

MEDDELELSER OM GRØNLAND

UDGIVNE AF

KOMMISSIONEN FOR VIDENSKABELIGE UNDERSØGELSER I GRØNLAND

Bd. 107 • Nr. 3

6. OG 7. THULE-EXPEDITION TIL SYDØSTGRØNLAND 1931-33

LEDER: KNUD RASMUSSEN

**QUATERNARY GEOLOGICAL
OBSERVATIONS ETC. IN SOUTH-EAST
AND SOUTH GREENLAND**

BY

RICHARD BØGVAD

WITH 25 FIGURES IN THE TEXT

KØBENHAVN

C. A. REITZELS FORLAG

BIANCO LUNOS BOGTRYKKERI A/S

1940

UDGIVET MED STØTTE AF CARLSBERGFONDET

CONTENTS

	Page
Preface	5
The Late Quaternary Land Rise.....	7
Introduction	7
Description of the Localities.....	9
Subfossil Shells.....	24
The Recent Subsidence of the Land.....	25
Peat Bogs	30
The Receding of the Glaciers.....	31
The Igdlorssuit Glacier.....	34
Icefall in Inugssuarmitut.....	37
Ice Caves.....	38
Blocks transported by the Drift Ice.....	39
Search for Sediment Boulders near the Border of the Inland Ice	40
Bibliography	41

PREFACE

In the summer of 1932, as a member of Dr. Knud Rasmussen's 7th Thule Expedition, I travelled by motor boat along the coast of Greenland from Julianehaab through the Kap Farvel district up the east coast to Nûgârfik, also visiting Krumpens Fjord, Umivik, and Angmagssalik by ship. In the summer of 1933 I explored the coast from Oksefjord to Kap Gustav Holm and thence continued northward to Scoresbysund. During this part of the journey I worked on land for shorter or longer periods, inter alia at Nûgâlik, in the Kangerdlugssuaq-Mikis Fjord, and at Kap Dalton.

On some of the journeys I was with other working groups of the expedition, and in some places this somewhat limited the working possibilities in spite of the greatest helpfulness on the part of the leader and my companions on the expedition.

The chief object of the geological work was an examination of the metamorphic and igneous rocks over as large as possible an area of the southern part of the east coast, so only a short time could be devoted to other problems. But since the area treated in the present paper has been so little explored before, it seemed to me that even casual quaternary-geological and other observations from this region might be of interest.

The treatise is translated from the Danish by Miss ANNIE I. FAUSBØLL, M. A.

The Late Quaternary Land Rise.

Introduction.

Neither H. Knutsen nor P. Eberlin¹⁾ observed raised terraces or shore-lines along the stretch Kap Farvel—Angmagssalik. A. Jessen²⁾, however, suggests that it might be possible to find traces of a recent rise on the south-east coast of Greenland.

C. Kruuse³⁾ has several notes on raised terraces and shore-lines in the region from Angmagssalik to Kangerdlugssuaq, but from the southern part of the east coast no information was available until Th. Vogt⁴⁾ published the results of his journey to South-East Greenland in 1931. On this journey he observed raised terraces and shore-lines in the Tingmiarmiut, Ūmánaq, and Skjoldunge districts, determining their height by levelling in several localities in the two latter areas.—Vogt measured 7 different shore-lines among which the 25 m line and the 9 m line are the best developed. About the former Vogt says⁵⁾, "With its typical shore ridges and quite strong excavations in the ground it has the same general features as, e.g., the Tapes-line in North-Norway." From the measured altitudes of the 25 m line he constructs the plane of the shore-lines and compares the result with previously recorded measurements of shore-lines in Greenland. Further he discusses the climatic conditions during their formation, drawing parallels with the land rise in Fennoscandia.

Finally, Gunnar Horn⁶⁾ mentions raised beaches in Lindenows Fjord and in Puiagtoq Fjord as also to the south of Napassorsuaq Fjord.

For previous investigations in regions outside those visited by the present expedition the reader is referred to A. Jessen⁷⁾ and to Vogt's

¹⁾ Knutsen and Eberlin, pp. 249 and 260 respectively.

²⁾ Jessen, 1896, p. 148.

³⁾ Kruuse, 1912.

⁴⁾ Vogt, 1933 (A).

⁵⁾ l. c., p. 11.

⁶⁾ Horn, 1933.

⁷⁾ Jessen, pp. 147—155.

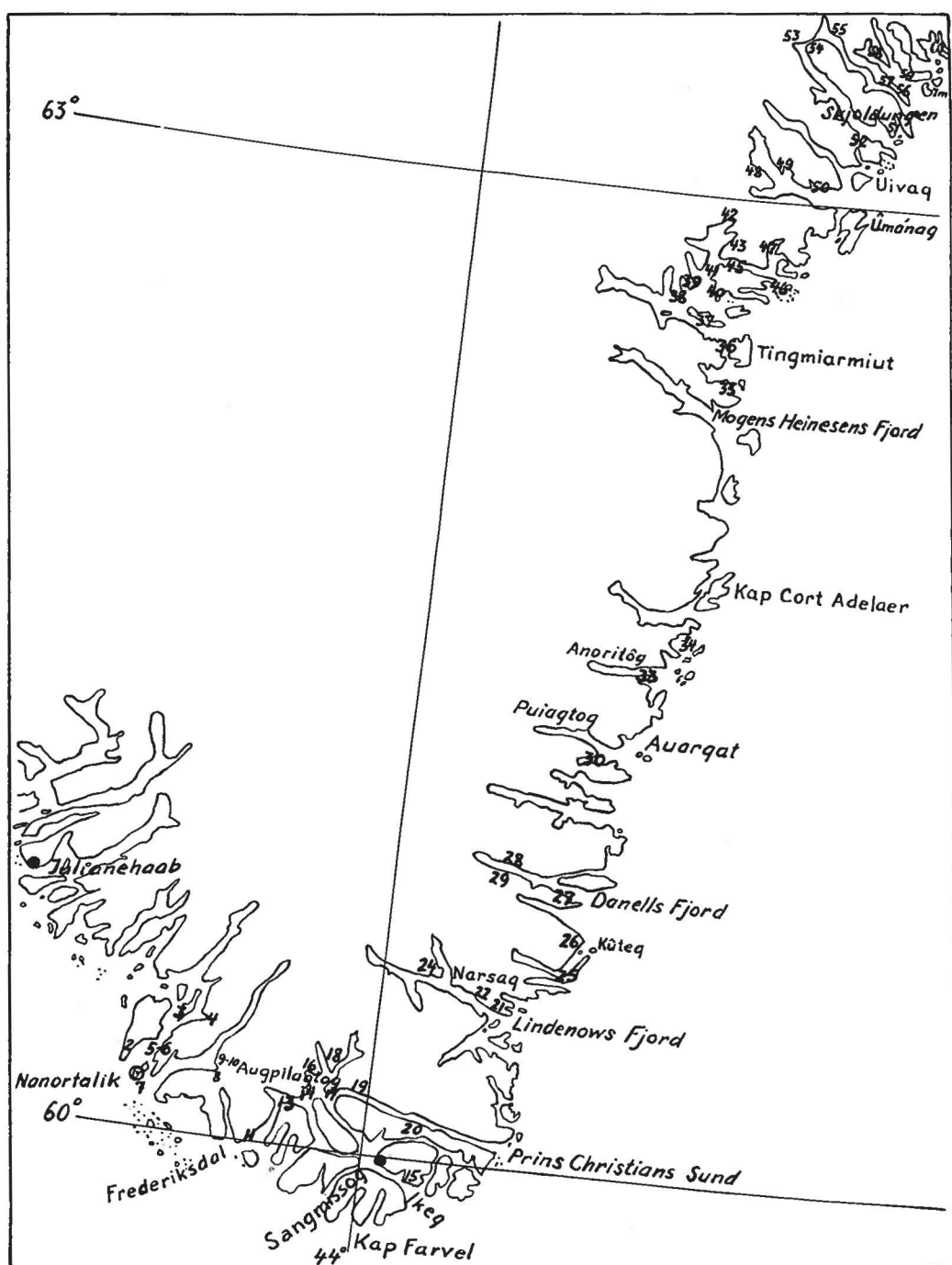


Fig. 1. Sketch map after Gabel-Jørgensen 1940. Nos. 2—60 show localities for raised terraces and shore-lines. (12 is near 11, 23 near 22, 31 near 30, 32 on the north side of Puiagtoq Fjord, and 44 a little to the south of 43).

aforementioned paper, in which will be found detailed reports and references to the literature, notably with regard to the west coast of Greenland. A. Noe-Nygaard¹⁾ and Hans Poser²⁾ treat the raised shore-lines from the east coast north of Scoresbysund, and here further information is to be found as to previous investigations.

Description of the Localities.

In this section I have described the shore-lines etc. observed and measured on the explored part of the coast during the expedition from Julianehaab through the Kap Farvel district up the east coast to the Blosserville Kyst. The observations previously recorded from this area have been inserted in accordance with their geographical situation.

As will appear from the text, a great many of the altitudes recorded were estimated while sailing past places where it was impossible to stop. (In the sequel such altitudes will be preceded by a "c"). Some measurements were made by means of two aneroid barometers (the altitudes marked "bar."), and the rest were obtained by rough levelling with a spirit level and a measuring rod (altitudes marked "lev."). The measurements were made from high water mark, and "o.h." denotes "over high water mark". The figures placed in square brackets denote the situation of the localities in the sketch maps Fig. 1 (Nos. 2—60) and Fig. 2 (Nos. 61—91).

Julianehaab—Frederiksdal.

Already on the first day's journey towards the east coast from Julianehaab to Nanortalik eastward round Kangeq and Sermersôq raised terraces and shore-lines were observed in several places, some of them being previously known. A. Jessen³⁾, for instance, measured a shore-line 48.4 m o. h. at Igdlorsuit on the east side of Sermersôq, and another on the same island at Kangeq [2] 22.7 m o. h. On the west side of Amitsoq [3] there occur high clay slopes here and there, and at the head of Itivdlerssuaq [4] east of Amitsoq there are terraces at several levels. The highest of these has been estimated to be 30 m o. h. It is intersected by a river coming from the east. The slopes of the river bed show distinct stratification, fine material alternating with coarser strata (Fig. 3). On the eastern side of Ikerasârssuk [5], in the southern part of Sermilik a little to the north of Nanortalik, raised terraces were likewise discovered. They contained "fragment clay" and stratified

¹⁾ Noe-Nygaard, 1932.

²⁾ Poser, 1932, pp. 7—17.

³⁾ Jessen, p. 152.

sand. Jessen¹⁾ indicates a shore-line at a height of 17.7 m at Qeqertasugssuk [6] north of Nanortalik, and a shore-line 10.5 m o.h. at Nanortalik [7].

In the eastern part of Tasiussaq [8] to the eastward of Tasermiut, south of Taserssuaq, there are very marked raised terraces, the height of which has been estimated at 15 m from a distance. Raised shore-lines also occur along the shores of the large lake Taserssuaq [9], showing

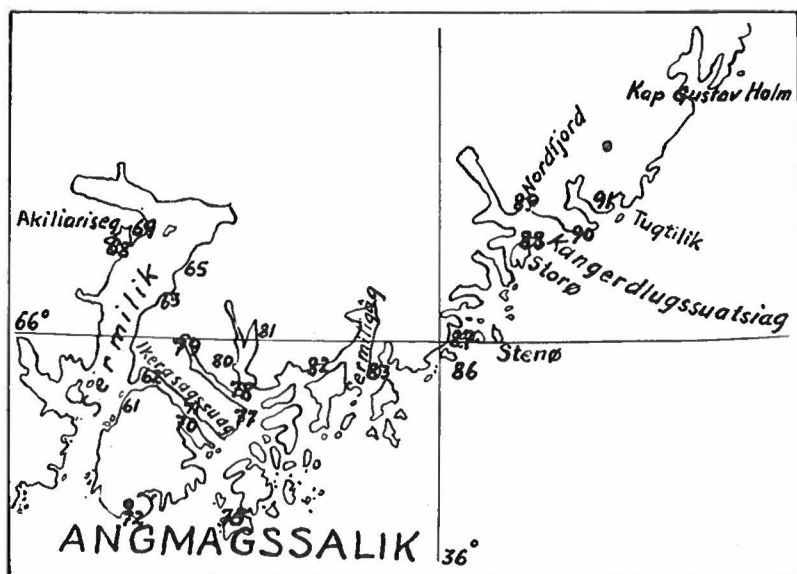


Fig. 2. Sketch map after Gabel-Jorgensen 1940. Nos. 61—91 show localities for raised terraces and shore-lines. (64 is near 63, 66 near 65, 67 a little north of 65, 73 near 72, 74 near 75, 76 between 75 and 77, 84 near 83. 85 eliminated).

that the lake has either been an arm of Tasermiut or an ice-dammed lake. The tract east of the lake [10], a little above the present water level, shows flat areas likewise indicating a higher water level in earlier times.

At Frederiksdal [11] and especially to the south of that locality strongly marked terraces occur c. 5 and c. 10 m o.h. and from the sea outside a well defined line may be observed at an estimated height of 50 m above sea-level. The latter may possibly be due to jointing in the rock.

Torssukátak—Ilua Fjord—Prins Christians Sund.

In the southern part of Torssukátak [12] east of Frederiksdal, and in Qáqarssuaq [13] a little to the west of Augpilagtoq, both on the

¹⁾ l. c., p. 152.



Fig. 3. Itivdlerssuaq, loc. [4]. Raised terraces.

northern and the southern side, more or less distinct terraces were observed as we sailed past. Their height was estimated at 5 m o.h. In certain places by the latter sound they are covered with a willow copse which makes them very conspicuous. Further, there is a shore-line modelled in gravel 9 m (lev.) o.h. at the inlet to the harbour of Aug-pilagtoq [14].

East of Sangmissok on the north side of Ikeq [15] in a small bay there, as well as to the east of this, terraces appear at two levels; their height has been estimated at 5 m and 10 m o.h. respectively.

Raised terraces have been observed in several places in Ilua Fjord. Thus in the lateral fjord Kangerdluk [16] where they are found c. 10 m o.h. both on the north and the south side, and on the western side of the spit of land [17] which separates Prins Christians Sund from Ilua Fjord. Here I have omitted to note down the altitude. The terraces on the coasts of Kangerdluk are covered with rather a dense growth. Their green colour makes them very conspicuous against the reddish screes even at a long distance. North of Kangerdluk, a little way to the north of the settlement Nùk [18] there occur terraces about 7 m o.h.

In the western part of Prins Christians Sund on the north side by Igdlorssuit [19] and nearly in the middle of the sound on the south side [20] raised terraces are observed 2—3 m o.h.



Fig. 4. Narssaq in Lindenows Fjord, loc. [22]. Raised shore-line with the old coastal cliffs.

Lindenows Fjord—Napassorssuaq Fjord.

On the north side of Lindenows Fjord close to Nunatsuk [21] Gunnar Horn¹⁾ measured a terrace c. 30 m o.h., but notably the coast at Narssaq [22] shows evidence of a recent uplift. On both sides of the Danish house a gently sloping plain runs from the mountains down to the fjord and has given its name "Narssaq" to the place. The plain abuts on the mountains at a height of 16 m (lev.) o.h. (Fig. 4), and it would seem as if we have here the old coastal rocks. A little way to the west of the house, terraces are seen at heights of 7, 10.5, 15.5, and 19 m o.h. (lev.). Between 10.5 m and 15.5 m appeared a couple of less well-defined terraces, the height of which was not measured. From a valley in this place a small stream flows towards the fjord. It has a broad bed bounded on both sides by ridges consisting of gravel and large stones which must have been thrown out on the sides when there was a much larger volume of water in the stream than now. The ridges suddenly come to an end at the 15.5 m terrace; thus they are not to be found below this level. Hence there would seem to be no doubt that a land rise has occurred since the ridges were formed.

At the head of the small bay immediately to the west of Narssaq [23] may be observed fragments of a well-defined terrace, the height of which is 11 m o.h. (lev.). Finally indistinct terraces have been ob-

¹⁾ Horn, p. 414.



Fig. 5. Kûtseq Fjord, loc. [25]. Raised terrace.

served a little to the west of the northern lateral fjord in Lindenows Fjord, in a small valley [24] enclosing a stagnant glacier.

In the western part of Kûtseq Fjord¹⁾, south of the peninsula situated between the sea and that part of the fjord which trends north-east—south-west there is a terrace [25] farthest to the east which is quite flat at the top and separates the ravine to the east from the fjord (Fig. 5). The terrace or ridge consists of sand, gravel, and shingle and lies 24 m o.h. (lev.). No shells were found in spite of careful search. On the western side the ridge is broken by a brook flowing into the Kûtseq Fjord. Through a ravine to the east of it another river flows with a gradually increasing fall to the outer coast which is a couple of km distant. Towards the east there are chimneys in the gneiss rocks c. 5 m above the bottom of the ravine.—The terrace may have been formed of glacial deposits at a time when the glaciers of Kûtseq Fjord extended far eastward and the land was considerably lower than now; G. Holm²⁾ mentions that the mountains east of the terrace are polished quite smooth by the ice. There is, however, also the possibility that the terrace has been formed in an ice-dammed lake, either by the easternmost part of the Kûtseq Fjord or the part of it trending north-east—south-west having been closed by glaciers.

In the northernmost part of Kûtseq Fjord, in a small creek on the

¹⁾ Spelled "Kûtseq" on the sketch map Fig. 1.

²⁾ Holm, 1889, p. 163.

west side, opposite the settlement Kûtseq, a terrace was measured [26] which lay 4 m o.h. (lev.).

On the southern side of Danells Fjord in the easternmost part in a small lateral fjord [27] raised terraces occur at several levels. The highest of them were estimated at 6 m o.h. On the northern side east of the easternmost glacier [28] shore-lines were measured 4 and 6 m o.h. (lev.). On the southern side of the same fjord near the head [29] a plain, covered with vegetation and consisting of gravel, slopes gently towards the fjord (Fig. 6). This plain exhibits several faintly defined terraces, the lowest of which is 5.5 m, while the highest is 14.5 m o.h. (lev.). There can hardly be any doubt that these are raised marine terraces. Slightly higher up than the highest terrace the plain meets the solid rock, the old coastal cliffs, at a height which has been estimated at 20 m o.h.

In the lateral fjord which debouches into Puiagtoq Fjord on the southern side, a little to the west of the cave at Tâterait, well-defined terraces are found both on the southern [30] and the northern side [31]. In the latter locality (Fig. 7) their height is c. 7 m o.h. Horn¹) further indicates a shore-line 20—25 m o.h. in a small bay on the north side of Puiagtoq Fjord [32].

On the peninsula Akia [33] in Anoritôq Fjord an obliterated terrace was observed c. 2 m o.h.

In the bay between Qeqertarssuaq and Inugssuit south of Napassorssuaq Fjord on an island [34] Horn²) indicates a ridge with rounded pebbles 13.3 m o.h. another one a couple of metres higher, and a third somewhat lower.

Napassorssuaq Fjord—Uvdorsitit.

From Napassorssuaq Fjord northward to Nagtoralik north of Mogens Heinesens Fjord no traces of a recent land rise were observed but it will no doubt be possible to find raised terraces or shore-lines between Kap Rantzau and Kap Adelaer.—On the south-west side of Nagtoralik [35] is seen what must be supposed to be a shore-line partly modelled in the solid rock c. 10 m o.h. Further, on the western side of Uvdorsitit Tunua, in the northern part [36], terraces were observed, the height of which cannot, however, be stated.

Tingmiarmiut.

In the Tingmiarmiut Fjord complex signs of a land rise are to be seen in several places, but in no place has the height of the terraces been

¹) Horn, p. 421.

²) l. c., p. 422.



Fig. 6. South side of Danells Fjord, loc. [29]. Gently sloping plain with terraces at several levels and the old coastal cliffs.

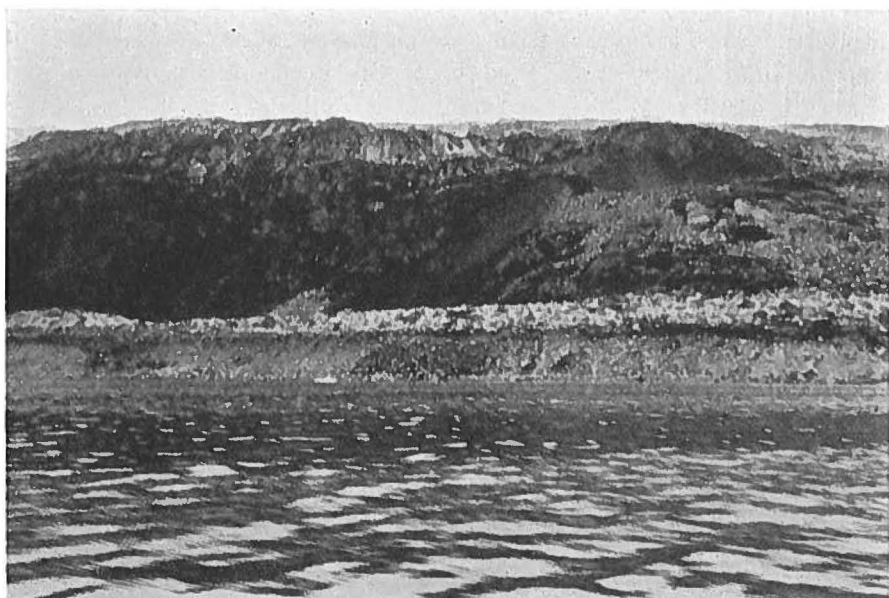


Fig. 7. Puiagtoq Fjord, lateral fjord a little west of Tåterait, loc. [31]. Raised terrace.

measured. On the oblong island Takisôq [37] there are terraces at several levels, and on the mainland north of Takisôq's north-western part [38] a terrace was observed whose height was estimated at 20 m o.h.—North of this on Igdlormiut peninsula [39] Vogt¹⁾ observed “a small plain which appeared to have formed a kind of reef near the level of the sea between the outer part of the Igdlormiut peninsula and the mainland.” He cautiously estimated the height of this at between 50 and 100 m above sea-level.

Both at Saneraq [40] near the south-western corner of the Tingmiarmiut island and at Ikerasak [41] west of the island, obliterated terraces or shore-lines were observed at a height of a few metres. North of Igtitarajugtoq at the head of the smaller northern branch of the fjord [42], between a stagnant glacier and its terminal moraine, there is a raised terrace, the height of which has been estimated at 10 m o.h., and in the branch of the fjord to the east hereof, especially on the south-eastern side, [43] terraces are likewise seen in several places.—A little to the south of this locality, near some Eskimo house ruins [44] Vogt²⁾ observed at an inconsiderable height a moraine ridge which seemed to have been flattened by the sea.—In the sound north of the Tingmiarmiut island [45] well-defined terraces have been observed c. 20 m o.h.

On the north side of Nunarssuaq [46], south of Igdlut, a small branch of the fjord extends in a south-westerly direction. It is divided into an inner and an outer part by a threshold which becomes visible at low water. Along the shore by the threshold traces of a raised beach are seen. The terrain here is covered with a dense growth of willows surrounding some Eskimo house ruins. Finally, at the head of the western part of Sarfap arqaliva Fjord [47] there occur some terraces the height of which has not been measured.

Ûmánaq Fjord.

Here and there in the Ûmánaq Fjord are seen raised terraces for instance near the head of the fjord on the south-western side [48], where the height of one terrace was estimated at 4 m o.h. Vogt³⁾ observed river terraces in the eastern part of Agnat Fjord at Pilerkit [49] in a valley, and right across the mouth of the valley an old terminal moraine intersected by the river coming from the north.—I visited the place the year after Vogt. The terminal moraine which, incidentally, has been mentioned by Garde⁴⁾ shows, above, a level plateau 15 m o.h. (bar.). On the outer side it forms fresh erosion slopes, but on the inner side

¹⁾ Vogt, 1933 (A), p. 7.

²⁾ l. c., p. 7.

³⁾ l. c., p. 7.

⁴⁾ Holm and Garde, 1889, p. 192.



Fig. 8. Agnat Fjord, loc. [49]. Intersected terminal moraine with shore-lines. Terraces in the foreground, right.

towards a finely developed U-shaped valley it is covered with vegetation, and here two well-marked shore lines are plainly seen in the ridge at a height of 7—8 metres (Fig. 8). Along the river inside the terminal moraine may be seen the above-mentioned river terraces, which have been deposited during a higher water level than the present one at the same time as the above-mentioned shore-lines. The possibility cannot be excluded that they have been formed in a lake between the receded glacier and the terminal moraine; it is more likely, however, that they are marine terraces, for the flattened terminal moraine, which is higher than the terraces, shows evidence of having been formed or further developed below the surface of the sea.

On both sides of the sound bounding the little island [50] on the north, in the eastern part of the Ûmánaq Fjord, raised shore-lines are observed in many places, and here Vogt¹⁾ measured shore-lines and terraces at heights of 13.9, 18.4, 23.4, 25.3, and 27.5 m o.h. The last two values are averages of several measurements.

The Skjoldunge District—Kap Moltke.

In Skjoldunge Sydsund, Inugssuarmiut, raised shore-lines are seen in several places, thus in a small fjord intersecting the south-western coast of Skjoldunge Ø [51] and north of the sound closed by a glacier

¹⁾ Vogt, 1933 (A), p. 11.



Fig. 9. The head of Inugssuarmit, loc. [53]. The gently sloping plain may be the old floor of the fjord.

on the mainland [52]. The Norwegian house at Dronning Maries Dal stands on a gently sloping plain which may be the old floor of the fjord [53] (Fig. 9).

In the western part of the island, almost due east of Dronning Maries Dal [54] Vogt¹⁾ measured a shore-line 28.8 m o.h. and observed that it was overlain by a later terminal moraine belonging to a receded local glacier.

In Skjoldunge Nordsund, too, from the house ruins in the north [55] to Singiartuarfik [56] in the south, raised terraces are observed here and there. In one place their height was estimated at 7 m o.h.

At the Norwegian Station [57] in Graahs Fjord, the fjord north-east of and parallel with Skjoldunge Nordsund, Vogt²⁾ has devoted much time to his measurements, and he gives particulars from this part of terraces and shore-lines at heights of 9.2, (14.1), (19.4), 24.7, (28.0), 44.0, and 74.6 m o.h. The measurements enclosed in parentheses denote uncertain lines; the values 9.2 and 24.7 are averages of several measurements.—Near the head of the southern branch of the same fjord, on the eastern side [58], I have seen a shore-line partly modelled in gravel c. 10 m o.h.

On the north-eastern side in the outer part of Graahs Fjord Vogt³⁾

¹⁾ l. c., pp. 9 and 11.

²⁾ l. c., pp. 9 and 11.

³⁾ l. c., p. 10.



Fig. 10. The mainland north-west of Imarsivik Ø, loc. [59]. Well-defined line in the mountain.

observed a horizontal well-marked line which he thinks is "either a broad strand-line in the solid rock, or a ledge marking a structure surface of the rock."—It may be the same line I observed on the mainland NW. of Imarsivik Ø [59] (Fig. 10). Both observations were made from a distance. Vogt estimates the height at about 165 m. I took it to be about 100 m above the level of the sea, but both estimates are of course very uncertain.—The strike of the gneiss in this area lies between NW.—SE. and NNW.—SSE., that is to say nearly in the direction of the fjord, the dip being in the main towards the SW. Vogt's last assumption, therefore, is presumably the most likely.

In the small fjords between Kangerdlikajik and Kangerdlugssuaq (west of Kap Moltke) [60] Vogt¹⁾ measured shore-lines and terraces 8.9 m (average), 15.3, 22.7, and 24.0 m (average) o.h.

Kap Moltke—Angmagssalik.

In this area no observations are available as to a recent land rise.—Vogt²⁾ states that he did not see shore-lines at Umivik, but that such are perhaps to be found on the north side of the peninsula Nunarssuaq.

I have neither seen shore-lines in Krumpens Fjord nor from Pikiut-dleq to Sermilik Fjord, over which stretch the inland ice extends right down to the coast, and where hardly any loose material is deposited.

¹⁾ l. c., pp. 10 and 11.

²⁾ l. c., p. 10.



Fig. 11. Sermilik south of the settlement Sarfaq, loc. [61]. Raised terraces at several levels.

Sermilik—Ikerasagssuaq.

In Sermilik south of Sarfaq, on the north-western side of Angmagssalik Ø [61] (Fig. 11), and east of the settlement at Sarfaq [62] in the northern part of Ikerasagssuaq, raised shore-lines occur at three or four levels, the heights of which were not measured; and in a bay on the eastern side of Sermilik in the neighbourhood of Igdlarfik [63] there are terraces whose height is estimated at 30 m o.h.; a little further north, a shore line was observed near the mouth of a river [64]. On the eastern side of Sermilik south of Nûk a small shallow branch of the fjord is continued in a valley from which it is easy to get across to the head of Ikerasaussaq. On the northern side of this branch of the fjord [65] there are terraces partly consisting of stratified clay 9 m o.h. (lev.). Right across the river in the valley inside the head of the fjord [66] gravel terraces are seen at heights of 40 and 50 m o.h. (bar.). The highest distinct terrace lies at about 50 m but an apparent erosion line? may be observed in the solid rock 85 m above the level of the sea (bar.).—To the north of the above-mentioned branch of the fjord, on the eastern side of Sermilik [67] shore-lines have also been observed, the height of which cannot, however, be stated. On the western side of Sermilik on the island in Tasiussârssik [68] near Akiliariseq there are shore-lines c. 6 and 8 m o.h., and to the north of this, in a branch of the fjord near Nûk [69], a shore-line is partly modelled in the solid rock c. 8 m o.h. (Fig. 12).

In the southern part of Ikerasagssuaq [70], on the eastern side of Angmagssalik Ø at the mouth of a river shore-lines c. 15 m o.h. may be surmised, and on the opposite side of the sound by the southern-



Fig. 12. Branch of fjord at Nûk in Sermilik, loc. [69]. Raised shore-line (by the tent).

most glacier [71] are seen river terraces likewise c. 15 m o.h. The river has cut its way through the terraces and is now eroding its previous deposits.

Angmagssalik—Sermiligâq.

C. Kruuse¹⁾ states that the flat floor of the valley [72] west of the buildings of the Angmagssalik colony is a raised sea-floor, and east of the ship harbour [73] he²⁾ observed a small terrace 3 m o.h.—In the valley near Agdlue (Adloe) [74] north of Kap Dan he³⁾ saw marine

¹⁾ Kruuse, p. 103.

²⁾ l. c., p. 101.

³⁾ l. c., p. 155.

terraces 10 and 7 m o.h. and on the same island at Norssit [75]¹⁾ a valley which had once been a sound. He also saw here a shore-line c. 16 m o.h. and a marine terrace 7.3 m o.h.—On the large island with the settlement Umivik [76] Kruuse discovered a marine terrace 6 m o.h.

Near this latter place I observed a terrace c. 10 m o.h.

Between Tasiussârssik and Ikerasaussaq [77] may be seen from the middle of the fjord two well-defined almost horizontal lines of fairly wide extension. The lower one seems to be a plateau in the mountain a little way inside the coast line; the roches moutonnées at the coast lie at about the same height as this. On the voyage past, the height was roughly estimated at 75 m.—(The upper line lies at a height of several hundred metres and becomes very conspicuous in the autumn, being then plainly outlined by snow drifts).

At the northern point of Ikerasaussaq [78] Kruuse²⁾ indicates a terrace 5.5 m o.h. and at the head of the same fjord [79] terraces at several levels, the most distinct one being c. 10 m o.h.—At Sieraq [80]³⁾ he observed a very distinct terrace with two strata of clay 7 m o.h., and remains of terraces 3, 23, 31, and 47 m o.h. Of the three latter Kruuse, however, thinks that they may be due to ice damming.—At Tasiussaq Misugtok [81] Kruuse⁴⁾ saw an extensive terrace c. 32 m o.h. and another⁵⁾ 20 m o.h.

At Ikerasak north of Sieralik [82] a terrace, the height of which was not measured, is intersected by a river (Fig. 13).—On the eastern side of Sermiligâq [83] north of Utorqarmiut terraces occur c. 15 m o.h.

Leifs Ø—Kangerdlugssuatsiaq.

Kruuse⁶⁾ indicates a series of terraces at Kangerdluarssikajik [84], which bar an old sound; the highest of them is c. 20 m o.h.

On Kujutilik off Jærnø Bugt I observed terraces [86] though I am unable to state their height, and a little way to the north of Grusø [87] Kruuse saw terraces c. 20 m o.h.⁷⁾, just as he mentions⁸⁾ terraces 5 m o.h. on the northern side of Storø [88].

In Nordfjord [89] east of the mouth of Kangerdlugssuatsiaq there are, according to Kruuse⁹⁾, several marine terraces, two of which are very distinct, 10 and 50 m o.h. In the same place he indicates another

¹⁾ l. c., p. 157.

²⁾ l. c., p. 96.

³⁾ l. c., p. 122.

⁴⁾ l. c., p. 124.

⁵⁾ l. c., p. 125.

⁶⁾ l. c., p. 161.

⁷⁾ l. c., p. 164.

⁸⁾ l. c., p. 170.

⁹⁾ l. c., p. 172.

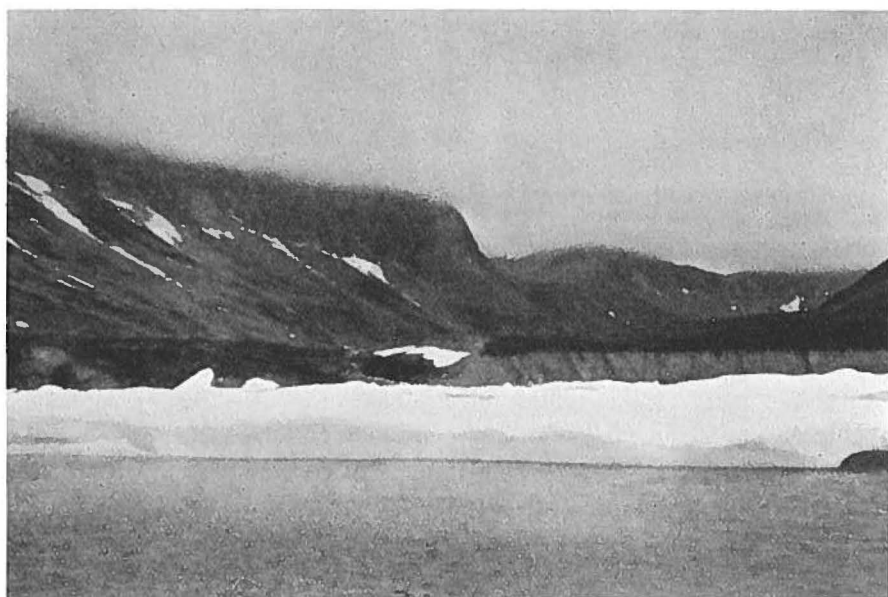


Fig. 13. Ikerasak north of Sieralik, loc. [82]. Raised terrace intersected by river.

shore-line 15 m o.h.—In a valley west of Kap Japetus Steenstrup [90] I observed terraces c. 50 m o.h.

Tugtilik—Kangerdlugssuaq.

In the inner part of Tugtilik [91] is seen a shore-line c. 10 m o.h.—From Tugtilik to Kangerdlugssuaq I was only ashore in few localities and nowhere did I see raised terraces or shore-lines.

Kangerdlugssuaq—Mikis Fjord.

In these fjords the screes are seen in several places suddenly to assume a steeper slope close to the coast line, and lateral moraines from receded glaciers lack the characteristic sharp ridge and are abruptly cut off a little above the surface of the sea. The abnormally steep slope of the screes can perhaps in some cases be explained by the fact that in the winter and the spring the fallen stones form a talus with normal inclination with the fjord ice as a base, while in spring, when the ice melts, the outermost edge slides down into the water. The appearance of the above-mentioned lateral moraines, on the other hand, is hardly to be explained except on the assumption of a land rise.

Mikis Fjord—Kap Brewster.

On this stretch I have only seen signs of uplift in a single place, namely at Kap Dalton where a shore-line is found at an inconsiderable height near the Danish house.

On mentioning various terraces above, the possibility was several times referred to that they might have been formed in ice-dammed lakes. That possibility has been strongly emphasised by A. Jessen¹⁾ and touched upon by Kruuse when he says²⁾ that three of his terraces in Ikerasaussaq may be due to "ice damming".—In future explorations it will doubtless be possible, in many doubtful cases, to obtain information concerning ice dammed lakes from the air photographs taken by the Geodetic Institute of Copenhagen during the expedition.

In the preceding part I have endeavoured to collect all available particulars of the rise of the south-east coast of Greenland. In Figs. 1 and 2 will be seen the geographical situation of the localities. Owing to the lack of shells in the deposits, and on account of the whole heterogeneous nature of the material of observation, I have for the present desisted from a detailed discussion of the problem of the land rise.

Subfossil Shells.

In spite of careful search I was not able to find subfossil shells in any of the localities visited from Kap Farvel to Kap Dalton, nor were Chr. Kruuse³⁾ and Th. Vogt⁴⁾ able to discover any in the localities explored by them. In this connection it should be mentioned that Kruuse⁵⁾, after speaking of the deposits without fossils in the Norssit locality, remarks that no living molluscs were found, either, in the shallow water outside the raised shore-lines.

A. Noe-Nygaard⁶⁾ surveys the shell-bearing deposits hitherto recorded from the east coast north of the area visited by the 7th Thule Expedition.

A. Jessen, who, as already mentioned, measured the height of various raised terraces etc. in the southern part of the west coast, remarks⁷⁾ that in spite of extensive search no shells were found in any raised shore-line or terrace in the area explored by him, probably because they have been washed out in the course of time of the loose sand and gravel. He mentions, however, that K. J. V. Steenstrup found two localities with shells in Tunugdliarfik. They were found at heights of

¹⁾ Jessen, p. 153.

²⁾ Kruuse, p. 122.

³⁾ l. c., pp. 95, 157, 164.

⁴⁾ Vogt, 1933 (A), p. 11.

⁵⁾ Kruuse, p. 157.

⁶⁾ Noe-Nygaard, 1932.

⁷⁾ Jessen, p. 149.

4—6 metres. The species found by Steenstrup¹⁾ are the same that now live on the shores of Greenland.

As shell-bearing deposits are so rare in this part of Greenland, there is reason to mention in this connection a new shell-bearing locality from the southern portion of the west coast.—Mr. Aage Rafn kindly informed me in 1933 that he had seen a shell deposit in the colony of Julianehaab, and from his directions I found it the same year. The locality is reached by following the road leading to the School Building (Efterskolen), turning off from this just east of one of the gables, and then heading for the lake till near the dam of the sheep-breeding station. The deposit lies c. 5 metres above high water mark and consists of gravel with countless fragments of *Mytilus*. It is about 20 cm thick and covers an area of 20 × 20 metres. The shell-bearing gravel as well as the underlying gravel without shells contains rounded boulders up to 20 cm. The entire deposit had evidently been covered by green turf.

Dr. V. Nordmann has kindly examined a sample of the shell-bearing gravel, which seems to have been lost since by a mistake. He states that besides *Mytilus edulis* L. the gravel contains inter alia *Puncturella noachina* L. which usually lives at depths of between 30 and 400 m off the shores of Greenland and probably never comes within the 20 m curve. He thinks, therefore, that the shells cannot well be derived from a midden, so in all probability they belong to a raised shell deposit.

The Recent Subsidence of the Land.

Since the appearance in 1927 of Thorolf Vogt's paper, in which he²⁾ mentions the recent subsidence of the land demonstrated on the west coast of Greenland and makes reference, inter alia, to R. Froda who measured the rate of subsidence at Godhavn³⁾ and found it to be 15 cm in 26 years (58 cm in 100 years), a number of new observations have been made in various places in Greenland, especially by Dr. Therkel Mathiassen, who has very kindly pointed out to me the passages in which he has dealt with a presumed recent subsidence of the land.

Thus in the Upernavik district⁴⁾ Mathiassen observed Eskimo house ruins, the walls of which had been almost entirely washed away by the sea, and middens⁵⁾ which had likewise been entirely or partly destroyed.

¹⁾ Steenstrup, p. 39.

²⁾ Vogt, 1927, pp. 337—341.

³⁾ Froda, 1924, p. 51.

⁴⁾ Mathiassen, 1930, pp. 163, 173, and 174.

⁵⁾ l. c., pp. 160, 164, 171, and 178.

—He made similar discoveries in the area round Disko Bugt¹⁾.—Mathiasen's observations as to a presumed subsidence of the land in the Kangâmiut district²⁾ may be summed up in a quotation from his paper; "... none of the earliest houses lies so low that it is partly washed away by the sea, whereas this is the case with several of the oblong houses: Qeqertarmiut, Tasiussánguaq, Ikerasak, Qagdlingajoq" (see also p. 28).

In 1931 Thorolf Vogt³⁾ saw in the Skjoldunge district on the south-east coast low-lying Eskimo house ruins which he thought indicated a recent submergence of the land, and A. Noe-Nygaard in his observations on marine erosion on the coastal rocks of Ella Island⁴⁾ and his investigation of the height of the youngest terraces compared with that of the preceding ones arrives at the conclusion that there must be a stagnation in the land rise demonstrated in these regions. His observations are not in conflict with a recent subsidence.—Further it may be mentioned that on Clavering Ø near Eskimonæs Helge Larsen⁵⁾ observed an Eskimo grave which at high tide was quite submerged.

Mathiasen did not find house ruins in the Angmagssalik district⁶⁾ at so low a level that a subsidence of the land could be inferred, but he has several such observations from the southern part of the east coast. Thus from the Lindenows Fjord district he⁷⁾ describes a house ruin at Kùgârmiut into which the sea enters at high tide (Type 2—3, 17th—18th century), and ⁸⁾ a house ruin at Pamiagdluk which has been undermined by the sea (type 3, 18th century). At Iluigdlup Qeqertâ Mathiasen⁹⁾ observed 2 house ruins, the front walls of which were entirely or partly carried away by the sea, and at Iluileq¹⁰⁾ he has seen the remains of a house which had been partly washed away (type 3, 18th century).

During my voyages in 1932 I, too, gained the impression from the same part of the coast that the land had been exposed to a recent submergence. Thus in several places I observed house ruins on the rocks denuded by the sea. Good examples of this will be found in the eastern part of South Tunua (c. 59°55' N. lat.), at Iluileq off Danells Fjord (c. 60°50') (see above), and on the north side of Kangerdluluk at "Syenitnæs" (c. 61°05'). The same has been observed in Tingmiarmiut Fjord west of Aussivit (c. 62°40'), on the small island (Fig. 14) off the western point of Tingmiarmiut Qeqertâ (c. 62°45'), where the house passage lies

¹⁾ Mathiasen, 1934, pp. 13—33, 50, 131, and 133.

²⁾ Mathiasen, 1931, p. 57.

³⁾ Vogt, 1932, pp. 570—574.

⁴⁾ Noe-Nygaard, 1932, p. 22.

⁵⁾ According to personal information from Helge Larsen, M. A.

⁶⁾ Mathiasen, 1933, p. 46.

⁷⁾ Mathiasen, 1936 (A), p. 11.

⁸⁾ I. c., p. 15.

⁹⁾ I. c., p. 16.

¹⁰⁾ I. c., p. 17.



Fig. 14. Tingmiarmiut Fjord. Eskimo house ruin partly destroyed by the sea.



Fig. 15. Graahs Fjord. Eskimo house ruin partly destroyed by the sea.

below high water mark, as also at Igdlut (c. $62^{\circ}45'$) a little way to the north of Nunarssuaq. I can confirm Vogt's observations¹⁾ from Qornoq in Inugssuarmiut (c. $63^{\circ}15'$), while on the south side of the peninsula in the middle of Graahs Fjord towards the north-east (c. $63^{\circ}25'$) a house ruin was likewise observed on a rock denuded by the sea (Fig. 15). The most striking evidence of a recent subsidence, however, was not found until our return voyage at Akia on the south side of Anoritôq Fjord (c. $61^{\circ}30'$). Here ruins were discovered of two houses built together which had measured c. 7×4 and 4×4 m. Part of the floor and the whole of the nearly 12 m long wall facing the sea, as well as part of the side walls had been washed away by the sea (Fig. 16—17). These ruins are mentioned by Mathiassen²⁾. They belong to his type 3, which was presumably inhabited in the 18th century.

Discussing the Norse ruin at Igaliko mentioned by Pingel K. J. V. Steenstrup³⁾ thinks that great caution should be exercised in inferring a recent subsidence of the land from the occurrence of house ruins partly destroyed by the sea. However, the conditions discovered for instance at the Akia ruins cannot well be explained in any other way than by assuming a subsidence after the houses were built. The locality is in a small lateral branch of the Anoritôq Fjord where the current is not very strong. That the house must have been inhabited for a long time appears from the numerous bones of animals found under the floor of the ruin.

Finally, in the Julianehaab district Therkel Mathiassen⁴⁾ observed house ruins and tent rings partly washed away, and here⁵⁾ as in the Kangamiut district he noticed that the oldest ruins (from the 14th to the 15th century) lie at the highest level and are untouched by the sea, while ruins from the 17th and 18th centuries, and even some from the 19th century, have been partly washed away. He says, "This circumstance might indicate an oscillation of the earth's crust in West Greenland: lastly a submergence which is still proceeding, beginning somewhere in the 17th or 18th century, the houses of which period consequently are found nearest the sea, and before that a rising of the land which made the earlier ruins lie so high that the subsequent sinking did not bring them so far down that the sea could reach them. However, there are Norse ruins which are now being washed away on account of the submergence, so the question is an uncertain one."⁶⁾

The total observation material renders it probable that the coastal

¹⁾ Vogt, 1932, p. 573.

²⁾ Mathiassen, 1936 (A), p. 22.

³⁾ Steenstrup, 1881, p. 40.

⁴⁾ Mathiassen, 1936 (B), pp. 28, 36, 66, 67, and 69.

⁵⁾ l. c., p. 86.

⁶⁾ See also a comprehensive presentation by Therkel Mathiassen in Gabel-Jørgensen and Egedal, 1940 and Egedal's remarks on the subject.



Fig. 16. Akia in Anoritôq Fjord. Eskimo house ruins. The sea has washed away all the front wall and part of the floor.

area of Greenland both on the west and east coasts from Kap Farvel to lat. c. 74° N. has been subject to a recent subsidence which has superseded the post-glacial land rise. It further appears, according to oral communication from Mr. Erik Holtved, that at Thule, in c. 77° N. lat., a number of house ruins have been more or less washed away by the sea, and Vogt¹⁾ mentions similar observations by E. K. Kane, Lauge Koch, and O. Sverdrup from the same district up to $78^{\circ}20'$ N. lat.

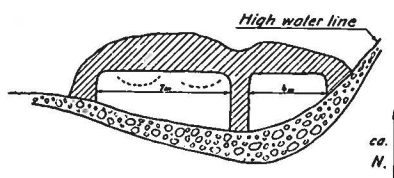


Fig. 17. Ground plan of house ruins at Akia, partly washed away.

On the 7th Thule expedition C. C. A. Gabel-Jørgensen²⁾ made tidal observations at Nanortalik at G. Holm's old bench mark so as to gain an idea of the rate of submergence in the southern part of the west coast. J. Egedal²⁾, who has treated the material, informs me that the subsidence here amounts to 19 cm in 49 years (39 cm in 100 years).

¹⁾ Vogt, 1927, p. 339.

²⁾ Gabel-Jørgensen and Egedal, 1940.

It may also be mentioned that at Ivigtut A/S "Kryolith Mine og Handels Selskabet" caused daily tidal observations to be made for 13 months in 1937—38 by means of a tide staff whose zero point was determined in relation to the fix point réseau of the Cryolite Mines. Thus it will be possible in the future to repeat the observations and receive information of the rate of submergence in that locality¹).

Peat Bogs.

A. Jessen²) mentions that peat bogs in a wider sense are fairly common, but mostly insignificant, in the southern part of West Greenland visited by him.

Such a small peat bog is found at the settlement Sarqarmiut in Sermitsialik Fjord near Julianehaab. The bog, which I visited in October 1933, had a layer of peat up to 1 m deep which was used by the Greenlanders. The peat rested directly on roches moutonnées, and living *Carex* was found on the surface.—Dr. J. Iversen has analysed some samples taken for pollen analysis. The result is seen in Table 1. Sample No. 1 is from the bottom of the bog, No. 6 from the surface.

Pollen Analyses from a Bog near Sarqarmiut.

Table 1. Pollen sum 100 % constituted of *Salix*, *Betula*, *Ericales*, and *Alnus*. The frequency of *Cyperaceae*, *Graminieae* etc. calculated in relation to the four first-mentioned. In all samples *Betula* consisted mainly of *Betula nana* or *glandulosa*.

Samples	Salix	Betula	Ericales	Alnus	Cyperaceae	Graminieae	Pinus and Picea transported from great distances
No. 6	4	38	55	2.5	73	1	1
- 4	10	18	67	..	97	2	4
- 1	9	32	56	3	300	20	1.5

¹) The Company states that a levelling of the tide staff in the boat harbour on the 26.11.1938 showed that the zero point of the staff lies in cote $\div 0.023$ m in relation to the fix point in the south-western corner of the office building, whose cote is $+1.810$ m. The water level was read every third hour throughout the 24 hours and at high and low tides. The hour of high tide was determined by means of the Nautical Almanac by adding 5 hours and 50 minutes to high tide at London Bridge. (At that time Ivigtut was 30 minutes in advance of Greenlandish time). Low tide is assumed to be midway between two high tides. In the day time the actual high and low tides were read as far as possible.

²) Jessen, p. 147.

Iversen gives the following information. "The pollen analyses of the peat do not indicate any material climatic change in the time the peat was formed, and I think it is most probable that the formation of peat did not begin until that deterioration of the climate set in which is known both from marine deposits¹⁾ and from a bog near Ujaragssuit²⁾. The greatest interest attaches to the occurrence of *Alnus* pollen, for nowadays this shrub has its southern limit by Ivigtut Fjord, that is to say, a little north of the bog. The slight quantity of *Alnus* pollen may easily be explained by its being transported from a distance by the wind. Since there is so little *Alnus* pollen both in the lower and the upper layers, one arrives at the conclusion that *Alnus* has had pretty much the same southern limit through a long period. Thus it is probable that life conditions in the southern part of Greenland form an obstacle to the spread of *Alnus*."

Sargarmiut is situated 31 miles south-east of Ivigtut.

The Receding of the Glaciers.

Throughout the area visited there are signs that the ice has previously had a greater extent and thickness. Thus in many places there are ice-free cirques and U-shaped valleys, and roches moutonnées occur along the entire coast. There are likewise in many localities derelict terminal and lateral moraines, though the former are less frequent than the latter.

Th. Vogt³⁾ observed this receding of the glaciers in 1931 in the part of the South-East Greenland coast which he then visited, just as Gunnar Horn⁴⁾ has some few observations pointing in the same direction.

Above the outlying settlement Augpilagtoq are seen the remains of a glacier the far greater extent of which in former days is now marked by a terminal moraine deeply intersected by rivers; and in Prins Christian Sund, in Kangerdluk in the Ilua Fjord, and in the northern part of Tingmiarmiut Fjord derelict terminal moraines are likewise seen. On the east side of Sermilik (near Angmagssalik) by the pass leading to Ikerasaussaq mentioned at p. 20, at a height of 140 m in front of a cirque with slight quantities of ice, there are 3 terminal moraines marking various stationary periods of the glacier, which has now receded very far. The outermost and largest one overlies an earlier talus-fan probably

¹⁾ Jensen and Harder, 1910.

²⁾ Iversen, 1934.

³⁾ Vogt, 1933 (B), p. 302.

⁴⁾ Horn, p. 426.

deposited by a stream.—At the head of Mikis Fjord in front of a stagnant glacier in the middle of the fjord 2 almost parallel terminal moraines are deposited close to each other; they bound a lagoon. Inside the two outermost are seen traces at low tide of two more terminal moraines, and thus the glacier must have had at least four stationary periods (Fig. 18)¹⁾. Adjoining the two outermost there are further the remains of a derelict terminal moraine from a still productive glacier which was previously connected with the former. That the ice in this area formerly extended much further than now appeared moreover from several



Fig. 18. Mikis Fjord. In the left half of the picture, in front of the stagnant glacier, two derelict terminal moraines and remains of a third inside these. About the centre, remains of the derelict terminal moraine of the productive glacier.

gneiss blocks transported by the ice, seen at a height of 680 metres on the basalt mountain from which the photo reproduced in Fig. 18 was taken. By the house in Mikis Fjord and at Kap Dalton are likewise seen derelict terminal moraines which now form lagunes. Here may also be noted the submerged moraine in the Skjoldunge district observed by Vogt²⁾.

With respect to lateral moraines, which are seen along the whole of the explored part of the coast, I shall merely mention that they are handsomely developed in Tingmiarmiut Fjord, in Ikerasagssuaq, and at the head of Kangerdlugssuatsiaq (Figs. 19 and 20). Further it deserves to be noted that the derelict lateral moraines near a glacier on the north side of Danells Fjord are covered with vegetation on the outer side while they are quite bare on the inner side, where the glacier, now lower than the lateral moraine but still in motion, can evidently still make the gravel on the inner side roll down and so prevent the plants from taking root³⁾.

¹⁾ See further Ejnar Mikkelsen, 1933, p. 63.

²⁾ Vogt, 1933 (B), p. 306.

³⁾ See further Vogt, l. c., p. 302.



Fig. 19. Kangerdlugssuatsiaq, at the head. Lateral moraines.



Fig. 20. Head of Kangerdlugssuatsiaq. Much reduced glacier with derelict lateral moraines of various ages.



Fig. 21. South side of Ūmánaq Fjord. The light-coloured zone to the right of and above the glacier is the area without lichens showing the previous thickness of the glacier.

In several places on the side walls of glacier-filled clefts and valleys a larger or smaller part of the rock is seen to be without any growth of lichens, thus marking the former greater thickness of the glacier. The height of this area without lichens has been estimated at 20–30 m at Sermeq kujatdleq in Prins Christians Sund, and at c. 30 m near a glacier on the south side of Ūmánaq Fjord (Fig. 21). Such zones devoid of lichens have also been observed at the head of Lindenows Fjord, at the head of Ilua Fjord, in Puiagtoq Fjord (Fig. 22), and Tingmiarmiut Fjord (Fig. 23), in Sermilik near Angmagssalik, in Ikerasak north of Angmagssalik, and finally at the head of Kangerdlugssuatsiaq and in Tugtilik.

The Igdlorssuit Glacier.

W. A. Graah, quoting Cranz, mentions a rumour to the effect that some savage, cruel people live among the mountains in Lindenows Fjord. They come down to the coast every spring, chase away the Greenlanders living there, and destroy their houses¹⁾. G. Holm calls attention to a tale of how people in the old days crossed over from Ilua Fjord

¹⁾ Graah, p. 71.

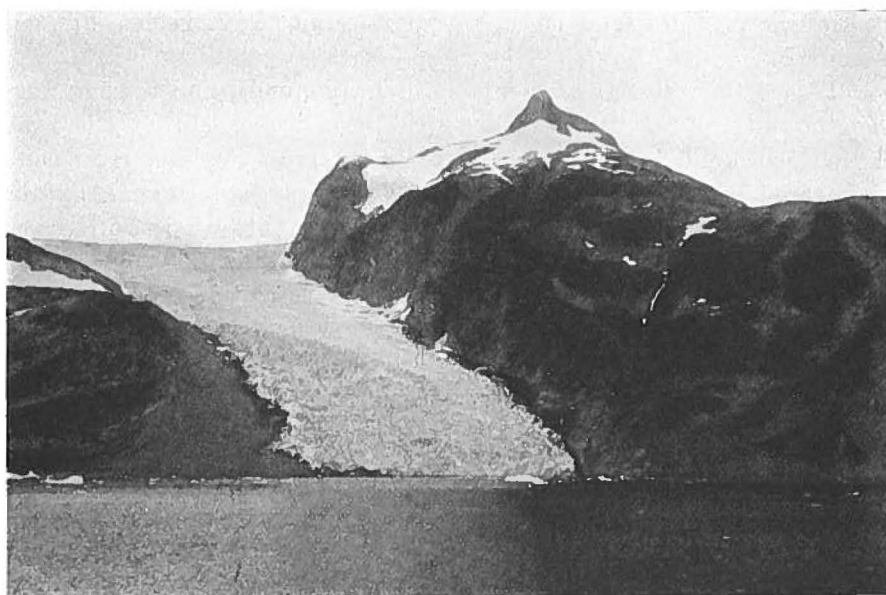


Fig. 22. Puiagtoq Fjord, north side. Receded glacier with lateral moraines and "zone without lichens".

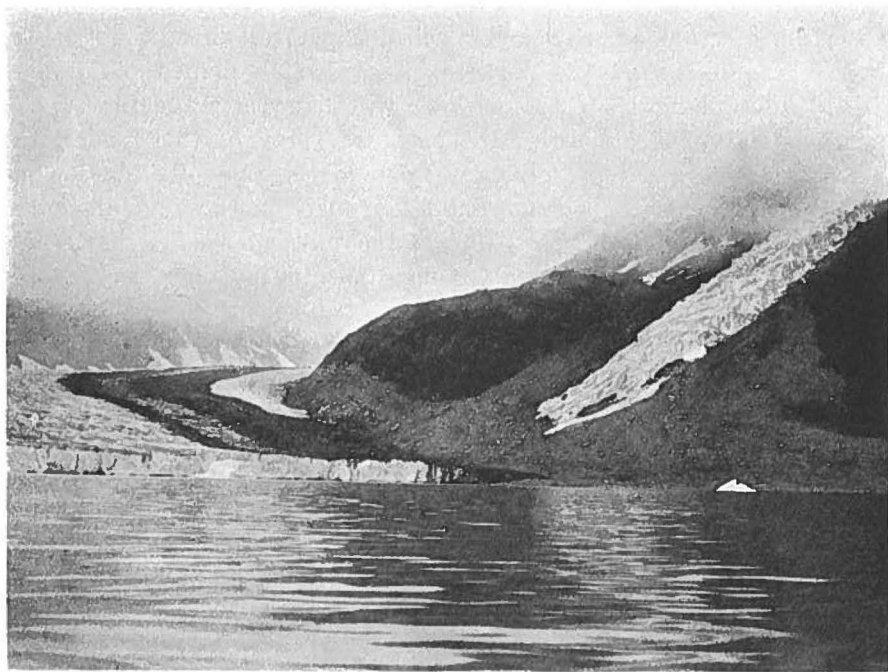


Fig. 23. Tingmiarmiut Fjord. Productive and stagnant glaciers; medial moraines, lateral moraines, and "zone without lichens".

to Lindenows Fjord, and he adds that it cannot have been a difficult crossing¹⁾.

I tried this crossing in company of Esajas and Apollos from Aug-pilagtoq on the 20/8 1932. We camped near Igdlorssuit at the head of Ilua Fjord and from there we proceeded to cross the large river delta and ascended the stagnant glacier north of Qiporqaq. Holm²⁾, by the way, has described conditions in a part of the route where he climbed a nunatak.—There were hardly any deep crevasses in the western part of the glacier, but the surface was full of cracks and very rough owing to the melting of the ice. There were many cryoconite holes, up to 1 m deep, with stones, earth, leaves, and grouse droppings at the bottom. We followed the glacier until we reached the northern lateral moraine and continued our way along this and the very loose screes connected with it. Soon after, however, we were again forced to ascend the glacier which below c. 600 m above the sea-level consisted of solid blue ice devoid of snow and with countless deep crevasses.—At altitudes of more than 600 m the crevasses were partly filled with snow and the ice covered with snow from the previous winter. Three medial moraines, which could be traced from the edge of the glacier to this spot, disappeared under the snow at a height of c. 600 metres. The snow was here (at 2 o'clock p.m.) saturated with water in several places.—Some distance higher up we headed north-east along a very steep snow drift consisting of granular snow and reached a pass at an altitude of 900 metres, passing round the north side of a small domed nunatak.—Holm³⁾, describing his ascent, which was likewise made in August, mentions both the crevasses, the snow-free area of the glacier, the medial moraines, and the granular snow in the snow drift below the pass. Thus no essential change has taken place in these conditions in the course of about 50 years.—From the pass we headed north-east through a depression bounded by nunataks in several places. Along this stretch the ice was covered with a deep layer of snow; apart from crevasses in the immediate vicinity of the nunataks only narrow cracks were seen now and again. After a little while the southern small fjord opening into Lindenows Fjord came in sight, and as we approached the fjord the crevasses became closer and closer together and wider and wider. About 2 km from the head of the fjord, at a height of c. 550 metres it was impossible to proceed without a special glacier equipment, the crevasses preventing further progress. Apart from pauses for resting the journey to this place had taken about 7 hours. We returned, ascending to the 730 m level, and pitched our tent between two crevasses.—

¹⁾ Holm, 1889, p. 159.

²⁾ Holm, 1881, p. 168.

³⁾ I. c., p. 168.

Everywhere the ground was covered with snow from the last winter, and many cracks were hidden by it. It stormed and rained the whole of the night. Next day we returned to Ilua Fjord. The temperature at the surface of the sea in Ilua Fjord was 9°C . on the $20/9$, 1932 at 9 a.m., at the tent on the glacier at 7 p.m. on the same day it was 5°C . and on the $21/9$ at 7 a.m. 4°C .

The domed nunatak (Fig. 24) by the pass and the steep, bare mountain slopes everywhere in the neighbourhood of the glacier showed plainly that the ice had previously been thicker.—Medial moraines were



Fig. 24. Domed nunatak by the pass on the Igdlorssuit Glacier. The descent to Ilua Fjord is to the right of the nunatak.

not seen in the glacier extending to Lindenows Fjord in the area visited by me (at heights above 550 m), though they should be capable of being formed in connection with the nunataks present there. This fact, in conjunction with conditions by the three medial moraines on the Ilua side, shows plainly that the snow lying on the glacier from 1931—32 was not able to melt in the course of the summer at heights of over c. 600 m. That year the first snow fell already on the $11/10$.

In the spring when the snow covers the crevasses there is no doubt that a crossing from one fjord to the other may easily be effected, and it is possible that "the savage and cruel people" came this way.

Icefall in Inugssuarmit.

When Graah visited Ekalungmiut, Dronning Maries Dal on the $30/8$ 1829, he made the following observation¹⁾. "From a small cleft

¹⁾ Graah, 1932, p. 109.

or crack on the south-western side of the creek, large masses of ice came crashing down every moment. As they dropped they were dissolved in dust amid a roaring as of thunder.”

In 1931 Th. Vogt¹⁾ observed in the same place a small steep glacier which sent down its ice masses amid a thunderous din. I visited the place on the $\frac{1}{8}$ 1932 and observed the same phenomenon. The Norwegians then living at Ekalungmiut told me that the glaciers grow more productive in the course of August.

A little to the south of this locality, still on the western side of Inugssuarmiut, is seen another glacier filling a narrow cleft several hundred metres above the level of the sea. The ice of this detaches itself and falls down on a ledge at a height of 150—200 metres, where part of the fallen ice masses seem to have become fused with the arm of a glacier from another cleft. Once or twice an hour ($\frac{1}{8}$ 1932 in the afternoon) large masses of ice are detached from the ledge and with a deafening noise crash further down the mountain slope to the fjord where for the third time they appear to become fused to a compact mass just at the surface of the fjord.

There can be no doubt that the glacier which Graah observed behaves in the same manner now, about 100 years later; though of course it cannot be inferred from this that there have not been fluctuations in the interval.

Ice Caves.

In a snow drift in the south-eastern part of Skjoldunge Ø, c. 5 km north of Kap Juel, an ice cave was found excavated through which flowed a stream. The cave was 20—30 m long; the transverse section at the mouth was roughly semicircular with a radius of c. 2 m (Fig. 25). The roof and walls consisted of a network of large depressions which showed sharp ridges where they joined each other. The cave is far smaller than the Canning Land Cave²⁾ nor is it at all comparable to the famous Gnipa Cave at Danmarkshavn³⁾. Its semicircular section would seem to indicate that the cave, originally excavated by a small stream, has been further expanded by melting and evaporation from the roof and walls above the surface of the river, a mode of formation also assumed by Noe-Nygaard for the Canning Land ice cave.

Ice caves on a smaller scale do not seem to be rare in Greenland. Presumably there will always be a possibility that they may be formed at the bottom of watered valleys where snow drifts, which in one way

¹⁾ Vogt, 1933 (B), p. 305.

²⁾ Noe-Nygaard, 1935, p. 181.

³⁾ Koch, J. P. and A. Wegener, 1912, p. 64.

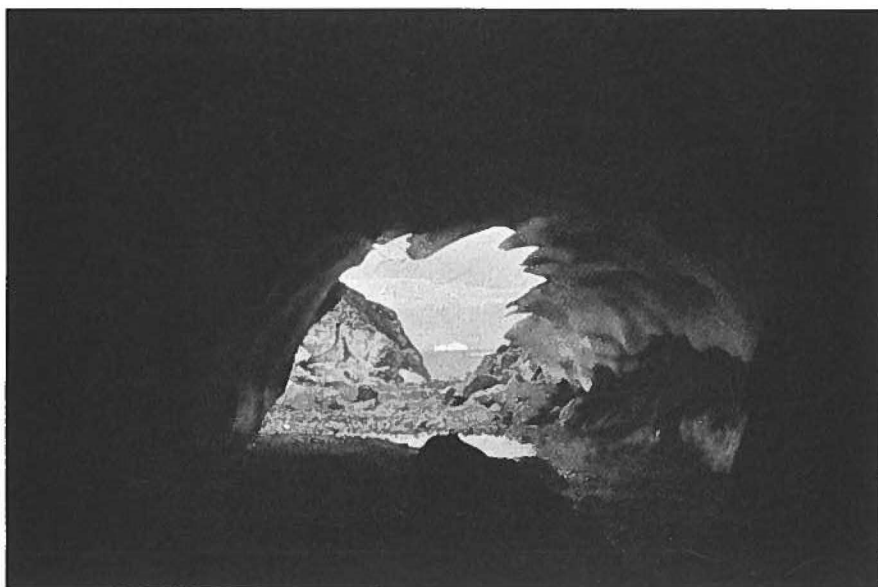


Fig. 25. Skjoldungen north of Kap Juel. Ice cave.

or another are sheltered from melting, will survive throughout the summer. In 1930, for instance, I saw an ice cave 30—40 m long in the south-western part of Hochstetter Forland by the coal bed there, and another in a valley near the shore of Tyrolerfjord north-west of the Danish station. Further I have observed ice caves near Ivigtut in south-west Greenland, thus at Grønnedal and in a valley between Tayler's harbour and Ivigtut.

Blocks transported by the Drift Ice.

Here and there on the stretch visited, especially near the outer coast, various erratic blocks have been found which have been carried by the drift ice over long distances. Thus at Narssaq in Lindenows Fjord there was a block of amygdaloidal basalt which must have come from the Blosseville Kyst or the region to the north of it. Eberlin¹), indeed, states that this rock is not rare in erratic blocks on the coasts of South Greenland. He likewise observed blocks of red sandstone in South Greenland, both on the east and west coasts. He mentions that Nansen found red sandstone on an iceberg off the east coast.

The author found a reddish brown rounded block of sandstone immediately south of Augpilagtoq in Ilua Fjord, a red sandstone with green grains and a white interstitial mass in the eastern part of Igutsat

¹) Knutsen and Eberlin, p. 266.

Fjord, a block of brown stratified sandstone at Imarsivik, and a greyish sandstone at Kap Dan. They are doubtless all derived from more northerly parts of the east coast, as is also a block of clay slate found in Tingmiarmiut Fjord.

In this connection it may also be mentioned that on the pack ice west of Sermersôq on the west coast¹⁾ a Greenlander picked up a piece of tertiary coal.

Search for Sediment Boulders near the Border of the Inland Ice.

Throughout the coast, wherever there has been any opportunity of doing so, the moraines in front of the glaciers, especially at the heads of the fjords, have been examined for sediment boulders so as to gain information of areas of sediments that might be present under the inland ice. The localities investigated were Ilua Fjord, Lindenows Fjord, Danells Fjord, Puiagtoq Fjord, the bay west of the southern part of Uvdlorstutit, the northern part of Tingmiarmiut Fjord, the branches of Ûmánaq Fjord, the Skjoldunge district, Krumpens Fjord, Sermilik, Sermiligâq, Kangerdlugssuatsiaq, and Tugtilik.—Everywhere, however, the result was negative.

On the island of Igdlorpait G. C. Laube²⁾ observed an erratic block which seemed to consist of grey limestone. According to oral communication State Geologist A. Jessen brought home samples of it in 1894.—In 1932 I visited Igdlorpait which lies off Ûnartoq Fjord in the Julianehaab district³⁾ and found the above-mentioned block close to the settlement on the north-east side of the island. It measures a couple of cubic metres and is regarded by the Greenlanders living there as something unusual. The block consists in the main of dolomite and has a Cryptozoon structure. This rock is characteristic of the precambrian part of the East Greenland geosyncline. Rock of this kind has never been observed on the east coast south of Scoresby Sund. It is possible that it may be derived from deposits north of Scoresby Sund and has been carried down along the coast round Kap Farvel by the drift ice.

Another possibility is that the stone has been transported to Igdlorpait with the glacier ice and comes from unknown precambrian deposits north-east of Ûnartoq Fjord.

¹⁾ Jessen, 1896, p. 166.

²⁾ Laube, p. 61.

³⁾ Bøgvad, p. 83.

BIBLIOGRAPHY

- BACKLUND, H. G. Über die Lagerungsbedingungen eines Torffundes in NO-Grönland. Medd. om Grönl., 87, No. 1, 1931.
- BØGGILD, O. B. Grönland. Handbuch der regionalen Geologie, IV, 2a, p. 15 and 19—20, Heidelberg 1917.
- BØGGVAD, R. Erratisk Blok med Cryptozoon i Sydvestgrönland. Medd. fra Dansk Geologisk Forening, 9, 1. H., p. 83, Copenhagen 1936.
- EBERLIN, P. See KNUTSEN, H. & P. EBERLIN.
- EGEDAL, J. See GABEL-JØRGENSEN, C. C. A. & J. EGEDAL.
- FRODA, F. Some observations made in North-Greenland 1923. Medd. om Grönl., 59, No. 4, 1924.
- GABEL-JØRGENSEN, C. C. A. Report on the expedition. Medd. om Grönl., 106, No. 1, 1940.
- GABEL-JØRGENSEN, C. C. A. & J. EGEDAL. Tidal Observations made at Nanortalik and Julianehaab in 1932—34. Medd. om Grönl., 107, Nr. 2, 1940.
- GARDE, V. See HOLM, G. & V. GARDE.
- GRAAH, W. A. Undersøgelses-Reise til Østkysten af Grönland, Copenhagen 1832.
- HOLM, G. F. Geographisk Undersøgelse af Grönlands sydligste Del. Medd. om Grönl., 6, No. 4, 1881.
- HOLM, G. & V. GARDE. Beretning om Konebaads-Expeditionen til Grönlands Østkyst 1883—85. Medd. om Grönl., 9, No. 2, 1889.
- HORN, GUNNAR. Norges Svalbard- og Ishavs-Undersøkelsers ekspedisjon til Sydostgrönland med "Veslemari" sommeren 1932. Norsk Geografisk Tidsskrift, IV, 7, Oslo 1933.
- IVERSEN, J. Moorgeologische Untersuchungen auf Grönland. Medd. fra Dansk Geologisk Forening, 8, 4. H., p. 341, Copenhagen 1934.
- JENSEN, AD. S. and P. HARDER. Post-glacial changes of climate in arctic regions etc., Stockholm 1910.
- JENSEN, J. A. D. Ekspeditionen t. Syd-Grönland i 1878. Medd. om Grönl., 1, No. 2, p. 34, 1879.
- JESSEN, A. Geologiske Iagttagelser. Medd. om Grönl., 16, No. 2, 1896.
- KNUTSEN, H. & P. EBERLIN. Om de geologiske Forhold i Dansk Østgrönland. Medd. om Grönl., 9, No. 4, 1889.
- KOCH, J. P. & A. WEGENER. Die glaciologischen Beobachtungen der Danmark-Expedition. Medd. om Grönl., 46, No. 1, 1911.
- KRUISE, C. Rejser og botaniske Undersøgelser i Ost-Grönland mellem 65°30' og 67°20' etc. Medd. om Grönl., 49, 1912.
- LAUBE, G. C. Geol. Beobachtungen gesammelt während der Reise auf der "Hansa" und gelegentlich des Aufenthaltes in Süd-Grönland. Sitzb. d. mathem.-naturw. Cl. d. Wiener Akad., 68, Wien 1873.

- MATHIASSEN, THERKEL. Inugsuk, A mediaeval Eskimo settlement in Upernivik district, West Greenland. *Medd. om Grønl.*, 77, No. 4, 1930.
- Ancient Eskimo settlements in the Kangâmiut area. *Medd. om Grønl.*, 91, No. 1, 1931.
 - Prehistory of the Angmagssalik Eskimos. *Medd. om Grønl.*, 92, No. 4, 1933.
 - Contributions to the Archaeology of Disko Bay. *Medd. om Grønl.*, 93, No. 2, 1934.
 - The former Eskimo settlements on Frederik VI's Coast. *Medd. om Grønl.*, 109, No. 2, 1936 (A).
- MATHIASSEN, THERKEL in collaboration with ERIK HOLTVED. The Eskimo Archaeology of Julianehaab District. *Medd. om Grønl.*, 118, No. 1, 1936 (B).
- MIKKELSEN, E. Report on the expedition. *Medd. om Grønl.*, 104, No. 1, 1933.
- NOE-NYGAARD, A. Remarks on *Mytilus Edulis* L. in raised beaches in East Greenland. *Medd. om Grønl.*, 95, No. 2, 1932.
- En nyopdaget Ishule i Øst-Grønland. *Geografisk Tidsskrift*, 38, 3.—4. H., Copenhagen 1935.
- PINGEL, C. Om Sænkningen af Grønlands Vestkyst. Beretning fra det 2. Skand. Naturf. Mode i København 1840, p. 353.
- Meddelelse om et Par nye Kendsgerninger vedrørende Sænkningen af Grønlands Vestkyst. *Vidensk. Selsk. Afhandl.*, XII, p. CXIX—CXXI, Copenhagen 1846.
- POSER, H. Einige Untersuchungen zur Morphologie Ostgrönlands. *Medd. om Grønl.*, 94, No. 5, 1932.
- STEENSTRUP, K. J. V. Bemærkninger til et geognostisk Oversigtskaart over en Del af Julianehaab Distrikt. *Medd. om Grønl.*, 2, No. 2, 1881.
- VOGT, TH. Bretrykk-teori og jordskorpebev. i arktiske trakter i ny tid. *Norsk Geografisk Tidsskrift*, I, p. 336, Oslo 1927.
- Landets senkning i nutiden på Spitsbergen og Ost-Grønland. *Norsk Geologisk Tidsskrift*, XII, Oslo 1932.
 - Late-Quaternary oscillations of level in Southeast-Greenland. *Skrifter om Svalbard og Ishavet*, No. 60, Oslo 1933 (A).
 - Norges Svalbard- og Ishavs-Undersøkelsers ekspedisjon til Sydostgrønland med "Heimen" sommeren 1931. *Norsk Geografisk Tidsskrift*, IV, 5, Oslo 1933 (B).