 11 m high, and is divided into two parts by a small brook, which cuts through the cliff below the easternmost of the Greenlander houses of the dwelling place. When following the cliff farther east, one arrives at the gneiss area between Qaersut and Qaersuarssuk. Here the gneiss crops out in smaller areas, and between these there are level planes suggesting terraces. They were entirely covered with vegetation, and shells were only found in a small section at a river cutting. The formation of the terraces may be imagined to have taken place in the following manner: When the whole of the area was submerged, these knolls lay like points or sunken rocks. Under the lee of them there was calm water, where material could be deposited. Later on, after the upheaval, the exogene forces have contributed to level the ground between the knolls, so that gneiss and alluvium appear with more or less the same height of surface.

The stratification of the cliff below the dwelling place appears from a design of the section (fig. 13) and a photograph (fig. 12). In the eastern part the cliff is composed of interchanging sand and clay layers, whereas there is nothing but clay in the western part, at any rate at the base. At the top throughout the length of the cliff there is a layer of stones of the size of a fist.

[1]) This was the designation used by the expedition for the more easterly situated Qaersuarssuk, as opposed to the westerly situated Qaersuarssuk west of Qaersut, which is called Q. kitdleq.



Author phot. 10/7 1939.

Fig. 12. The coast cliff at Qaersuarssuk kitdleq. For explanation see fig. 13.

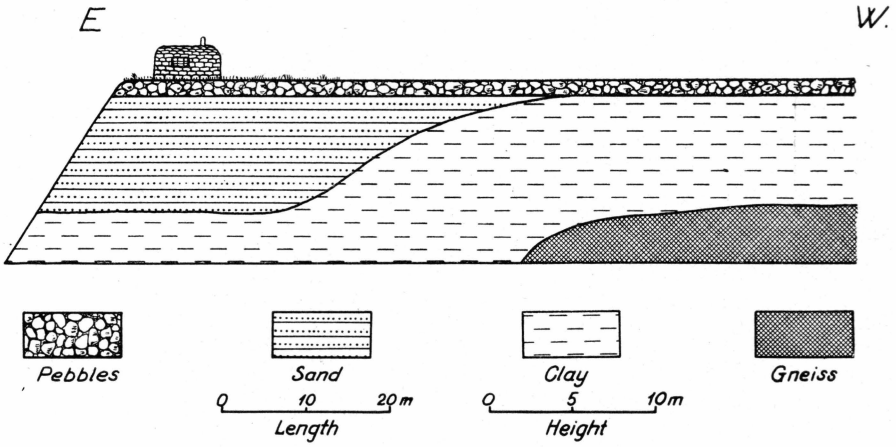


Fig. 13. The coast cliff at Qaersuarssuk kitdleq.

Shells were found at 3 horizons, viz. at an altitude of 4.5, 5, and 10—10.5 m above sea level.

The whole of the well developed terrace and delta system at Qaersuarssuk kitdleq will be mentioned later in the present work (pp. 92, 113).

Cliff at river cutting east of Qaersuarssuk kitdleq. Loose:

Cardium ciliatum FABR.
Serripes groenlandicum (CHEMN.)
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)

The cliff east of the brook at Qaersuarssuk kitdleq. Loose in the scree:

Saxicava arctica (L.)
Mya truncata (L.)
Serpula sp.

Qaersuarssuk kitdleq. Clay bed. Altitude: 4 m:

Pecten groenlandicus SOW. *var. major* COLLIN.
Pecten islandicus MÜLL.
Astarte montagui (DILL.) *var. striata* (LEACH) SARS
Astarte montagui (DILL.) *var. warhami* HANC.
Axinopsis orbiculata G. O. SARS
Cardium ciliatum FABR.
Serripes groenlandicum (CHEMN.)
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Lyonsia arenosa (MØLLER)
Margarita cinerea (COUTH.)
Natica sp. (bored shells)
Sipho togatus (MØRCH)
Balanus balanus (L.) DA COSTA
Balanus crenatus BRUG.
Serpula sp.

Sand bed. Altitude: 5.5 m:

Astarte montagui (DILL.) *var. striata* (LEACH) SARS
Cardium ciliatum FABR.
Serripes groenlandicum (CHEMN.)
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Lyonsia arenosa (MØLLER)
Natica clausa BROD. & SOW.
Shells bored by *Natica*

Sand bed. Altitude: 10 m:

Astarte borealis (CHEMN.)
Astarte elliptica (BROWN)
Cardium ciliatum FABR.
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Macoma calcarea. Shells bored by *Natica*

Sand bed. Altitude: 10.5 m:

Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Monodon monoceros (L.)

As to the climatic conditions at the time, when these layers were being deposited see pp. 106 et seq.

Tuperssuautâ.

At Tuperssuautâ west of the outpost of Niaqornat there is about 200 m east of the hunting hut a locality with alluvial beds.

The author has not had the opportunity to observe the beds closely. DREYER JØRGENSEN collected a number of shells, partly in the clay and partly in the delta deposits.

Altitude: about 20 m:

Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)

The climate probably arctic at the time when these deposits were being formed.

Qardloq.

East of the Qardloq site at the coast of Vaigat there is a system of raised terraces and deltas. However, there was nowhere any section to be found in the old terraces, and so collections could not be made as in the other localities. Only at a lagoon in a large raised plane called Sioraq some shells were found, but it is not possible to decide, whether they were fossil or recent shells.

Sand. Altitude: 3 m:

Mytilus edulis L.
Saxicava arctica (L.)
Mya truncata (L.)
Balanus balanus (L.) DA COSTA

3. Disko.

Asuk.

In the Asuk River a section, 24 m in height (fig. 14), was found in the eastern river bank at an altitude of 116 m. Lowest down there was a layer of screes, 8 m thick, and above that 6 m of stratified clay, sand and gravel, which in its turn was overlain by a layer of moving soil, 10 m thick. Right opposite to this section there was a terrace in the western bank, clearly a river terrace corresponding with the former bed of the river. From this place and up to 125 m above sea level both banks of the river were covered with screes, but at the altitude mentioned there was again, in both river banks, stratified sand and clay containing fragments of shells. The upper edge of the bank corresponds with a terrace.

In the collections of the Mineralogical Museum there is a specimen of *Macoma* (*Tellina*) *calcarea* CHEMN. from Asuk. It lies in a concretion of clay iron stone, and is said to have been collected by STEENSTRUP. The determination was undertaken by DE LORRIOL, as appears from the label: "Il me parait probable autre que c'un *Tellina calcarea* CHEMN. DE LORRIOL".

In order, if possible, to identify the layer from which the fossil had been collected, rather comprehensive investigations were undertaken, but with a negative result. Although investigations were made of the whole area, which might be supposed to be included in the designation of Asuk, no species of rock was found, which could be identified with the one mentioned above. As it is here a case of *Macoma calcarea*, only alluvial formations can be taken into account.

At an altitude of about 474 m above sea level a single fragment of a shell was found, viz. of *Saxicava arctica* (L.). It was found on a slope,

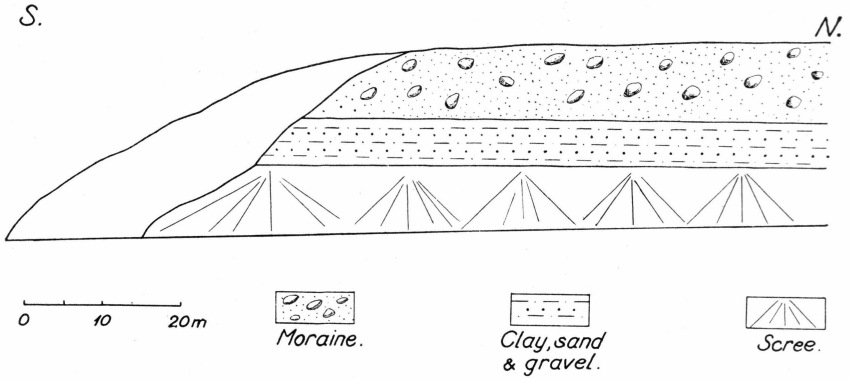


Fig. 14. Section of the slope in the western bank of the Asuk River. »Moraine« = Moving soil.

which was partly covered with vegetation, and it was impossible to find other traces of shells.

The occurrence of the shell fragment in this place, which, as far as can be proved, was not covered by alluvial marine beds, may be ascribed to birds, as has been mentioned by OTTO FABRICIUS in his description of the Greenland raven (*Corvus Corax* L.), "Fauna groenlandica", p. 63[1]).

Sand. Altitude: about 150 m:

Astarte elliptica (BROWN)
Saxicava arctica (L.)
Mya truncata (L.)

The climate probably arctic at the time of the deposition of the sand.

Loose in moving soil. Altitude: 474 m:

Saxicava arctica (L.)

Stordal (ɔ: great valley).

In Stordal, which leads from the head of Nordfjord (Kangersôq) to the interior of Disko, V. JENSEN-AARIS, as formerly mentioned (p. 12),

[1]) Professor AD. S. JENSEN, who has called my attention to this fact, mentions it in detail in his treatise on the naturalist OTTO FABRICIUS (Medd. om Grønland, 62, pp. 341—342).

found shells in pressed-up, dark and arenaceous layers, presumably a mud volcano. The shells were found everywhere in the "volcano cone". The mud volcano is situated at an altitude of 46 m above sea level. The following shells, determined by V. NORDMANN, were found:

Portlandia arctica (GRAY)
Cardium ciliatum FABR.
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)

The climate high-arctic at the time when the beds were deposited, as appears from the presence of *Portlandia arctica.*

4. The Egedesminde district.

Igíniarfik.

The locality is situated near the portage, slightly less than 1 km northeast of the outpost Igíniarfik, about 65 km south-southwest of Egedesminde, at a bay farthest in on the south side of the peninsula Alángorssuaq, which divides the Arfersiorfik fjord from the Ataneq fjord.

The shells were found by Dr. V. NORDMANN in fine clay, deposited in the sound, which was formerly to be found in the present locality of the portage. By the washing out of the very large sample brought home the following shells were identified:

Hemithyris psittacea (GML.)
Leda pernula (MÜLL.)
Anomia squamula L.
Pecten islandicus MÜLL.
Lima subauriculata MONT.
Crenella decussata (MONT.)
Mytilus edulis L.
Astarte borealis (CHEMN.)
Astarte montagui (DILL.)
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Boreochiton ruber LOWE
Scissurella crispata FLEM.
Puncturella noachina (L.)
Acmaea (*Tectura*) *rubella* (FABR.)
Lepeta coeca (MÜLL.)
Margarita helicina (PHIPPS)
Margarita cinerea (COUTH.)
Solariella obscura (COUTH.) *var. bella* VERKZ.
Moelleria costulata (MØLL.)
Littorina palliata SAY
Littorina saxatilis (OLIVI) *var. groenlandica* MØLL.

Cingula castanea (MØLL.)
Scalaria (*Acirsa*) *borealis* BECK
Natica clausa BROD. & SOW.
Trophon clathratus (L.)
Trophon truncatus (STRØM)
Admete viridula (FABR.)
Bela pingeli (BECK)
Bela violacea (MIGH.)
Balanus balanus (L.) DA COSTA
Balanus hammeri (ASCAN.) BROWN
Balanus crenatus BRUG.
Strongylocentrotus droebachiensis (MÜLL.)

The presence of *Anomia squamula* L., which is an undoubtedly boreal species, shows that the beds have been deposited at the time, when the climate has been proved to be mildest on the west coast of Greenland.

Gieseckes Sø.

To the north of and running parallel with Nordre Strømfjord a valley pass es from the coast at Eqalugssuit (Gamle Egedesminde) and nearly as far as the Ataneq fjord. The greater part of the valley is filled with Gieseckes Sø, which is among the largest known lakes in Greenland, more than 30 km in length.

The surface of this lake is about 10 m above sea level, and it is divided from the sea by a valley about 2 km in length, the pass point being about 22 m above sea level. According to V. NORDMANN (59, p. 47) there are rich shell banks in a couple of localities along the shores of the lake.

By the washing out of the samples brought home by Dr. NORDMANN the following shells were found:

The clay bank, lower part[1]):

Pecten islandicus MÜLL.
Lima subauriculata MONT.
Crenella decussata (MONT.)
Mytilus edulis L.
Astarte borealis (CHEMN.)
Astarte montagui (DILL.) *var. warhami* HANC.
Saxicava arctica (L.)
Mya truncata (L.)
Mya truncata (L.) *forma uddevallensis* HANC.
Lyonsia arenosa (MØLL.)
Boreochiton ruber LOWE
Scissurella crispata FLEM.
Puncturella noachina (L.)
Acmaea (*Tectura*) *rubella* (FABR.)

[1]) The designations of localities are given by Dr. NORDMANN.

Lepeta coeca (MÜLL.)
Margarita cinerea (COUTH.)
Margarita olivacea (BROWN)
Moelleria costulata (MØLL.)
Lacuna divaricata (FABR.)
Littorina saxatilis (OLIVI) *var. groenlandica* MØLL.
Scalaria (*Acirsa*) *borealis* BECK
Natica clausa BROD. & SOW.
Trophon clathratus (L.)
Trophon fabricii (BECK) MØLL.
Trophon truncatus (STRØM)
Buccinum groenlandicum CHEMN.
Balanus balanus (L.) DA COSTA
Balanus hammeri (ASCAN.) BROWN
Balanus crenatus BRUG.
Strongylocentrotus droebachiensis (MÜLL.)

The occurrence of *Mya truncata* (L.) *forma uddevallensis* HANC. and *Astarte montagui* (DILL.) *var. warhami* HANC. point towards arctic climatic conditions at the time when the clay was deposited. The presence of *Balanus hammeri* (ASCAN.) BROWN does not make against this supposition, although this species testifies to a milder climate than that now found in northern West Greenland, seeing that at the present time the northernmost locality, where it has been found, is at Nordre Strømfjord, only some twenty km south of Gieseckes Sø.

The clay bank, upper part:

Hemithyris psittacea (GML.)
Pecten islandicus MÜLL.
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Mya truncata (L.) *forma uddevallensis* HANC.
Puncturella noachina (L.)
Lepeta coeca (MÜLL.)
Trophon clathratus (L.)
Trophon truncatus (STRØM)
Buccinum groenlandicum CHEMN.
Balanus balanus (L.) DA COSTA
Balanus hammeri (ASCAN.) BROWN

The climatic conditions have been arctic at the time when this clay bank was deposited.

The upper part of the shell bank:

Pecten islandicus MÜLL.
Lima subauriculata MONT.
Mytilus edulis L.
Astarte borealis (CHEMN.)
Astarte montagui (DILL.)
Astarte montagui (DILL.) *var. warhami* HANC.

Macoma calcarea (CHEMN.)
Mya truncata (L.)
Mya truncata (L.) *forma ovata* JENSEN
Mya truncata (L.) *forma uddevallensis* HANC.
Boreochiton ruber LOWE
Puncturella noachina (L.)
Lepeta coeca (MÜLL.)
Margarita olivacea (BROWN)
Littorina palliata SAY
Littorina saxatilis (OLIVI) *var. groenlandica* MØLL.
Scalaria (*Acirsa*) *borealis* BECK
Natica clausa BROD. & SOW.
Trophon clathratus (L.)
Trophon fabricii (BECK) MØLL.
Trophon truncatus (STRØM)
Sipho togatus (MØRCH)
Admete viridula (FABR.)
Balanus balanus (L.) DA COSTA
Balanus hammeri (ASCAN.) BROWN
Balanus crenatus BRUG.
Strongylocentrotus droebachiensis (MÜLL.)

The climate arctic at the time when this shell bank was deposited.
The big shell bank:

Pecten islandicus MÜLL.
Lima subauriculata MONT.
Mytilus edulis L.
Astarte borealis (CHEMN.)
Astarte montagui (DILL.)
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Mya truncata (L.) *forma ovata* JENSEN
Puncturella noachina (L.)
Acmaea (*Tectura*) *rubella* (FABR.)
Lepeta coeca (MÜLL.)
Margarita groenlandica (CHEMN.)
Margarita olivacea (BROWN)
Littorina palliata SAY
Littorina saxatilis (OLIVI) *var. groenlandica* MØLL.
Cingula arenaria (MIGH. & ADAMS)
Scalaria (*Acirsa*) *borealis* BECK
Lunatia pallida (BROD. & SOW.)
Natica clausa BROD. & SOW.
Trophon clathratus (L.)
Trophon fabricii (BECK) MØLL.
Trophon truncatus (STRØM)
Admete viridula (FABR.)
Balanus balanus (L.) DA COSTA
Balanus hammeri (ASCAN.) BROWN
Balanus crenatus BRUG.
Strongylocentrotus droebachiensis (MÜLL.)

The climate arctic at the time when the big shell bank was deposited.

The shell bank on the opposite shore:

Pecten islandicus MÜLL.
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Mya truncata (L.) *forma uddevallensis* HANC.
Lepeta coeca (MÜLL.)
Margarita groenlandica (CHEMN.)
Littorina saxatilis (OLIVI) *var. groenlandica* MØLL.
Cingula castanea (MØLL.)
Scalaria (*Acirsa*) *borealis* BECK
Trophon fabricii (BECK) MØLL.
Balanus balanus (L.) DA COSTA

The climatic conditions arctic at the time when this bank was deposited.

Gieseckes Sø (without more detailed indications of localities):

Pecten islandicus MÜLL.
Macoma calcarea (CHEMN.)
Saxicava arctica (L.)
Mya truncata (L.)
Trophon fabricii (BECK) MØLL.
Balanus balanus (L.) DA COSTA
Balanus hammeri (ASCAN.) BROWN

As appears from the above, the climate has been very constant at the time when the banks along the shores of this lake were deposited. It is, however, probable that more detailed investigations in the area at different altitudes may bring about results, which will contribute greatly to clear up the problem of changes in level and climate along the west coast of Greenland after the glacial age.

FAUNISTIC REMARKS

While preparing this chapter, which deals with the forms found in the deposits in northern West-Greenland, the principal object has been to establish the occurrence of the various species, and not only the fossils, but also recent occurrences, as the latter may contribute towards clearing up the climatic conditions prevailing in the localities in question at the different stages. Further, all the facts have been collected, which it has been possible to gather on the occurrence of the species in Greenland, recent as well as fossil. It should be stated here that information is unfortunately lacking as to the recent material from Northeast Greenland, as the material of the "Danmark-Expedition" has not yet been worked up, while on the other hand the publications of recent years from East Greenland and Iceland have contributed largely towards elucidating these conditions. Also, as far as West Greenland is concerned, a number of facts are lacking as to the recent fauna e. g. from the Umanak Fjord. It is true that we have the work of POSSELT (68), but Professor AD. S. JENSEN has apprised the present author that the information therein contained must be used with some caution, as it does not always appear from the records, whether in the individual cases it is a question of a living or a dead, perhaps a fossil animal.

In the list of the places, where fossil specimens have been found in Greenland, unpublished collections have been indicated by stating that the specimens are to be found in the Mineralogical Museum (Min. Mus.) of Copenhagen. Most of the determinations and revisions of these older collections were undertaken by Professor AD. S. JENSEN, but have not been published until now.

I make use of this opportunity to call attention to the fact that my previous statement of the presence of *Cyprina islandica* and *Venus gallina*[1]) (73, p. 10) is due to an erroneous determination, for which reason it is hereby recalled.

The work dealing with the shells and alluvial formations in Greenland is only in its infancy. The following survey of all available facts will, it is to be hoped, be useful for future investigators.

[1]) In alluvial beds of the Umanak Fjord.

The statements concerning the recent distribution and fossil occurrence of the different species have been based upon the following publications, listed pp. 120 et seq.:

2—8b, 11—14, 19—31, 33—38, 42, 45—47, 49—50, 53—57, 61—62, 65—69, 71, 75—77, 79—82, 84—94, 98—106.

Ophiuroidea.

Ophiura (Ophioglypha) sarsii Lütken.

Literary record:

Ophiura Sarsii Ltk.: Steenstrup (81, p. 236).

Min. Mus. record:

Ophiura Sarsii Ltk.: Krarup Smith. 1869.

The species found at Pátorfik.

Of recent occurrence with a circumpolar distribution. In the Atlantic it occurs on the European side down to the southern part of the North Sea; on the American side it extends down to 35° lat. N. In Davis Strait it has been found from the southernmost part to Discovery Bay; in East Greenland it has been taken in Scoresby Sund.

?Ophiura (Ophioglypha) robusta Ayres.

A couple of specimens, which Dr. Th. Mortensen, though with some hesitation, refers to this species have been found at Pátorfik.

Of recent occurrence: the Murman Coast, the Kara Sea and from Spitzbergen to Øresund. In the western Atlantic along the coast of America it has been taken down to Cape Cod. In West Greenland it has been taken from the most southerly part as far as Franklin Pierce Bugt (79°25′ N.); in East Greenland from Angmagssalik to the waters round Danmarks Havn.

Ophiura sp.

Some specimens, which cannot be referred to species, have been found at Pátorfik.

Echinoidea.

Strongylocentrotus droebachiensis (O. Fr. Müller).

Literary records:

Toxopneustes Droebachiensis Müll.: Steenstrup (81, p. 236).
Toxopneustes Droebachiensis Müll.: J. A. D. Jensen (34, p. 73).
Strongylocentrotus droebachiensis Müll.: Jensen (30, p. 629).

Min. Mus. record:

Toxopneustes Droebachiensis Müll.: Hartz 1898—1900.

A few fragments of shells belonging to this species as well as an almost entirely unbroken specimen have been found at Pátorfik. At Igíniarfik (Egedesminde district) and Alángorssuaq some spines have been found, which are referred to this species.

Of recent occurrence with a circumpolar distribution, though not to the east of the Taimyr Peninsula. In the Atlantic it occurs from Spitzbergen to the Channel; along the eastern coast of America the most southerly locality, where it has been taken, is New Jersey. In West Greenland it has been taken from the most southerly part to Hages Point in the north; in East Greenland from Angmagssalik to the waters round Danmarks Havn.

Brachiopoda.

Hemithyris psittacea (GMELIN).

Literary records:

Rhynchonella psittacea GML.: STEENSTRUP (81, p. 236).
Rhynchonella psittacea GML.: PJETURSSON (65, pp. 329, 331, 334).

The species found in one locality at Gieseckes Sø and at Igíniarfik (Egedesminde district).

Of recent occurrence with a wide distribution in the arctic seas. It is circumpolar and extends towards south as far as Maine Bay and the North Sea. In West Greenland it has been found from the most southerly to the most northerly district, in East Greenland from Lindenows Fjord to Danmarks Havn.

Of fossil occurrence: Scandinavia, England, Canada and Siberia.

Mollusca.

Nucula tenuis (MONTAGU) var. expansa REEVE.

Plate 6, figs. 6 a, b.

Literary records:

Nucula inflata HANC.: STEENSTRUP (81, p. 236).
Nucula tenuis MONT.: STEENSTRUP (82, p. 285).
Nucula tenuis (MONT.) *var. expansa* REEVE: HARTZ (19, p. 40) (27, p. 229).
Nucula tenuis (MONT.): JENSEN and HARDER (28, p. 403).
Nucula tenuis MONT.: NOE-NYGAARD (56, pp. 12, 15).

Min. Mus. records:

Nucula tenuis (MONT.): KRARUP SMITH. 1869.
Nucula tenuis (MONT.) *var. expansa* REEVE: KRARUP SMITH. 1869.
Nucula tenuis (MONT.) *var. expansa* REEVE: PFAFF. 1874.

This species is found in the clay beds at Pátorfik, partly in the lowermost clay horizon, partly in the covering sand bed. There are numerous well preserved specimens and shells, all large, inflated with a projecting umbo. Further, it has been found at Igíniarfik (Disko Fjord), Niaqornaq and Orpigsôq.

The species proper is distributed in the arctic seas, but is also found near the heads of certain Norwegian fjords as e. g. the Oslo Fjord. In Arcticum the species is said to be littoral, as distinguished from the more southerly occurrences, where it is found in depths of up to 2000 m. In West Greenland the variety *expansa* has been taken in numerous localities from Julianehaab to Discovery Bay, the depths varying from 10—700 m. In East Greenland it has been taken as far as southeast of Sabine Ø in depths of up to 106 m.

Of fossil occurrence: Siberia, Scandinavia, Great Britain, Ireland, Calabria, Iceland, Canada and Maine. These records apply to the species proper, but it does not clearly appear, in which localities the variety occurs.

Leda pernula (MÜLLER).

Literary records:

Leda pernula MÜLL.: NORDENSKIÖLD (57, p. 1019).
Nuculana buccata STEENSTRUP: STEENSTRUP (81, p. 236).
Nuculana pernula MÜLL.: STEENSTRUP (81, p. 236).
Leda pernula MÜLL.: STEENSTRUP (82, p. 285).
Leda pernula MÜLL.: HARTZ (19, p. 40).
Leda pernula (MÜLL.): HARTZ (27, pp. 299, 316).
Leda pernula MÜLL.: NOE-NYGAARD (56, p. 12).

Min. Mus. records:

Leda buccata STEENSTRUP: RINK. 1848—51.
Leda pernula (MÜLL.): RINK. 1848—51.
Leda pernula (MÜLL.): KRARUP SMITH. 1869.
Leda pernula MÜLL.: PFAFF. 1874.

The species has been found in the neighbourhood of Pátorfik, both in the clay and in the sand beds, though not in the uppermost layers. From the clay beds there are only a few moulds and casts; from the sand layers many unbroken specimens and shells. Further, it has been found at Sarpiussat, Igíniarfik (Disko Fjord) and Orpigsôq and Igíniarfik (Egedesminde district).

In recent time *Leda pernula* is arctic-circumpolar and of common occurrence in all arctic seas. Towards south it has been taken alive off the Shetland Islands. In the Bay of Biscay and off the west coast of Ireland it has been taken at great depths (about 900 m), but only dead specimens. In West Greenland the species has been taken from Julianehaab to Discovery Bay on Grinnell Land (81°41′ lat. N.) in depths of

up to 700 m; in East Greenland as far as Sabine Ø in depths of up to 100 m.

Of fossil occurrence: North America, Iceland, Scandinavia, Great Britain, Ireland, Germany, Russia and Siberia.

Leda minuta (MÜLLER).

Literary record:

Nuculana caudata STEENSTRUP: STEENSTRUP (81, p. 236).

Min. Mus. record:

Leda caudata STEENSTRUP: KRARUP SMITH. 1869.

The species has been found at Pátorfik, the finds being represented by several unbroken specimens and unbroken shells.

Leda minuta occurs with a similar distribution as *Leda pernula*, but it extends farther south and is lacking in the actual high-arctic waters. It is common in West Greenland, where it has been taken from Julianehaab to as far as Richardson Bay in depths of up to 375 m. From East Greenland three shells are recorded from Ingmíkértoq (27, p. 317), but as the find only consists of empty shells, it can hardly be decided, whether they derive from recent specimens. THORSON does not record it from Scoresby Sund.

Of common fossil occurrence in a similar manner as *Leda pernula*. It has not been found in East Greenland.

Yoldia hyperborea LOVÉN.

Literary record:

Yoldia hyperborea LOVÉN: NORDENSKIÖLD (57, p. 1019).

The species has been found at Sarpiussat and Lerbugt (Claushavn).

Of recent occurrence: Spitzbergen, Novaja Zemlya, the Kara Sea and the Siberian Ice Sea. In the eastern Atlantic it extends as far as Lofoten and Iceland; in the western Atlantic as far as Massachusetts. In West Greenland it has been taken from the Julianehaab district as far as the Upernavik district (Augpilagtoq); in East Greenland it seems not to have been taken.

Of fossil occurrence: Scandinavia.

Portlandia arctica (GRAY).

Literary records:

Yoldia truncata BR.: NORDENSKIÖLD (57, p. 1019).
Yoldia arctica GRAY: STEENSTRUP (81, p. 236).
Portlandia (*Yoldia*) *arctica* GRAY: STEENSTRUP (82, p. 295).

Portlandia (*Leda*) *arctica* GRAY: HARTZ (4, p. 176).
Yoldia arctica GRAY: HARTZ (27, p. 299).
Yoldia arctica GRAY: JENSEN and HARDER (28, p. 403).
Yoldia (*Portlandia*) *arctica* GRAY: JENSEN (30, pp. 622 et seq.).
Portlandia arctica GRAY: NOE-NYGAARD (56, p. 12).
Portlandia (*Yoldia*) *arctica* GRAY: JENSEN (33, pp. 4 et seq.).

Min. Mus. record:

Yoldia arctica GRAY: PFAFF. 1874.

The distribution of this species in and off Greenland appears from the map (fig. 15), based upon the map of AD. S. JENSEN (33). New occurrences are the localities on the Svartenhuk peninsula (the Kugssineq cliff) and in the valley leading from Nordfjord to the interior of the island of Disko. The already known localities will be mentioned in the following.

This pronouncedly stenotherm species is of recent occurrence in all high-arctic waters. According to AD. S. JENSEN (25, p. 392) it can only live in water, the temperature of which is between ÷ 2°6 C and + 2°5 C. However, in his most recent work AD. S. JENSEN puts the lower limit at about ÷ 2° C (33, p. 16). Here a complete enumeration has also been made of all the occurrences known up to 1942. It has, on several occasions, been mentioned by earlier authors that the distribution of *Portlandia arctica* in Greenland is rather peculiar (27, 33). In West Greenland it does not occur south of about $77^1/_2°$ lat. N. according to AD. S. JENSEN (33). In East Greenland it extends considerably farther south, presumably owing to the cold coastal current. In the Sermilik Fjord in the Angmagssalik district a specimen has been taken, but the shells were empty (5, p. 25). The most southerly locality, where living specimens have been taken, is Mikis Fjord in Kangerdlugssuaq (68°44′ lat. N.). From here and as far as Scoresby Sund it has been sparsely found, whereas it is of frequent occurrence in Scoresby Sund and within the Kong Oscar Fjord archipelago.

Of fossil occurrence: Scandinavia, Latvia, North Germany, Scotland, Iceland, U.S.A. down to New England, Canada and Siberia. In Denmark it occurs in the first interglacial period (Mindel-Riss) in the lowermost beds of the so-called Esbjerg Yoldia clay. Further, it occurs in the second interglacial period (Riss-Würm) in the Portlandia arctica zone of the Skærumhede-series and in the late-glacial Yoldia clay in Vendsyssel. All of these formations have been deposited in immediate connection with a glacial period. From West Greenland it is known from Nordre Strømfjord (Lersletten ɔ: the clay plain), Sydost Bugt, Orpigsôq and Kiagtoq, both localities near Christianshaab, in Lerbugt at Claushavn and Niaqornaq at Jakobshavn. Further it has, as formerly mentioned, been found in the interior of Disko (p. 35) and in the Kugssineq

cliff on the southern coast of the Svartenhuk peninsula (p. 13). In East Greenland it has been found in Gaasefjord, in Scoresby Sund (HARTZ 1901), on Ella Ø, in Kong Oscar Fjord archipelago (NOE-NYGAARD) and in the following localities discovered by the Danmark Expedition: Store Koldewey Ø, northwest of Teufelkap, Dove Bugt, Snenæs (76°50′ lat. N., 19°25′ long. W.), Ile de France and, finally, on the east coast of Peary Land (82°46′ lat. N., 21°05′ long. W.).

Portlandia lenticula (MØLLER).

Literary record:

Portlandia lenticula (MØLLER): NOE-NYGAARD (56, p. 12).

This species was found in two localities at Pátorfik, the find being represented by numerous complete specimens and unbroken shells.

Of recent occurrence this species has an arctic-circumpolar distribution and has been found at Bodø, on the west coast of Norway, Iceland, the Faroes, the Shetland Islands and the Atlantic west of Ireland, and at Marocco, in the two latter cases, however, only dead specimens. In West Greenland it has been found from Julianehaab as far as the Umanak Fjord in depths of about 100—700 m; from East Greenland it is known from Kap Dalton as far as north of the Franz Joseph Fjord archipelago in depths up to about 220 m.

Of fossil occurrence: Scandinavia, England, Siberia, Canada and Maine. As far as can be seen, it has not formerly been found in West Greenland.

Arca glacialis GRAY.

Literary record:

Nuculana glacialis GRAY: STEENSTRUP (81, p. 236).

The species found at Niaqornaq:

Of recent occurrence: Iceland, Spitzbergen, Barentz Sea, Novaja Zemlya, Kara Sea; the easterly Finmarken, the Shetland Islands. Dead shells have been found in the Bay of Biscay and the northern Atlantic. Off the coast of eastern America it has been taken in Wellington Channel, the Gulf of St. Lawrence and Fundy Bay. In West Greenland it has been taken at Julianehaab, Umanak and in Baffin Bay off Prøven. In East Greenland it has been taken in the Scoresby Sund district, and in the Franz Joseph and Kong Oscar Fjord archipelagos.

Of fossil occurrence: Scandinavia.

Anomia squamula LINNÉ.

Literary records:

Anomia ephippium L.: J. A. D. JENSEN (34, pp. 49, 73).
Anomia ephippium L.: AD. S. JENSEN (27, p. 293).
Anomia ephippium L.: AD. S. JENSEN and HARDER (28, p. 402).
Anomia squamula L.: AD. S. JENSEN (33, p. 20).

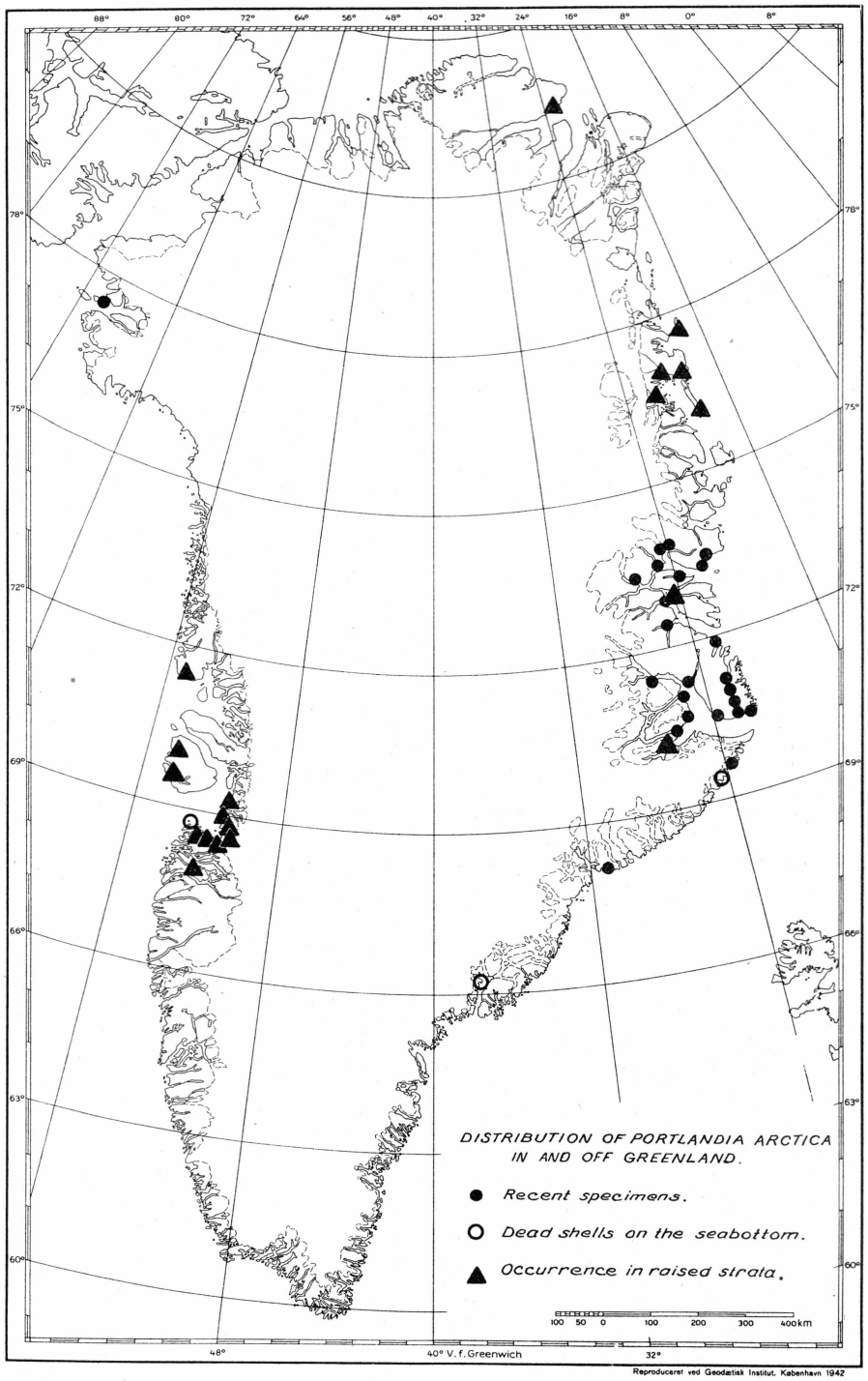


Fig. 15. Sketch map of Greenland showing distribution of *Portlandia arctica* (GRAY). After AD. S. JENSEN (33), with some additions.

The species has been found at Iginiarfik (Egedesminde district), the find consisting of a left valve and some fragments. Further, it has been found at Orpigsôq.

Of recent occurrence in the warm part of the White Sea, off the Murman Coast, the Faroes, Iceland and along the coast of Norway down to the Bay of Biscay. At the coast of America it occurs from the southern part of Labrador to Cape Hatteras.

In Greenland it has not been found alive.

Of fossil occurrence: Spitzbergen, Scandinavia, England and Iceland.

In Southwest Greenland it has formerly been found by J. A. D. JENSEN (34, pp. 49, 73) in two localities in the southern part.

The presence of this undoubtedly boreal form shows, as stated by AD. S. JENSEN (27, p. 293; 28, p. 402), that a milder climate has formerly prevailed along the west coast of Greenland. In the former of the two articles quoted, AD. S. JENSEN expresses some doubt as to the advisability of drawing far-reaching conclusions from the presence of the species in the locality mentioned, seeing that *Anomia squamula* L. is a sessile mollusc i. a. on floating seaweed. Later finds of *Zirphæa crispata* at Orpigsôq (Orpigssuit) near Disko Bugt have, however, done away with these doubts.

Pecten groenlandicus SOWERBY **var. major** COLLIN.

Literary records:
Pecten groenlandicus Low.[1]): STEENSTRUP (81, p. 236).
Pecten groenlandicus Sow.: JENSEN (33, pp. 4 et seq.).

Min. Mus. record:
Pecten groenlandicus Sow.: KRARUP SMITH. 1869.

Two unbroken shells of this species have been found, one at Vibekes Elv and one at Qaersuarssuk kitdleq. When it is so sparsely represented in the collections, this is hardly because it has formerly been of rare occurrence, but more probably because of its extremely thin shell, which can easily be crushed, so that it is difficult to distinguish it in the sediment. Both shells belong to *var. major*, measuring respectively 13 and 17 mm in length.

Further, this variety has been found at Pátorfik (KRARUP SMITH), length 14.5 mm, and at Nordre Strømfjord (33).

Of recent occurrence in high arctic seas. In his recently published work AD. S. JENSEN (33) calls attention to the fact that *Pecten groenlandicus var. major* must live under the same conditions as *Portlandia arctica*, and also that it is the only lamellibranch, which in the Northeast

[1]) Low. is a misprint for Sow.

Greenland fjords constantly occurs at temperatures below 0° C (33, p. 18; cf. THORSON 91, p. 112).

In Davis Strait it has been taken from Discovery Bay on Grinnell Land and Sherard Osborn Fjord on the north coast of Greenland (THORILD WULFF coll.) to the Umanak Fjord, but not south of the latter, in depths of up to about 750 m. In East Greenland it has been taken from Angmagssalik as far as southeast of Pendulum Ø (74°35′ lat. N.) in depths of up to about 220 m.

Of fossil occurrence: Grinnell Land in several localities, Scotland, Norway, Siberia and Maine.

In East Greenland it has not been found in a fossil state.

Pecten islandicus MÜLLER.

Literary records:

Pecten islandicus MÜLLER: RINK (71, p. 61).
Pecten islandicus L.: NORDENSKIÖLD (57, p. 1019).
Pecten islandicus MÜLLER: STEENSTRUP (81, p. 236).
Pecten islandicus MÜLLER: STEENSTRUP (82, p. 285).
Pecten islandicus MÜLLER: KORNERUP (42, p. 187).
Pecten islandicus MÜLLER: J. A. D. JENSEN (34, pp. 49, 73, 85).
Pecten islandicus MÜLLER: HARTZ (4, pp. 175, 176).
Pecten islandicus MÜLLER: PJETURSSON (65, pp. 324 et seq.).
Pecten islandicus L.: WHITE and SCHUCHERT (100, p. 349).
Pecten islandicus MÜLLER: JENSEN and HARDER (28, p. 404).
Pecten islandicus MÜLLER: JENSEN (30, p. 627).
Pecten islandicus MÜLLER: QUERVAIN (69, pp. 183, 184).
Pecten islandicus MÜLLER: NOE-NYGAARD (56, pp. 7, 10).

Min. Mus. records:

Pecten islandicus MÜLLER: KRARUP SMITH. 1869.
Pecten islandicus MÜLLER: PFAFF. 1874.
Pecten islandicus MÜLLER: J. A. D. JENSEN. 1885.
Pecten islandicus MÜLLER: SØREN HANSEN. 1888.
Pecten islandicus MÜLLER: STEENSTRUP. 1888. (Ivigtût.)

Specimens and unbroken shells of this large and easily distinguishable species have been found in a great number of localities. In spite of energetic searching only two small and two minute specimens were found in the lower clay bed at the Pátorfik river, at an altitude of 24 and 25—30 m, but it is possible that these fragments are derived from higher beds. However, there were in the lower clay bed in Kløft II (altitude 30 m) many large fragments of shells and a single unbroken specimen, measuring 90 mm in height and 86 mm in length. There is thus hardly any doubt that *Pecten islandicus* also belongs in the clay bed. In the sand layers above the clay bed it is only found in fragments. In the sand layer at Mellemkløft there were many well preserved frag-

ments, both of small and large specimens. A single complete shell measures 92 mm in height and 85 mm in length. In the consolidated horizon ("the famous Pátorfik deposits") a few unbroken specimens were found measuring:

Height	Length
44 mm	40 mm
70 mm	68 mm
74 mm	68 mm
75 mm	72 mm
86 mm	79 mm

Of recent occurrence everywhere in the southern part of the arctic area. In the Atlantic it extends as far south as Cape Cod in America and about 59° lat. N. on the Norwegian coast.

It does not extend into the high-arctic areas, and has not been taken alive in Danish waters. In West Greenland it has been found up to 76° lat. N. In East Greenland it has been taken alive in the Franz Joseph Fjord archipelago (THORSON 89, pp. 12, 14, 22, 32, 38); on the other hand, AD. S. JENSEN considers the fragments of shells found at Angmagssalik and in Forsblads Fjord as having been washed out of sub-fossil deposits (27, p. 333).

Of fossil occurrence: Iceland, Scandinavia, England, the coasts of the Mediterranean and the arctic coast of Asia.

Lima subauriculata MONTAGU.

Literary record:

Limatula subauriculata MONT.: PJETURSSON (65, pp. 332, 333).

The species found at Igíniarfik (Egedesminde district) and Alángorssuaq.

Of recent occurrence from western Finmarken to the Canary Islands, as well as off Iceland and the Faroes. On the east coast of America it has been taken from Labrador to Florida. In West Greenland it occurs from the most southerly part as far as Upernavik. In East Greenland it seems not to have been taken.

Of fossil occurrence i. a. Scandinavia and Belgium.

Crenella decussata (MONTAGU).

Literary records:

Crenella decussata (MONT.): J. A. D. JENSEN (34, p. 49).
Crenella decussata (MONT.): PJETURSSON (65, p. 333).

The species found at Igíniarfik (Egedesminde district).

Of recent occurrence: Iceland, the Faroes, Spitzbergen, Norway, Kara Sea and Bering Sea. At great depths it has been taken off England and in the Mediterranean. Along the coast of America it has been found from Melville Bugt to Cape Hatteras. In West Greenland it occurs from the Julianehaab district to the Upernavik district. In East Greenland it has been taken slightly north of Angmagssalik and in the Franz Joseph Fjord archipelago.

Of fossil occurrence: Russia, Norway, Scotland and Sicily.

Mytilus edulis LINNÉ.

Literary records:

Mytilus edulis L.: NORDENSKIÖLD (57, p. 1019).
Mytilus edulis L.: STEENSTRUP (81, p. 236).
Mytilus edulis L.: J. A. D. JENSEN (34, pp. 49, 85).
Mytilus edulis L.: PJETURSSON (65, pp. 324 et seq.).
Mytilus edulis L.: NATHORST (55, p. 304).
Mytilus edulis L.: ENGELL (27, p. 295).
Mytilus edulis L.: JENSEN and HARDER (28, p. 404).
Mytilus edulis L.: QUERVAIN (69, p. 143).
Mytilus edulis L.: NOE-NYGAARD (56, pp. 4 et seq.).

Min. Mus. record:

Mytilus edulis L.: RINK. 1848—51.

The species found at Pátorfik, the Egedesminde island, Aumat, Agto, Orpigsôq and Igíniarfik (Egedesminde district).

Of recent occurrence widely distributed. It is lacking in the high-arctic seas, but is otherwise cosmopolitan. In West Greenland it occurs in the waters as far as Melville Bugt. In East Greenland it is not found north of 66°30′ lat. N.

Of fossil occurrence in many localities outside the present area of distribution e. g. Spitzbergen, the northern coast of Siberia and Franz Joseph Land.

Species of the genus *Modiolaria* have not hitherto been found within the area here investigated. Farther south in the Godthaab district at Kugssuk *Modiolaria faba* (MÜLLER) and *Modiolaria lævigata* GRAY have been collected in raised strata by H. P. C. MØLLER. These species, of whom *M. faba*, according to AD. S. JENSEN (29), is only found living along the American side of the Atlantic and in West Greenland waters, must be expected in future collections from marine deposits in Northern West Greenland.

Astarte borealis (CHEMNITZ.)

Literary records:

Astarte corrugata BROWN: RINK (71, p. 61).
Astarte semisulcata LEACH: RINK (71, p. 61).

Astarte corrugata BROWN: NORDENSKIÖLD (57, p. 1019).
Astarte semisulcata LEACH: STEENSTRUP (81, p. 236).
Astarte semisulcata LEACH: WHITE and SCHUCHERT (100, p. 349).
Astarte arctica GRAY?: WHITE and SCHUCHERT (100, p. 349).
Astarte borealis CHEMN.: HARTZ (27, p. 336).
Astarte arctica GRAY: NATHORST (55, p. 304).
Astarte borealis CHEMN.: JENSEN (30, pp. 625, 626, 627, 628, 630, 631).
Astarte borealis CHEMN.: NOE-NYGAARD (56, pp. 8, 10, 12, 13, 14, 15, 16).

Min. Mus. record:

Astarte borealis CHEMN.: J. A. D. JENSEN. 1885.

The species found in many localities, the finds being represented by unbroken specimens and shells. It varies a good deal in the shape and sculpture of the shells and occurs both together with high-arctic and more thermophile forms.

Of recent occurrence in the arctic-circumpolar seas. Along the coast of Norway it is not found south of Bergen, but it occurs again in south-western Kattegat, Øresund and the Belts, from where it passes into the Baltic. ASBJØRNSEN records it as being found in the Oslo Fjord, but according to BRØGGER this is owing to a mistake (8a, p. 581); neither is it recorded from there by G. O. SARS (75). Along the coast of America it has been found as far south as New England. In the waters of West Greenland it has been taken from Julianehaab to Smith Sound in depths of 10—55 m, in Arctic Canada in 82°30′ lat. N. In East Greenland it is up to the present known from Angmagssalik to Shannon Ø in rather shallow depths, though a shell is recorded to have been found north of Steward Ø at a depth of about 300 m.

Of fossil occurrence: Grinnell Land, Port Kennedy, Iceland, Russia, Scandinavia, Great Britain and Ireland, Siberia and northeastern America.

Astarte montagui (DILLWYN).

Literary records:

Astarte compressa L.?: STEENSTRUP (81, p. 236).
Astarte banksii LEACH: HARTZ (4, p. 171).
Astarte banksii MØLLER: PJETURSSON (65, p. 330).
Astarte banksii LEACH: HARTZ (27, p. 335).
Astarte banksii LEACH: JENSEN and HARDER (28, p. 404).
Astarte (*Nicania*) *banksii* LEACH: QUERVAIN (69, p. 184).
Astarte banksii LEACH: JENSEN (30, p. 628).
Astarte banksii LEACH: NOE-NYGAARD (56, pp. 10, 14, 15).

The species found in many localities.

Of recent occurrence in the arctic-circumpolar seas. Towards south it is somewhat more widely distributed than *Astarte borealis*, extending along the coasts of the eastern Atlantic, along the entire coast of Norway

and right down to the Bay of Biscay. On the coasts of America it is found right down to Massachusetts. In West Greenland it is met with from the southern part as far as Kap York. In East Greenland it is found between Angmagssalik and Sabine Ø.

Of fossil occurrence: Grinnell Land, Siberia, Russia, Iceland, Scandinavia, the British Isles and northeastern America.

Astarte montagui (DILLWYN) **var. striata** (LEACH) SARS.

Literary record:

Astarte striata LEACH: KORNERUP (42, p. 187).

This variety has been found in a number of localities round the Umanak Fjord. It is of recent occurrence in many localities in Greenland, from the Julianehaab district as far as north of Kap York, in depths of up to 307 m. In East Greenland it has been taken together with the species proper.

Astarte montagui (DILLWYN) **var. warhami** HANCOCK.

This variety has been found at Pátorfik, Qaersuarssuk kitdleq and Gieseckes Sø.

In West Greenland it is distributed from the most southerly district as far as northwest of Kap York. In East Greenland it has been taken in Hekla Havn.

As far as can be proved, it has not formerly been found in a fossil state in West Greenland.

As to the distribution of the two above mentioned varieties AD. S. JENSEN writes (29, p. 104):

"It may be seen from the foregoing, that there is a certain regularity in the variation of the species, since the form becomes elongated on the whole in the same degree as the marine climate becomes more severe. At the Færoes and the southern West Iceland we have only the short *A. Montagui typica*, though sometimes with a tendency in the direction of the slightly more elongated variety *striata*; at northern West Iceland the variety *striata* begins to appear and at East Iceland it occurs commonly together with the typical *Montagui*. At West Greenland the variety *striata* is by far the most predominant, and at the same time the still more elongated variety *Warhami* is appearing; lastly, at East Greenland the variety *Warhami* is almost the only form."

According to this it is the *warhami* variety, which is the more arctic form of the two. In this respect it is interesting to prove that the *striata* variety is the one most frequently occurring in the alluvial deposits, except on Svartenhuk, where the *warhami* variety predominates together with *Portlandia arctica*.

Astarte sulcata (DA COSTA).

Literary record:

Astarte sulcata DA COSTA: WHITE and SCHUCHERT (100, p. 349).

Min. Mus. record:

Astarte sulcata DA COSTA: HARTZ. 1888—90.

The species found at Pátorfik.

Of recent occurrence from the Murman coast as far as the coast of northwestern Africa and in the Mediterranean. In West Greenland it is reported as having been taken in the Igaliko Fjord, at Sukkertoppen and at Upernavik. However, it should be borne in mind that, as far as can be seen, it is at Upernavik a case of empty shells, so that it is surely only found alive from Sukkertoppen and southwards.

Of fossil occurrence: Norway, England and Siberia.

Astarte elliptica (BROWN).

Literary records:

Astarte elliptica BROWN: NORDENSKIÖLD (57, p. 1019).
Astarte compressa L.: STEENSTRUP (81, p. 236).
Astarte elliptica BROWN: HARTZ (27, p. 340).
Astarte compressa L.: HARTZ (27, p. 340).
Astarte elliptica BROWN: NOE-NYGAARD (56, p. 10).

Min. Mus. records:

Astarte elliptica BROWN: PFAFF. 1874.
Astarte elliptica BROWN: RINK. 1881.

The species found in many localities within the area in question. The finds are nearly always represented by well preserved, complete specimens or unbroken shells. Only in a few localities nothing but fragments were found.

Of recent occurrence in the eastern Atlantic as far as to the coast of France; off the coasts of America it occurs as far as New England. In West Greenland it has been found as high up as Melville Bugt. In East Greenland it has, up to the present, been taken from Angmagssalik to Forsblads Fjord.

Of fossil occurrence: Russia, Scandinavia, Iceland, Labrador and Maine.

Astarte crenata (GRAY).

A single specimen of this species has been found at Pátorfik.

Of recent occurrence in the eastern Atlantic along the coast of Norway as far as Lofoten; in the western Atlantic it has been found as far as Maine. In West Greenland it has been found from the Julianehaab district to Melville Bugt and Kap York. In East Greenland it has

up to the present been identified as far as Shannon Ø. *Astarte crenata* is a deep-sea form, which only in exceptional cases is met with in shallow water.

Of fossil occurrence: Scandinavia and England. In Greenland it has not until now been found in alluvial deposits.

Axinopsis orbiculata G. O. SARS.

Literary record:

Axinopsis orbiculata SARS: HARTZ (27, p. 342).

Min. Mus. record:

Axinopsis orbiculata SARS: STEENSTRUP. 1881.

Several specimens of this species have been found at Pátorfik and Orpigsôq.

Nowadays this species has a circumpolar distribution to a line from Cape Cod across Iceland to Finmarken.

Of fossil occurrence: Scandinavia.

Thyasira flexuosa (MONTAGU).

Literary records:

Axinus flexuosus MONT.: STEENSTRUP (82, p. 285).
Axinus flexuosus MONT.: HARTZ (27, p. 341).

The species found at Pátorfik, Igíniarfik (Disko Fjord) and Orpigsôq.

Of recent occurrence: very widely distributed; circumpolar in the arctic seas; found off Iceland, the Faroes, Jan Mayen, Spitzbergen, Novaja Zemlya; in the Kara Sea and the Siberian Ice Sea. Towards south it extends in the eastern Atlantic as far as the Canary Islands and into the Mediterranean; at the eastern coasts of America from Labrador to the Mexican Gulf. The species is also recorded as being widely distributed in the seas of the southern hemisphere.

In West Greenland it has been taken from the Julianehaab district as far as the most northerly parts; in East Greenland it has been taken in the Scoresby Sund district and the Franz Joseph Fjord archipelago.

Of fossil occurrence: Scandinavia, Great Britain, Belgium, France, Italy, Madeira and U.S.A.

Cardium minimum (PHILIPPI).

Literary record:

Cardium minimum PHIL.: STEENSTRUP (81, p. 236).

STEENSTRUP records this species from Pátorfik. However, the specimen is not to be found in the collections of the Mineralogical Museum,

and when taking the present geographical distribution of the species into consideration, its fossil occurrence in Greenland must be considered doubtful, until incontrovertible evidence is at hand, for which reason the species must be omitted from the list of Quaternary marine shells from West Greenland.

POSSELT records the species as living in West Greenland (68, p. 60), but this statement is questioned by AD. S. JENSEN (29, p. 74).

Cardium ciliatum FABRICIUS.

Literary records:

Cardium islandicum CHEMN.: RINK (71, p. 60).
Cardium islandicum CHEMN.: NORDENSKIÖLD (57, p. 1019).
Cardium ciliatum FABR.: STEENSTRUP (81, p. 236).
Cardium ciliatum FABR.: STEENSTRUP (82, p. 285).
Cardium islandicum CHEMN.: HELLAND (21, p. 114).
Cardium ciliatum FABR.: KORNERUP (42, p. 187).
Cardium ciliatum FABR.: J. A. D. JENSEN (34, p. 49).
Cardium ciliatum FABR.: HARTZ (19, p. 40).
Cardium ciliatum FABR.: RYDER (4, p. 173).
Cardium ciliatum FABR.: NATHORST (55, p. 304).
Cardium ciliatum FABR.: WHITE and SCHUCHERT (100, p. 349).
Cardium ciliatum FABR.: QUERVAIN (69, p. 184).
Cardium ciliatum FABR.: JENSEN and HARDER (28, p. 404).
Cardium ciliatum FABR.: JENSEN (30, p. 625).
Cardium ciliatum FABR.: NOE-NYGAARD (56, pp. 7, 8, 10, 12, 13, 15, 17).
Cardium ciliatum FABR.: JENSEN (33, p. 24).

Min. Mus. records:

Cardium ciliatum FABR.: KRARUP SMITH. 1869.
Cardium ciliatum FABR.: BOYE. 1872.
Cardium ciliatum FABR.: PFAFF. 1874.
Cardium ciliatum FABR.: RYDER. 1885.

The species found in a great number of localities, at the Umanak Fjord and at the head of Nordre Strømfjord, the finds comprising numerous complete specimens, unbroken shells and fragments.

Of recent occurrence of a circumpolar distribution in the high-arctic seas, extending towards south to Cape Cod, northern Iceland and Finmarken. In West Greenland it has been taken from the most southern part as far as Melville Bugt and Grinnell Land. In East Greenland it has been taken in some localities from Angmagssalik to Mackenzie Bugt.

Of fossil occurrence: Iceland, Scandinavia, the arctic coasts of Europe, Asia and America, and Grinnell Land.

Cardium elegantulum (BECK) MØLLER.

Min. Mus. record:

Cardium elegantulum MØLLER: RINK. 1848—51.

A few specimens of this species, collected by RINK at Pâtorfik, are included in the collections of the Mineralogical Museum.

Of recent occurrence off northwestern Norway as far as Tromsø, northern and eastern Iceland. In West Greenland it occurs from Julianehaab as far as Upernavik. In East Greenland it has been found at Tasiussaq.

Of fossil occurrence from Norway and the Russian coast of the Arctic Sea.

Serripes groenlandicum (CHEMNITZ).

Plate 6, fig. 1.

Literary records:

Cardium groenlandicum CHEMN.: RINK (71, p. 61).
Cardium groenlandicum CHEMN.: NORDENSKIÖLD (57, p. 1019).
Cardium groenlandicum CHEMN.: STEENSTRUP (81, p. 236).
Cardium groenlandicum CHEMN.: STEENSTRUP (82, p. 285).
Cardium groenlandicum CHEMN.: HELLAND (21, p. 114).
Cardium groenlandicum CHEMN.: J. A. D. JENSEN (34, p. 85).
Cardium groenlandicum CHEMN.: HARTZ (19, p. 40).
Cardium groenlandicum CHEMN.: RYDER (4, p. 173).
Cardium groenlandicum CHEMN.: WHITE and SCHUCHERT (100, p. 349).
Cardium groenlandicum CHEMN.: NATHORST (55, p. 304).
Cardium groenlandicum CHEMN.: JENSEN and HARDER (28, p. 404).
Cardium groenlandicum CHEMN.: JENSEN (30, pp. 625, 628, 630).
Cardium groenlandicum CHEMN.: NOE-NYGAARD (56, pp. 15, 17).

Min. Mus. records:

Cardium groenlandicum CHEMN.: KRARUP SMITH. 1869.
Cardium groenlandicum CHEMN.: PFAFF. 1874.

The species found in many localities round the Umanak Fjord and at the head of Disko Bugt. In some places it occurs numerously in entire specimens as well as in single shells, but owing to the rather thin shells most frequently in fragments.

Of recent occurrence of a circumpolar distribution in the arctic seas, with Finmarken, southern Iceland and Cape Cod as its southern boundary. In West Greenland it has been taken from the most southerly district as far as Melville Bugt. In East Greenland it occurs from Angmagssalik to Sabine Ø.

Of fossil occurrence: Scandinavia, Siberia, Iceland, Arctic Canada and St. Lawrence River.

Macoma baltica (LINNÉ) **var. groenlandica** BECK.

Literary records:

Macoma sp.: PJETURSSON (65, p. 326).
Tellina (*Macoma*) *baltica* L.: JENSEN (26, p. 31).

The species found at Aumat and Orpigsôq, the name given on the labels by AD. S. JENSEN being *var. groenlandica.*

Of recent occurrence in the warm area of the White Sea, from Finmarken to Madeira and in the Mediterranean. It does not occur off Iceland and the Faroes. On the east coast of America it occurs in the waters at Labrador as far as Georgia. In West Greenland it occurs, according to AD. S. JENSEN (26, p. 31), from the most southerly part as far as Ingnerit (72°05′ lat. N.). In East Greenland it does not seem to have been taken.

The distribution of the variety does not clearly appear from the literary records. POSSELT (68, p. 83) only mentions the variety, whereas AD. S. JENSEN (op. cit.), who criticises the various literary records of the species, states that its distribution is the same as that of *Tellina baltica*.

Macoma calcarea (CHEMNITZ).

Literary records:

Tellina lata GM.: RINK (71, p. 60).
Tellina sabulosa SPGL.: NORDENSKIÖLD (57, p. 1019).
Tellina tenua LEACH: NORDENSKIÖLD (57, p. 1019).
Tellina calcarea CHEMN.: STEENSTRUP (81, p. 235).
Tellina calcarea CHEMN.: STEENSTRUP (82, p. 285).
Tellina calcarea CHEMN.: HELLAND (21, p. 114).
Tellina calcarea CHEMN.: KORNERUP (42, p. 187).
Macoma calcarea CHEMN.: J. A. D. JENSEN (34, p. 49).
Tellina calcarea CHEMN.: J. A. D. JENSEN (34, p. 85).
Tellina calcarea CHEMN.: HARTZ (19, p. 40).
Macoma calcarea CHEMN.: RYDER (4, p. 173).
Macoma sabulosa SPGL.: WHITE and SCHUCHERT (100, p. 349).
Tellina calcarea CHEMN.: HARTZ (27, p. 343).
Tellina calcarea CHEMN.: HARTZ (27, p. 343).
Tellina (*Macerna*)[1]) *calcarea* CHEMN.: QUERVAIN (69, pp. 183, 184).
Tellina calcarea CHEMN.: JENSEN (30, p. 625).
Tellina calcarea CHEMN.: NOE-NYGAARD (56, pp. 7, 8, 10, 12, 13, 14, 15).

Min. Mus. records:

Tellina calcarea CHEMN.: KRARUP SMITH. 1869.
Tellina calcarea CHEMN.: PFAFF. 1874.
Tellina calcarea CHEMN.: SØREN HANSEN. 1885.
Tellina calcarea CHEMN.: STEENSTRUP. 1888. (Ivigtût.)

The species found in nearly all the localities investigated, the finds as a rule consisting of a great number of unbroken shells.

Of recent occurrence in the arctic-circumpolar seas, being the predominant shallow-water mussel. Outside the arctic area proper it occurs in the interior parts of certain Norwegian, Swedish and Faroe fjords. The latter occurrence is, however, regarded as being of the nature of a relict. In West Greenland it occurs from the most southerly part as far

[1]) Must be a misreading for *Macoma*.

as Melville Bugt. In East Greenland it is recorded from the southeastern coast, as well as from the Scoresby Sund district and the Franz Joseph Fjord archipelago.

Of fossil occurrence: Iceland, Scandinavia, Great Britain, Holland, Canada and Siberia.

Macoma loveni JAP. STEENSTRUP.

Literary records:
Macoma sp.: PJETURSSON (65, p. 326).
Tellina (Macoma) Loveni STEENSTRUP: JENSEN (30, p. 630).

The species found at Aumat.

Of recent occurrence in the Kara Sea, at Spitzbergen and Baffin Land. In West Greenland it has been found in the Davis Strait off Holsteinsborg. In East Greenland it has been taken in Scoresby Sund, the Kong Oscar and Franz Joseph Fjord archipelagos.

Cyrtodaria siliqua (SPENGLER).

Plate 6, figs. 2—5.

Literary records:
Glycimeris siliqua SPGL.: RINK (71, p. 60).
Cyrtodaria siliqua SPGL.: NORDENSKIÖLD (57, p. 1018).
Cyrtodaria siliqua SPGL.: STEENSTRUP (81, p. 236).
Cyrtodaria siliqua SPGL.: WHITE and SCHUCHERT (100, p. 349).

The species found at Pátorfik, Sarpiussat and Lerbugt, the specimens and shells being as a rule large and solid.

Of recent occurrence in the arctic-circumpolar seas, off the coast of America as far south as New England. In Greenland waters only half a shell has been found, and so it is a question, whether it occurs alive off the coasts of Greenland.

Of fossil occurrence off Labrador. It has also been found in the Icelandic Crag.

Panopæa norvegica (SPENGLER).

Literary records:
Panopæa norvegica SPGL.: RINK (71, p. 60).
Saxicava norvegica SPGL.: NORDENSKIÖLD (57, p. 1018).
Panomya norvegica SPGL.: STEENSTRUP (81, p. 236).
Panopaea norvegica SPGL.: JENSEN (33, pp. 24 et seq.).

Min. Mus. records:
Panopæa norvegica SPGL.: KRARUP SMITH. 1869.
Panopæa norvegica SPGL.: PFAFF. 1874.

The species found in two localities, viz. at Pátorfik and Kløft II east of Pátorfik; in both cases in the lower clay bed. Double-valved

specimens as well as unbroken single shells and fragments have been found in both places. On an average the specimens found are large and well developed, as appears from the measurements given below.

	Height mm	Length mm
Pâtorfik	34,5	55,4
—	35,6	57,0
Kløft II	26,85	38,0
—	28,6	39,1
—	31,0	57,7
—	34,65	54,65
—	35,55	57,8
—	36,1	51,6
—	36,8	60,85
—	37,15	56,25
—	37,9	51,3
—	41,3	69,2
—	46,0	68,65
—	52,3	—

Of recent occurrence from northern Norway to England; off the east coast of America as far as Halifax and Grand Manan. In West Greenland and East Greenland it has not been taken alive. It is, however, recorded as having been taken in Baffin Bay (68, p. 94)[1]). However, as mentioned by JENSEN and SPÄRCK (31, p. 163) and JENSEN (33, p. 27), it must be taken into account that it lives buried in the sea bottom, and so must be reckoned as being of more frequent occurrence than indicated in the literature. It may therefore also be found alive in Greenland and other arctic seas, from which the finds are now only represented by empty shells.

Of fossil occurrence: Russia, Scandinavia, England and Canada. In Greenland, within the area in question, it is only known from Pâtorfik. Besides AD. S. JENSEN records it from Søndre Strømfjord (33, p. 24) and a couple of empty shells were taken by Dr. V. NORDMANN in Nordre Strømfjord at a depth of 375—380 m (33, p. 27).

Mesodesma deaurata TURTON.

Literary record:

Mesodesma deaurata TURTON: WHITE and SCHUCHERT (100, p. 349).

This species is recorded as having been found at Pâtorfik by WHITE and SCHUCHERT, but has otherwise not been found in raised marine beds or alive off the coast of Greenland.

[1]) AD. S. JENSEN, who has later on dealt with the species (33, p. 27) regards this record as unsubstantiated.

Of recent occurrence along the northern coast of eastern North America, but not along the European coast of the Atlantic.

The fossil occurrence of this species in Greenland must be considered doubtful.

Saxicava arctica (LINNÉ).

Literary records:

Saxicava rugosa L.: RINK (71, p. 60).
Saxicava arctica L.: NORDENSKIÖLD (57, p. 1019).
Saxicava rugosa L.: STEENSTRUP (81, p. 235).
Saxicava arctica L.: STEENSTRUP (82, p. 285).
Saxicava arctica L.: HELLAND (21, p. 114).
Saxicava arctica L.: KORNERUP (42, p. 187).
Saxicava arctica L.: J. A. D. JENSEN (34, p. 85).
Saxicava arctica L.: HARTZ (4, pp. 171, 172, 173, 176).
Saxicava rugosa L.: PJETURSSON (65, pp. 324 et seq.).
Saxicava arctica L.: HARTZ (27, p. 359).
Saxicava arctica L.: NATHORST (55, p. 304).
Saxicava arctica L.: JENSEN and HARDER (28, p. 404).
Saxicava arctica L.: QUERVAIN (69, pp. 183, 184).
Saxicava arctica L.: JENSEN (30, pp. 624 et seq.).
Saxicava rugosa L.: NOE-NYGAARD (56, pp. 7 et seq.).
Saxicava arctica L.: JENSEN (33, p. 25).

Min. Mus. records:

Saxicava arctica L.: KRARUP SMITH. 1869.
Saxicava arctica L.: PFAFF. 1874.
Saxicava arctica L.: SØREN HANSEN. 1885.

The species found in all the localities investigated, the finds being represented by a great number of entire specimens and unbroken shells as well as fragments. The shells found vary rather much, but no attempt has been made to distinguish between varieties, seeing that the material shows gradual transitions, which makes it impossible to establish distinguishing marks merely on the strength of the form.

Of recent occurrence in all seas and apparently pronouncedly cosmopolitan. In West Greenland it has been found from the most southerly part as far as Tasiussaq (73°21′ lat. N.). It has curiously enough not been found in the Thule district, even after the most recent investigations (VIBE (94)). On the Canadian side of Davis Strait it has been taken right up to Dobbin Bay (79°40′). In East Greenland it has been found from the south coast as far as Sabine Ø, but it must be presumed that it extends farther north.

In a fossil state it has been taken in numerous places all over the globe.

Mya truncata (LINNÉ).

Literary records:

Mya truncata L.: RINK (71, p. 60).
Mya truncata L.: NORDENSKIÖLD (57, p. 1018).

Mya truncata L.: STEENSTRUP (81, p. 235).
Mya truncata L.: STEENSTRUP (82, p. 285).
Mya truncata L.: HELLAND (21, p. 114).
Mya truncata L.: J. A. D. JENSEN (34, pp. 49, 73, 85).
Mya truncata L.: HARTZ (19, p. 40).
Mya truncata L.: HARTZ (4, pp. 171, 172, 173, 174).
Mya truncata L.: HARTZ (27, p. 355).
Mya truncata L.: PJETURSSON (67, pp. 324 et seq.).
Mya truncata L.: WHITE and SCHUCHERT (100, p. 349).
Mya truncata L.: JENSEN and HARDER (28, p. 404).
Mya truncata L.: JENSEN (30, pp. 625 et seq.).
Mya truncata L.: NOE-NYGAARD (56, pp. 7 et seq.).

Min. Mus. records:

Mya truncata L.: KRARUP SMITH. 1869.
Mya truncata L.: PFAFF. 1874.
Mya truncata L.: SØREN HANSEN. 1885.
Mya truncata L.: STEENSTRUP. 1888. (Ivigtût.)

The species is extremely common in the deposits, and has been found in practically all localities.

Of recent occurrence with a very wide distribution in the seas of the northern hemisphere. In the Atlantic it extends as far south as the Bay of Biscay on the European side, and on the American side as far as Massachusetts. In West Greenland it has been taken from the most southerly district as far as North-Star Bay in about 76°30′ lat. N. (94, table 4); along the Canadian coasts of the Greenland waters it has been taken as far as Dobbin Bay. In East Greenland it has been found up the southern coast of Sabine Ø, but it is to be presumed that it is also met with north of there.

Of fossil occurrence with a wide distribution along all arctic coasts, Iceland, Scandinavia, the coasts of Europe, the Mediterranean and the Black Sea, Labrador, Montreal, Portland and New Brunswick.

Mya truncata (L.) **forma ovata** AD. S. JENSEN.

Literary records:

Mya arenaria L.: NORDENSKIÖLD (57, p. 1018).
Mya arenaria L.: STEENSTRUP (81, p. 235).
Mya truncata L. *var. ovata* JENSEN: STEENSTRUP (82, p. 285).
Mya arenaria L.: HELLAND (21, p. 114).
Mya arenaria L.: KORNERUP (42, p. 187).
Mya arenaria L.: J. A. D. JENSEN (34, p. 85).
Mya truncata L. *f. ovata* JENSEN: HARTZ (19, p. 40).
Mya arenaria L.: RYDER (4, p. 173).
Mya arenaria L.: WHITE and SCHUCHERT (100, p. 349).
Mya truncata L.: NATHORST (55, p. 304).
Mya truncata L. *f. ovata* JENSEN: JENSEN and HARDER (28, p. 403).

Min. Mus. record:

Mya truncata L. *f. ovata* JENSEN: PFAFF. 1874.

The species found in a number of localities distributed over the whole of the area, the finds being partly represented by adult and partly by juvenile specimens.

Of recent occurrence in the arctic seas, off Iceland, Spitzbergen and Siberia. In West Greenland it has been taken as far as Melville Bugt. In East Greenland it has, as far as can be seen, not been taken.

Apparently only of fossil occurrence on Greenland; however, it is common in the Icelandic Crag at Hallbjarnarstaðir. That it has not been recorded from elsewhere has probably some bearing upon the fact that it has either been identified as *Mya truncata* or, which is more probable, has erroneously been called *Mya arenaria* (L.) (cf. AD. S. JENSEN (24)).

Mya truncata (L.) **forma uddevallensis** HANCOCK.

Literary records:

Mya truncata L.: STEENSTRUP (81, p. 235).
Mya truncata L.: HARTZ (4, pp. 171, 172, 172).
Mya truncata L.: HARTZ (27, p. 355).
Mya truncata L.: PJETURSSON (65, pp. 332, 334).

Min. Mus. record:

Mya truncata L. *f. uddevallensis* HANC.: J. A. D. JENSEN. 1885.

The species found at Kugssineq, in two localities in the Pátorfik area, at Ungôrsivik on the northern side of Disko, Alángorssuaq and Igíniarfik (Egedesminde district).

Of recent occurrence only in the high-arctic seas. Shells which have been found in the Kattegat, Denmark, are supposed to have been washed out from the late-glacial Yoldia clay.

Of fossil occurrence: Scandinavia, Iceland and Arctic America.

Zirphæa crispata (LINNÉ).

Literary records:

Zirphæa (*Pholas*) *crispata* L.: JENSEN (27, p. 296).
Zirphæa crispata L.: ENGELL (15, p. 90).
Zirphæa crispata L.: JENSEN and HARDER (28, pp. 402 et seq.).
Zirphæa crispata L.: JENSEN (33, pp. 20 et seq.).

The species found at Orpigsôq.

Of recent occurrence from Finmarken to western France as well as off Iceland. Off the east coast of America it is found as far north as the Gulf of St. Lawrence, but it is of most common occurrence off New England (12, p. 227). No more of recent occurrence in Greenland

waters but as already demonstrated by AD. S. JENSEN (27, pp. 295—297) its fossil occurrence points to an earlier warmer period in Greenland.

Of fossil occurrence: Scandinavia; in Greenland not north of Disko Bugt.

Lyonsia arenosa (MØLLER).

Literary record:

Lyonsia arenosa MØLLER: NORDENSKIÖLD (57, p. 1019).

The species found at Qaersuarssuk kangigdleq and Sarpiussat.

Of recent arctic-circumpolar occurrence. In the Atlantic it extends towards south to Portland in America and to Finmarken in Europe. In West Greenland it has been taken at various localities from the most southerly to the most northerly district. In East Greenland it has been taken in Scoresby Sund.

Of fossil occurrence: Scandinavia, Canada and Maine.

Thracia sp.

A fragment of a shell has been found in Kløft II at Pátorfik, which may be referred to the genus *Thracia*, though it is impossible to determine it as to species.

Gastropoda.

Boreochiton ruber LOWE.

The species found at Gieseckes Sø and Igíniarfik (Egedesminde district).

Of recent occurrence: Jan Mayen, Iceland, the Faroes, Spitzbergen, the White Sea, the Siberian Ice Sea, the Bering Sea, the northern and western coasts of Norway, Denmark and the British Isles. In America it has been taken along the Arctic Sea and Labrador as far as Maine. In West Greenland it occurs from the Julianehaab district as far as Prøven. In East Greenland it is not recorded as having been taken, but it is probable that it is to be found there.

Of fossil occurrence: Norway and England.

Scissurella crispata FLEMING.

Literary record:

Scissurella crispata FLEM.: PJETURSSON (65, pp. 332, 334).

The species found at Gieseckes Sø, Igíniarfik (Egedesminde district) and Alángorssuaq.

Of recent occurrence: Iceland, between the Faroes and the Hebrides, Spitzbergen, the western coast of Norway, Bohuslän, the British Isles,

to the west of Ireland, the Bay at Gascogne, the Bay of Biscay, the Mediterranean, Marocco and the Azores. Along the eastern coast of America it occurs from eastern Canada to the West Indies. In West Greenland it has been taken at Godthaab and Hunde Eiland. In East Greenland it is known from the northeastern coast area, the district of the Franz Joseph Fjord archipelago and the Scoresby Sund district.

Of fossil occurrence known from many localities in Europe.

Puncturella noachina (LINNÉ).

Literary records:
Cemoria noachina L.: STEENSTRUP (81, p. 235).
Puncturella noachina L.: PJETURSSON (65, pp. 330, 332).

Min. Mus. record:
Puncturella noachina L.: PFAFF. 1874.

The species found at Pátorfik, Igíniarfik (Egedesminde district) and Agto.

Of recent occurrence in arctic, antarctic and boreal seas, Iceland, the Faroes, Jan Mayen, Spitzbergen, the Murman coast, the Kara Sea, the White Sea, the Bering Sea; along the entire coast of Norway, Denmark (Kattegat), the North Sea, England, France and Portugal. Along the coast of eastern America it occurs from the most northerly regions as far as Cape Cod. In West Greenland it has been found from the Julianehaab district to Upernavik. In East Greenland it is recorded from the Franz Joseph Fjord archipelago, the Scoresby Sund district and the southeastern coast area.

Of fossil occurrence: Scandinavia, England, Italy, Iceland, Canada and Novaja Zemlya.

Acmæa (Tectura) rubella (FABRICIUS).

Literary record:
Tectura rubella FABR.: J. A. D. JENSEN (34, p. 49).

The species found at Pátorfik, Orpigsôq, Gieseckes Sø and Igíniarfik (Egedesminde district).

Of recent occurrence in Europe along the coast of Norway from Tromsø and northwards, as far as Varanger Fjord; off the Murman coast and Novaja Zemlya, Spitzbergen and Jan Mayen. Off the coasts of America it is found along eastern Canada and New Foundland. In West Greenland it has been taken from the Julianehaab district as far as Upernavik; in East Greenland in the northeastern coast area, the Franz Joseph Fjord archipelago, the Scoresby Sund district and the southern coast area.

Of fossil occurrence: Scandinavia.

Lepeta coeca (MÜLLER).

Literary records:

Lepeta coeca MÜLL.: STEENSTRUP (81, p. 235).
Lepeta coeca MÜLL.: PJETURSSON (65, pp. 332, 334).
Lepeta coeca MÜLL.: JENSEN and HARDER (28, p. 404).
Lepeta coeca MÜLL.: NOE-NYGAARD (56, pp. 7, 13).

Min. Mus. records:

Tectura coeca MÜLL.: KRARUP SMITH. 1869.
Tectura coeca MÜLL.: PFAFF. 1874.

The species found at Pátorfik, Orpigsôq, Igíniarfik (Egedesminde district), Agto and Gieseckes Sø.

Of recent occurrence along the coasts of Scandinavia and northern Asia, and along the coast of America from New England to Grinnell Land. In West Greenland it has been taken from the Julianehaab district as far as Upernavik.

VIBE (94) does not mention it from the Thule district, but it is recorded from Jones Sound and off Grinnell Land. In East Greenland it is found along the entire coast.

Of fossil occurrence: Scandinavia, Iceland and arctic Canada.

Margarita groenlandica (CHEMNITZ).

The species found at Gieseckes Sø.

Of recent occurrence: Iceland, the Faroes, Jan Mayen, Spitzbergen, arctic Norway, the Murman coast, the White Sea, Novaja Zemlya, the Kara Sea, Franz Joseph Land, the British Isles. On the eastern coast of America it extends south to Cape Cod. In West Greenland it has been taken from the Julianehaab district as far as Upernavik. In East Greenland it occurs along the whole of the coast.

Of fossil occurrence: Scandinavia, the British Isles, Iceland and Siberia.

Margarita helicina (PHIPPS).

The species found at Igíniarfik (Egedesminde district).

Of recent occurrence: Jan Mayen, Spitzbergen, the Murman coast, the White Sea, the Kara Sea, Novaja Zemlya, Franz Joseph Land, the Bering Sea; the southern boundary extends from northern Kattegat along southern Norway and across the British Isles, the Faroes and Iceland. In West Greenland it has been found from the Julianehaab district to the northernmost part of the coast (off Grinnell Land). In East Greenland it has been taken in the Franz Joseph Fjord archipelago, the Scoresby Sund district, the Kangerdlugssuaq area and the southeastern coast area.

Of fossil occurrence: Scandinavia, England and Canada.

Margarita cinerea (COUTHOUY).

Literary records:
Margarita cinerea COUTH.: PJETURSSON (65, p. 334).
Margarita cinerea COUTH.: NOE-NYGAARD (56, p. 15).

The species found at Qaersuarssuk kangigdleq, Igíniarfik (Egedesminde district) and Gieseckes Sø.

Of recent occurrence along the western coast of Norway and Finmarken; further, along the Murman coast and the northern coast of Siberia. Along the eastern coast of America it occurs from Cape Cod as far as Grinnell Land. In West Greenland it has been taken from the Julianehaab district as far as Upernavik. In East Greenland it is found all along the coast.

Of fossil occurrence: Scandinavia, the British Isles, Siberia and the eastern coast of Canada.

Margarita olivacea (BROWN).

The species found at Gieseckes Sø.

Of recent occurrence: Iceland, Spitzbergen, northernmost Norway, the Murman coast, the Kara Sea, the Barents Sea, Novaja Zemlya, the White Sea, the Siberian Ice Sea, the Bering Strait. Along the eastern coast of America it has been found off Grinnell Land, Jones Land, North Devon and towards north at the Parry Islands. Its southern boundary passes from Cape Cod to Scotland and the Hebrides. In West Greenland it has been taken from the Julianehaab district to the northernmost part of the country; in East Greenland all along the coast.

Of fossil occurrence: Scandinavia, England and Canada.

Solariella obscura (COUTHOUY) **var. bella** VERKRÜZEN.

The species found at Igíniarfik (Egedesminde district).

Of recent occurrence: Iceland, the coast of Norway (Lofoten), Bear Island, the White Sea, Spitzbergen; eastern Canada and New England. In West Greenland it has been taken at Godthaab? In East Greenland it has been taken in the northeastern coast area, the Franz Joseph Fjord archipelago and the Scoresby Sund district.

Moelleria costulata (MØLLER).

Min. Mus. record:
Moelleria costulata MØLL.: PFAFF. 1874.

The species found at Igíniarfik (Egedesminde district) and Orpigsôq.

Of recent occurrence with a wide distribution: Iceland, the Faroes, Spitzbergen, the Murman coast, the White Sea, Franz Joseph Land,

northern Norway from Varanger Fjord (Vadsø) as far as Lofoten, north-east of the Shetland Islands and off Bohuslän. In the eastern Atlantic it has been found off Labrador, New Foundland and Grand Manan. The southern boundary extends from New England, across St. Thomas, east of Marocco, off Portugal to the Bay at Gascogne. In West Greenland it has been taken from the Julianehaal district as far as Nordfjord on the island of Disko. In East Greenland it has been taken in the Franz Joseph Fjord archipelago and the Scoresby Sund district.

Of fossil occurrence: Scandinavia, the British Isles and Canada.

Lacuna divaricata (FABRICIUS).

The species found at Gieseckes Sø.

Of recent occurrence: Iceland, the Faroes, the White Sea, the Murman coast, the Western coast of Norway, Kattegat, the British Isles, the Bay of Biscay, northeastern America, East Port, New England. In West Greenland it has been taken from Julianehaab as far as Jakobshavn. It is not known from East Greenland.

Of fossil occurrence: Scandinavia, Iceland and England.

Littorina palliata SAY.

Literary record:

Littorina palliata SAY: JENSEN and HARDER (28, p. 404).

The species found at Igíniarfik (Egedesminde district), Gieseckes Sø and Orpigsôq.

Of recent occurrence: Iceland, the Faroes, Jan Mayen, Novaja Zemlya, the Russian Lapmark, the British Isles, the Mediterranean. Along the east coast of America it has been taken from New Scotland to New Jersey. In West Greenland it has been found from Julianehaab as far as Prøven. It has not been taken in East Greenland.

Of fossil occurrence: Scandinavia, Iceland and North-America.

Littorina saxatilis (OLIVI) **var. groenlandica** MØLLER.

Literary records:

Littorina rudis MATON: J. A. D. JENSEN (34, p. 49).
Littorina rudis MATON *var. groenlandica* MØLLER: PJETURSSON (65, p. 326).

The variety found at Igíniarfik (Egedesminde district), Gieseckes Sø, Orpigsôq and Aumat.

Of recent occurrence: Iceland, the Faroes, Spitzbergen, the Siberian Ice Sea, the coasts of Scandinavia and western Europe, the Mediterranean and the Black Sea. Along the eastern coast of America it extends from Labrador to New England. The variety must, however, only be supposed

to have a northerly distribution (cf. SARS (75, p. 165) and THORSON (91, p. 28)). In West Greenland it has been taken from Kap Farvel to Upernavik; in East Greenland at Angmagssalik.

Of fossil occurrence: Scandinavia, Iceland and England.

Cingula castanea (MØLLER).

Literary record:

Rissoa castanea MØLLER: J. A. D. JENSEN (34, p. 49).

The species found at Igíniarfik (Egedesminde district).

Of recent occurrence: northern and eastern Iceland, Spitzbergen, the Russian Lapmark, Matochkin Schar, the coast of Norway at Vadsø. Along the east coast of America it has been taken in the Gulf of St. Lawrence and off New Brunswick and New Foundland. In Greenland it has been taken as far as Prøven. In East Greenland it occurs in the Franz Joseph Fjord archipelago, the Scoresby Sund district and the southeastern coast area.

Cingula arenaria (MIGHEL & ADAMS).

Literary record:

Rissoa castanea var. minor MØLLER: PJETURSSON (65, p. 334).

The species found at Igíniarfik (Egedesminde district).

Of recent occurrence: Iceland, Spitzbergen, Norway (Varanger Fjord (Vadsø)), New Foundland and Casco Bay. In West Greenland it has been found from Godthaab to Godhavn. From East Greenland it is recorded from the Franz Joseph Fjord archipelago as far as the southeastern coast area.

POSSELT writes of this species (68, p. 223) that it can hardly be distinguished from *Rissoa castanea var. minor* MØLLER, whereas THORSON (92, p. 35) states, as regards the Icelandic specimens of *Cingula arenaria* (MIGH. & AD.) that they exactly resemble the type specimens of *Rissoa castanea var. minor* MØLLER. According to the opinion now held by zoologists, it must be regarded as most correct to identify the specimens found by PJETURSSON as *Cingula arenaria* (MIGH. & AD.) and to let *Rissoa castanea var. minor* MØLLER be omitted from the list of Quaternary shells from West Greenland.

Alvania scrobiculata (MØLLER).

Literary record:

Alvania scrobiculata MØLLER: PJETURSSON (65, p. 334).

The species found at Igíniarfik (Egedesminde district).

Of recent occurrence: Eastern Iceland, Jan Mayen, Spitzbergen, the northern Arctic Sea and Finmarken. In West Greenland it has been taken off Frederikshaab, Sukkertoppen and Hunde Ejland. In East Greenland it occurs along the whole coast except the Kangerdlugssuaq area.

Alvania jan-mayeni (FRIELE).

The species found at Pátorfik.

Of recent occurrence: Finmarken, the Murman coast, the Barents Sea, the White Sea, the Kara Sea and the western part of the Siberian Ice Sea. Further, it occurs along the eastern coast of America as far as New England. In West Greenland it has been taken at Godhavn and Upernavik; in East Greenland in the Franz Joseph Fjord archipelago, the Scoresby Sund district and the southeastern coast district.

Of fossil occurrence known from the eastern coast of Canada and in Scandinavia.

Alvania wyville-thomsoni (FRIELE) **var. pátorfikensis nov. var.**

Plate 6, figs. 7 a, b; 8 a, b.

There are in all 8 specimens of this variety, distributed over two localities (5 + 3) at Pátorfik.

Description: Shells larger and somewhat more scalarite than those of the typical form. The unbroken specimens have the following measurements:

	Length and width	Height and width of mouth
1.	5.5 × 3.0 mm	2.0 × 1.9 mm
2.	5.0 × 2.9 —	2.1 × 1.9 —
3.	5.0 × 2.8 —	1.8 × 1.4 —
4.	4.4 × 2.5 —	1.8 × 1.5 —

The sculpture is significantly coarser in this variety. Thus, the radial ribs in connection with the coarse and distinct spiral lines form regular tubercles on the crossing points. The sculpture is characteristic of the last two and a half whorl, while on the top-whorl the radial ribs are dominating.

The whole appearance of *var. pátorfikensis* seems to tend towards a form, which has lived under more optimal conditions, than has been the case with the small typical specimens mainly restricted to the deep-sea areas poor in nourishment.

Turritella erosa COUTHOUY.

The species found in two localities at Pátorfik.

Of recent occurrence: Spitzbergen and the Siberian Arctic Sea; further, the east coast of America from Labrador as far as Cape Cod.

In West Greenland it has been taken from the Julianehaab district as far as Melville Bugt. In East Greenland it is recorded as having been taken off the southeastern coast.

Of fossil occurrence: Scandinavia, Siberia, Iceland and Canada.

Scalaria (Acirsa) borealis Beck.

The species found at Gieseckes Sø and Igíniarfik (Egedesminde district).

Of recent occurrence: Spitzbergen, Canada, East Port, New Foundland. In West Greenland it has been taken from Nanortalik as far as Jakobshavn. Not recorded from East Greenland.

Of fossil occurrence: Canada, Uddevalla and Aberdeenshire.

Amaura candida Møller.

Plate 6, figs. 11 a, b.

The species found in two localities at Pátorfik.

Of recent occurrence: off Finmarken. In West Greenland it has only been found at Godthaab and Claushavn. Not recorded from East Greenland.

Of fossil occurrence: England.

Lunatia pallida (Broderip & Sowerby).

Literary records:

Natica groenlandica Bk.: Steenstrup (81, p. 235).
Natica groenlandica Bk.: Noe-Nygaard (56, p. 15).

Min. Mus. records:

Natica groenlandica Bk.: Krarup Smith. 1869.
Natica groenlandica Bk.: Pfaff. 1874.

The species found at Pátorfik.

Of recent occurrence: Jan Mayen, Iceland, Spitzbergen, the eastern part of the Atlantic Sea from the Finmarken as far as Belgium, the Murman coast, the Barents Sea, the White Sea, the Kara Sea and the Siberian Ice Sea. In the western part of the Atlantic it extends from arctic Canada to Cape Hatteras. In West Greenland it has been taken from the Julianehaab district as far as Upernavik; in East Greenland along the whole of the coast.

Of fossil occurrence: Scandinavia, Iceland, Siberia, Canada and New England.

Natica clausa BRODERIP & SOWERBY.

Literary records:

Natica clausa SOW. & BROD.: RINK (71, p. 61).
Natica clausa SOW.: NORDENSKIÖLD (57, p. 1019).
Natica affinis GML.: STEENSTRUP (81, p. 235).
Natica affinis GML.: JENSEN and HARDER (28, p. 405).
Natica affinis GML.: JENSEN (30, p. 629).

The species has been found in a great number of localities.

Of recent occurrence: the Atlantic along the coasts of Scandinavia; southern and western Ireland, the Shetland Islands, the Faroes and Iceland. Further, along the Murman coast and the whole of the Russian and Siberian coast of the Arctic Sea. Off the east coast of America it has been taken from Wellington Channel to Cape Hatteras. In West Greenland it has been taken from Nanortalik to Dobbin Bay, in East Greenland along the whole of the coast.

Of fossil occurrence: Scandinavia, Iceland, the British Isles, Russia, Siberia and North America.

Trophon clathratus (LINNÉ).

Literary records:

Trophon clathratus L.: STEENSTRUP (81, p. 235).
Trophon clathratus L.: J. A. D. JENSEN (34, p. 49).
Trophon clathratus L.: PJETURSSON (65, p. 334).
Trophon clathratus L.: JENSEN (30, p. 629).

Min. Mus. records:

Trophon clathratus L.: KRARUP SMITH. 1869.
Trophon clathratus L.: PFAFF. 1874.

The species found at Pátorfik, Igíniarfik (Egedesminde district) and Gieseckes Sø.

Of recent occurrence: The coast of Norway, Bohuslän, northern England, the Faroes, Iceland, Spitzbergen, the White Sea and the Siberian Ice Sea. Along the eastern coast of America it occurs off Baffin Land, New England and Cape Cod. In Greenland it has been taken from the Julianehaab district as far as Prøven.

Of fossil occurrence: Northern Europe, Iceland and Siberia.

Trophon clathratus (LINNÉ) **var. gunneri** LOVÉN.

Literary record:

Trophon gunneri LOV.: STEENSTRUP (81, p. 235).

This variety found at Pátorfik.

Of recent occurrence: Iceland, the Faroes, the Hebrides, Spitz-

bergen, the Murman coast, the White Sea, Novaja Zemlya, the Kara Sea, the Siberian Arctic Sea. In eastern America it has been taken off Labrador, New England and Cape Cod. In West Greenland it occurs from Godthaab to Ritenbenk; in East Greenland off the southeastern coast area.

Of fossil occurrence: northern Europe, Siberia and Ellesmere Land (Cape Joseph Henry).

Trophon fabricii (BECK) MØLLER.

Literary record:
Trophon craticulatus FABR.: STEENSTRUP (81, p. 235).

The species found at Pátorfik, Gieseckes Sø and Igíniarfik (Egedesminde district).

Of recent occurrence: Iceland, Spitzbergen, Finmarken(?), the Bering Sea; in eastern America: the Wellington Channel, River Clyde (66°30′ lat. N., 68° long. W.), Labrador, the Gulf of St. Lawrence. In West Greenland it occurs from the Julianehaab district as far as Upernavik. In East Greenland it has been taken in the Franz Joseph Fjord archipelago and off the southeastern coast.

Trophon truncatus (STRØM.)

The species taken at Pátorfik, Igíniarfik (Egedesminde district) and Gieseckes Sø.

Of recent occurrence along the northern and western coasts of Norway, the British Isles, the Faroes, Iceland, the Murman coast, the Barents Sea and the Siberian Ice Sea; on the east coast of America off New England and Canada. In West Greenland it has been taken from Frederikshaab as far as Ritenbenk; in East Greenland in the southeastern coast area.

Of fossil occurrence: northern Europe, Iceland, England and Canada.

Sipho (Siphonorbis) ebur (MØRCH.)

Literary record:
Fusus ebur MØRCH: STEENSTRUP (81, p. 235).

Min. Mus. record:
Fusus ebur MØRCH: PFAFF. 1874.

The species taken at Pátorfik.

Of recent occurrence: Norway, off Kap Lindesnæs, the Shetland Islands, southern Iceland and Bear Island. In Greenland it has been taken at Christianshaab.

Of fossil occurrence: England.

Sipho (Siphonorbis) propinquus (ALDER).

Literary records:

Fusus propinquus ALD.: RINK (71, p. 61).
Fusus propinquus ALD.: STEENSTRUP (81, p. 235).

The species occurs at Pátorfik.

Of recent occurrence in Norway south of Lofoten, and in the southern part of the North Sea as far as the Bay of Biscay. From Greenland POSSELT records it (68, p. 179) partly from West Greenland (Egedesminde), partly from East Greenland. THORSON, however, has excluded it from the East Greenlandic fauna (93, p. 72). The specimen quoted by STEENSTRUP originates from RINK's collections.

Sipho togatus (MØRCH).

The species found at Pátorfik, Qaersuarssuk kitdleq and Gieseckes Sø.

Of recent occurrence: Spitzbergen, between Bear Island and Finmarken, the Murman coast, Franz Joseph Land, the Barents Sea, the Kara Sea, Novaja Zemlya, Iceland and the western Atlantic. In Greenland it has been taken from the Sukkertoppen district (64°53′ lat. N., 53°06′ long. W.) as far as off the Upernavik district (72°04′ lat. N., 59°50′ long. W.).

Of fossil occurrence: Iceland, Scandinavia.

Neptunea despecta (LINNÉ).

Literary records:

Fusus despectus L.: RINK (71, p. 61).
Fusus despectus L.: STEENSTRUP (81, p. 235).
Fusus fornicatus FABR.: STEENSTRUP (81, p. 235).

The species found in two localities at Pátorfik.

Of recent occurrence with a wide distribution: Norway, Denmark, the British Isles, Portugal, the Faroes, Iceland, Jan Mayen, Bear Island, Spitzbergen, the Murman coast, the White Sea, the Kara Sea, the Siberian Ice Sea, Labrador, New Foundland and Cape Cod. In West Greenland it has been taken at Christianshaab and Akugdleq; in East Greenland in the Franz Joseph Fjord archipelago, the Scoresby Sund district and the southeastern coast area.

Of fossil occurrence: Iceland, Scandinavia, Russia and Canada.

Neptunea despecta (L.) **var. carinata** LAMARCK.

Literary record:

Fusus despectus L. *var. carinata* LAM.: RINK (71, p. 60).

The species found at Pátorfik.

Of recent occurrence: Lofoten, Finmarken, Spitzbergen, the Bering Sea and the eastern coast of North-America. In West Greenland it has been taken from Skinderhvalen as far as Umanak.

Of fossil occurrence: Norway and Russia.

Buccinum undatum LINNÉ.

Literary records:

Tritonium undatum L.: STEENSTRUP (81, p. 235).
Buccinum undatum L.: QUERVAIN (69, p. 183).

Min. Mus. record:

Buccinum undatum L.: KRARUP SMITH. 1869.

The species found at Pátorfik and Sarfánguaq.

Of recent occurrence: Scandinavia, the British Isles, the Bay of Biscay, the Faroes, Iceland, Jan Mayen, Spitzbergen, the Barents Sea, the White Sea, Novaja Zemlya, the Siberian Ice Sea; in the western Atlantic it occurs at Labrador, New England and Cape Cod. In West Greenland it has been taken from Godthaab as far as Qeqertaq (Vaigat). In East Greenland, according to POSSELT, it has been taken at Jackson Ø and Clavering Ø (67, p. 193); THORSON, however, excludes it (93, p. 87).

Of fossil occurrence: Iceland, Scandinavia and Siberia.

Buccinum groenlandicum CHEMNITZ.

Literary records:

Tritonium groenlandicum CHEMN.: NORDENSKIÖLD (57, p. 1019).
Tritonium undulatum MØLL.: STEENSTRUP (81, p. 235).
Buccinum groenlandicum CHEMN.: HELLAND (21, p. 114).

The species found at Pátorfik, Lerbugten and Gieseckes Sø.

Of recent occurrence: eastern Iceland, Finmarken, Spitzbergen, the Murman coast, the White Sea, the Barents Sea, the Siberian Ice Sea, Labrador and Nova Scotia. In West Greenland it has been taken from Nanortalik to Tasiussaq; in East Greenland along the southeastern coast area.

Of fossil occurrence: Scandinavia, England, Siberia and Canada.

Buccinum hydrophanum HANCOCK.

Literary records:

Tritonium hydrophanum HANC.: NORDENSKIÖLD (57, p. 1019).
Tritonium hydrophanum HANC.: STEENSTRUP (81, p. 235).

Min. Mus. records:

Buccinum hydrophanum HANC.: KRARUP SMITH. 1869.
Buccinum hydrophanum HANC.: PFAFF. 1874.

The species occurs at Pátorfik and Sarpiussat.

Of recent occurrence: Iceland, between the Faroes and the Hebrides, northern Norway (Finmarken), Spitzbergen, the Murman coast, the Barents Sea, Novaja Zemlya, the Kara Sea, Franz Joseph Land, the Siberian Ice Sea. Along eastern America it has been found at Baffin Land and New Foundland. In West Greenland it has been found from the Godthaab district as far as Kap York; in East Greenland along the whole of the coast.

Of fossil occurrence: Scandinavia.

Buccinum hydrophanum HANCOCK **var. texturata** POSSELT.

The variety found at Pátorfik. The find is represented by the upper part of a specimen, which agrees with the one figured by POSSELT (68, table II, fig. 15).

Of recent occurrence only recorded in the Umanak Fjord.

Admete viridula (FABRICIUS).

The species taken at Pátorfik in two localities, at Gieseckes Sø and at Igíniarfik (Egedesminde district).

Of recent occurrence: the Faroes (dead specimen), Iceland, Spitzbergen, the Kara Sea, Novaja Zemlya, the Siberian Ice Sea, the Bering Sea, Norway (Finmarken as far as Oslo Fjord) and the Channel. Along the east coast of America it occurs from Baffin Land to New England. In West Greenland it is recorded as having been taken from the Godthaab district to Umanak. In East Greenland all along the coast.

Of fossil occurrence: Scandinavia and Iceland.

Bela pingeli (BECK).

The species has been found at Igíniarfik (Egedesminde district).

Of recent occurrence: Iceland, Spitzbergen, eastern Finmarken and the Murman coast. Along the eastern coast of America it is known from the Gulf of St. Lawrence, Nova Scotia and Cape Cod. In West Greenland it has been taken from Julianehaab as far as Godhavn. In East Greenland it has been found in the southeastern coast area.

Of fossil occurrence: Scandinavia.

Bela nobilis (MØLLER) **(incl. var. scalaris** MØLLER).

Literary record:

Defrancia nobilis MØLL.: (= *Bela nobilis var. scalaris*): STEENSTRUP (81, p. 235).

Min. Mus. record:

Defrancia nobilis MØLL.: KRARUP SMITH. 1869.

The species and variety found at Pátorfik.

Of recent occurrence: Norway, Iceland, the Faroes, Jan Mayen, Spitzbergen, the Barents Sea, the Murman coast, the Kara Sea, the Siberian Ice Sea, Labrador, Nova Scotia and Cape Cod. In West Greenland it has been taken from Nanortalik as far as Melville Bugt. In East Greenland it has been taken all along the coast.

Of fossil occurrence: Scandinavia, Great Britain, Siberia and Canada.

Bela exarata (MØLLER).

Literary record:

Pleurotoma turricola MONT.: STEENSTRUP (81, p. 235).

The species found in two localities at Pátorfik.

Of recent occurrence: Norway, west of Ireland, the Faroes, Iceland, Spitzbergen, the Kara Sea, the Siberian Ice Sea, Labrador and New England. In West Greenland it has been taken from Frederikshaab as far as Umanak; in East Greenland in the Scoresby Sund district and in the southeastern coast area.

Of fossil occurrence: Scandinavia and Labrador.

Bela harpularia (COUTHOUY).

The species found at Pátorfik.

Of recent occurrence: Norway, the British Isles, the east coast of North-America. In West Greenland it has been taken from Frederikshaab as far as Ritenbenk. In East Greenland it has not yet been taken.

Of fossil occurrence: Labrador, Scotland and Scandinavia.

Bela trevelyana (TURTON).

The species found at Pátorfik.

Of recent occurrence: Scandinavia, the British Isles, the Faroes, Iceland, Jan Mayen, Spitzbergen, Bear Island, the Murman coast, the White Sea, the Barents Sea, the Kara Sea; along the coast of eastern America it has been taken from the Davis Strait to Cape Cod. In West Greenland it has been taken from Frederikshaab and as far as Umanak; in East Greenland all along the coast.

Of fossil occurrence: Scandinavia and Canada.

Bela violacea (MIGHEL) **(incl. var. bicarinata** COUTHOUY).

Literary records:

Pleurotoma violacea MIGH. & AD.: STEENSTRUP (81, p. 235).
Bela violacea (MIGH.): JENSEN and HARDER (28, p. 404).

Min. Mus. record:

Defrancia violacea MIGH.: KRARUP SMITH. 1869.

The species found at Pátorfik, Igíniarfik (Egedesminde district) and Orpigsôq.

Of recent occurrence: Scandinavia, west of Ireland, Iceland, Spitzbergen, the Murman coast, the Barents Sea, the White Sea, the Kara Sea, the Siberian Ice Sea, Parry Island, New Foundland and New England. In West Greenland it has been taken from Julianehaab as far as off Grinnell Land; in East Greenland all along the coast.

Of fossil occurrence: Scandinavia and Canada.

Bela tenuicostata (M. SARS).

The species found at Pátorfik.

Of recent occurrence: Norway, Bay of Biscay, west of Ireland, the waters round the Faroes, Iceland, Jan Mayen, Spitzbergen, Bear Island, the Barents Sea, Novaja Zemlya and the eastern coast of North-America. In West Greenland it has been taken in the southerly part, in East Greenland along the southeasterly coast area and in the Franz Joseph Fjord archipelago.

Of fossil occurrence: Scandinavia, Canada and Ellesmere Land (82°27′ lat. N., 61°42′ long. W.).

Bela decussata (COUTHOUY) **var. livida** MØLLER.

The variety found at Pátorfik.

Of recent occurrence: Finmarken, north of the Faroes, Iceland, Spitzbergen, Jan Mayen, the Siberian Ice Sea, Labrador and New England. In West Greenland it has been taken from Frederikshaab as far as Vaigat; in East Greenland in the Franz Joseph Fjord archipelago and the Scoresby Sund district.

Cylichna alba (BROWN).

Literary record:

Cylichna alba BROWN: STEENSTRUP (81, p. 235).

The species found at Pátorfik.

Of recent occurrence: the western coast of Europe from northern Norway to the Azores, the British Isles, the Faroes, Iceland, Spitzbergen, the Barents Sea, the Siberian Ice Sea. In the western Atlantic it has been taken along the east coast of Canada. In West Greenland it has been taken from Fyllas Banke as far as off southern Upernavik; in East Greenland in the Franz Joseph Fjord archipelago.

Of fossil occurrence: Scandinavia and North-America.

Utriculus (Retusa) pertenuis (MIGHEL).

The species found at Pátorfik.

Of recent occurrence along the northern coasts of Europe, the Faroes and Iceland. In the western Atlantic it has been taken in Baffin

Bay, and off Nova Scotia as far as Maine. In West Greenland it has been taken from Holsteinsborg to Godhavn; in East Greenland it is known from the Scoresby Sund district and the Franz Joseph Fjord archipelago.

Of fossil occurrence: Scandinavia and North-America.

Cirripedia.

Balanus (Eubalanus) balanus (Linné) Da Costa.

Literary records:

Balanus porcatus Da Costa: Steenstrup (81, p. 236).
Balanus porcatus Da Costa: Helland (21, p. 114).
Balanus porcatus Da Costa: J. A. D. Jensen (34, pp. 49, 73).
Balanus porcatus Da Costa: Jensen and Harder (28, p. 405).
Balanus porcatus Da Costa: Quervain (69, p. 184).
Balanus porcatus Da Costa: Jensen (30, p. 630).

Min. Mus. record:

Balanus porcatus Da Costa: Giesecke. 1806—13.

The species found in a number of localities, scattered over the whole area.

Of recent occurrence it is very common in the northern hemisphere. It occurs from Franz Joseph Land along the Norwegian coast to the Channel. On the American side it extends as far as the Gulf of St. Lawrence and the coast of New England. It has been taken in depths of up to 300 m. In West Greenland is has been taken as far as Discovery Bay (81°41′ lat. N.); in East Greenland the most northerly locality, where it has been taken, is Danmarks Havn.

Balanus (Chirona) hammeri (Ascanius) Brown.

Literary records:

Balanus Hameri Ascan.: Steenstrup (81, p. 236).
Balanus Hameri Ascan.: J. A. D. Jensen (34, p. 85).
Balanus Hameri Ascan.: Jensen and Harder (28, pp. 403 et seq.).
Balanus Hameri Ascan.: Quervain (69, p. 183).
Balanus Hammeri Ascan.: Jensen (33, p. 25).

The species found at a number of localities scattered all over the area.

Of recent occurrence: the Atlantic from Finmarken to the Channel; on the American side it is found along the coast of New England. In Greenland it has only been found once, viz., at Nordre Strømfjord (about 67° lat. N.) on the west coast. It never lives in shallower depths than 40—50 m; occurs as far down as about 300 m.

Thus the occurrence of *Balanus hammeri* testifies to a milder climate than the one now prevailing in West Greenland.

Balanus (Eubalanus) crenatus BRUGIERE.

Literary record:

Balanus crenatus BRUG.: QUERVAIN (69, p. 184).

The species found in a number of localities within the whole of the area.

Of recent occurrence and wide distribution in the waters of the northern hemisphere. In West Greenland it has been taken in Vaigat and Lille Qarajaq Fjord at Umanak. From East Greenland it is recorded with some doubt from Danmarks Havn (84, p. 549).

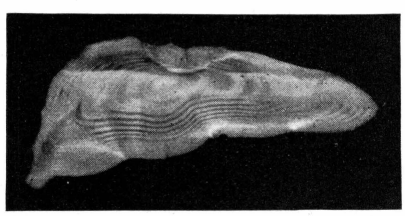
Decapoda.

Hyas (araneus LINNÉ?).

In the locality of Mellemkløft a chela has been found, which Dr. K. STEPHENSEN, with some hesitation, has referred to the species quoted above.

Hyas spp.

A number of partly connected and partly separated joints of extremities have been found, belonging to the *Hyas* family. They cannot be referred to any species.



E. BERTELSEN phot.

Fig. 16. *Gadus callarias* L. The otolith has been polished to show the concentric structure. ab. × 4. Length of the otolith 10.5 mm.

Pisces.

Gadus callarias LINNÉ.

Fig. 16.

In the locality of Mellemkløft at Pátorfik an otolith was found in the sand bed, 60 m above sea level. Dr. Å. VEDEL TÅNING has undertaken the determination of it and writes: "The fish has been 16—17 years old, when it died. Its size has presumably been about 90—120 cm. The ring formation in the otolith is very like the ring formation seen at the present time in cods from the Greenland area. The fish has

probably, as at present, become sexually ripe at an age of about 10 years." Further, an otolith of this species was found at Igíniarfik (Egedesminde district).

Aves.

Uria arra (PALL.).

A bone has been found in the locality of Mellemkløft, which Dr. M. DEGERBØL has determined as belonging to the species in question.

Mammalia.

Rangifer tarandus LINNÉ.

Some antlers and bones belonging to a reindeer have been found, partly on the surface of the ground, partly embedded in the soil at Mellemkløft. It is, however, hardly probable that these fragments have been deposited in the water. It is more probable that, at a far later period, they have been thrown on the ground in this locality, and in some way or other have become embedded in the soil.

Monodon monoceros (LINNÉ).

Two fragments of bones have been found at Qaersuarssuk kitdleq.

Phoca groenlandica O. FABRICIUS.

Some lower jaws and some loose teeth have been found at Qaersuarssuk kangigdleq and in Mellemkløft at Pátorfik.

Phoca foetida O. FABRICIUS.

Some jaws have been found at Qaersuarssuk kangigdleq.

All the mammals mentioned live nowadays off or in Greenland. Consequently they yield no information of a climate deviating from the present one at the time when the layers were deposited.

Besides the species mentioned in the present chapter a number of Bryozoa and Serpulids have been found on shells and stones in various localities. Further, after our return, some Foraminifera were found in the material, and these have been treated by K. DREYER JØRGENSEN in the following chapter.

FORAMINIFERA

By K. Dreyer Jørgensen

The samples investigated have all been taken with special regard to the malacological investigations, the idea of an investigation of the Foraminifera in the Quaternary, raised shell-bearing beds having only arisen, after the expedition was completed. Though the samples are consequently inadequate for the purpose of a stratigraphic division of the raised shell-bearing beds by means of the Foraminifera fauna, a list of the forms found may, however, be thought to be of some interest.

From the lower clay layers of the Pátorfik cliff (as to the details of the situation of the localities see pag. 17) three samples of faintly sandy silt have been examined. The samples were taken at 25—30 m above sea level.

From Pátorfik—Elvskrænten (pag. 20) three samples have likewise been investigated from the lower clay layers. The samples have been collected in beds, which correspond with those from the Pátorfik cliff and at 25 and 30 m above sea level. Further, a sample has been examined, which was taken from the same slope at 50 m, being of the same appearance as the preceding ones.

Finally, two samples from Kløft II and Mellemkløft (pp. 21 and 24) have been examined, which were collected at an altitude of 45 and 60 m, respectively. The samples are here considerably more sandy than those from the lower beds.

A sample of the stony marine clay from Sarfarfik (pag. 29) was devoid of Foraminifera.

From the cliff east of Qaersuarssuk kitdleq (pag. 30) samples have been examined from 5 m, 6 m, 10 m and 10.5 m (2 samples) above sea level. All the samples from here consist of rather fine, but badly assorted sand.

In the Pátorfik area it appears from the sequence that the upper layers (the samples from 45 m—60 m) are younger than the lower ones (the samples from 25—30 m). On the other hand, the layers in the low coastal cliff at Qaersuarssuk kitdleq (the samples from 5—10.5 m) have

been deposited, after the country had risen above the sea level at which the marine shell beds at Pâtorfik were deposited. For further details see the treatise of DAN LAURSEN.

Family **Textulariidae.**

Virgulinae D'ORBIGNY, 1826.

In a single sample a fragmentary specimen has been found, which should presumably be referred to this genus.

Cassidulina translucens CUSHMAN & HUGHES, 1925.
CUSHMAN & HUGHES, 1925, p. 15.
Fig. 17 (1a, b).

In some samples there are found a few specimens of a *Cassidulina*, representing a type which by many former investigators has been referred to *Cassidulina laevigata* D'ORBIGNY. A. NØRVANG, who has had the opportunity to go over my material, has, however, called my attention

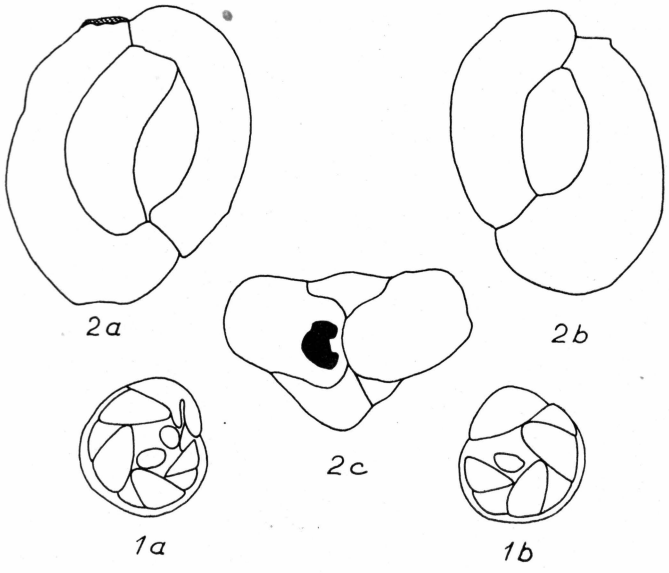


Fig. 17. 1a & b. *Cassidulina translucens* CUSHMAN & HUGHES. Coast cliff at Qaersuarssuk kitdleq. Alt. 5 m. Ab. 35 × 1. A. NØRVANG del. 2a, b & c. *Quinqueloculina agglutinata*? CUSHMAN. Kløft II. Pâtorfik. Ab. 25 × 1. K. D. J. del.

to the great resemblance between this form and *C. translucens*. It seems to occur rather frequently in arctic waters, and according to a verbal communication from A. NØRVANG it occurs off the arctic part of the coast of Iceland, but neither off its western nor its southern coast. The

occurrence of *C. translucens* in Arctica must a priori be regarded as very peculiar, seeing that this species has hitherto only been known from the Pliocene and Pleistocene of California. The correctness of the determination can, however, not be tested, until an exchange with America again becomes possible.

Cassidulina crassa d'Orbigny, 1839.
Cushman 1922, pp. 124—125.

Only one specimen of this species has been identified. In the waters along the western coast of Greenland it is of rather frequent occurrence, as according to Ellinger (1914, p. 775) it has been found in samples from 15 localities in all. It has otherwise been met with in numerous localities in the Atlantic, the Mediterranean and the Pacific.

Family **Lagenidae.**

Nodosaria pauperata d'Orbigny, 1846.
Cushman 1923, p. 72.
Fig. 18.

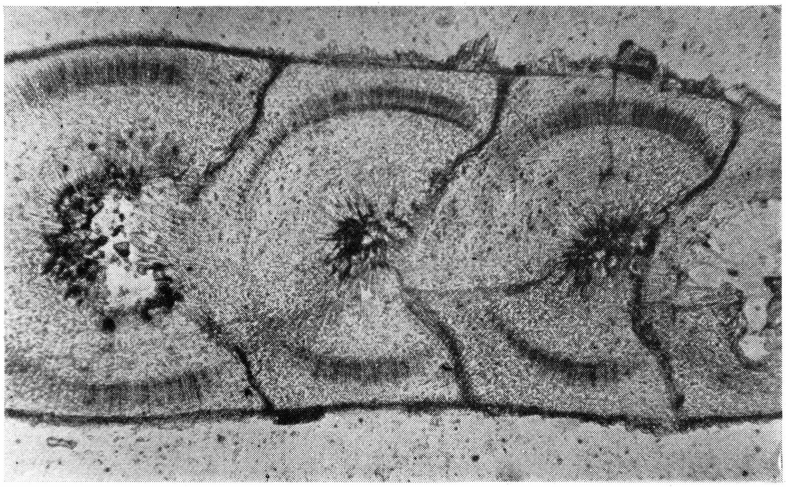
Fragments and entire shells of a medium-sized *Nodosaria* are of rather frequent occurrence in the samples. Unfortunately a layer of calcite has in all cases been deposited on the surfaces of the shells, the sutures being often quite hidden. However, from observations made on thin slides, which show the number and outlines of the chambers, and on the preserved exteriors of the best preserved specimens it appears that, at any rate the latter are identical with *N. pauperata.*

Lagena costata? Williamson, 1858.
Cushman 1923, p. 12.

In one of the samples a *Lagena* has been found, which must undoubtedly be referred to the species mentioned above. The area of the aperture has, however, been broken off, so that the determination can not be said to be entirely reliable.

Polymorphina compressa d'Orbigny, 1846.
Cushman 1923, p. 154.

According to Brady (1884, p. 566) this is a cosmopolitan form, but particularly common in temperate latitudes. In the waters of West Greenland it has been met with in 4 localities in all, and extends as far north as Smith Sound, 78°35′ lat. N. (Brady 1884, p. 566).



K. D. J. phot.

Fig. 18. *Nodosaria pauperata* D'ORBIGNY. The lower clay layer of the Pâtorfik cliff. Longitudinal section through an individual incrustated in calcite. 98 × 1.

Family **Globigerinidae.**

Orbulina universa D'ORBIGNY, 1839.
CUSHMAN 1924, pp. 28—32.

The samples comprise a specimen of this pelagic species, the distribution of which is very wide. Up to the present there is, however, no record of it from Greenland waters.

Family **Nonionidae.**

Nonion scaphum FICHTEL & MOLL, 1798.
CUSHMAN 1930, pp. 5—6.

A number of specimens have been referred to this species, in spite of the fact that they are all in a poor state of preservation. According to BRADY (1884, p. 730) it is a very widely distributed form, which is common off the west coast af Europe, but rather rare in the Mediterranean and the southern Atlantic. In the waters of West Greenland it has been found in 13 localities in all (ELLINGER 1914, p. 806).

Nonion labradoricum DAWSON, 1860.
CUSHMAN 1930, pp. 11—12.

This form has been found in cold water from New England and farther north (CUSHMAN 1930). It is besides known from Danish waters and Novaja Zemlya (MADSEN 1895, p. 13), as well as from the coast of Norway off Bergen (NØRVANG 1941, p. 13). It has only been identified

in one locality off West Greenland viz. Lievely Harbour, 70° lat. N. (ELLINGER 1914, p. 806).

Astrononion stellatum CUSHMAN & EDWARDS, 1937.
CUSHMAN & EDWARDS 1937, p. 32.

This species is rather widely distributed in the northern part of the North-Atlantic, from the neighbourhood of the British Isles and northwards. It is probably also identical with the forms, which have been mentioned by ELLINGER from 11 localities in West Greenland, under the name of *Nonionina stelligera* D'ORBIGNY.

Elphidium incertum WILLIAMSON **var. clavatum** CUSHMAN, 1930.
CUSHMAN 1930, p. 20.

This form, which is rather widely distributed in the samples investigated, was only in 1930 separated from the large group of forms, which in former times have been referred to *Polystomella striato-punctata* FICHTEL & MOLL. According to CUSHMAN it occurs off the east coast of America from Cape Cod northwards, as well as along the northern coasts of Europe.

Elphidiella arctica? PARKER & JONES, 1864.
CUSHMAN 1930, pp. 27—28; 1936, p. 89.

A few large specimens have, with some uncertainty, been referred to the above-mentioned species. Superficially they resemble the latter entirely, but in none of them the double rows of pores are to be observed. A. NØRVANG, however, has told me that such a form was found off Iceland, and that there is an even transition to quite typical specimens of the species.

Family **Rotaliidae.**

Eponides frigida CUSHMAN, 1931.
CUSHMAN 1931, pp. 45—46.

This is a widely distributed, almost exclusively arctic and sub-arctic form, which in the waters of West Greenland has been found in no less than 18 localities (ELLINGER 1914, p. 803).

Family **Anomalinidae.**

Cibicides lobatula WALKER & JACOB, 1798.
CUSHMAN 1931, pp. 118—120.

This form is common in practically all latitudes, though, chiefly in rather shallow water. In the waters of West Greenland it has been found in 20 localities (ELLINGER 1914, p. 801).

Cibicides refulgens MONTFORD, 1808.
CUSHMAN 1931, pp. 116—117.

The distribution of this species is rather incompletely known. In spite of the fact that it seems to prefer cold waters, it has not been identified with certainty in the waters of Greenland.

Family **Miliolidae.**

Quinqueloculina agglutinata? CUSHMAN, 1917.
CUSHMAN 1917, p. 43.
Fig. 17 (2a, b, c).

A great quantity of specimens of an agglutinating *Quinqueloculina* have been found in one of the samples. They are distinguished from *Q. agglutinans* D'ORBIGNY in that the chambers are angular and very pronouncedly broadest towards their bases; an apertural neck is not, or only very faintly developed, and it merges into the base of the preceding chamber. These characters it has in common with the *Q. agglutinata*, which was described by CUSHMAN in 1917, having been found in a single locality in the Pacific "off Alasca". As the apertural teeth have unfortunately been broken off in all the Greenland forms, it is impossible to work out a final determination.

Triloculina tricarinata D'ORBIGNY, 1826.
CUSHMAN 1929, pp. 56—57.

This form is cosmopolitan. In West Greenland waters it has been found in 4 localities in all, farthest north in 83°19′ lat. N.

Family **Ophtalmiidae.**

Cornuspira foliacea? PHILIPPI, 1844.
CUSHMAN 1929, pp. 79—80.

The collections made include a single specimen of a *Cornuspira*, which may probably be referred to this species. As the specimen is not quite that of an adult individual, it will be difficult with certainty to exclude the possibility that it ought to be referred to *C. involvens* REUS. The last whorl is, however, distinctly flattened, and I am of the opinion that it would be most correct therefore to refer it to *C. foliacea*. It is very widely distributed in most seas. From the waters of West Greenland it has been recorded twice, farthest north in 82°29′ lat. N.

The following table gives a summary of the occurrence of the forms mentioned in the different samples which have been made subject to investigation.

	Coast cliff at Qaersuarssuk kitdleq	—	—	—	Pátorfik. Mellemkløft	Pátorfik. Kløft II	Pátorfik. Elvskrænten.	Pátorfik. Elvskrænten, lower layer	Pátorfikklinten, lower layer
Level in metres	5	6	10	10,5	60	45	50	25–30	25–30
Virgulina sp.	..	..	..	..	..	..	..	×	..
Cassidulina translucens	×	×	×	×	..	×	..	×	×
— crassa	×	..	..	..	..	..	..	..	..
Nodosaria pauperata	..	..	..	..	..	..	..	×	×
Lagena costata?	..	..	..	..	..	..	..	×	..
Polymorphina compressa	..	..	..	..	..	×	..	..	..
Orbulina universa	..	..	..	..	..	×	..	..	..
Nonion scaphum	..	..	..	..	..	×	..	×	×
— labradoricum	..	..	..	..	..	×	..	×	..
Astrononion stellatum	×	×	×	×	..	..	..	..	..
Elphidium incertum var. clavatum	×	×	×	×	?	×	?	×	×
Elphidiella arctica?	×	×	..	×	..	×	..	..	..
Eponides frigida	×	×	..	..	..	×	..	×	..
Cibicides lobatula	×	×	×	×	..	..	..	..	..
— refulgens	..	..	..	..	..	..	..	×	×
Quinqueloculina agglutinata?	..	..	..	..	..	×	..	..	..
Triloculina tricarinata	..	..	..	..	..	×	..	..	..
Cornuspira foliacea?	..	..	..	..	..	×	..	..	..

As already stated in the introduction, the samples collected do not lend themselves to a stratigraphical division of the shell layers investigated. The small number of samples and the fact that they have been collected in a manner, which was unsystematic with a view to investigations of Foraminifera, leave far too wide a margin for accidentality.

The state of preservation of the Foraminifera.

All the shells from the coast cliff at Qaersuarssuk kitdleq are very well preserved, and as regards their state of preservation they are hardly to be distinguished from recent forms. The shells from the lower clay layers of the Pátorfik area, however, present a somewhat different appearance. The chambers are generally filled with a yellowish aggregate

of calcite, and a deposition of the same mineral has often taken place on the outsides of the shells, which may thus be covered by a mantle of a secondary material (see fig. 18). In this state the shells may naturally often be quite indeterminable.

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CHANGES OF LEVELS

The presence of elevated shore lines has enabled former investigators to prove a higher sea level in earlier times. In the course of the investigations undertaken in 1939 this phenomenon was studied in details, and terraces were identified at considerably higher levels than those at which they had hitherto been found. Further, a new evidence of the formerly higher water level was studied, viz. raised deltas which are connected with the old shore lines.

It had been planned to carry out a systematic investigation, partly along the coasts in an easterly-westerly direction, and partly perpendicularly on the coast, so as to collect a series of connected figures, which might be used for a more accurate fixing of the changes of levels in the course of the alluvial period. It was, however, not possible to carry out the investigation planned in its full extent, as owing to solifluction there were long stretches of coast, which supplied no information whatsoever in this respect. The measurings made, however, yield sufficient material to produce a result.

Conditions are most pronounced in the Umanak Fjord on the northern coast of the Nûgssuaq peninsula east of Ikorfat, and especially between Pátorfik and Sarfarfik. At Pátorfik a levelling was made from the coast as far as about 1 km inland. The line of the section, which was obtained by this levelling, is shown on fig. 19. From the base to the top of the cliff the following altitudes of terraces were measured:

10 m
22 m
28 m
35 m

The levelling comprises the front edges of the terraces, and as far as this part of the measurement is concerned, the altitude is only given in metres without decimals, as owing to the solifluction it was often difficult to identify a distinct edge.

Along the distance from the top of the cliff as far as 1 km inland the following altitudes of terraces were found:

Front edge:	Hind edge:
59.3 m	72.6 m
91.1 m	98.0 m
101.4 m	104.7 m
130.1 m	133.8 m
148.7 m	152.2 m
220.0 m	223.8 m

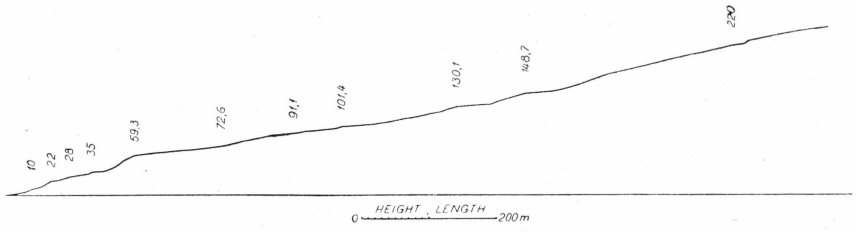

Fig. 19. Section showing the position of the terraces at Pâtorfik. The line is drawn from the levelling made at right angles to the shore line.

A series of measurings made farther east with a Paulin barometer yielded the following results:

10 m (front edge)
25 m (front edge)
35 m (front edge)
60 m (front edge)
97 m (hind edge)
150 m (front edge)

For Paulin measurings the following method has been adopted, viz. to measure the front or the hind edge, where it was most pronounced, although the place was somewhat outside the actual measuring line.

At Qaersuarssuk kangigdleq the following measurements were undertaken; it must, however, be borne in mind that it was impossible to undertake measurings in lower altitudes at the mouth of the river or near it.

100 m (front edge)
130 m (front edge)
155 m (hind edge)

At the Kûgtsiaq river the following terraces were measured:

8 m
25 m
45 m
70 m
90 m

At the debouch of the Sarfarfik river only two terraces were formed at the following altitudes:

30 m
70 m

At Kûk terraces were found at the following altitudes:

75 m
90 m
130 m

In connection with the terraces, raised deltas have been observed in several localities. Thus deltas have been found at Pátorfik connected with the terraces at an altitude of 10 and 35 m and with the terrace between 91.1 and 98.0 m. Further, at about 65 m was found a large flat alluvial cone of a similar kind as the recent one observed at Qaersuarssuk kitdleq (see fig. 26) and Auvfarssuaq. The inland delta observed at Pátorfik seems to suggest that the motion of the coast line at one time must here have been very slow, so that the river has not been able to transport the material carried along by it. Later on the motion of the coast line has again become more rapid, and the river has cut a bed resembling a cañon into the old delta, such as is known from recent river courses. Similar phenomena as those mentioned above are known from several other localities in Greenland; among others, NOE NYGAARD mentions them from Kap Simpson and Suess Land in East Greenland (56, p. 21) and BRETZ (7, pp. 163 et seq.).

At Qaersuarssuk kitdleq there was, as mentioned in the description of localities, a cliff the altitude of which is 11 m above sea level. This cliff is cut into a terrace, which is now being slowly eroded away by the sea, and which extends without interruptions as far as a delta, the base of which is situated at 79.5 m above sea level. At 84.5 m above sea level there is a stretch of meadow up to 100 m wide, terminating in a small but distinctly marked slope, which constitutes the front edge of a second terrace at a level of 85.5 m above sea level. Farther inland the features are obscured, and only at an altitude of 149.5 m above sea level is it again possible to identify a definitely marked terrace. In connection with this terrace a delta was found, and also a delta cone at an altitude of 135 m above sea level. At 224.5 m above sea level the front edge of a terrace was again found, extending as far as 230 m above sea level and with a corresponding delta.

When comparing these terraces with those at Pátorfik it appears that the terraces at Qaersuarssuk kitdleq correspond with the highest of those found at Pátorfik.

Terrace	at	85.5 m	at	Qaersuarssuk	kitdleq	corresponds	with	91.1 m	at	Pátorfik
—	-	149.5 m	-	—	—	—	—	148.7 m	-	—
—	-	224.5 m	-	—	—	—	—	220.0 m	-	—

Author phot. $^{23}/_{6}$ 1939.

Fig. 20. Terraces along the coast between Vibeke's Elv (to the right) and Qaersuarssuk kangigdleq (to the left). In the background Qilertínguit (1968 m).

The delta in about 135 m at Qaersuarssuk kitdleq corresponds with the terrace in 130.1—133.8 m at Pátorfik. As regards the lower terraces the terrace at Qaersuarssuk kitdleq, which extends as far up as 79.5 m above sea level, must correspond with the terrace at Pátorfik, at any rate as far as the upper parts are concerned. When there is not a similar series of well defined terraces at Qaersuarssuk kitdleq, as there was at Pátorfik, this is due to the fact that the distinct marking has been obscured by solifluction. That there have been shore lines below 85.5 m above sea level at Qaersuarssuk kitdleq appears from fig. 21, where one or perhaps two old shore lines are visible below the well-marked terrace plane.

At Tuperssuautâ, some 300 m from the shore, Dreyer Jørgensen found a terrace at 22 m above sea level. This terrace, which was covered with moving soil, could be traced up to about 50 m above sea level.

At Nûgssuaq on the northwestern side of the peninsula a measuring was undertaken between the now abandoned outpost and Bjørnefælden (ɔ: the bear trap, probably built by the old Norsemen), where two series of terraces had been developed with corresponding deltas. It was not possible to measure the front edge of the lower terrace, but the hind edge was at about 20 m above sea level; the front edge of the

second terrace was at 21 m and the hind edge at 42 m above sea level. Conditions in this locality are, as shown in fig. 22, an excellent illustration of connected terraces and deltas.

At Marrait terraces were found in the basalt area north of the Kûgssuaq delta, being situated between the projecting basalt benches at the following altitudes:

10 m
30 m
40 m
45 m
60 m
70 m

The weight which should be attached to all of these terraces, as compared with those measured on the north coast, may be subject to discussion, as it might seem that the altitudes were to some extent determined by the upper edge of the basalt bench. Similar conditions were observed in the gneiss area between Pátorfik and Qaersut, where there were small terraces at all altitudes, up to about 70 m above sea level. There is every reason to suppose that this is due to the fact that the water between the rocks was calm during this period of submergence, so as to make a regular deposition possible.

On the south coast of the Nûgssuaq peninsula investigations were undertaken at Qardloq. Here on a small plain there was an old dwelling place consisting of four houses, one of which has been repaired and is used as a hunting hut. A couple of hundred metres from the old hut there is another small plain, which is an old terrace. Here at an altitude of 2 m above sea level a barrier was found, which must be connected with the present coast line. The hind edge of the terrace was at 18 m above sea level. At 20 m above sea level there was another barrier, and behind it another terrace extending as far as the wall of the rock lying near it.

Farther east a couple of small rivers debouch. In the most westerly of these there was a terrace, the front and hind edges of which were at 2 m and 11 m above sea level, respectively, the terrace only measuring 40 m across. In connection with the terrace a delta was found, the lowest point of which was at 11 m, the top point at 17 m above sea level. Still farther east, near the next river, terraces were found both west and east of it. On the east side there were two terraces:

Front edge:	Hind edge:	Width:
3 m	5 m	20 m
7 m	12 m	25 m

On the west side there were also terraces near the coast, the altitudes of which above the present sea level was very small, but the features

A. ROSENKRANTZ phot. $^{5}/_{7}$ 1939.

Fig. 21. Qaersuarssuk kitdleq. Below the distinct shore line, 85.5 m above sea level, one or perhaps two old shore lines are visible. To the left in the middle the alluvial cone of the river Østerfjældelven. In the background Qilertínguit.

were so obscured that it was not possible to determine the levels with any degree of accuracy. On the other hand, there was at 87 m above sea level a terrace extending up to 102 m. Somewhat higher up there were traces of another terrace, but it was not possible to undertake exact measurings, and so it is not included in the present material. More

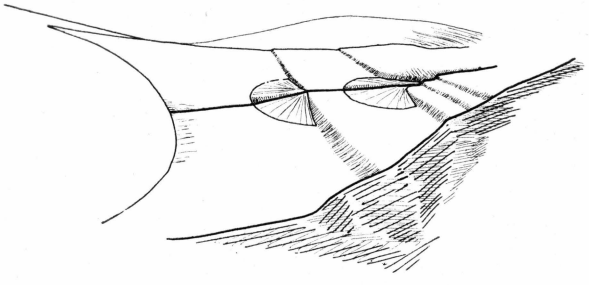

Fig. 22. Terraces with corresponding deltas at the former outpost Nûgssuaq.

than 102 m above sea level a system of raised deltas was found, both east and west of the river, one of them with its top point at 125 m above sea level. Into this is cut another delta, the top point of which is at 105 m above sea level. It extends right down to the coast, that is a distance of about 500 m, and here it forms a 3 m high cliff facing

the Vaigat. The present river had cut into this delta, and near the coast it had formed another and smaller delta.

At Asuk on the northern coast of Disko there were in all three terraces:

Front edge:	Hind edge:
44 m	74 m
104 m	136 m
189 m	194 m

A little higher than 132 m above sea level a series of barriers was found. Over the whole of the area the surface was covered with moving soil, containing many basalt blocks and zeolites.

Survey of the terraces measured. (See p. 97).

In the preliminary report of the results of the expedition (73) the author has arranged the various measurings of the terraces into groups. The figures mentioned there are in the main correct; however, a few minor errors have been found by a renewed calculation, the intervals within which the various groups of terraces are situated being:

2— 10 m
21— 45 m
59— 75 m
85—101 m
130—155 m
over 220 m

Where there are many faintly marked shore lines within the same area, it may be taken for granted that a comparatively rapid change has taken place in the level of the coast line, seeing that the sea has not had time to define it sharply. Few but definitely marked shore lines suggest corresponding periods of balance.

When examining the terraces measured by the expedition it might seem, as if the rise was greatest in the interior of the Umanak Fjord farthest away from the outer coast, which conditions are also known from other formerly glaciated areas. However, it appears as if the rise, which can be established by means of the terraces of up to 10 m, has been more or less the same throughout the area.

The Sarfarfik terraces at 30 m above sea level correspond with the Kûgtsiaq terrace (at 25 m), the terraces at Pátorfik (at 25 m), Tuperssuautâ (at 22 m) and Nûgssuaq (at 20 m). Similarly, the terraces at Kûk (75 m), Kûgtsiaq (70 m) and Pátorfik (59.3—72.6) correspond with each other, and the higher, strongly marked benches at Kûk, Sarfarfik, Kûgtsiaq (90 m), Pátorfik (91.1) and Qaersuarssuk kitdleq (85.5) have undoubtedly been formed at the same time.

Survey of the terraces measured.

Kûk	..	..	..	..	..	..	..	75	90	..	130	..	..
Sarfarfik	..	..	..	30	..	..	..	70	90	..	..	..	..
Kûgtsiaq	..	8	25	..	..	..	45	70	90	..	..	..	..
Q. kangigdleq	..	..	..	..	..	..	..	..	..	100	130	155	..
Pátorfik (Bar.)	..	10	25	..	35	..	..	60	97	..	..	150	..
Pátorfik (Level)	..	10	22	28	35	..	..	59.3—72.6	91.1—98	101.4—104.7	130.1—133.8	148.7—152.2	220—223.8
Q. kitdleq	..	(11)	..	..	..	..	..	79.5	85.5	..	..	149.5	224.5
Tuperssuautâ	..	..	22	..	..	..	..	..	..	..	..	..	..
Nûgssuaq	..	..	21	..	..	..	..	..	..	..	..	..	..
Marrait	..	10	..	30	..	40	45	60 70	..	..	..	..	..
Qardloq	3	7	..	..	..	..	..	..	87—102	..	..	..	..
Asuk	..	..	..	..	..	..	44—74	..	..	..	104—136	..	189—194

The connection of the various terraces, which can with any certainty be grouped together, appears from the following table:

Kûk	Sarfarfik	Kûgtsiaq	Q. kangigdleq	Pátorfik	Q. kitdleq	Tupersuautâ	Nûgssuaq
—	30	25	—	25	—	22	20
75	70	70	—	72.6	—	—	—
90	—	90	—	91.1	85.5	—	—
—	—	—	100	101.4	—	—	—
130	—	—	130	130	—	—	—
—	—	—	155	152.2	149.5	—	—
—	—	—	—	220	224.5	—	—

As already mentioned, the highest terraces measured at Pátorfik have their upper edges in 223.8 and at Qaersuarssuk kitdleq at 224.5; in the latter case the terrace at 224.5 extends as far as 230 m above sea level. This means that on the northern coast of Nûgssuaq the upper marine limit may be put at 230 m above the present level of the sea.

As regards the measurings at Asuk on the north coast of Disko, the material is so slight as not to permit of the drawing of any far-reaching conclusions. The terrace at 44 m undoubtedly corresponds with the period, when the terrace at Pátorfik was formed at an altitude of 59.3 above sea level, that is, a period when the rise was suspended. The highest level of the sea has been found at 194 m at Asuk. The upper marine boundary may thus in this area be put at about 200 m above the present level of the sea, the upper marine limit being lower, the further south and west one penetrates.

LAUGE KOCH (41, p. 517) estimates the upper marine boundary at 210 m in the case of North Greenland. Shells have been found up to a height of 135 m and driftwood at a height of 165 m. KOCH however writes: »above this limit (viz. the 210 m line) there are in several places suggestions of shore lines«. It may thus be regarded as probable that the upper marine boundary in the whole of Greenland falls from north towards south.

KOCH further has observed two pronounced shore lines along the coast of North Greenland, viz. one at 105 m and another at about 65 m above sea level. In the Kap York district the most outstanding shore line is about 50—55 m above sea level. KOCH thinks it probable that the 65 m line corresponds with this 50—55 m line, but adds that it can not be proved. The present author regards this supposition on the part of KOCH as very probable, and there is hardly any doubt that the 105 m line corresponds with a terrace in the area delt with in the 85—101 m group in the Umanak district (see p. 96) whereas the 65

(or 50—55 respectively) m line corresponds with a terrace in the 21—45 m group.

On plate 4 all the terraces measured in northern Greenland by earlier investigators and the present author have been collected and arranged.

Generally speaking, the list arranged does not allow of many conclusions as to the conditions of rise and subsidence along this part of the coast of Greenland, the material being too heterogeneous for this purpose. Practically all measurings have been undertaken by means of barometers, the exactness of the measurings being unknown. There is only little information as to the water levels used as a starting point for the measurings, and finally it seems as if the measurings have not everywhere been taken at the same point of the terraces; at any rate PJETURSSON (65) in some cases refers to the front edges, in others to the hind edges of the terraces. When this list nevertheless is included in the present material, it is because it permits of the drawing of certain important conclusions.

When starting from the supposition that the Akuliaruserssuaq terrace at 177 m above sea level is the uppermost, it is a safe conclusion that the upper marine limit is situated somewhere near this altitude, and this corroborates the view already set forth, viz. that the upper marine limit is lower, the farther south one gets. According to PJETURSSON (65, p. 323) the upper marine limit is situated on the island of Manîtsoq in the Egedesminde district at about 108 m above sea level; also this corroborates what has been said above, even though the actual figure, as mentioned by PJETURSSON himself (65, p. 324), is a little too high.

From the list it further appears that terraces at about 10 m above sea level are of frequent occurrence within the whole of the area. In the northern part of the area terraces of about 25 m above sea level are frequent, whereas in the southern part terraces of about 22 m predominate. It might seem, as if these terraces of about 20 m have been deposited at the same time as the 25 m terraces, and this suggests that the rise has been greater in the north than in the south. This, however, apparently does not hold good in the case of the 10 m terraces, and thus it seems as if this rise has been equally great everywhere along the coast. Other and similar considerations might be said to apply to a number of the other measurings, but as it seems to the author that the material of figures is not sufficiently accurate, it will be more correct to put off such considerations, until more and more exact measures are at hand.

It appears as if a rise has taken place everywhere within the area. When therefore PJETURSSON (65, p. 318) quotes SALISBURY's statement to the effect that no trace of the rise of the land has been found at Jakobshavn, this is not correct. At Sermermiut, 2.5 km south of Jakobs-

havn, A. ROSENKRANTZ in 1939 found shell-bearing raised clay beds below the famous kitchen midden.

At the present time a subsidence of Greenland is taking place. On a journey in Greenland in 1828—29 PINGEL (63, 64) had found indications of a recent subsidence, and later on STEENSTRUP (81) and FRODA (16) made similar discoveries in northern Greenland. Also MATHIASSEN has made observations on Eskimo ruins and kitchen middens, which are threatened by the sea in the Upernavik district (51) and in the region round Disko Bugt (52), these observations corroborating what has been said above.

In various places within the area inesvtigated it was possible to prove the subsidence of the land. This appeared partly from the strong process of erosion, which took place along the coast in the cliffs situated there and also in several of the lowermost raised deltas, as for instance at Qardloq, Angnertuneq and Qaersuarssuk kangigdleq. In many localities the erosion of the old Greenland dwelling places was evident; thus, great parts of the kitchen midden had been eroded away by the sea at Ikorfat, and this was also the case at Sermermiut and Nûssaq, where the blubber house was now situated at the very edge of the cliff, and would probably within a very short time be swallowed by the sea. It is hardly possible that the store house, of which the blubber house forms a continuation, was originally built in such an exposed position. Numerous observations of a similar kind have already been made by STEENSTRUP (81, p. 237).

A. E. NORDENSKIÖLD has pointed out the desirability of undertaking investigations of the water level off the coasts of Greenland. STEENSTRUP proposes that daily observations of the water level ought to be made for a number of years, but until this can take place, he has—for the guidance of subsequent expeditions—undertaken levellings at 21 points from Prøven to Egedesminde. As STEENSTRUP himself points out, it will, however, be difficult for later travellers to identify the water level, at which the points were originally measured.

In three of the points measured by STEENSTRUP a re-measuring has been undertaken by the Nûgssuaq Expedition.

1. Uvkusigssat.

Ring bolt on northern side of the harbour, measured at ordinary high-water:

STEENSTRUP: 2.4 m above sea level.
Nûgssuaq Expedition: 2.5 m above sea level.
Rise of sea level: ÷ 0.1 m[1]).

[1]) As STEENSTRUP himself states that his measurements are not exact down to decimetres, full figures are used here and in the following.

2. Umanak.

Ring bolt on northern side of the harbour, measured at ordinary high-water:

STEENSTRUP: 5.7 m above sea level.
Nûgssuaq Expedition: 4.7 m above sea level.
Rise of sea level: + 1.0 m.

3. Jakobshavn.

Ring bolt on southern shore of the harbour, about 120 m northeast of the settlement:

Height of the ring bolt: STEENSTRUP 0.3 m.
Nûgssuaq Expedition: 0.315 m.
STEENSTRUP: 0.8 m above sea level.
Nûgssuaq Expedition: 0.1 m above sea level.
Rise of sea level: + 0.7 m.

STEENSTRUP has measured to the end of the iron peg, to which the ring is attached. When indicating the height of the ring bolt, it is to be presumed that he has measured from the surface of the sea to the free end of the peg, i. e. on the ring bolt itself, and the measurings of the expedition have been undertaken to this point. At Jakobshavn it has thus been possible to prove a rise of the sea level amounting to 0.7 m. However, STEENSTRUP may have measured to the place, where the peg is made fast in the soil, in which case the rise becomes 1 m.

The two latter of these three measurings distinctly corroborate a subsidence of the land. Some error or other has undoubtedly crept into the measuring at Uvkusigssat, and it is probable that the high-water mark is erroneously fixed. However, the material is too slight for the drawing of any conclusions as to the extent of the subsidence, but together with the formerly undertaken measurings it nevertheless permits of fixing the extent of the subsidence.

According to the two last mentioned measurings the extent of the subsidence should amount to about 1 m in the course of the sixty years, which have elapsed since they were made. PJETURSSON has undertaken some re-measurings of other of the points of STEENSTRUP. At Egedesminde a subsidence of 8.8 m was found extending over a hundred years, but PJETURSSON himself states (65, p. 346) that the measurings are subject to rather great errors, so that no attention can be paid to this result. A measuring at Ritenbenk yields a subsidence of 0.2 m within 17 years, which corresponds with 1.17 m in the course of a hundred years. In 1897 and 1923 FRODA undertook a measuring and a re-measuring at Godhavn (16, p. 51) and there found a subsidence of 15 cm in the

course of the 26 years, which lay between the two measurings, and this corresponds with a subsidence of 58 cm in a hundred years. Like STEENSTRUP, FRODA made a levelling of the ring bolt on the southern side of the harbour, but as STEENSTRUP generally uses high water as his starting point and FRODA the edge of the sea weed, the results obtained are very different and cannot be directly compared, STEENSTRUP measuring 3.30 m and FRODA 1.20 m to the ring bolt. Further, FRODA has undertaken a measuring with a view to a subsequent re-measuring at Egedesminde. However, both here and at Godhavn FRODA uses the balanus bands as a starting point for his measurings, and he takes it for granted that these bands occur at a definite distance below the average high water level. But as the position of the balani is also conditioned by other factors, i. a. the nature of the substratum (18, p. 43), these bands cannot be used without introducing inaccuracies into the result of the measurings.

In South Greenland GUSTAV HOLM in 1885 undertook measurings of the sea level at Nanortalik. Re-measurings were undertaken by the 7. Thule Expedition, and J. EGEDAL, who has prepared the material (18), arrives at the result that the region at Nanortalik in 1932—33 is 19 cm lower, than it was in 1885, which corresponds with a subsidence of 39 cm in a hundred years. These latter measurings are very accurate, but this cannot, as already mentioned, be said of the measurings from North Greenland. Nevertheless a comparison of these results may be of interest:

Umanak:	subsidence of	1.67 m	in	100	years
Ritenbenk:	—	1.17 m	-	—	—
Jakobshavn:	—	1.17 m	-	—	—
Godhavn:	—	0.58 m	-	—	—
Nanortalik:	—	0.39 m	-	—	—

It appears that the subsidence is greatest in North Greenland. When considering the short distance between Ritenbenk and Jakobshavn it is worthy of note that the subsidence computed is equally great at these two localities, which may naturally be due to chance. The result from Godhavn does not fit into the picture of a gradual decrease of the subsidence from north to south, but the divergence may be caused by the inaccuracy of the result. However, it must be borne in mind that there is nothing to prevent the view that Disko does not follow the subsidence of the main land. The exact extent of the subsidence can only be fixed by a series of coast measurings along the whole of the coast of Greenland, and according to BØGVAD (10, p. 30) such measurings were commenced by the Kryolith Mine- og Handelsselskabet Ltd. at Ivigtût in 1937—38. When due regard is paid to the greater thickness of the sea ice in North Greenland, it will undoubtedly be possible to use the method

described by GABEL JØRGENSEN (18, pp. 14 et seq.) for the determination of the daily tidal oscillation and the fixing of the mean water level. If, further, the latter is determined in relation to a control point inland, it will undoubtedly be possible to prove the subsidence in the course of comparatively few years.

In the preceding the expression the rise of the land has everywhere been used. However, the changes of levels are partly the results of isostatic and partly of eustatic factors. Whereas it should be taken for granted that the level of the sea must be the same, at any rate within such a small area, as we are dealing with here and in the following, the motion taking place in the earth's crust is not equally strong everywhere. When, as mentioned above, terraces are found in many localities at 10 m above sea level, this undoubtedly means that the change, which has taken place in the shore line, is exclusively due to the agency of the sea. If, on the other hand, it can be established that corresponding terraces are more elevated in the north than in the south, then it means that isostatic forces also there played their part. As far as the glaciated areas are concerned, the isostatic factor is of the greatest importance near the centre of glaciation. In Greenland the centre of glaciation is situated in the north, and so the agency of the isostatic forces will be stronger there than in South Greenland, which it is true is glaciated, but where the weight of the ice per unity of surface will be considerably less, owing to the presumably smaller thickness of the ice sheet.

THE DEVELOPMENT AFTER THE GLACIAL AGE

It appears from STEENSTRUP's lists of fossils (81, p. 235) that different faunas may be found in the raised beds, but as the recent fauna in the Umanak Fjord was then insufficiently known, he could not draw any conclusions as to possible changes of temperature. Since STEENSTRUP nothing has been published as to this subject on the strength of investigations made in the Umanak Fjord.

Various investigators have undertaken researches south of the Vaigat and have dealt with the problem. Based upon investigations of terraces and glaciological researches along the coasts of Disko Bugt and the Egedesminde district, PJETURSSON arrives at the following result (65, p. 340): "In a, geologically speaking, very near past the climate of Greenland has been somewhat milder, than it is at present, and in consequence the ice has receded somewhat."

Later on AD. S. JENSEN (27, p. 297) set forth the following statement, based upon the molluscs collected in the course of time by various travellers, particularly in the area around Disko Bugt: "In West Greenland in three localities situated rather distant from one another (65°50′, 66°45′ and 68°37,5′) we are now acquainted with raised beaches containing a mollusc-fauna in which a few species suggest a more genial marine climate than the present. I do not believe this period to be very far back." The three molluscs to which AD. S. JENSEN attaches a certain weight are *Cyprina islandica* L., *Anomia squamula* L. and *Zirphaea crispata* L. The latter form has been found at Orpigsôq (Orpigssuit) by ENGELL, who calls attention to the find and its importance (15, p. 90); however, the information given by him originates from AD. S. JENSEN (27, p. 305).

In 1906 AD. S. JENSEN, together with P. HARDER, undertook an investigation of the area round Disko Bugt, and as the result of the molluscs found the following facts were established (28, p. 404):

"With regard, firstly, to the oldest of the marine layers (horizon B), the few fossils found therein point to a period of formation, in which the climate has not been high-arctic but rather resembled somewhat that

of the present time. — In the next layers of clay (horizon C and D), the gradual change of the fauna indicates that the climate has gradually become colder until high-arctic (*Yoldia*), and it is interesting to notice, that both the fauna and the petrographic nature of the layers show that a considerable submergence has occurred.—The fauna in the following layers (horizon E) shows, that these have been laid down under conditions similar to those which now prevail in the sublittoral region of these parts, or, in other words, we may imagine these layers to have been formed at a time when the land had again been raised to a height of about 50 m below the present level, and the climate had become almost as at present.—Lastly, the occurrence of the boreal forms *Zirphaea* and *Anomia* in the strand-gravel (horizon F) shows, that the temperature has thereafter risen higher during the further raising of the land, so that there has been a temperature maximum at a time, when the sea stood only about 10 m higher than at present." This temperature maximum is succeeded by a decrease in temperature, so that the present conditions are attained.

Later on Ad. S. Jensen has shown that a few localities at Nordre and Søndre Strømfjord fit into the above-mentioned stratigraphy (33).

As to climatic conditions in Greenland during the Tertiary period, it is known that they were considerably better than at present. At the end of this period, however, the temperature falls, and gradually the Inland Ice is being formed. It must, however, be borne in mind that the present thickness of the ice cover in the latitudes comprising the part of the marginal area, which is dealt with here, has been measured up to 500—1000 m, whereas in the central parts it is hardly 2 km; at any rate it has not been less, when the ice reached its greatest extent. As will be mentioned in the subsequent chapter the glaciers have projected far into the fjords of those days, so that possible deposits, formed before the glacial period and during its beginning, have been removed. Deposits from interglacial periods and evidence of an ice cover, diminished in extent during the same period, have not with certainty been proved in Greenland. But towards the end of the last glacial epoch the fronts of the glaciers recede, and the fjords open up. At this period the level of the Nûgssuaq peninsula must have been at least 230 m lower than at present (p. 98). The climate must have been pronouncedly high-arctic, as appears from the fauna from Vibekes Elv at an altitude of 190 m. The beds in this locality have been deposited in connection with the upper marine limit, and the fauna is characterized by *Pecten groenlandicus* Sow. *var. major* Collin. Also the clay bed at an altitude of 200 m near Lillebæk must have been deposited at this period, although exclusively high-arctic mollusc forms have not been found there. This

supposition is justified by the position of the bed and its altitude above sea level, as compared with the bed at Vibekes Elv.

After the deposition of these layers the country rises gradually, until the coast line is about 160—170 m higher than the present sea level. At this period distinct benches are formed within the interval of altitudes in question, which proves that the upheaval of the country and the rise of the sea level must have counterbalanced each other for some time. At the same time an improvement of the climate must have taken place, causing new large water masses to be carried out to the sea through the rivers, this development being further emphasized by

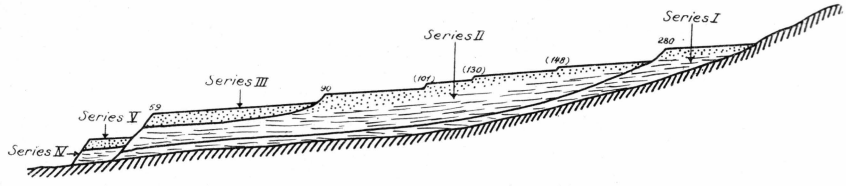

Fig. 23. Schematic section through the marine, alluvial beds at the north coast of the Nûgssuaq peninsula.

Series I. High-arctic beds characterized by *Pecten groenlandicus var. major.*
Series II. Arctic beds.
Series III. Boreo-arctic beds characterized by *Mytilus edulis* and *Balanus hammeri.*
Series IV. High-arctic beds characterized by *Pecten groenlandicus var. major* (and in the Svartenhuk peninsula by *Portlandia arctica*).
Series V. Arctic beds.

the presence of the deltas at Pátorfik and Qaersuarssuk kitdleq in connection with the level of 160—170 m.

This condition has, however, again been replaced by a relative rise of the country, interrupted by short periods of balance, which have left their marks in the faintly developed terraces between 148 and 155 m.

At Pátorfik, between the altitudes of 91 and 130 m, there are farther a number of well-developed terraces, which mark new periods of balance, the cause of which must be looked for in a new rise of temperature and the influx into the sea of the increased water masses. The improvements of the climate, which have caused the changes of levels described above, are also reflected in the beds deposited from the time, when the coast line was set approximately at 160—170 m, until it was about 91 m higher than at present. The corresponding beds crop out in the lowermost beds of the Pátorfik cliff, in Elvskrænten and Kløft II. The beds are characterized by the contents of *Leda pernula*, *Astarte borealis*, *Astarte elliptica*, *Cardium ciliatum*, *Serripes groenlandicum*, *Macoma calcarea*, *Panopaea norvegica*, *Mya truncata* and *Saxicava arctica*, which are all typical arctic species. An exception is perhaps *Panopaea norvegica*, of

which Ad. S. Jensen writes (33, p. 28): "If conclusions should be drawn only from the places in which *P. norvegica* has been found to occur alive—from northern Norway and southern Iceland to the North Sea and the Sound—it should be regarded as a boreal form, and its occurrence in Greenland then derives from a warmer period than the present. But as *P. norvegica* lives buried in the bottom and therefore is difficult to take with the dredge, the possibility exists that it may be found alive in arctic seas, from which only its empty shells are now known." However, the faunistic association, in which *P. norvegica* is found at Pátorfik, does not point towards *P. norvegica* being a boreal form, but rather boreo-arctic or perhaps even arctic. It is therefore probable that the fact of its lying "buried in the bottom", is the reason why it has not until now been found alive in the arctic seas.

When the increased influx of water has again ceased, the rise of the land once more gets the upper hand, until the coast line is at an altitude of about 75 m above the present level of the sea. At this period a new rise of temperature again causes an increased influx of water or also a decreased upheaval of the land, so that there is a state of balance. This must have lasted for a comparatively long period, which appears from the strongly developed benches and the thickness of the deposits connected with the terraces from this period, viz. the sand beds in Kløft II, Kløft III and Mellemkløft. The improvement of the climate also distinctly appears from the shells to be found in the beds. The beds are characterized by the presence of the species *Mytilus edulis* and *Balanus hammeri*. It will generally be rather bold to draw any conclusions as to temperatures and climatic conditions from the occurrence of *Mytilus edulis*, but conditions being as they are in the localities in question, it is justifiable, as *Mytilus edulis* has not been found in beds older than the clay beds at altitudes of 24—30 m, which are arctic and deposited in continuation of the arctic period. Thus *Mytilus edulis* has immigrated at a time, when the climate had become milder, and this supposition is supported by the presence of *Balanus hammeri*, which is characteristic of a climate somewhat milder than the arctic one. According to Stephensen (86, p. 423; 85, p. 71; 87, p. 121) *Balanus hammeri* has only been taken once in Greenland, viz. in Nordre Strømfjord (67°40′ lat. N., 53° long. W.), and so the climate must at that time have been somewhat milder than it is at present in the Umanak Fjord.

After this lengthy state of balance the land again rises. New relative interruptions occur in the upheaval of the land, as appears from the summary of the terraces (p. 97) at several levels, one of these being of special interest, viz. the one marked by the bench at 40 m above sea level. Based upon all the measurings of terraces undertaken in Greenland until 1933, Vogt (96) has made an attempt to establish the connection

between the change of levels in Greenland and Scandinavia. VOGT is, however, only interested in the lower lying terraces, having concentrated on determining the so-called e-line in Greenland, which should correspond with the *Tapes*-line in Scandinavia. According to his calculations the e-line at Pátorfik is situated at about 35 m above sea level. The *Tapes* period is comparatively warm and moist, and owing to the renewed influx of water into the sea, there would be a state of balance like the one prevailing at present. However, attention must be called to the fact that the deposits in Sydost Bugt, upon which VOGT i. a. builds his suppositions, and which show a climate somewhat warmer than the present one, are situated at an altitude of about 30 m above sea level, whereas the beds in the Umanak Fjord with which, judging by climatic evidence, the beds of the Sydost Bugt should be compared, are to be found at an altitude of about 60 m. There is, however, the possibility that the altitude of the beds in Sydost Bugt has been put too low, as it seems only to be roughly estimated. On the other hand, the upheaval on the Nûgssuaq peninsula must has been less than at Sydost Bugt, because the peninsula is farther away from the centre of glaciation. Upon the whole it seems difficult to harmonize conditions in the Umanak Fjord with VOGT's calculations, which in the opinion of the present author rest upon too slender a foundation, particularly as far as northern West Greenland is concerned (cf. 96, pp. 22 et seq.).

A longer state of balance has again been established, when the coast line was about 15 m above the present level of the sea. It is characteristic of this period that extensive terraces occur with benches at some 10 m above sea level, and this state of balance is again replaced by an upheaval of the land. The extent of this upheaval cannot be given, but it has as described above been succeeded by a subsidence at the present time. The beds, which have been deposited in connection with the formation of the lowest terraces, show a colder climate, as appears from the lowermost clay bed at Qaersuarssuk kitdleq, which is characterized by the presence of *Pecten groenlandicus*. It is hardly probable that the clay bed dates from the high-arctic period in connection with an upper marine limit, for in that case the bed should be deposited at a depth of at least 225 m. Most of the species found in the bed do not normally occur at such depths, and species like *Pecten islandicus*, *Astarte montagui var. striata* and *Serripes groenlandicum* have, as far as can be seen, not been taken in Greenland at depths exceeding 100 m. *Saxicava arctica* has been taken a few times at depths as low as a couple of hundred metres, but it generally occurs in shallow water. The occurrence of *Pecten islandicus* is at variance with the supposition that the bed is high-arctic. However, the species is absent in the succeeding beds, which might point towards its being extinct in this locality, so that its appearance in the lowermost

bed occurs a short time before it is driven away by the cold. The high-arctic *Portlandia*-horizon at Kugssineq on the Svartenhuk peninsula has most probably been deposited within the same period as the bed of clay at Qaersuarssuk kitdleq.

The sand bed succeeding the clay bed at Qaersuarssuk kitdleq shows a rise in temperature synchronising with the upheaval of the land. For the fauna at 5.5 m and 10—10.5 m is arctic and contains species, which also at the present time are found in the Umanak Fjord. It is a likely supposition that the low-lying sand and clay beds, which are to be found in the coast cliff between Pátorfik and Sarfarfik, are contemporaneous with the beds at Qaersuarssuk kitdleq, but it cannot be decided with certainty, whether the layers are to be connected with the high-arctic or arctic horizon. None of the fossils point decidedly in the direction of high-arctic conditions, but all the species found live both under high-arctic and arctic conditions.

The fauna found at Qardloq on the south coast of the Nûgssuaq peninsula was situated at a very low level, viz. 3 m above the level of the sea. It could not be decided, whether the shells were recent or subfossil. If subfossil they must, however, have been deposited at a very late period, when climatic conditions were as they are at present, seeing that the species found all live in the Vaigat at the present time.

The fauna from Asuk on the northern coast of the island of Disko is probably arctic, and the position of the layers at an altitude of 150 m above sea level seems to suggest that it is here a question of the arctic period, which succeeds the high-arctic one in connection with the upper marine limit.

The species found at Stordal on the island of Disko have been deposited under high-arctic conditions, as appears from the presence of *Portlandia arctica*. As the shells have been found in dislocated strata, it is not possible, without further investigations, to connect this locality with others.

When comparing the results obtained by Ad. S. Jensen and P. Harder in Disko Bugt (28, p. 405) it appears that the high-arctic beds deposited in connection with the upper marine limit on the Nûgssuaq peninsula correspond with horizon A at Sydost Bugt; the beds at Pátorfik (the Pátorfik cliff and Elvskrænten), Kløft II, Mellemkløft and Kløft III correspond with the arctic horizons B and C at Orpigsôq (Orpigssuit) and Sydost Bugt. The clay beds at Qaersuarssuk kitdleq and in the Kugssineq cliff on Svartenhuk are contemporaneous with horizon D, which is high-arctic, whereas the sand beds at Qaersuarssuk kitdleq correspond with the arctic horizon E at Orpigsôq (Orpigssuit).

Beds corresponding with those at Orpigsôq (Orpigssuit), which show the maximum temperature characterized by *Zirphaea crispata* (horizon F)

have not been found at the Umanak Fjord. At Orpigsôq (Orpigssuit) these beds extend up to a height of 10 m above sea level—rather an insignificant height—so it is possible that they have not been raised above the level of the sea within the area investigated on Nûgssuaq. In the opinion of the author the possibility should be taken into account that temperature conditions in the Umanak Fjord have not been so favorable during the Quaternary period that *Zirphaea crispata* and *Anomia squamula* have been able to live there. The Nûgssuaq peninsula forms a boundary between the northern and southern parts of the area, which it is difficult for the species to pass. The mollusc larva are pelagic and can only be distributed through oceanic currents, but the latter are, at any rate in recent years, forced westwards into the Davis Strait (40), and only a very small part of them reach as far as north of Disko. This naturally does not prevent the distribution of the species, but it makes it more difficult.

J. HARLEN BRETZ who has made detailed investigations of the elevated shore lines in the Franz Joseph Fjord district in East Greenland prefers the conclusion that East Greenland has risen *pari passu* (as he writes) with the waning of the ice. BRETZ has, however, in several places (7, pp. 163 et seq.) observed the erosion of the sea in raised deltas, prominent shore lines etc. Further, BRETZ has put together a table (7, table 1, p. 226) of the elevated shore features between Trail Island and Wollaston Foreland below 350 feet (about 100 m) above sea level. Although there are at least two levels, where a fairly great number of features are observed (viz. a number of 17 and 12), BRETZ does not think it possible to correlate the latter, neither does he find a suggestion of a deformation during the uplift. It seems to the present author that it is not possible to establish, merely on the strength of what has been stated above (7, p. 220) "that the uplift has been essentially continuous, and that no evidence yet collected points to any deformation during uplift".

Author phot. $^{2}/_{9}$ 1939.

Fig. 24. Delta of the Kûgssuaq River. In the background to the right the island Hareøen.

APPENDIX

The greater rivers traverse large distances, cut into old fluviatile material, which is also an evidence of the level of the land having been lower in former times. Thus Kûgssuaq, which debouches at Marrait on the west coast of the Nûgssuaq peninsula, and Usuit kûat on Svartenhuk ran in such deeply excavated valleys. The distance between the terrace planes varies from 2—3 m to some ten metres.

In the Auvfarssuaq Valley, which is traversed by the said Kûgssuaq, one of the largest rivers of Greenland, there were thus fairly large terraces. An investigation was undertaken in a locality situated about 1 km into the valley, reckoned from the top point of the present delta of the river (fig. 24). The altitude of the terrace plane in this place was 40 m above the present river bed, which corresponds with a little less than 70 m above sea level. In this locality the terrace was intersected by a tributary river, so that an opportunity presented itself of observing the stratification (fig. 25). Lowest down there was fat clay, free from stones, succeeded by arenaceous clay which farther up passed into coarser and coarser sand. The terrace was covered with stones of the size of hens'

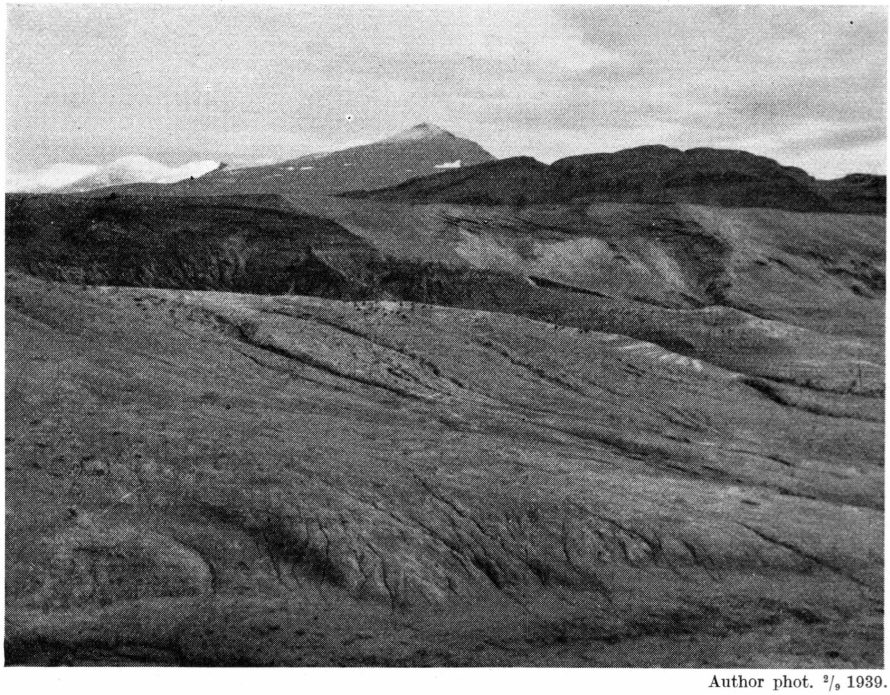

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Fig. 25. Section through the terraces in the Auvfarssuaq Valley. In the foreground clay without stones, which farther back is succeeded by cross-bedded sand. In the background the mountain Qáqarssuaq (1235 m).

eggs. In the sand section an extremely distinct cross-bedding was observed, and in the clay there were a number of concretions which, however, did not contain fossils. The clay must, however, be regarded as marine. In this area, when seen from the mountain side, it was possible to distinguish a delta cone of a considerable extent, and the structural conditions in the sandy surface deposits do not contradict the view taken of the beds as delta formations. The top point of the old delta cone is situated 1 km farther into Auvfarssuaq than the locality mentioned above, and marked by a fairly large assortment of blocks.

The deposition of such a colossal delta system must necessarily be a rather lengthy process, and it can therefore be established, either that the epirogenetic motion of the land has been suspended for some length of time, or also that the motion of the surface of the sea and the land have counter-balanced each other at a time, when the altitude of the coast line was about 70 m higher than at present. This agrees with the conditions found as regards the marine terraces on the north coast of Nûgssuaq, where the very largest deltas have been connected with the coast line at an altitude of 70 m.

In all the great valleys outstanding terraces were observed.

Rather large fluviatile deposits were also found at Kûk on the north coast of the Nûgssuaq peninsula. At the debouch of the river four terraces in all had been formed, consisting of fluviatile deposits, viz. farthest down clay with a few blocks and sand beds, succeeded by sand which, however, at the hind edge of the terrace passed into gravel and stones. Formations of a similar kind were found in several localities at the mouths of rivers.

Another area, in which it has been possible to identify large deposits, was Qaersuarssuk kitdleq. As appears from the sketch (fig. 26) a rather

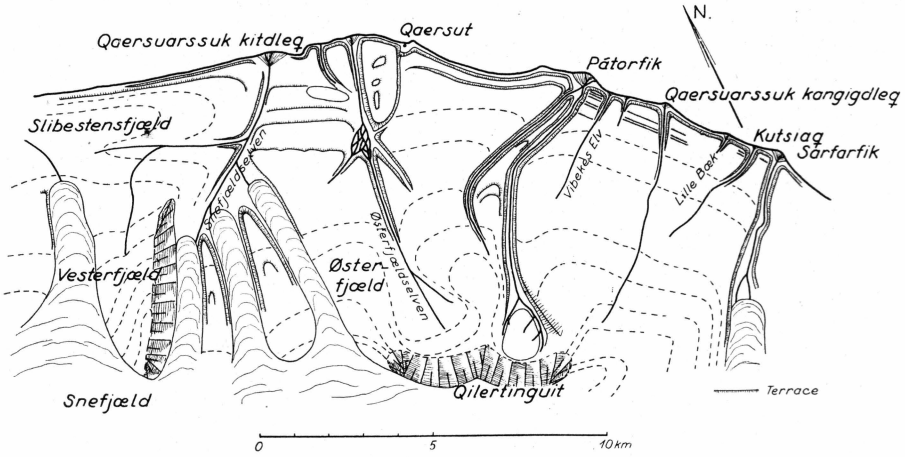


Fig. 26. Sketch map of the Qaerssuarssuk kitdleq — Sarfarfik area.

large river takes its rise from the Snefjæld-Vesterfjæld-Slibesten area towards west, and a somewhat smaller one from Østerfjæld, which is the westerly outcrop from Qilertínguit. Between these two rivers the country is covered, partly by marine, partly by fluviatile deposits. About midway between these two rivers there is a formation resembling a drumlin, about 1 km long, the rather even surface of which reaches a height of 89.5 m above sea level. Heim describes it as a moraine, which description is not quite correct, as it does not contain morainic material and also rests upon alluvial shell-bearing beds. The formation must be regarded as an erosion relic of an old river deposit. The eastern river has formerly had an entirely different course from its present one, the main course originating from the middle part of the Qilertínguit-massif and continueing towards the area between the present course and Snefjældselven (fig. 26). At that time the level of the country was some 70—80 m lower than at present. In front of the barrier there is a very large delta (fig. 26), but as far as can be seen, it is not the Østerfjældselv alone, which has formed this huge deposit, to which Snefjældselv has contributed largely. It appears from the picture (fig. 27) that the old

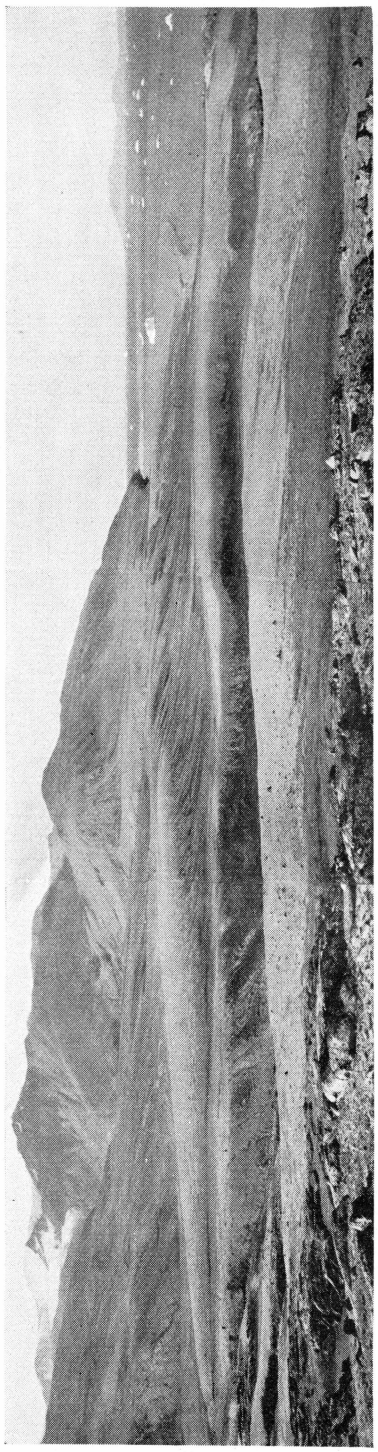
delta stands out rather distinctly within the area, and that it is connected with the marine terrace at 85 m above sea level.

At the present time Østerfjældselv debouches about 1 km east of the old outlet, and in the place where the new river bed traverses the old one, there is a well developed alluvial cone.

The moraines play a rather subordinate part within the area investigated. It must be regarded as excluded that, apart from the glaciers projecting towards the coast, there has been any glaciation of the country in the lower levels after the deposition of the marine Quaternary beds, for if so, it should be possible to trace it in the latter which, however, is not the case. The Nûgssuaq peninsula has undoubtedly at one time been completely covered by the Inland Ice, but as at Svartenhuk the ice has only in spots caused thicker deposits to be formed. Evidence of such a glaciation must be looked for in moraines, glacial striae and boulders. In the coast regions, which have been below sea level, the moraine deposits have either been washed away or re-deposited. Above the upper marine boundary the moraine cover is very thin, and there are hardly any glacial striae, the presence of such only having been identified at Ikorfat by STEENSTRUP, where their direction suggests a motion of the ice from the Inland Ice towards the outer coast. On the coast stretch between Qaersuarssuk kangigdleq and Sarfarfik there were a number of small marble blocks, probably originating from the Tunulia massif. They must be supposed to have been carried from there to the coast by the Sarfarfik glacier and thence farther west by ice or coast currents.

Thus the moraine cover from the big glaciation is thin on the mountain slopes, whereas this is not the case on the plateaux as e. g. Qáqap qárssua. The material, which is now to be found on the surface of the slopes, is undoubtedly a mixture of moraine and disintegration matters. Moraine materials in large quantities are further found in connection with the valley regions at the end of the glaciers shooting down from the mountains. In several localities e. g. at Sarfarfik, in the Snefjæld area and Umîviup qáqai on the Svartenhuk peninsula, it might however be established that the glaciers were receding, which i. a. appears from a comparison of former maps (20, p. 225, plate 9) with those of the Geodetic Institute. Very large terminal moraines were observed at the Sarfarfik glacier (fig. 28).

In the basin high up below the steep wall of Qilertínguit there was further a very large dead glacier, extending for some distance into the Pátorfik valley, though not farther than up to 950 m above sea level. It is from this "dead glacier" that the river derives the greater part of its water masses. At Kûk anernilik a very large dead glacier, covered by moraine matter and bordered by large marginal moraines, projects



Author phot. 10/7 1939.

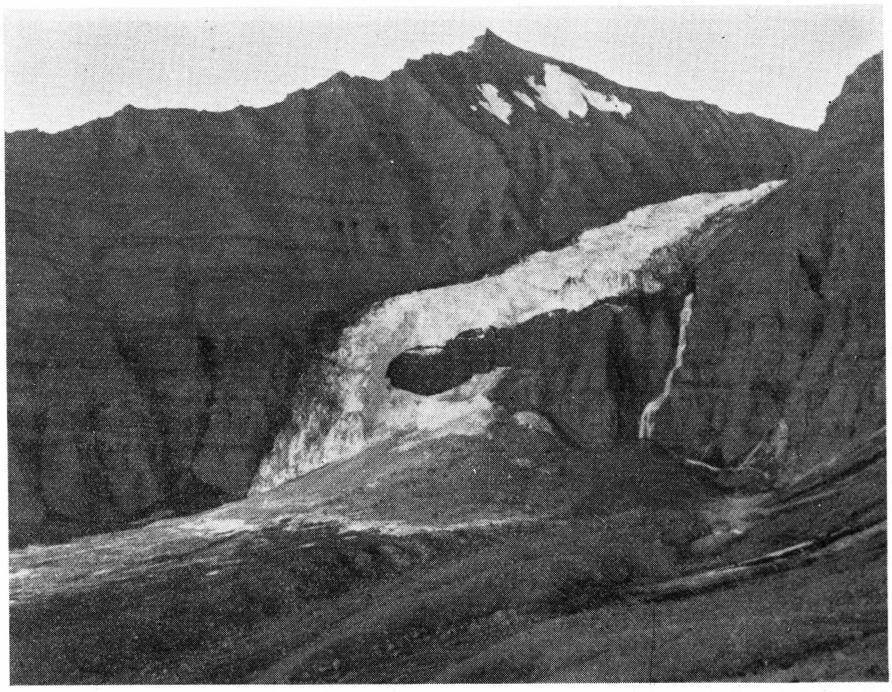
Fig. 27. View of the area west of Qaersuarssuk kitdleq. In the fore- and middle-ground the large terrace and the old and new deltas of the river Snefjældselv. In the background from the right the mountains Slibestensfjæld (741 m), Vesterfjæld (1615 m) and Snefjæld (2092 m). Farthest to the right Ubekendt Ejland.

Author phot. $^{30}/_{6}$ 1939.

Fig. 28. The Sarfarfik glacier. The front part of the glacier tongue greatly melted and covered by moraine.

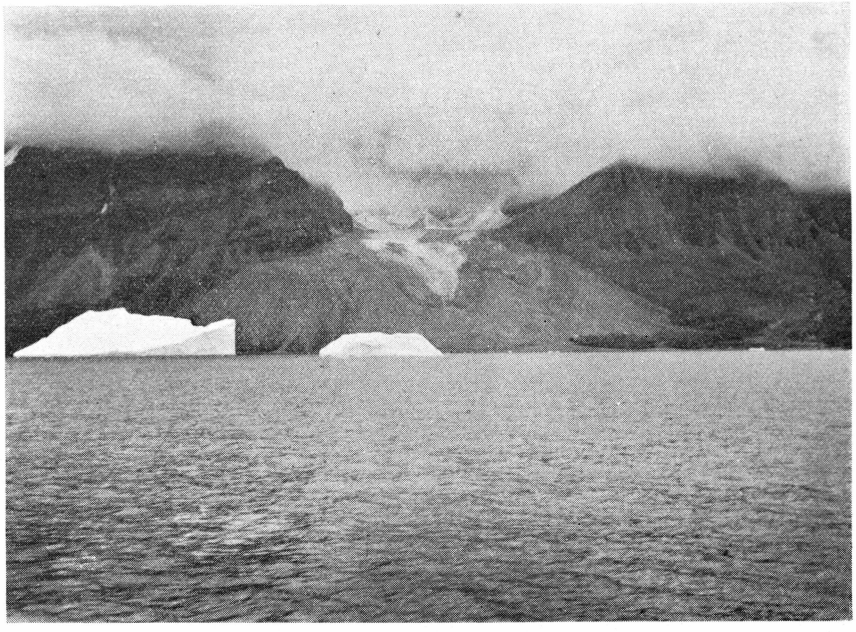
A. ROSENKRANTZ phot. $^{5}/_{7}$ 1939.

Fig. 29 The dead glacier at Kùk anernilik extends almost down to the coast in continuation of the active glacier tongue in the background.



Author phot. $^{19}/_{7}$ 1939.

Fig. 30. The Saviarqat glacier. In the background the glacier is seen sliding over the steep slope and continueing as a reconstructed glacier. In the foreground the dead glacier covered by moraine.



Author phot. $^{16}/_{8}$ 1939.

Fig. 31. Receding glacier on the Qîoqe peninsula. The large terminal moraine, which extends right down into the Inukavsait sound, shows that the glacier in former time has reached the coast.

towards the coast, which it nearly reaches (fig. 29), and at the Saviarqat there is another large "dead glacier" (fig. 30).

In the area between Saviarqat and Kangilia at an altitude of 650 m above sea level, there were very large moraine barriers, which practically only consisted of basaltic material. These moraines originate from glaciers projecting from the mountain range Kingigtup kangilia (fig. 32).

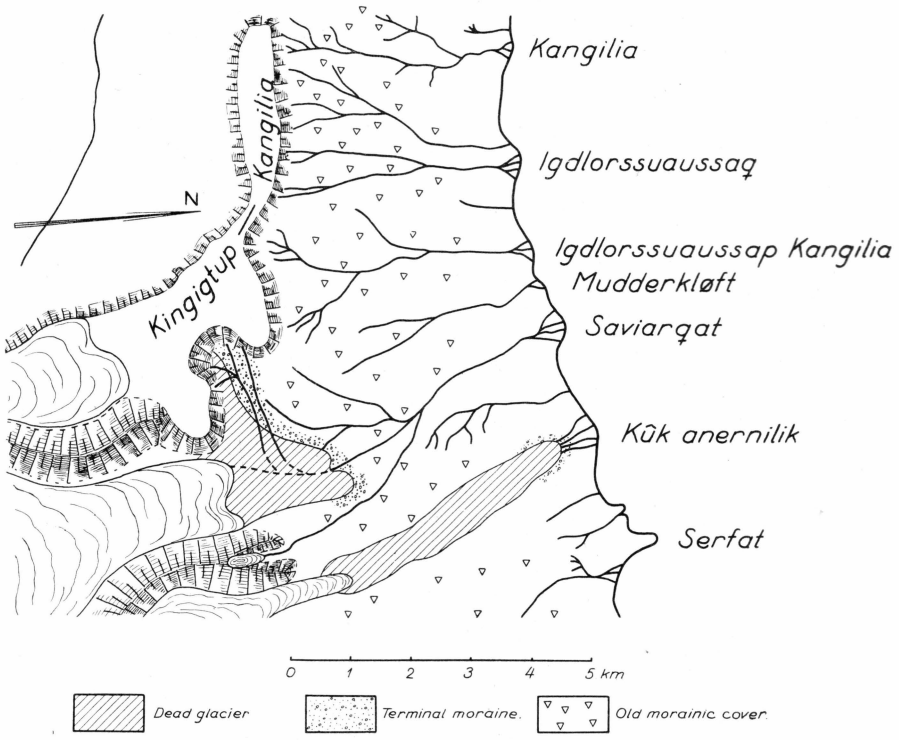


Fig. 32. Sketch map of the area between Serfat and Kangilia on the northern coast of the Nûgssuaq peninsula.

These two projections of local glaciers described above suggest a fall of temperature, which must have taken place at a rather late period, as the "dead glacier" at Kûk anernilik must otherwise have been completely melted away. Fluctuations of temperature from the old Norsemen's time has been identified by NØRLUND (60). Recent fluctuations of climate and their influence on geophysical and biological conditions have been thoroughly dealt with by AD. S. JENSEN (32). A survey of the changes of temperature in West Greenland in recent time has been given by LYSGAARD (48).

It may be established that the glaciers, which nowadays come down from the Inland Ice, in former times had a much greater extent, as is

shown by the glacial striae at Ikorfat. It is therefore also a likely supposition that there has been a large glacier extending from the Inland Ice through the Auvfarssuaq valley towards west; the material at the bottom of the valley is fluviatile, probably intermixed with a re-deposited moraine, whereas the slopes of the valley are covered by a thin moraine layer.

Observations showing the former large extent of the Inland Ice have also been made on the island of Qeqertarssuaq at the mouth of Karrats Isfjord. On the southern side of the island the outpost Nûgátsiaq is situated, and below the dwelling place a cliff facing the harbour. The cliff consists of a moraine clay deposited on gneiss, on which there are distinct glacial striae running in a west-south-westerly direction. These glacial striae show a motion in the ice, which can only be explained in the manner that the Umiámáko glacier between Akuliarusínguaq and Umiámákut Nunât has formerly projected through the northern part of Karrats Isfjord, across the southern part of Qeqertarssuaq, possibly being connected with Rinks Isbræ. In a former article (74) the author has already rendered an account of conditions on Svartenhuk, and observations made by Steenstrup in the fjords forming the eastern and western limits of Svartenhuk also point towards a much larger extent of the glaciers in former times.

However, there are various literary records (16, pp. 39 et seq.; 10, pp. 31 et seq.; 32, p. 64; 42, p. 193) to the effect that similar conditions have prevailed along the entire coast area, and from these it appears that Greenland at the present time finds itself in a comparatively mild period, and that at the same time a subsidence of the land apparently takes place in all its coast areas.

Postscript.

The shells collected by A. Rosenkrantz at Sermermiut, 2.5 km south of Jakobshavn (see p. 99), which for some time have been mislaid, comprise the following species taken in arenaceous clay at 1 m above sea level: *Portlandia arctica* (Gray) and *Macoma calcarea* (Chemn.). Thus the strata have been deposited under high-arctic conditions and belong to the second, alluvial, high-arctic period.

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Færdig fra Trykkeriet den 23. December 1944.

PLATES

Plate 1.

Section in the coast cliff between Pátorfik and Sarfarfik on the northern coast of the Nûgssuaq peninsula.

Explanation of signatures:

Gneiss.

Lacustrine sandstone. Cretaceous.

Marine clay, alluvial.

Marine sand, alluvial.

Stratified marine clay and sand, alluvial.

Sand and gravel, alluvial.

Old delta deposits

Recent delta.

Scree covered with vegetation.

F = Fault.

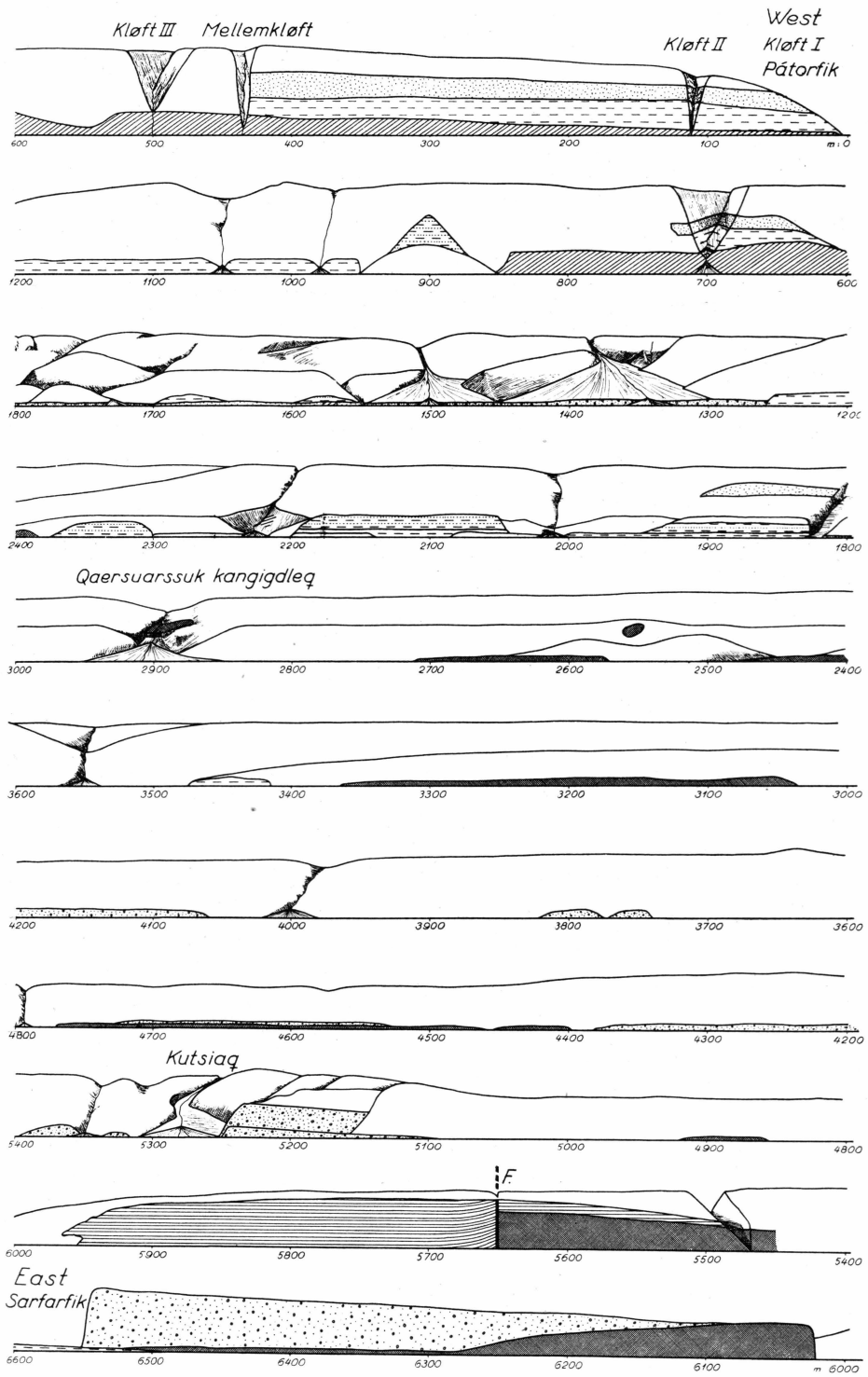
Kløft III
Mellemkløft
Kløft II
West
Kløft I
Pátorfik
600
500
400
300
200
100
m: 0
1200
1100
1000
900
800
700
1800
1700
1600
1500
1400
1300
2400
2300
2200
2100
2000
1900
1800
Qaersuarssuk kangigdleq
3000
2900
2800
2700
2600
2500
2400
3600
3500
3400
3300
3200
3100
3000
4200
4100
4000
3900
3800
3700
3600
4800
4700
4600
4500
4400
4300
4200
Kutsiaq
5400
5300
5200
5100
5000
4900
4800
F
6000
5900
5800
5700
5600
5500
5400
East
Sarfarfik
6600
6500
6400
6300
6200
6100
m 6000

Plate 2 a.

List of the Brachiopoda and Pelecypoda found in Northern West Greenland, with indications of the finding places.

Abbreviations: A Ey = Arveprindsens Ejland, Ritenbenk district. Ag = Agto, Egedesminde district. Al = Alángorssuaq, Egedesminde district. Au = Aumat, Egedesminde district. E = Erqigtoq, Diskofjord, Godhavn district. Eg = Egedesminde Island, Egedesminde district. If = Ikorfat, Umanak district. Ig = Igíniarfik, Egedesminde district. Ik = Igíniarfik, Diskofjord, Godhavn district. K = Kugssineq, Svartenhuk, Umanak district. L = Lerbugten, Claushavn, Christianshaab district. N = Northern side of Nordfjord, Disko, Godhavn district. Ne = Nagsugtôq Elven (river), Nordre Strømfjord, Egedesminde district. Nq = Niaqornaq, Jakobshavn district. Ns = Nordre Strømfjord, Egedesminde district. O = Orpigsôq, Christianshaab district. P = Pátorfik, Umanak district. Q = Qaigissat, Disko, Godhavn district. S = Southern side of Nordfjord, Disko, Godhavn district. Sa = Sarpiussat, Christianshaab district. Si = Simiutarssuaq, Egedesminde district. T = Tinuteqassâq, Egedesminde district. Ts = Tasiussarssuaq, Christianshaab district. U = Ungôrsivik, Diskofjord, Godhavn district.

List of the Brachiopoda and Pelecypoda found in Northern West Greenland, with indications of the finding places.

	1. Coast cliff. Kugssineq. Clay	2. Coast cliff. Kugssineq. Sand	3. The Kugssineq valley	4. The Pâtorfik cliff 24 m	5. The Pâtorfik cliff 39 m	6. The Pâtorfik cliff 42 m	7. The Pâtorfik cliff 50 m	8. The Pâtorfik cliff. Loose lying	9. Elvskrænten, Pâtorfik 25—30 m	10. Kloft II 5,5—32,5 m	11. Kloft II 32,5—42,5 m	12. Mellemkloft. Consolidated bed	13. Mellemkloft. Sand bed	14. Kloft III 60 m	15. 1650 m east of Pâtorfik 3 m	16. 1850 m east of Pâtorfik 5 m	17. 1900 m east of Pâtorfik 30 m	18. 2050 m east of Pâtorfik 5 m	19. Kûgtsiaq 40 m	20. Sarfarfik 30 m	21. Vibekes Elv 190 m	22. Lillebaik 200 m	23. Qaersuarssuk kitdleq. Loose lying	24. Qaersuarssuk kitdleq. East. Loose lying	25. Qaersuarssuk kitdleq 4 m	26. Qaersuarssuk kitdleq 5.5 m	27. Qaersuarssuk kitdleq 10 m	28. Qaersuarssuk kitdleq 10.5 m	29. Tupersuaut 20 m	30. Qardloq 3 m	31. Asuk 150 m	32. Asuk 474 m	I. Stordal, Disko	II. Giesseckes So. Clay bed. Lower part	III. Giesseckes So. Clay bed. Upper part	IV. Giesseckes So. Shell bank. Upper part	V. Giesseckes So. The big shell bank	VI. Giesseckes So. Shell bank on the opposite shore	VII. Giesseckes So	VIII. Igfiarfik	Giesecke 1806—12	Rink 1848—51	Krauup Smith 1869	Nordenskiöld 1870	Steenstrup 1871—98	Boye 1872	Pfaff 1874	Helland 1875	Kornerup 1879	Søren Hansen 1888	Hartz 1890	Pjetursson 1897	White & Schuchert 1898	Engell 1902	Jensen & Harder 1906	Dendixen 1916
Brachiopoda.																																																			
Hemithyris psittacea (Gmel.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	..	.	..	..	.	..	.	.	.	..	.	.	..	.
Lamellibranchiata.																																																			
Nucula tenuis (Mont.) *var. expansa* Reeve	.	.	.	.	.	.	.	.	×	.	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	P	..	P, Ik, Nq	.	P	.	..	.	O	..	.	O	.
Leda pernula (Müll.)	.	.	.	.	×	×	.	.	×	.	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	P	P	P, Sa	P, Ik	.	P	.	..	.	O	..	.	O	.
Leda minuta (Müll.)	.	.	.	.	.	.	.	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	P	..	P	.	..	.	..	.	.	..	.	..	.
Yoldia hyperborea Lovén	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	Sa, L	..	.	..	.	..	.	.	..	.	..	.
Portlandia arctica (Gray)	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	Sa, L	Ik, Nq, L	.	L	L	..	.	O	..	.	O, Sa	Ns
Portlandia lenticula (Møll.)	.	.	.	.	.	.	.	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	..	.	..	.	..	.	.	..	.	..	.
Arca glacialis Gray	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	Nq	.	..	.	..	.	.	..	.	..	.
Anomia squamula L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	..	.	..	..	.	..	.	..	.	.	..	.	O	.
Pecten groenlandicus Sow. *var. major* Collin	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	..	P	..	P	.	..	.	..	.	.	..	.	..	Ns
Pecten islandicus Müll.	.	.	.	.	×	.	×	×	×	×	×	×	.	.	.	×	.	.	×	.	.	×	.	.	.	.	.	.	.	.	×	×	×	×	×	×	.	.	P	P	P	P, S, E, Ik, Q	.	P	.	Ne	If	.	Eg, T, Au, Ig, Al, Ag, Si	P	.	O	.
Lima subauriculata Mont.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	..	.	..	..	.	..	.	..	.	.	Ig, Al	.	..	.
Crenella decussata (Mont.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	..	.	..	..	.	..	.	..	.	.	Ig	.	..	.
Mytilus edulis L.	.	.	.	.	.	.	.	×	.	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	×	.	×	P	.	P	P	.	..	L	..	.	.	Eg, Au, Ag	.	O	O	.
Astarte borealis (Chemn.)	.	.	×	×	×	.	.	×	×	×	×	.	.	.	.	×	×	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	×	.	×	×	P	.	P, Sa	P	.	..	.	..	.	.	..	P	.	..	.
Astarte montagui (Dill.)	×	.	.	.	.	.	.	×	×	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	×	..	.	..	E	.	..	.	..	.	.	Si	.	.	O, Sa	.
Astarte montagui var. striata (Leach) Sars	×	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	×	.	.	.	.	.	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	..	.	..	.	Ne	.	.	..	.	..	.
Astarte montagui var. warhami Hanc.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	×	.	.	.	.	..	.	..	..	.	..	.	..	.	.	..	.	..	.
Astarte sulcata (Da Costa)	.	.	.	.	×	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	..	.	..	.	..	.	.	..	P	..	.
Astarte elliptica (Brown)	×	.	.	×	×	.	.	×	×	×	.	×	.	.	.	.	×	×	.	.	×	.	.	.	×	.	.	×	.	.	.	.	.	.	.	.	.	.	P	.	P, L	P, K, N, S, E	.	L	.	..	.	.	..	P	..	.
Astarte crenata (Gray)	.	.	.	.	.	.	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	..	.	..	.	..	.	.	..	.	..	.
Axinopsis orbiculata G. O. Sars	.	.	.	.	.	.	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	..	.	..	.	..	O	.	..	.	..	.
Thyasira flexuosa (Mont.)	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	Ik	.	..	.	..	O	.	..	.	O	.
Cardium ciliatum Fabr.	.	.	.	×	×	.	.	×	×	×	×	×	×	.	×	×	×	.	.	×	×	×	.	×	×	×	.	.	.	.	.	.	.	.	.	×	.	.	P	P	P, Sa, L	P, N, E, U, L, Ik	P	P	L	Ne	.	O	..	P	O	.
Cardium elegantulum (Beck) Møll.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	P	.	..	..	.	..	.	..	.	.	..	.	..	.
Serripes groenlandicum (Chemn.)	.	.	.	.	×	.	.	×	×	×	×	×	.	.	.	.	.	×	.	×	.	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	P	P	P, Sa, L	P, Ik	.	P	L	..	.	O	..	P	O	.
Macoma baltica (L.) *var. groenlandica* Beck	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	..	.	..	.	..	.	.	Au	.	O	O	.
Macoma calcarea (Chemn.)	×	.	.	.	.	×	×	×	×	×	×	×	×	×	×	×	×	×	.	.	×	×	.	×	×	×	×	×	.	.	.	×	.	×	×	×	×	×	P	P	P, Sa, L	P, K, N, E, U, Nq, L, Ig	.	P, L	L	..	If	O	..	P	O	..	.
Macoma loveni Jap. Ststr.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	..	.	..	.	..	.	.	Au	.	..	.
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Panopaea norvegica (Spgl.)	.	.	.	×	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	P	P	P	P	.	P	.	..	.	.	..	.	..	.
Saxicava arctica (L.)	×	×	×	.	.	×	×	×	×	×	×	×	.	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	P, AEy	P	P, L, Ts	P, K, N, S, Q, E, U, Nq, L, Ik	.	L	L	Ne	If	.	Eg, T, Au, Ag, Al, Si	.	O	O	.
Mya truncata (L.)	×	×	×	×	×	×	×	×	×	.	×	×	×	×	×	×	×	×	.	.	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	P	P	P, Sa, L	P, K, N, S, Q, E, U, Nq, L, Ik	.	P, L	L	Ne	If	O	Eg, T, Ig, Ag, Al	P	.	O	.
Mya truncata forma ovata Ad. S. Jensen	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	×	×	.	.	.	..	.	P, Sa, L	P, L, Ik, Q	.	P, L	L	Ne	.	O	..	.	O	.
Mya truncata forma uddevallensis Hanc.	×	.	.	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	×	×	.	×	.	..	.	..	U, N	.	..	.	..	.	.	Ig, Al	.	..	.
Zirphaea crispata (L.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	..	.	..	.	..	.	.	..	.	O	O	.
Lyonsia arenosa (Møll.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	..	.	Sa	..	.	..	.	..	.	.	..	.	..	.
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Plate 2 b.

List of the Gastropoda, Cirripedia, Ophiuroidea and Echinoidea found in Northern West Greenland, with indications of the finding places.

Abbreviations: A Ey = Arveprindsens Ejland, Ritenbenk district. Ag = Agto, Egedesminde district. Al = Alángorssuaq, Egedesminde district. Au = Aumat, Egedesminde district. E = Erqigtoq, Diskofjord, Godhavn district. Eg = Egedesminde Island, Egedesminde district. If = Ikorfat, Umanak district. Ig = Igíniarfik, Egedesminde district. Ik = Igíniarfik, Diskofjord, Godhavn district. K = Kugssineq, Svartenhuk, Umanak district. L = Lerbugten, Claushavn, Christianshaab district. N = Northern side of Nordfjord, Disko, Godhavn district. Ne = Nagsugtôq Elven (river), Nordre Strømfjord, Egedesminde district. Nq = Niaqornaq, Jakobshavn district. Ns = Nordre Strømfjord, Egedesminde district. O = Orpigsôq, Christianshaab district. P = Pátorfik, Umanak district. Q = Qaigissat, Disko, Godhavn district. S = Southern side of Nordfjord, Disko, Godhavn district. Sa = Sarpiussat, Christianshaab district. Si = Simiutarssuaq, Egedesminde district. T = Tinuteqassâq, Egedesminde district. Ts = Tasiussarssuaq, Christianshaab district. U = Ungôrsivik, Diskofjord, Godhavn district.

List of the Gastropoda, Cirripedia, Ophiuroidea and Echinoidea found in Northern West Greenland, with indications of the finding places.

	1. Coast cliff. Kugssineq. Clay	2. Coast cliff. Kugssineq. Sand	3. The Kugssineq valley	4. The Påtorfik cliff 24 m	5. The Påtorfik cliff 39 m	6. The Påtorfik cliff 42 m	7. The Påtorfik cliff 50 m	8. The Påtorfik cliff. Loose lying	9. Elvskrenten, Påtorfik 25—30 m	10. Kloft II 5,5—32,5 m	11. Kloft II 32,5—42,5 m	12. Mellemkloft. Consolidated bed	13. Mellemkloft. Sand bed	14. Kloft III 60 m	15. 1650 m east of Påtorfik 3 m	16. 1850 m east of Påtorfik 5 m	17. 1900 m east of Påtorfik 30 m	18. 2050 m east of Påtorfik 5 m	19. Kûgtsiaq 40 m	20. Sarfarfik 30 m	21. Vibekes Elv 190 m	22. Lillebæk 200 m	23. Qaersuarssuk kitdleq. Loose lying	24. Qaersuarssuk kitdleq. East. Loose lying	25. Qaersuarssuk kitdleq 4 m	26. Qaersuarssuk kitdleq 5.5 m	27. Qaersuarssuk kitdleq 10 m	28. Qaersuarssuk kitdleq 10.5 m	29. Tupertsuatût 20 m	30. Qardloq 3 m	31. Asuk 150 m	32. Asuk 474 m	I. Stordal, Disko	II. Giesecke's So. Clay bed. Lower part	III. Giesecke's So. Clay bed. Upper part	IV. Giesecke's So. Shell bank. Upper part	V. Giesecke's So. The big shell bank	VI. Giesecke's So. Shell bank on the opposite shore	VII. Giesecke's So	VIII. Igniarfik	Giesecke 1806—12	Rink 1848—51	Krabup Smith 1869	Nordenskiöld 1870	Steenstrup 1871—90	Boye 1872	Pfaff 1874	Helland 1875	Kornerup 1879	Søren Hansen 1888	Hartz 1890	Pjetursson 1897	White & Schuchert 1898	Engell 1902	Jensen & Harder 1906	Bendixen 1916
Gastropoda.																																																					
Boreochiton ruber Lowe	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	..	.	.	..	.	.	.	.	.	.	.	.	.
Scissurella crispata Flem.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	..	.	.	..	.	Al, Ig	.	.	.	.	.	.	.
Puncturella noachina (L.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	P	.	Ig, Ag	.	.	.	.	Ig	.	.	.	.	.	.
Acmaea (Tectura) rubella (Fabr.)	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	O	.	.	.
Lepeta coeca (Müll.)	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	P	.	Ig, Ag	.	.	.	.	Al, Ig	.	.	O	.	.	.
Margarita groenlandica (Chemn.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Margarita helicina (Phipps)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Margarita cinerea (Couth.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	Ig	.	.	.	.	..	.	.	.	.	.	.
Margarita olivacea (Brown)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Solariella obscura (Couth.) *var. bella* Verkz.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Moelleria costulata (Møll.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	O	.	.	.
Lacuna divaricata (Fabr.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Littorina palliata Say	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	O	.	.	.
Littorina saxatilis (Olivi) *var. groenlandica* Møll.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	O	.	.	.
Cingula castanea (Møll.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Cingula arenarea (Migh. & Adams)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	Ig	.	.	.	.	.	.
Alvanea scrobiculata (Møll.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	Ig	.	.	.	.	.	.
Alvanea jan-mayeni (Friele)	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Alvanea wyville-thomsoni (Fr.) *var. pâtortikensis* n. v.	.	.	.	.	.	.	.	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Turritella erosa (Couth.)	.	.	.	.	.	.	.	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Scalaria (Acirsa) borealis Beck	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	×	×	×	×	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Amaura candida Møll.	.	.	.	.	.	.	.	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Lunatia pallida (Brod. & Sow.)	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	P	..	.	P	.	.	.	.	..	.	.	.	.	.	.
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Trophon clathratus (L.)	.	.	.	.	.	.	.	.	.	.	×	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	×	×	×	.	×	.	P	..	.	P	.	.	.	Ig	.	.	.
Trophon clathratus (L.) *var. gunneri* Lovén	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
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Trophon truncatus (Strøm)	.	.	.	.	.	.	.	.	×	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	×	×	×	.	.	×	.	..	.	.	.	.	..	.	.	.	.	.	.
Sipho (Siphonorbis) ebur (Mørch)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Sipho (Siphonorbis) propinquus (Ald.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Sipho togatus (Mørch)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
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Neptunea despecta (L.) *var. carinata* Lam.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Buccinum undatum L.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Buccinum groenlandicum Chemn.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	×	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Buccinum hydrophanum Hanc.	.	.	.	.	.	.	.	.	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Buccinum hydrophanum Hanc. *var. texturata* Posselt	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Admete viridula (Fabr.)	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	×	.	.	×	.	..	.	.	.	.	..	.	.	.	.	.	.
Bela pingeli (Beck)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	..	.	.	.	.	..	.	.	.	.	.	.
Bela nobilis (Møll.) incl. *var. scalaris* Møll.	.	.	×	.	.	.	.	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Bela exarata (Møll.)	.	.	.	.	.	.	.	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Bela harpularia (Couth.)	.	.	.	.	.	.	.	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Bela trevelyana (Turt.)	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Bela violacea (Migh.) incl. *var. bicarinata* Couth.	.	.	.	.	.	.	.	.	.	.	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	P	.	..	.	.	.	.	..	.	.	O	.	.	.
Bela tenuicostata (M. Sars)	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Bela decussata (Couth.) *var. livida* Møll.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Cylicna alba (Brown)	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Utriculus (Retusa) pertenuis (Migh.)	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	..	.	.	.	.	..	.	.	.	.	.	.
Cirripedia.																																																					
Balanus (Eubalanus) balanus (L.) Da Costa	.	.	.	.	.	.	.	.	.	×	×	×	×	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	×	×	×	×	×	×	×	P	..	.	L	.	.	..	.	Sa	.
Balanus (Chirona) hammeri (Ascan.) Brown	.	.	.	.	.	.	.	.	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	×	×	×	.	×	×	.	..	P, K, N, E, U	..	.	.	.	..	.	O	Sa	.
Balanus (Eubalanus) crenatus Brug.	.	.	.	.	.	.	.	.	.	×	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	×	×	.	.	×	.	..	.	..	.	.	..	.	..	.	.	.	.
Ophiuroidea.																																																				
Ophiura (Ophioglypha) sarsii Lütk.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	P	..	.	.	.	..	.	.	.	.	.	.
Ophiura (Ophioglypha) robusta Ayres?	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	..	.	.	.	.	..	.	.	.	.	.	.
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Echinoidea.																																																				
Strongylocentrotus droebachiensis (Müll.)	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	×	×	×	.	.	×	.	..	.	.	.	.	..	Al, Ig	.	.	.	.	.

Plate 3.

Map showing the situation of the localities where shells have been collected. The figures correspond with the numbers of localities on plates 2a and 2b.

Arabic numerals indicate localities, where collections have been made by the Nûgssuaq Expeditions; Roman numerals indicate the localities of older collections which have been worked up in the present publication. The letters indicate the localities of other old collections.

1— 2. The coast cliff at the debouch of Kugssineq. Svartenhuk.
3. The Kugssineq valley.
4—22. The area between Pâtorfik and Sarfarfik. Nûgssuaq.
23—28. The area of Qaersuarssuk kitdleq.
29. Tuperssuautâ.
30. Qardloq.
31—32. Asuk. Disko.
I. Stordal. Disko.
II—VII. Gieseckes Sø. The Egedesminde district.
VIII. Igíniarfik. The Egedesminde district.

AEy = Arveprindsens Ejland, Ritenbenk district. Ag = Agto, Egedesminde district. Al = Alángorssuaq, Egedesminde district. Au = Aumat, Egedesminde district. E = Erqigtoq, Diskofjord, Godhavn district. Eg = Egedesminde Island, Egedesminde district. If = Ikorfat, Umanak district. Ig = Igíniarfik, Egedesminde district. Ik = Igíniarfik, Diskofjord, Godhavn district. K = Kugssineq, Svartenhuk, Umanak district. L = Lerbugten, Claushavn, Christianshaab district. N = Northern side of Nordfjord, Disko, Godhavn district. Ne = Nagsugtôq Elven (river), Nordre Strømfjord, Egedesminde district. Nq = Niaqornaq, Jakobshavn district. Ns = Nordre Strømfjord, Egedesminde district. O. = Orpigsôq, Christianshaab district. P = Pâtorfik, Umanak district. Q = Qaigissat, Disko, Godhavn district. S = Southern side of Nordfjord, Disko, Godhavn district. Sa = Sarpiussat, Christianshaab district. Si = Simiutarssuaq, Egedesminde district. T = Tinuteqassâq, Egedesminde district. Ts = Tasiussarssuaq, Christianshaab district. U = Ungôrsivik, Diskofjord, Godhavn district.

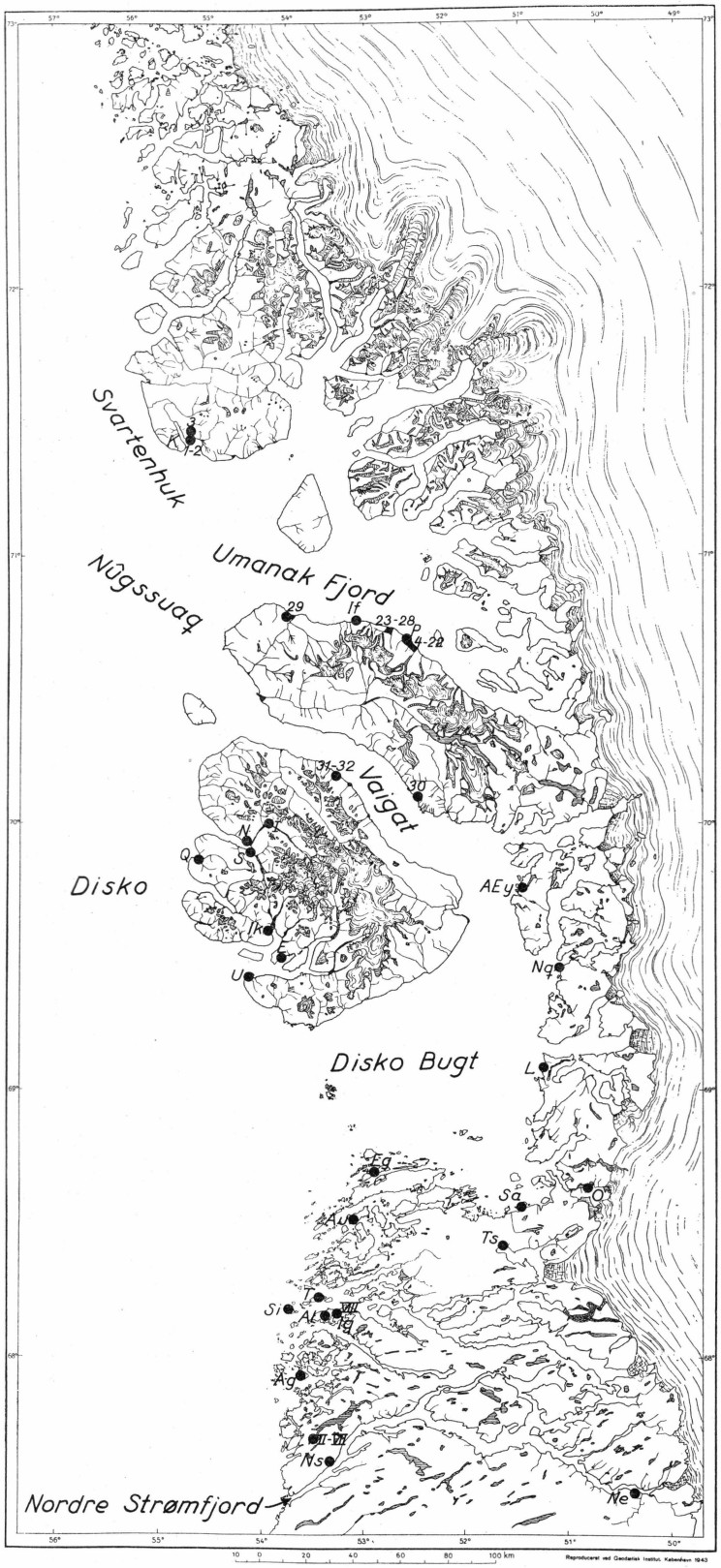

Svartenhuk
Umanak Fjord
Nûgssuaq
Disko
Vaigat
Disko Bugt
Nordre Strømfjord
1-2
29
If
23-28
4-22
31-32
30
N
Q
J
K
E
U
AEy
Nq
L
Cg
Sa
O
Au
Ts
Si
Al
VIII
Ig
Ag
T
VII-VI
Ns
Ne
56°
55°
54°
53°
52°
51°
50°
73°
72°
71°
70°
69°
68°
10 0 20 40 60 80 100 km

Plate 4.

List of all the terraces measured in Northern West Greenland. For location of the localities see plate 5.

The letters placed after the names of the localities indicate the observer.

K = Kornerup (42)
N = Nûgssuaq Expedition 1939.
P = Pjetursson (65).
S = Steenstrup (81, 82).

Orthography in the main according to the maps of the Geodetic Institute, Copenhagen. In parenthesis the names commonly used in literature.

List of all the terraces measured in Northern West Greenland.

No.	Locality		0—10	11—20	21—30	31—40	41—50	51—60	61—70	71—80	81—90	91—100	101—110	121—130	146—155	171—180	181—190	220—230
			m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
1	Sdr. Upernavik	S	..	..	..	39.6	..	..	..	..	..	..	..	..	..	..	..	..
2	Kugssineq	S	..	12.5	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	Inugsivik (Qíngua)	S	..	..	..	..	..	..	..	..	..	..	..	..	150	..	..	..
4	Kugssinerssuaq (Kugsiníngnaq)	S	..	..	..	..	..	..	..	..	..	..	101	..	..	..	..	..
5	Kûk	N	..	..	..	..	..	..	..	75	90	..	..	130	..	..	..	..
6	Sarfarfik	N	..	..	30	..	..	..	70	..	90	..	..	..	..	..	..	..
7	Kûgtsiaq	N	8	..	25	..	45	..	70	..	90	..	..	..	..	..	..	..
8	Qaersuarssuk kangigdleq	N	..	..	..	..	..	..	..	..	..	100	..	130	155	..	..	..
9	Pâtorfik	S	..	..	..	..	..	59.6	..	..	..	..	..	..	..	..	..	..
	Pâtorfik (barometer)	N	10	..	25	35	..	60	..	..	..	97	..	..	150	..	..	..
	Pâtorfik (levelling)	N	10	..	22, 28	35	..	59.3	..	..	..	91.1	101.4	130.1	148.7	..	..	220
10	Qaersuarssuk kitdleq	N	..	..	..	..	..	..	..	79, 5	85.5	..	..	..	149.5	..	..	224.5
11	Ikorfat (Ekorgfat)	S	c. 6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
12	Tuperssuautâ	N	..	..	22	..	..	..	..	..	..	..	..	..	..	..	..	..
13	Nûgssuaq	N	..	..	21	..	..	..	..	..	..	..	..	..	..	..	..	..
14	Marrait, Nûgssuaq	N	10	..	30	40	45	60	70	..	..	..	..	..	..	..	..	..
15	Qôrorssuaq (Tasiussaq)	S	..	..	..	..	..	51.1	..	..	..	..	..	129.8	..	..	..	..
16	Qardloq	N	3, 7	..	..	..	..	..	..	..	87	..	..	..	..	..	..	..
17	Isúnguaq, Disko	S	..	12.5, 14.6	..	33.8, 39.7	..	..	..	..	..	..	..	..	..	..	..	..
18	Asuk	N	..	..	..	..	44	..	..	..	..	..	104	..	..	..	189	..
19	Napassuligssuaq	S	..	..	..	36.7	..	..	..	..	..	..	..	..	..	..	..	..
20	Igdlorpait	S	..	..	25.8	..	..	..	..	..	..	..	..	..	..	..	..	..
21	Igdluluarssuit	S	..	..	..	39.8	..	..	..	..	..	..	..	..	..	..	..	..
22	Perdlertât, Nordfjord	S	..	..	25.8	..	..	..	..	..	83.2	..	..	..	..	..	..	..
23	Head of Nordfjord, northern side	S	..	..	22	.	..	..	..	..	..	..	..	..	..	..	..	..
24	Head of Nordfjord, southern side	S	..	..	25.1	.	..	..	..	..	..	..	..	..	..	..	..	..
25	Qasigissat (Kasigsat)	S	c. 10	..	..	.	..	..	..	..	..	..	..	..	..	..	..	..
26	Jernpynten, Mellemfjord	S	..	..	24	.	..	..	..	..	..	..	..	..	..	..	..	..
27	Head of Mellemfjord	S	..	..	..	..	41.7	..	..	..	..	..	..	..	..	..	..	..
28	Enochs Havn, Ivisarqut (Ivigsarkut)	S	2.2, 6.5	..	30.5	..	..	..	..	..	..	..	..	..	..	..	..	..
29	Nordre Laksebugt (Laksebugten)	S	..	..	..	37.3	..	..	..	..	..	..	..	..	..	..	..	..
30	Kagsimavik	S	..	..	..	..	..	..	..	..	89	..	..	..	..	..	..	..
31	Nângissat	S	..	..	29	..	..	..	..	..	..	..	..	..	..	..	..	..
32	Sioránguaq	S	..	..	..	..	47, 48.5	..	..	..	..	..	..	..	..	..	..	..
33	Kûgssuaq, Diskofjord	S	7.7	..	28.5	..	..	53.9	..	79.3	..	..	..	..	..	..	..	..
34	Akuliaruserssuaq	S	..	..	..	..	..	..	..	..	..	..	..	..	..	177	..	..
35	East of Qivítut	S	..	..	..	..	..	..	..	..	..	..	..	127	..	..	..	..
36	Ungôrsivik	S	c. 2, c. 6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
37	Lyngmarksdalen	P	10	..	..	33	..	53	..	..	..	..	..	..	..	..	..	..
38	East of Lyngmarksdalen	P	..	11	27.5	..	41	54.8	..	..	..	..	..	..	..	..	..	..
39	Godhavn	P	..	..	29.7	..	..	..	..	..	..	..	..	..	..	..	..	..
40	Blæsedalen	S	..	..	22.5	..	..	..	..	..	..	..	..	..	..	..	..	..
41	Per Dams Skib	S	..	..	22	38	..	..	..	76	..	..	..	..	..	..	..	..
42	Brededal	S	..	13.2	..	37.3	..	..	..	..	..	..	..	..	..	..	..	..
43	Sinigfik	S	..	12.2	..	..	..	..	62	..	..	..	..	..	..	..	..	..
44	East of Sinigfik	S	4.5	19	..	38	..	..	..	..	..	..	..	..	..	..	..	..
45	Marrait, Disko	S	..	11	..	..	..	..	..	..	..	..	..	..	..	..	..	..
46	Skansen, west of the houses	S	8.6	..	..	40.4	..	..	..	..	..	..	..	..	..	..	..	..
47	Skansen, east of the houses	S	..	..	26.3	..	49.4	..	..	..	88.7	..	..	..	..	..	..	..
48	Flakkerhuk	S	..	..	..	31.5	..	..	..	..	..	98.1	..	..	..	..	..	..
49	Imerigsoq, Kronprinsens Ejland	P	..	11.3, 16.8	27, 27.8, 28.4	35, 40.5	..	..	..	..	..	..	..	..	..	..	..	..
50	Qagsserssuaq, Kronprinsens Ejland	P	..	11	..	33.5	..	..	..	..	..	..	..	..	..	..	..	..
51	Ivnarssulik, Kronprinsens Ejland	P	..	11.9	22, 28.8	..	..	..	..	..	..	..	..	..	..	..	..	..
52	Oqaq, Kronprinsens Ejland	P	..	16.1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
53	Nunarssuaq, Kronprinsens Ejland	P	..	..	23, 26.5	32, 34.3, 35, 36	47	..	66.1, 70	71.6, 76.8, 77	..	..	..	..	..	..	..	..
54	Ritenbenk	P	..	..	..	..	42,3	..	..	..	..	..	..	..	..	..	..	..
55	Niaqornaq, north of Jakobshavn	P	..	..	..	..	44.8	..	..	..	..	..	..	..	..	..	..	..
56	Hunde Ejland	P	8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
57	Manîtsoq	P	..	..	..	34.5	50.7	..	62.7 64.8	..	90	98, 99.2	108	..	..	..	..	..
58	Egedesminde Island	P	..	..	28	..	50	..	..	..	..	..	..	..	..	..	..	..
59	Kitdlît, Vester Ejland	P	..	16	..	..	..	..	..	..	..	..	..	..	..	..	..	..
60	Augpilagtoq	P	..	11	..	..	..	..	62	..	..	..	..	..	..	..	..	..
61	Aumat, Niaqornaq	P	..	20	28	..	..	59	..	71	..	91	..	..	..	..	..	..
62	Aumat, SW-valley	P	..	..	..	33	..	..	..	..	..	..	..	..	..	..	..	..
63	Portusût	P	..	..	..	34.5	..	..	..	..	..	..	..	..	..	..	..	..
64	Ivnalik	P	..	..	..	37.5	..	..	..	..	..	..	..	..	..	..	..	..
65	Qeqertarssuatsiaq	P	10	20.5	..	31.3	..	..	..	c. 80—90		..	..	..	..	..	..	..
66	Tunugdleq	P	..	15	..	..	..	..	..	..	..	..	..	..	..	..	..	..
67	Kangâtsiaq Fjord	P	..	..	..	36	..	..	68	..	88	94	..	..	..	..	..	..
68	Kangâtsiaq	P	..	11	27	c. 30, c. 35	..	..	..	..	..	..	..	..	..	..	..	..
69	Augpalârtoq	P	..	..	22.5	31.5	..	..	..	..	..	..	..	..	..	..	..	..
70	Ipernik	P	..	..	..	..	..	56	..	77	..	..	..	..	..	..	..	..
71	Inugsulik	P	..	..	..	c. 30	46.5	..	..	..	..	..	..	..	..	..	..	..
72	Sagdlerssuaq	P	..	..	..	30, 39.5	50	57, 60	..	..	..	..	..	..	..	..	..	..
73	Oqaitsut (Okaitssorsuit)	P	..	20—25		..	..	..	63	..	..	91	..	..	..	..	..	..
74	Tinuteqissâq	P	..	..	..	..	44	..	..	..	..	..	..	..	..	..	..	..
75	Aulatsivik Itivdleq	P	..	..	..	35	..	..	..	..	..	..	..	..	..	..	..	..
76	Aulatsivik	P	8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
77	Tasiussaq qaqa, Aulatsivik bay	P	..	..	..	..	..	..	..	..	..	97	..	..	..	..	..	..
78	Igíniarfik	P	10—11		..	..	..	..	..	..	..	..	..	..	..	..	..	..
79	Alángorssuaq	P	..	..	26.5	33.5	40—41, 45	59	..	..	..	..	..	..	..	..	..	..
80	Ikerasârssuk	P	..	..	..	39	..	..	..	..	..	..	..	..	..	..	..	..
81	Simiutarssuaq	P	..	..	..	..	41	57	..	..	..	..	..	..	..	..	..	..
82	Ivnârssulik	P	..	20	22.6	32	..	55	..	..	..	..	..	..	..	..	..	..
83	Ikerasak	P	..	..	..	33	..	60	c. 70	..	86, 90	..	..	..	..	..	..	..
84	Rifkol	P	..	..	..	34—35	47	53, 57.5	68	..	..	..	..	..	..	..	..	..
85	Agto	P	..	..	21.5, c.25	31.5, 32	42.5	..	..	..	..	..	..	..	..	..	..	..
86	Afersiorfik	P	..	..	..	..	..		..	..	83	..	..	..	..	..	..	..
87	Nagsugtôq, head	K	6.3, 10.1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
88	Nagsugtôq	P	10—11		..	..	..	54	65	..	..	..	..	..	..	..	..	..
89	Eqaliaruserssuaq	P	..	..	22	..	..	..	..	..	..	..	..	..	..	..	..	..
90	Ilivilik valley	P	c. 10	..	..	c. 32	c. 50	..	..	..	..	..	..	..	..	..	..	..

Plate 5.

Map, showing the situation of all localities in Northern West Greenland, where terraces have been measured. The numbers correspond with the numbers of plate 4.

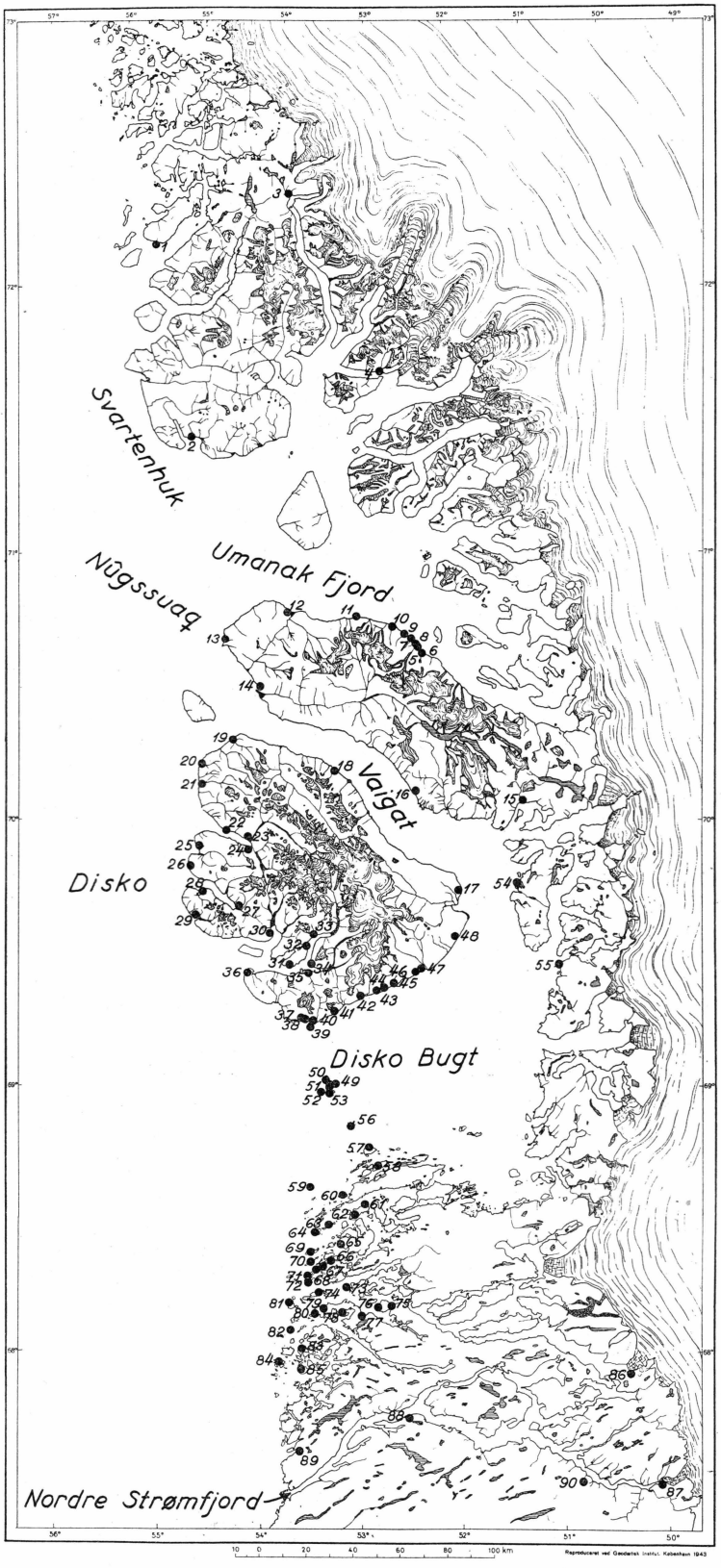

Svartenhuk
Umanak Fjord
Nûgssuaq
Vaigat
Disko
Disko Bugt
Nordre Strømfjord

Plate 6.

Fig. 1. *Serripes groenlandicum* (Chemn.). Right valve $^{1}/_{1}$. Pátorfik. Mellemkløft. 60 m above sea level in sand bed. Coll. 1939.

Figs. 2—5. *Cyrtodaria siliqua* (Spgl.).

Fig. 2. Right valve seen from the inner side $^{3}/_{2}$. Pátorfik. Rink coll. 1848—51.

Fig. 3. Fragment of left valve showing marks of the hindmost adductor scar and the pallial sinus $^{1}/_{1}$. Pátorfik. Rink coll. 1848—51.

Fig. 4. Left valve viewed from the outer side $^{1}/_{1}$. Pátorfik. Kløft II. 30 m. Clay bed. Coll. 1939.

Fig. 5. Right valve viewed from the inner side $^{1}/_{1}$. Shows adductor scars, pallial sinus. Pátorfik. Mellemkløft. 60 m. Sand bed. Coll. 1939.

Fig. 6 a, b. *Nucula tenuis* (Mont.) *var. expansa* Reeve. $^{2}/_{1}$. a. Right valve. b. viewed from behind. Pátorfik. Kløft II. 45 m. Sand bed. Coll. 1939.

Fig. 7 a, b, fig. 8 a, b. *Alvania wyville-thomsoni* (Friele) *var. pátorfikensis n. v.* Two specimens $^{4}/_{1}$. Pátorfik. Elvklinten. 25—30 m. Clay bed. Coll. 1939. Fig. 7 holotype.

Fig. 9 a, b, fig. 10 a, b. *Alvania wyville-thomsoni* (Friele). Two specimens $^{4}/_{1}$. Hurry Inlet, Scoresbysund area, East Greenland. 50 fathoms. Søren Jensen leg. $^{12}/_{10}$ 1900. The Carlsberg Fund Expedition to the East Coast of Greenland. The specimens belong to the Zoological Museum, Copenhagen.

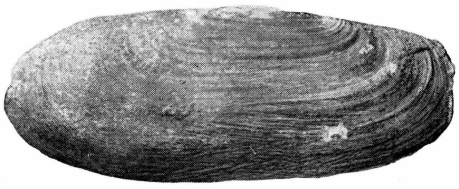
Fig. 11 a, b. *Amaura candida* Møller. $^{4}/_{1}$. Pátorfik. Kløft II, 45 m. Sand bed. Coll. 1939.

Where no other indication has been given, the specimens figured are to be found in the collections of the Mineralogical and Geological Museum, Copenhagen.

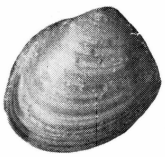
2

1

3



4



6a

6b

5

8a

7a

7b

8b

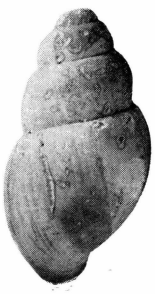
11a

9a

9b

10a

10b



11b

Chr. Halkier phot.