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7. INLAND ICE DEPOSITS–INNER ZONE

7.1. Definition of inner zone

The inner zone comprises a belt of ice margin deposits running parallel to the existing Inland Ice margin at distances of c. 0.5 to 10 km. In places where the former glacier has been a calving lobe, the distance between the westernmost ice margin deposits of this zone and the present glacier front can be up to c. 25 km. The form of the surface of the inner zone can be expressed by

$$\Delta h_i = z_i e^{k_i h}$$

where z_i, the surface characteristic is 350 m and k_i is -0.00161, *i.e.* $\Delta h_i = 350 \cdot 0.9984^h$, as shown in fig. 31.

7.2. Julianehåb district to Godthåb district

The Narssarssuaq stage described previously from the northern parts of the Julianehåb district (Weidick 1963b) fits fairly well with the characteristic of the inner zone mentioned above.

Around Kiagtût sermiat and Narssarssuaq the deposits of the Narssarssuaq stage are not cut by any sea level higher than the present one, though ruins of Norse farms on them indicate that their age is more than 1000 years. The location of the stage is indicated in fig. 32.

In the Frederikshåb district, Holst (1886, p. 56) mentioned the occurrence of old moraines at Fox Havn in Arsuk Fjord c. 5 km west of the present glacier front, but no details are known about them. Further north in the districts south of Frederikshåbs Isblink, current investigations suggest the existence of deposits which can be correlated with this zone (Kelly personal communication).

Sparse ice margin deposits are reported from the southern part of the Godthåb district by Graff-Petersen (1952) and further north ice margin deposits have been seen on aerial photographs around Nakaissorssuaq, Qajartoriaq and Isortuarssûp tasia. All the deposits which have been observed are plotted on the map in plate 3, but because of their scattered nature a closer correlation of them is impossible.

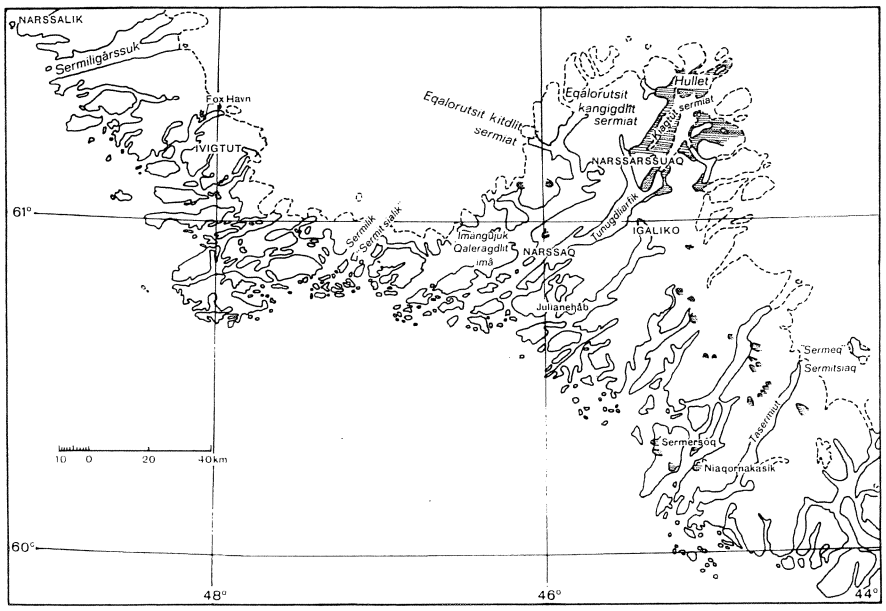

Fig. 32. Map showing the extent of prehistoric marginal stages in Julianehåb district.

In the northernmost parts of the Godthåb district, at Kangersuneq in the interior part of Godthåbsfjord, the aerial photographs show groups of moraines, formed by the glacier lobe of Narssap sermia, stretching towards the ice dammed lake Ujaragtôq (180 m a.s.l.). These ice margin features are situated 100–200 m above present glacier surface.

7.3. Sukkertoppen, Holsteinsborg and Egedesminde districts

Whilst there is only sparse evidence of the inner zone from the area between the Julianehåb and Godthåb districts, the zone is amply represented further north.

7.3.1. Interior part of Søndre Isortoq

Three areas with ice margin deposits which possibly belong to this zone, can be seen on the aerial photographs (see plate 3).

On the northern side of Søndre Isortoq valley a large system of marginal moraines surrounds one of the recent lobes from the eastern Sukkertoppen ice cap. Together with marginal moraines on the nunataks further east, these ice margin deposits indicate the former existence there of a great major lobe of the Inland Ice c. 13 km west of the present margin, which received tributaries from the local Sukkertoppen ice cap

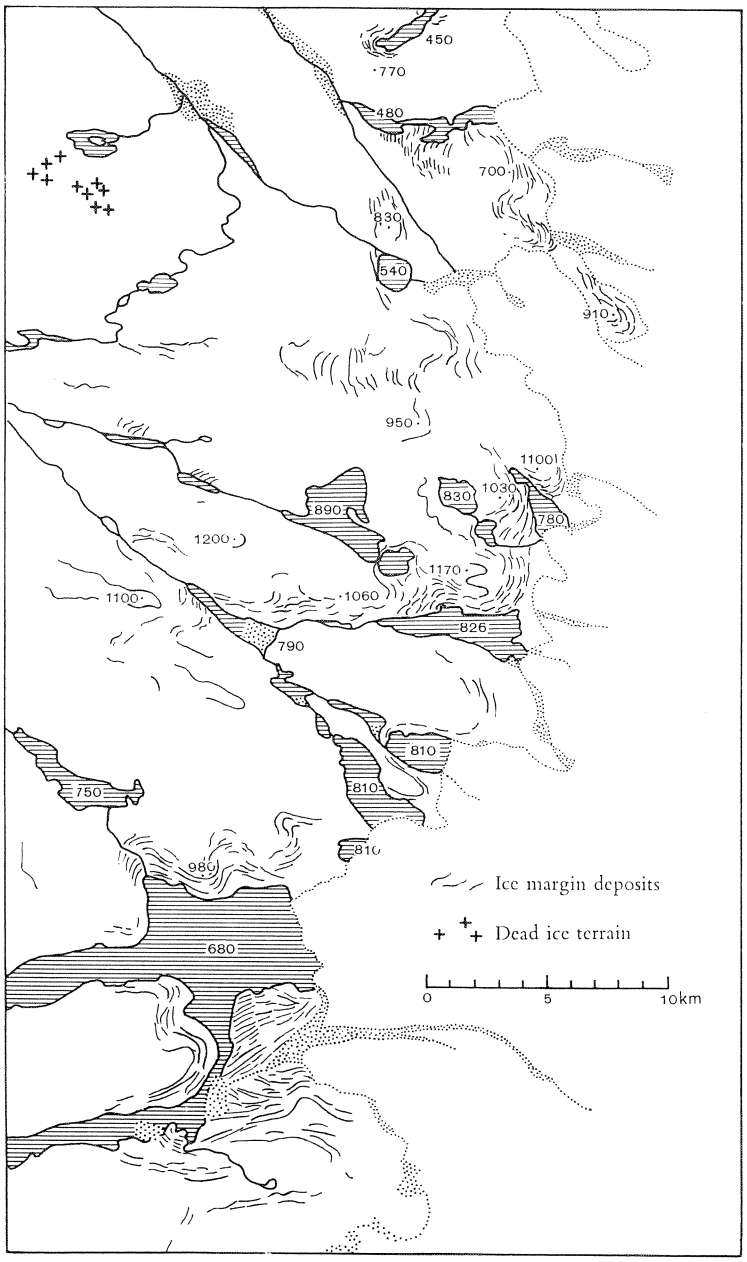

Fig. 33. Details of the inner zone south of Søndre Strømfjord (cf. plate 3), compiled from aerial photographs. Based on part of the Geodetic Institute's 1:250,000 map sheet 66 V2, Søndre Strømfjord Øst. By permission of the Geodetic Institute.

north of it. The old moraine system lies 400 m above the present front, which itself is only a few metres above sea level.

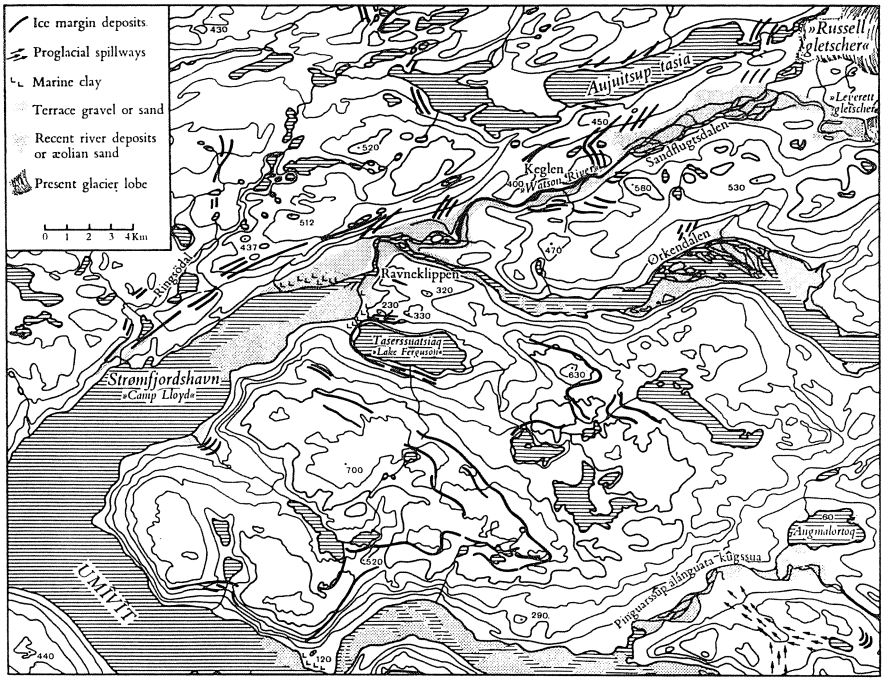

Fig. 34a. Sketch map of the area at the head of Søndre Strømfjord. Map based on the Geodetic Institute's 1:250,000 map sheets 66 V2, Søndre Strømfjord Øst and 67 V2, Nordre Strømfjord Øst. By permission of the Geodetic Institute.

7.3.2. Tasersiaq lake to Ørkendalen

The southernmost parts of this area are being investigated by Ohio State University expeditions and more detailed information than that given here from aerial photographic interpretation can be expected.

Individual sections of the Inland Ice margin from the southernmost part of the area have been described previously (WEIDICK 1963a). There, as well as in the area as a whole, the inner zone is developed as a 5–15 km wide belt in which the underlying bedrock is veiled by thick ground moraine, the surface of which is a closely spaced series of marginal moraine ridges running parallel to the present ice margin. Even where the outer limit is not marked by a ridge feature it can still be recognised as an attenuated drift border, in the sense of FLINT (1947, p. 157). It has not been possible to map the area thoroughly from the aerial photographs, but fig. 33 gives an idea of the extent of the zone.

The ice margin in the southernmost part of the area is situated around 700 m and the upper limit of the inner zone in the same place is c. 1000 m a.s l. In the north, the present Inland Ice margin is 300–400 m a.s.l. and the upper limit of the zone is here at 700–800 m. a.s.l.

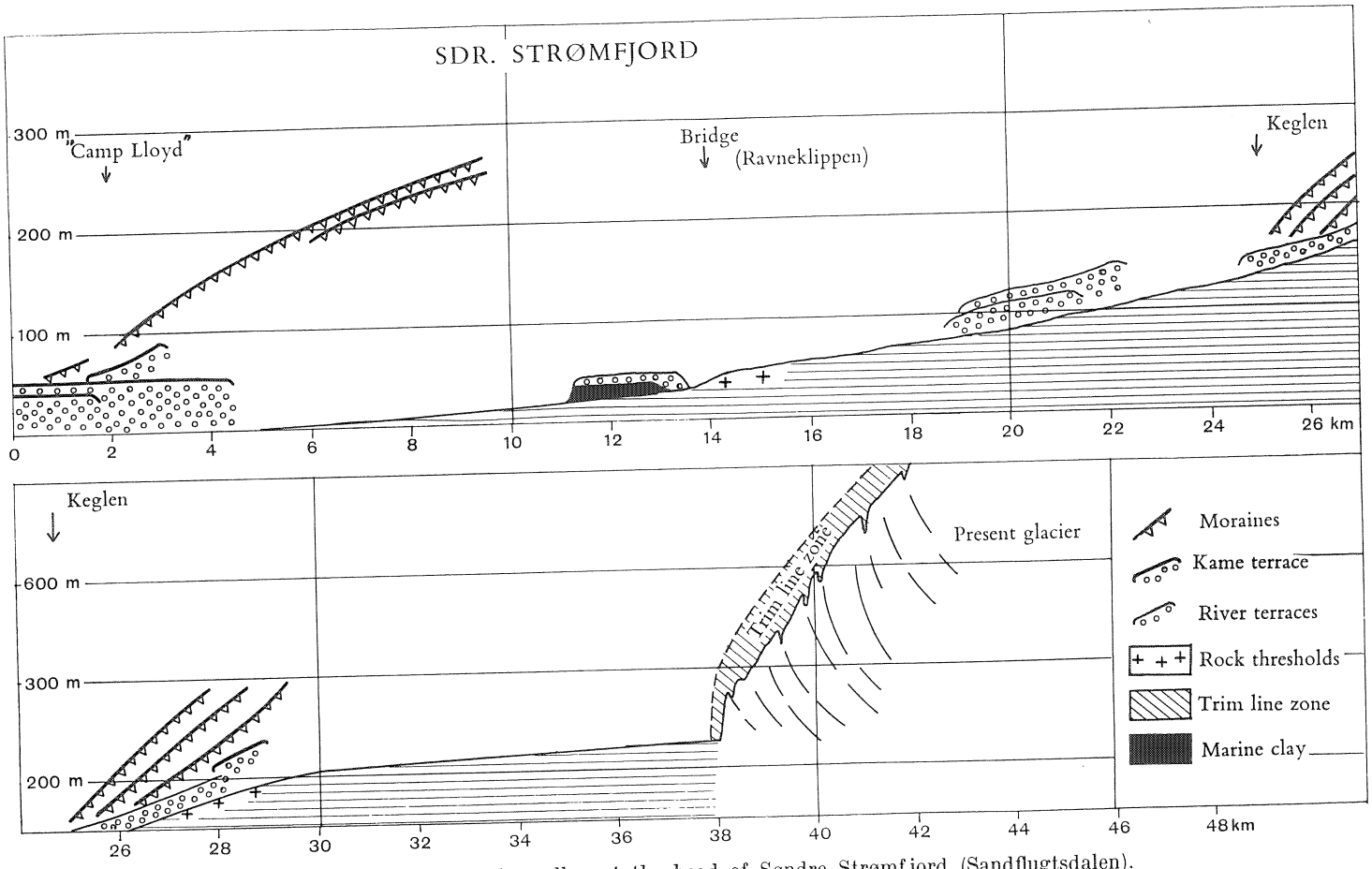

Fig. 34b. Profile along the valley at the head of Søndre Strømfjord (Sandflugtsdalen).

7.3.3. Søndre Strømfjord to Sandflugtsdalen

The area has been dealt with before by HOBBS (1941), BELKNAP (1941) and BØCHER (1949, pp. 60–61). Only BØCHER has tried to establish the relative chronology of the deposits in the valley. He discerns two stages in the retreat of the Inland Ice margin; one around "Camp Lloyd" (Strømfjordshavn) at the head of Søndre Strømfjord and one at mount Keglen, c. 25 km further east. These are shown on plate 3, and on the sketch map and profile in fig. 34. The surface characteristic of the deposits shows that only the mount Keglen stage belongs to the inner zone. Then the ice margin was situated 12–13 km west of the present margin of "Russell gletscher". The older marginal moraines of the zone are cut by a terrace, c. 30 m above the present river ("Watson River"), whilst the younger moraines grade into kame terraces and the river terrace mentioned above. Both the moraines and the kame and river terraces are lithologically similar, being formed of coarse gravel and pebbles with numerous rounded boulders.

Towards the north the inner zone is represented by isolated areas of moraine around the lake of Aujuitsup tasia and the glacier lobe of Isúnguata sermia.

7.3.4. Isúnguata sermia to Eqalungmiut nunât

On the aerial photographs numerous ice margin deposits can be seen between the two lobes from the Inland Ice, Isúnguata sermia (named "Otto Nordenskiöld Glacier" by HOBBS) and Inugpait qûat (plate 3). The deposits are grouped into two zones situated 5–10 and 10–15 km respectively from the present ice margin. The inner of these (the inner zone moraines) seem to be situated c. 300 m above the present ice margin, which is between 200 and 500 m a.s.l. The inner zone occurs only in the highest parts of the area. Further north, towards the glacier lobe of Usugdlûp sermia, only scattered and isolated ice margin deposits of this zone can be seen.

7.3.5. Interior part of Arfersiorfik fjord

The Inland Ice margin in the area in general is only 200–400 m a.s.l. and in two places lobes of the Inland Ice reach down to sea level: Usugdlûp sermia and Nordenskiölds Gletscher. Only a few isolated moraines in this sector can be referred to the inner zone (plate 3).

7.4. Disko Bugt

The coastal stretch in this sector is only 30–40 km wide, enabling easy access to the present Inland Ice margin and its older ice margin deposits. The maximum altitudes for the area are only c. 700 m a.s.l.

Fig. 35
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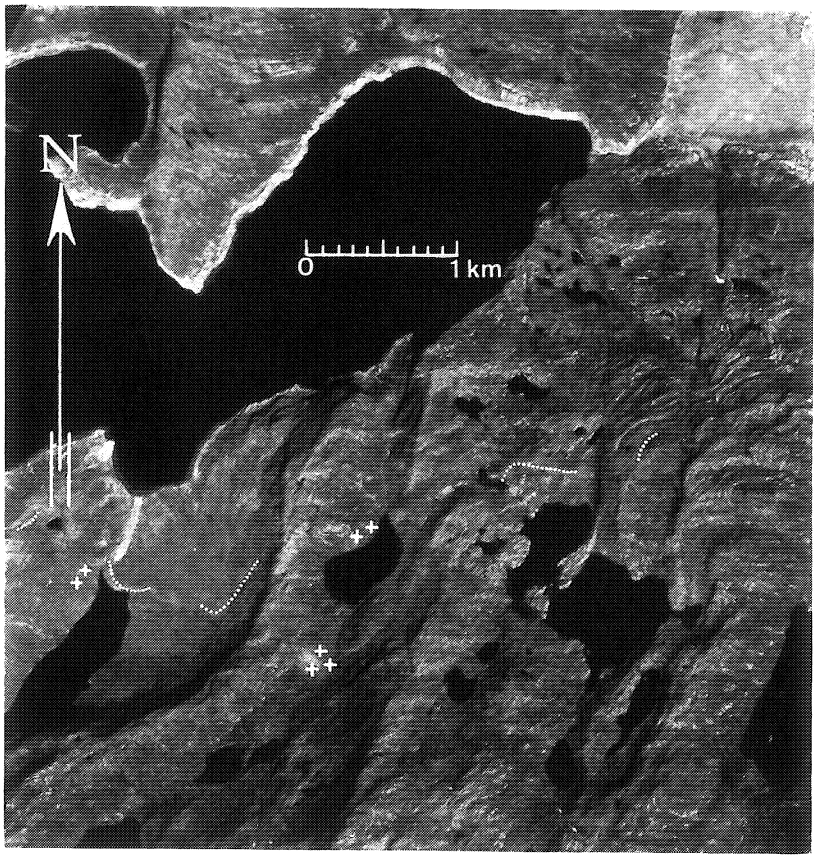


Fig. 35. Marginal moraine (dotted) and stoss moraine (crosses) south of Nunatap tasia, Jakobshavns Isfjord. Geodetic Institute's route 273C, no. 106 (12.7.1964). Copyright Geodetic Institute.

7.4.1. Jakobshavns Isfjord and Tasiussaq area

In the southeasternmost branches of the Tasiussaq fjord complex, two well developed moraine systems have been observed, both in the field and on aerial photographs, running across the peninsula of Qavdlunâp nunâ near Alángordliup sermia. The moraines consists of river gravel and are cut by terraces, the highest of which is c. 30 m a.s.l. In the terraces, and elsewhere at several places in the interior parts of Tasiussaq up to 35 m a.s.l., are deposits of clays which appear to be non-marine. It is therefore highly possible that the deposits and terraces are products of an ice dammed lake. This would require the blocking of the entrance to Tasiussaq at Qajâ (see fig. 47) by a glacier in Jakobshavns Isfjord.

Deposits observed on aerial photographs in the most eastern parts of Tivssarigsoq (fig. 35) and on the southern side of Nunatap tasia are a possible continuation of the system on Qavdlunâp nunâ.

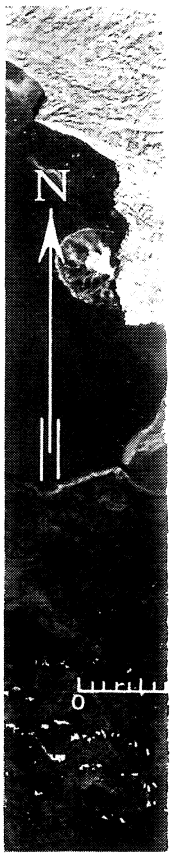
At Qavdlunâp nunâ near Alángordliup sermia the moraines of this system at 200–240 m a.s.l. are poorly sorted gravel ridges, but towards the west end of Nunatap tasia there are great gravel heaps on the glacially upstream side of the valleys. They should be classified as stoss moraines (ANDERSEN 1960, pp. 64–65, 107) having been deposited behind the bedrock escarpments which are there parallel to the present ice margin. In the same area, around the west end of the lake of Nunatap tasia, there are clay terraces of prehistoric age which seem to belong to a phase in the retreat of Jakobshavns Isbræ from the position indicated by the stoss moraines.

Further towards the west on the southern side of Jakobshavns Isfjord, large marginal moraines were observed in the field, on the top of the mountain ridge south of Qajâ. They are composed of blocks without much matrix. South of Qajâ the moraines are situated at 80–100 m a.s.l. and they terminate abruptly at a steep "bird cliff", giving no indication of the level of the sea at the time they were deposited. The archeological site of Qajâ, situated close to the moraines, indicates a minimum age for them of 3000–3500 years (LARSEN and MELDGAARD 1958, FREDSKILD 1967).

7.4.2. Eqip sermia to Torssukátak fjord

Neither aerial photographs nor field investigations have shown anything other than isolated ice margin deposits of the inner zone between Jakobshavns Isbræ and Pâkitsup ilordlia. However, north of Pâkitsup ilordlia, a nearly continous system of moraines extends up to the nunatak of Qapiarfik, north of the glacier lobe of Eqip sermia. Parts of this moraine system have been investigated by DE QUERVAIN and MERCANTON (1925, p. 237), BOYÉ (1950, pp. 62–63) and BAUER (1955c, pp. 91–96). MERCANTON describes moraine at three levels in the Qapiarfik area, at 700 m a.s.l. and at 150 and 100 m above the present ice margin; the last two must be phases of the inner zone. BOYÉ in contrast to MERCANTON, states that at Qapiarfik, unlike the southern side of Eqip sermia, there are continous ice margin deposits showing evidence of an "englacement d'ensemble", with widespread frontal and lateral moraines indicating a complicated history of deglaciation of the nunatak. Plotting from aerial photographs shows numerous moraines in the area, in a zone 100–200 m above the present Inland Ice surface.

On the southern side of Eqip sermia all three investigators referred to above report the existence of extensive ice margin deposits at 100–200 m above the present ice surface. These are also clearly seen on the aerial photographs (fig. 36). BAUER (1955c, pp. 95–96) mentions the presence of three terraces with an altitude of 25 m at the front of Eqip



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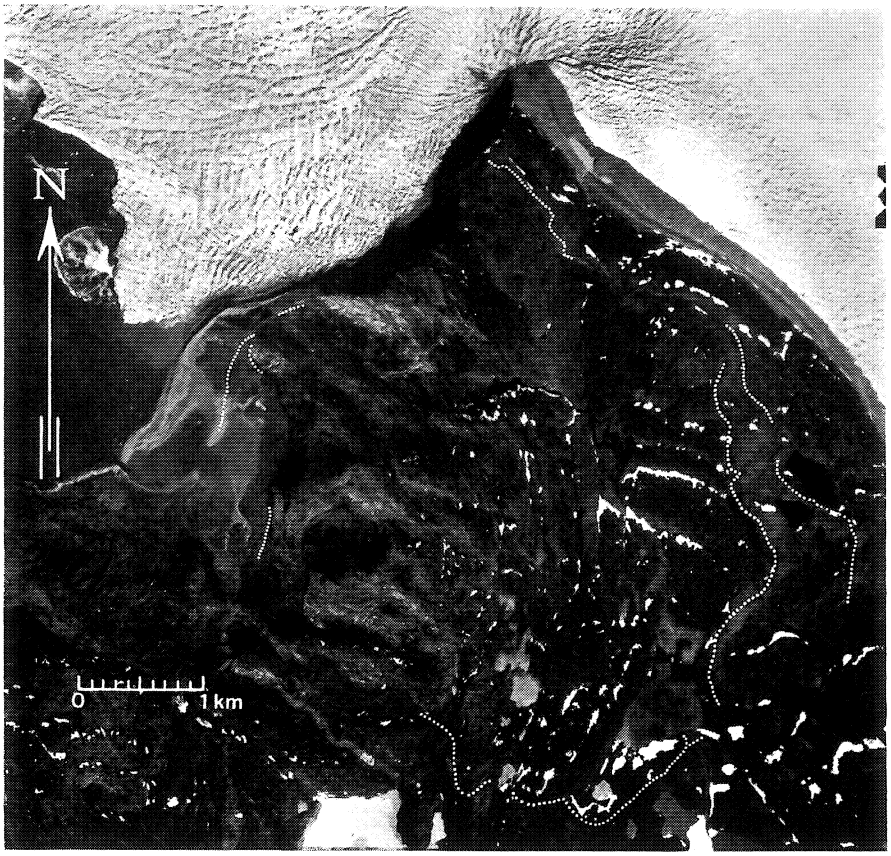

Fig. 36. Moraines of the inner zone, Inland Ice margin south of Eqip sermia (loc. 74 in plate 2). Geodetic Institute's route 272E, no. 252 (29.6.1964). Copyright Geodetic Institute.

sermia but it is not clear whether they are ice margin terraces or are of marine origin. East of these terraces he describes a "moraine ancienne" presumably of prehistoric age, which goes straight down to the present sea level without signs of marine disturbance.

North of Qapiarfik, no ice margin deposits are seen on the steep slopes surrounding the lobe of Kangilerngata sermia. The zone can be picked up again further north at Anap nunâ and around the glaciers at the head of Torssukátak fjord. At Anap nunâ, the deposits are just outside the historical trim line zone at altitudes 100–200 m above the present ice margin. Deposits of the zone investigated in the field near the front of Sermeq avangnardleq showed no trace of reworking by the sea other than that occurring at present sea level.

7.4.3. Nûgssuaq peninsula

A continous belt of ice margin deposits crosses the peninsula, parallel to the present margin of the Inland Ice. Their height above the present Inland Ice margin remains constant at 100–200 m. An aerial photograph of their central section is shown in fig. 30, and the extent of the moraines can be seen in plate 3.

The moraines and kame terraces are often of considerable size, rising ten to twenty metres above the underlying rock surface, and consist mostly of moraine gravel with rounded boulders. The whole zone across Nûgssuaq has been called the Drygalski stage because its first description was by members of the German expedition of 1891–1893 led by DRYGALSKI.

In part, the deposits can be split up into two phases, an inner phase (or stage), which at Torssukátak fjord can be seen to be cut by present sea level only, and an outer phase, which towards the fjord ends on a steep rock wall near a large lake, 2–3 km west of the Inland Ice, called Amitsup tasia.

In the central parts of the peninsula the moraines (as shown in fig. 30a) are broken into a series of short lengths which show all transitions in form between stoss moraines and marginal moraines, with an accompanying variation in composition. In front of the glacier in the central part of the peninsula and further north at the Store Gletscher in "Qarajaks Isfjord", the moraines are block moraines, whilst in the intervening stretch they are gravel with rounded boulders. At the southern margin of Store Gletscher also, the moraines are undisturbed down to the present sea level.

Besides the moraines on Nûgssuaq, DRYGALSKI partly described their northern continuation (1897, pp. 57–60) and from his description, and the aerial photographs, the zone can be followed easily as far as "Ingnerit fjord" (Perdlerfiup kangerdlua). No inner zone ice margin deposits are known with certainty from north of there.

Thus in the northern sector of the area ice margin deposits of the inner zone stretch in a belt for 120 km from Eqip sermia to Itivdliarssup kangerdlua. There is also clear evidence that the deposition of at any rate an inner system, was contemporaneous with a sea level no higher than the present. In general, the surface characteristic of the zone in this sector is amazingly low, 100–200 m, and this value seems to be constant for higher elevations of the present ice surface, up to c. 600 m a.s.l. at the nunataks of Qapiarfik and Rensdyrnunatak. This steep profile of the inner zone surface may be due to the presence of bedrock thresholds beneath the ice beyond the heads of the ice-fjords of Torssukátak and "Qarajaks Isfjord", thresholds which apparently still operate and are responsible for the steepness of the present lobes.

8. INLAND ICE DEPOSITS – OUTER ZONE

8.1. Definition of outer zone

The outer zone can be characterized as a belt of ice margin deposits roughly parallel to the actual Inland Ice margin at distances of 5 to 40 km. The greatest distance is exceptional and is presumed to indicate former calving glacier lobes. The ice surface is described by,

$$\Delta h_o = z_o \, e^{k_o h}$$

where z_o, the surface characteristic equals 650, and k_o equals -0.000921, *i.e.* $\Delta h_o = 650 \cdot 0.9991^h$, as shown in fig. 31.

8.2. Julianehåb and Frederikshåb districts

The Tunugdliarfik stage of the Julianehåb district has been described previously (Weidick 1963b) and only the main features will be given here. Its deposits do not lie far outside the younger Narssarssuaq deposits but their surface characteristic agrees with the curve for the outer zone given in fig. 31. These deposits are more weathered and their surface morphology more subdued by solifluction, than the deposits of the Narssarssuaq stage (see 7.2, p. 83). There is also a lithological difference, large angular boulders being more abundant in the deposits of the Tunugdliarfik stage. Only on the plain at Narssarssuaq air base do the deposits reach the coast and there the flattening of a kame terrace may indicate the position of the contemporaneous sea level, at 10–15 m above the present one.

Little has been published about the Frederikshåb district, but the recent investigations in the northern parts point towards the existence of ice margin deposits of the outer zone in this area (Kelly personal communication).

8.3. Godthåb district

As the map of plate 3 shows, not much is known about the ice margin deposits of the southern parts of this district. In the north however, numerous ice margin deposits have been observed in the field and on aerial photographs.

8.3.1. Bjørnesund (Agdlumersat)

KORNERUP (1890, p 100) records terraces up to an altitude of 192 m a.s.l. at Qáqarssuaq on the southern side of the entrance to Bjørnesund which VOGT (1933, p. 17) describes as being of marine origin, though this is doubtful. On the slope of Ũmánarssuaq mountain on the south side of Bjørnesund, terraces also occur at altitudes of 500–600 m a.s.l. Since the distance between Qáqarssuaq and Umánarssuaq is 16–17 km it is possible that both deposits are of glacial origin and belong to a stage of the outer zone.

8.3.2. Sermilik

Around Sermilik fjord and Sermilik glacier ice margin deposits are widespread, though scattered in their occurrence. Inland, minor ice margin deposits occur around the lake of Qajartoriaq (500–600 m a.s.l.) and on the northern slopes of Sinarssuk valley (800 m a.s.l.). Both localities are situated 10–12 km from the present lobe from the Inland Ice whose margin is at c. 600 m a.s.l. On the north side of Sermilik glacier, a c. 1 km long stretch of ice margin deposits is present at an altitude of 900–1000 m a.s.l., the present glacier surface being situated at c. 700 m a.s.l. Elsewhere in the area there are less well marked ice margin deposits, situated around 900 and 1000 m a.s.l.

Terraces at Sermilik fjord are numerous and well developed. They were first described by KORNERUP (1890, pp. 97–99) who compared their formation with that of the present alluvial plain in front of the glaciers of Frederikshåbs Isblink, thus interpreting them as ice margin terraces. According to him they are composed of marine sediments overlain by fluviatile sediments which have a flat surface situated at 13 m a.s.l. However, STEENSTRUP (*in* JESSEN 1896, p. 150, VOGT 1933, p. 17) gives the altitude of the terraces as between 43.3 and 51.5 m a.s.l., which agrees with the altitudes given on the Geodetic Institute's map sheet 1:250,000 (63 V 1, Færingehavn). On this map the maximum altitudes of the plains and terraces around the mouth of Sermilik fjord, at Marraq as well as Sanerâta timâ can be seen to be situated at or above c. 50 m a.s.l. Presumably KORNERUP has confused measurements made in feet and in metres.

The terraces at Marraq (fig. 37) and Sanerâta timâ slope down towards the west, away from Sermilik fjord. Further east, in Amitsuarssuk fjord, marginal terraces or moraines descend from 400 m a.s.l. at the head of the fjord to c. 100 m a.s.l. immediately east of Marraq. These two systems together presumably represent a stage in the position of the lobe of the Inland Ice. The deposits at altitudes of 900–1000 m a.s.l. mentioned above are a natural continuation of this stage towards the east.

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Fig. 37. Marraq, seen from the south. Aerial photograph, Geodetic Institute's route 504 N–N, no. 49 (26.7.1948). Copyright Geodetic Institute.

8.3.3. Head of Ameralik fjord

The terrain at the head of the fjord has been described by numerous people since 1729 (Weidick 1959, pp. 141–151), though only a few made any observations about the Quaternary deposits. Kornerup (1890, p. 99) mentions three terraces at the head of the Ameragdla branch of the fjord, the lowermost of which was stated to be at 60 m a.s.l. and the uppermost at 106 m a.s.l. Kornerup seems to have interpreted these as ice margin terraces. Nansen (1890, p. 539) mentions a terminal moraine at the entrance of Austmannadalen and marine deposits in the valley up to 20 m a.s.l., which contained "Blaaskjel" (*i. e. Mytilus edulis*). According to the Geodetic Institute's 1:250,000 map sheet (67 V 2, Kapisigdlit) this terminal moraine has a very level surface at c. 50 m a.s.l. It is possible that the upper terraces mentioned by Kornerup are an older stage, and the terminal moraine in Austmannadalen a younger stage of the outer zone.

These ice margin deposits lie in a belt 15–20 km from the present margin and can be followed for 50 km from the lake of Kangerdluarssungûp taserssua in the south to Tungmeralik in the north. At the present ice margin where the glacier surface is situated between 100 and 500 m a.s.l., the deposits are at 800 m a.s.l.

8.3.4. Kangersuneq in Godthåbsfjord

The ice margin deposits in Ameralik fjord can be seen on the aerial photographs to continue north to Kangersuneq. Along the sides of Kangersuneq fjord they decrease in elevation from 800 m a.s.l. in the south at Tungmeralik, to 50–100 m a.s.l. in the north at Nâlagfik (10 kms north of Kapisigdlit). At Kapisigdlit kangerdluat they outline a broad lobe which extended towards this fjord. Investigations of the area in 1965 revealed the presence of well sorted pebbles and features like beach-ridges on the moraines between 50 and 80 m a.s.l. The moraines themselves consist of numerous rounded boulders in a sand to gravel matrix. Other clear evidence of marine action on the moraines was found further north, at Nâlagfik, where a continous series of beach ridges extends from the present sea level up to c. 50 m a.s.l. Above this are vegetation covered ridges up to a wide terrace between 70 and 80 m a.s.l.

8.3.5. Narssap sermia and Ujaragssuit pâvat

On the aerial photographs a c. 10 km long system of moraines belonging to the inner zone can be seen on the north side of Narssap sermia glacier. At higher altitudes, between 750 and 800 m a.s.l. west of this and northwest of Sarqánguaq, are fragments of moraines about 0.5–1 km long which from their situation belong to the outer zone. To this same zone is referred the great system of ice margin deposits which surrounds Ujaragssuit pâvat at 900 m a.s.l. in the east to 300 m a.s.l. in the west. This system can be traced towards the east where it forms two nunatak moraines at 750 and 900 m, and towards the west where it finally ends at the steep mountain slopes near Majuala, giving it a total length of 15 km.

At Majuala itself, JENSEN (1889, pp. 92–93) has observed terraces at altitudes of 6, 26, 57, 97, 123 and 130 m a.s.l. and in addition, a marginal terrace at 489 m a.s.l. All these terraces were reported to consist of gravel with rounded boulders, but whether they are of marine or glacio-fluviatile origin cannot be decided from the description.

8.3.6. Ilulialik and Narssarssuaq

Both localities are well known for their marine deposits and GIESECKE (1910, p. 140) states that these deposits are to be found in all bays on the north side of Godthåbsfjord.

In Ilulialik, the moraine systems drop from the north down to near sea level but in Ilulialik bay the only features are terraces at c. 15, 40 and 100 m a.s.l. Some of these are developed in marine sediments but the highest situated south of Eqaluit, is possibly a kame terrace.

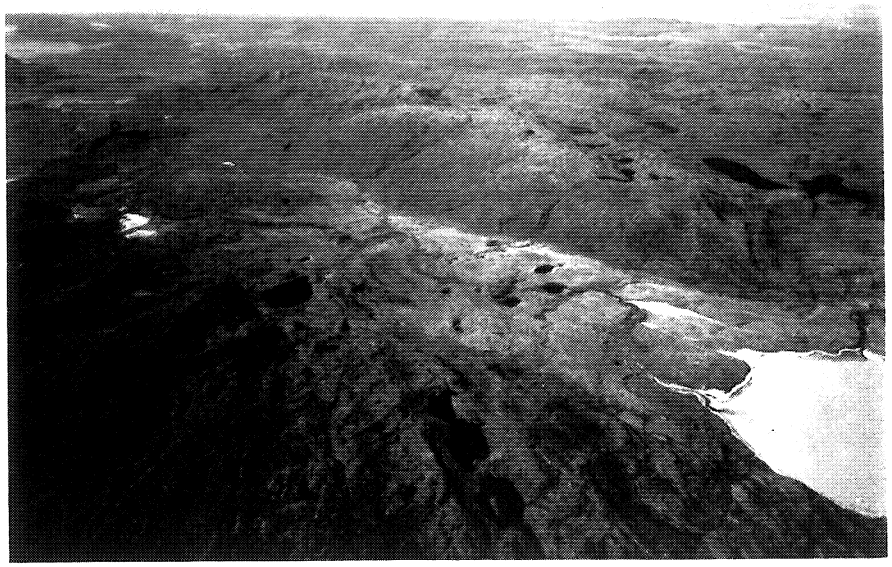

Fig. 38. Narssarssuaq plain north of Godthåbsfjord. In the right foreground Tasersuaq lake and in the left background, Pingorssuaq mountain (p). Geodetic Institute's route 505 D_1–V, no. 5384 (4.9.1948). Copyright Geodetic Institute.

In Narssarssuaq (fig. 38, 39), the main moraine system can be followed only on the southeastern side of the valley. There, it ends in a system of kame terraces with the principal terrace lying between 60 and 80 m a.s.l. Just outside the kames and continuing across the southern part of Narssarssuaq valley as far as Pingorssuaq mountain is a broad zone of kettle moraine. The fluviatile deposits, which form the alluvial plain surface over much of the Narssarssuaq valley, must have been laid down in conjunction with the lowermost moraines, partly burying older dead ice near Pingorssuaq. This younger stage seems to have graded to a sea level of c. 50 m, as shown in the profile fig. 39.

In the cliffs towards the coast, and in the gullies in the plain, the sandy gravel of the terrace surface can be seen to grade downward into laminated sand and silt and finally, between 20 and 35 m a.s.l., into clayey silt. Extremely rich shell layers were found in the clay, at the base of the cliffs around the outer coast of the headland in the inner southern part of Qugssuk inlet (× in fig. 39). However, the chronological relationship of the deposits to these terrace surfaces above and others further inland is not clear.

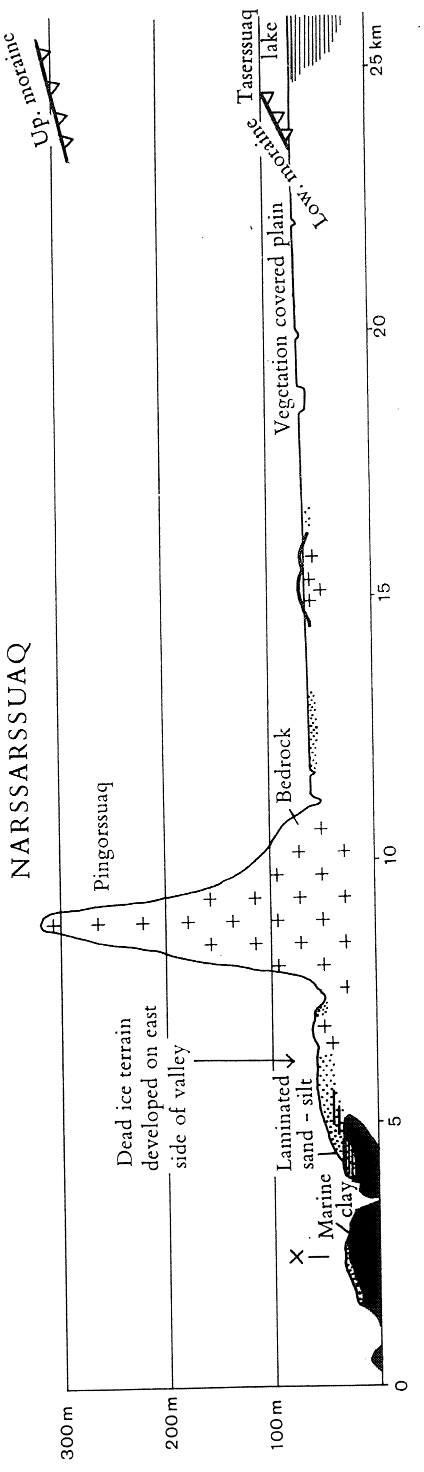

Fig. 39. Profile along the valley of Narssarssuaq. Vertical exaggeration × 20.

8.4. Sukkertoppen district

The district can be divided topographically into three units, a 1200 m high plateau north of Godthåbsfjord and east of Taserssuaq lake, the lowland area around the interior part of Søndre Isortoq fjord and the 2000 m high Sukkertoppen plateaus in the northern parts of the district.

8.4.1. Taserssuaq

The lake of Taserssuaq at 74 m a.s.l., is surrounded by ice margin deposits. Above the central parts of the lake, they lie at 600–700 m and from there they drop down towards the south and the north. At the southern end of the lake, towards Narssarssuaq and Ilulialik, they are between 100 and 300 m a.s.l. At the northern end they descend, at c. 500 m a.s.l., into a valley which leads westwards towards the lake of "Taserssuatsiaq", but there is no evidence of an extension of the system further west.

On the western side of the lake the ice margin deposits in the central part end at a valley which leads westwards to Fiskefjord (Niaqúngunaq). Since the bottom of this valley is below 100 m a.s.l. it is probable that the ice of the outer zone filled the valley and reached Fiskefjord. However, neither the aerial photographs nor JENSEN's (1889, pp. 83–84) report of a visit to the area suggest the existence of ice margin deposits in the valley.

On the northeastern shore of Taserssuaq (fig. 40) there is a well developed nunatak moraine system at 600 m a.s.l. The easterly branch of the lake, south of these nunatak moraines, leads to a glacier lobe from the present Inland Ice (the "Sarqaq glacier"). The ice margin deposits of the outer zone cannot be followed very far towards the east along this "Sarqaq branch" of the lake, but it seems likely that the ice margin of the outer zone was situated 700–800 m above the present one.

8.4.2. The area between Tasersuaq and Quvnerup qáqâ

The landscape here is an irregular plateau, situated mostly between 800 and 900 m a.s.l. but in places descending down to c. 400 m a.s.l.

A belt of ice margin deposits stretch from the northern end of Taserssuaq (see plate 3) towards the Majorqaq valley in the Søndre Isortoq area. The deposits are at 600–700 m until the "Qaersutsiaq" valley where they descend nearly to present sea level. Along the sides of this valley they are wider and thicker than on the plateau to the south and two separate stages can be distinguished. The westernmost of these

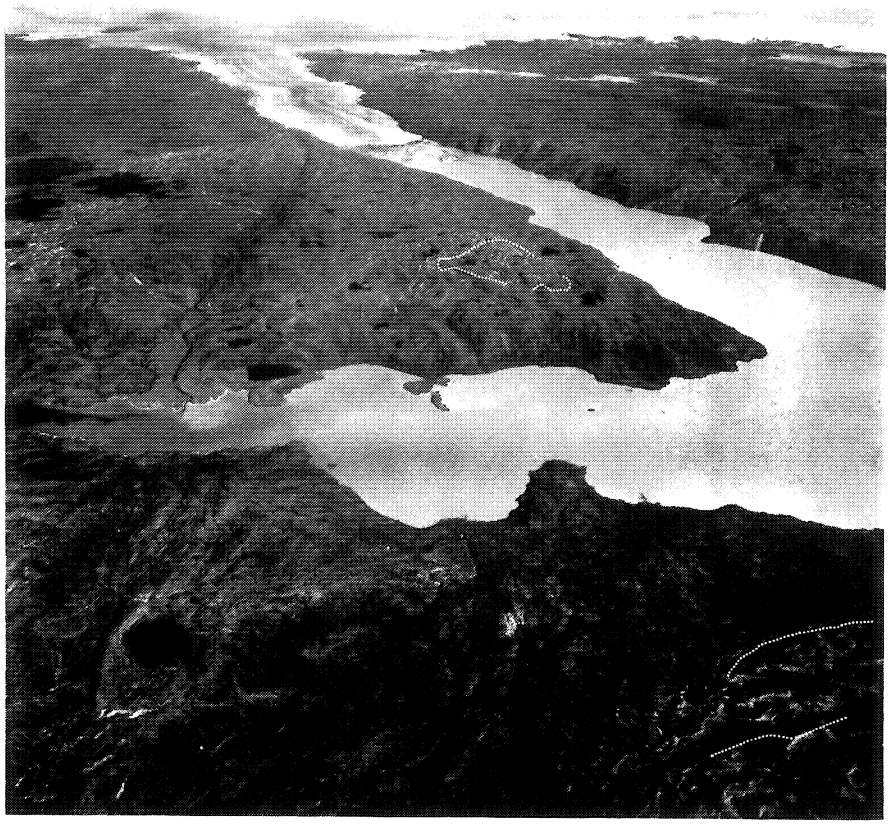

Fig. 40. Northern end of Taserssuaq lake, seen from the west. In the right foreground are ice margin deposits. The white dots (a–a) indicate the situation of the nunatak moraines mentioned in the text. In the background "Sarqaq glacier" (loc. 31 in plate 2). Geodetic Institute's route 505 D–Ø, no. 4681 (20.8.1948). Copyright Geodetic Institute.

descends nearly to sea level at the mouth of the valley whilst the eastern one reaches down to c. 300 m a.s.l. c. 6 km east of this.

The mouth of "Qaersutsiaq" valley has been visited by both JENSEN (1889, pp. 79–81) and HOLST (1886, p. 64). JENSEN describes terraces in the valley going up to 600 m a.s.l., built of non-fossiliferous clayey gravel containing rounded boulders. He supposed that they were river terraces, but did not exclude the possibility of their being ice margin features (*ibid.* p. 81). North of "Qaersutsiaq" extensive terraces which are clearly related to the former presence of ice dammed lakes between 400 and 450 m a.s.l., can be seen on the aerial photographs. They can be seen also to connect with the more easterly stage of the moraines in the "Qaersutsiaq" valley mentioned above. A nunatak moraine at approximately 500 m a.s.l. south of the valley is also connected to this inner stage.

Holst states that there are deposits of bluish-grey clay at "Qaersutsiaq" as well as at "Ilulialik", and that at the former locality an upper terrace level is developed on the clays at 31 m a.s.l. He says also that at "Ilulialik" this clay is covered by 1.5–3 m of arenaceous deposits consisting of sand below and gravel with rounded boulders above. In the clay were found shells, including *Pecten islandicus* and *Mytilus edulis*. As far as can be seen from his descriptions, the relationships between the glacial and marine deposits are very like those found in Godthåbsfjord (see pp. 96–97). It seems from the aerial photographs and the Geodetic Institute's maps that the outer moraines at "Qaersutsiaq" valley are cut at least by one terrace, at c. 50 m a.s.l.

8.4.3. Majorqaq area

The area includes the three east-west trending valleys, "Quvneq", Majorqaq and "Ilulialik". In all three valleys are ice margin deposits which slope down towards the west, but in none has a terminal moraine been seen. Presumably they have been removed by recent river erosion.

A more westerly situated stage is present in these three valleys also and is clearly a continuation of the deposits at the entrance to the "Qaersutsiaq" valley. In addition, the eastern stage is composite in character, especially around "Ilulialik". Its deposits have a trend parallel to the deposits of the more westerly stage, but are in two series situated 30–50 and 50–80 m lower respectively.

These moraines around Lûtiviup nunatarssua and "Ilulialik" are of special interest. Their distribution and form indicates that they have been formed by a lobe from the Inland Ice lying between the two large ice caps on the Sukkertoppen highlands. Their proximity to them indicates that the local ice caps have never been much more extensive than now (fig. 41).

The lower glaciation limit which is a prerequisite of an expanded Inland Ice could be the result of either lower temperatures or higher accumulation. Had accumulation been significantly greater than now, the local ice caps would have expanded also. On the other hand, if temperature decreased sufficiently to lower the glaciation limit by some 100 metres, there would only be an insignificant increase in the accumulation area of the ice caps, because of the steep form of the Sukkertoppen plateaus. Thus the implication is that the advanced position of the Inland Ice recorded by the ice margin deposits was due essentially to lower temperatures.

The same argument can be used to set an upper limit to the amount by which the glaciation limit was lower. If it had been more than 300 metres then the present ice caps around the highest points 870 m between

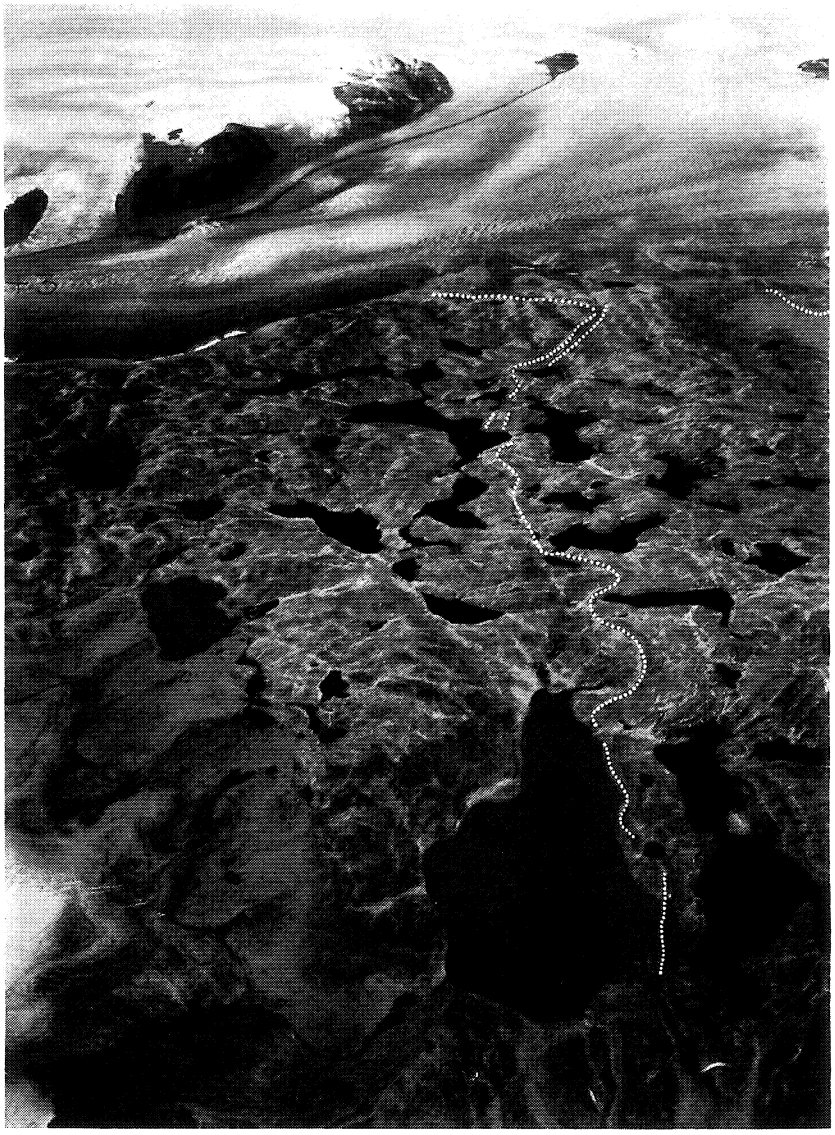

Fig. 41. The uppermost moraines at Lûtiviup nunatarssua, north of Søndre Isortoq, seen from the west. Geodetic Institute's route 505 D–Ø, no. 4720 (20.8.1948). Copyright Geodetic Institute.

"Ilulialik" and Majorqaq (Lûtiviup nunatarssua area) and 930 m on Quvnerup qáqâ (see plate 3 and fig. 42) would have been larger than now, destroying the ice margin deposits from the Inland Ice lobe.

It is not possible to give much information about the elevation of the Inland Ice at the time of formation of the outer zone in the area.

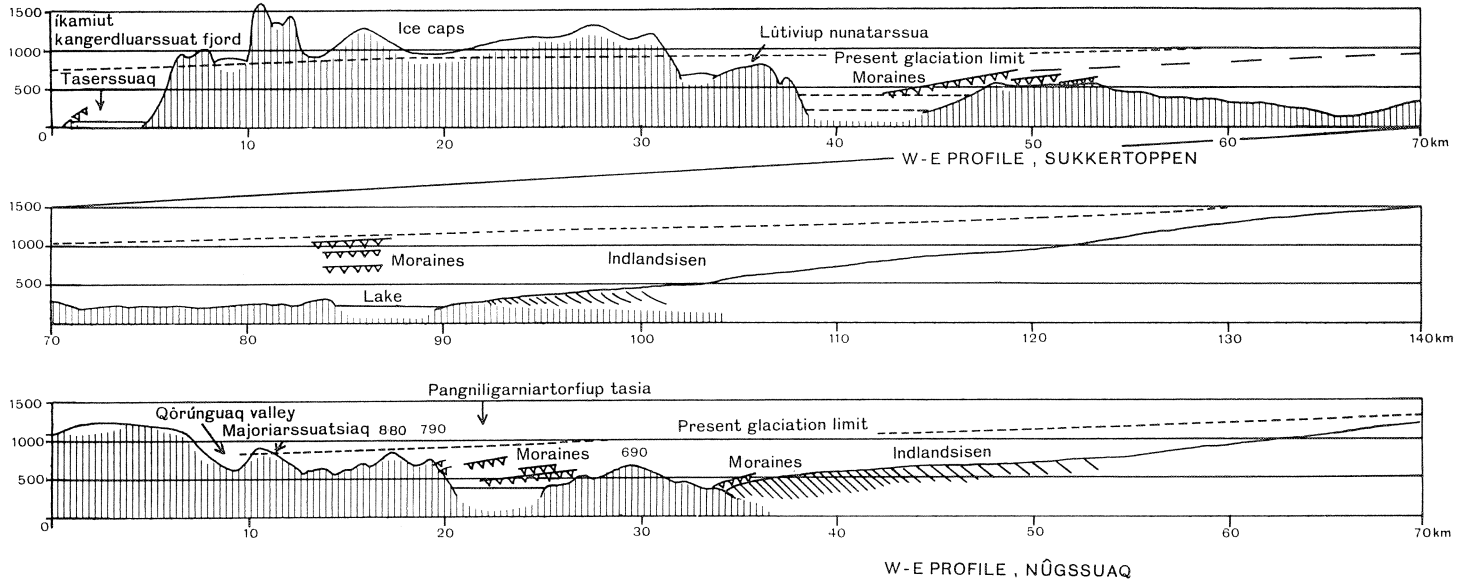

Fig. 42. Profile across Sukkertoppen district compared with a profile across the inner part of the Nûgssuaq peninsula. Instead of íkamiut, read Íkamiut.

The highest ice margin deposits on a nunatak north of "Kingingnerssuaq" (see plate 3) are at c. 1000 m a.s.l. whilst the present surface of the Inland Ice there is at 700 m a.s.l. As the profile in fig. 42 shows, the deposits are probably to be correlated with the two phases or stages of moraines recognisable at Lûtiviup nunatarssua further west.

8.4.4. The area from the Sukkertoppen ice caps to Qangátap kûa

Under the present conditions the easternmost of the local Sukkertoppen ice caps is confluent with the Inland Ice above 900 m a.s.l. towards the south of the area. The region is largely a plateau decreasing in height towards the north from 1300 to c. 700 m a.s.l.

The ice margin deposits have been mapped from aerial photographs. They consist of frontal and marginal deposits in the valley and on wider plateaus, and of nunatak moraines around isolated minor hills or higher plateaus. From their altitudinal relationships the nunatak moraines can be seen to be in two groups, only the lowermost of which can be considered as belonging to the outer zone. This one defines a former surface of the Inland Ice, situated at c. 1200 m a.s.l. over Tasersiaq lake and at 700–800 m a.s.l. near the river Qangátap kûa immediately south of the Umîvît branch of Søndre Strømfjord. The surface of the Inland Ice therefore must have been 400 to 800 m above the present Inland Ice margin.

8.4.5. Umîvît and Søndre Strømfjord

In Umîvît (see plate 3 and fig. 43) terraces of marine clay, up to an altitude of 40 to 50 m a.s.l., surround its inner part. Above this altitude the clayey-sandy deposits pass into gravel with rounded boulders. In the lower marine clay concretions with shells are abundant.

Above this system of marine and fluviatile terraces there are numerous moraine and kame terraces between 330 and 220 m a.s.l. The moraines descend towards the fjord, but they disappear on the steep mountain slopes before they come into contact with the marine terraces. However, it seems probable that the moraines surrounding Umîvît are older than a 45–50 m sea level.

The deposits in the interior part of Søndre Strømfjord proper are shown on the map and the profile in fig. 34. From the head of the fjord to Ravneklippen, the valley is dominated by terraces situated 15 to 30 m above the present river. The lowermost parts of these terraces consist of clay, containing shells, including *Portlandia arctica*. Near Ravneklippen, transitions from a lower clay to an upper fluviatile gravel are exposed in the profiles along the river at 25–35 m a.s.l. A sea level between 25

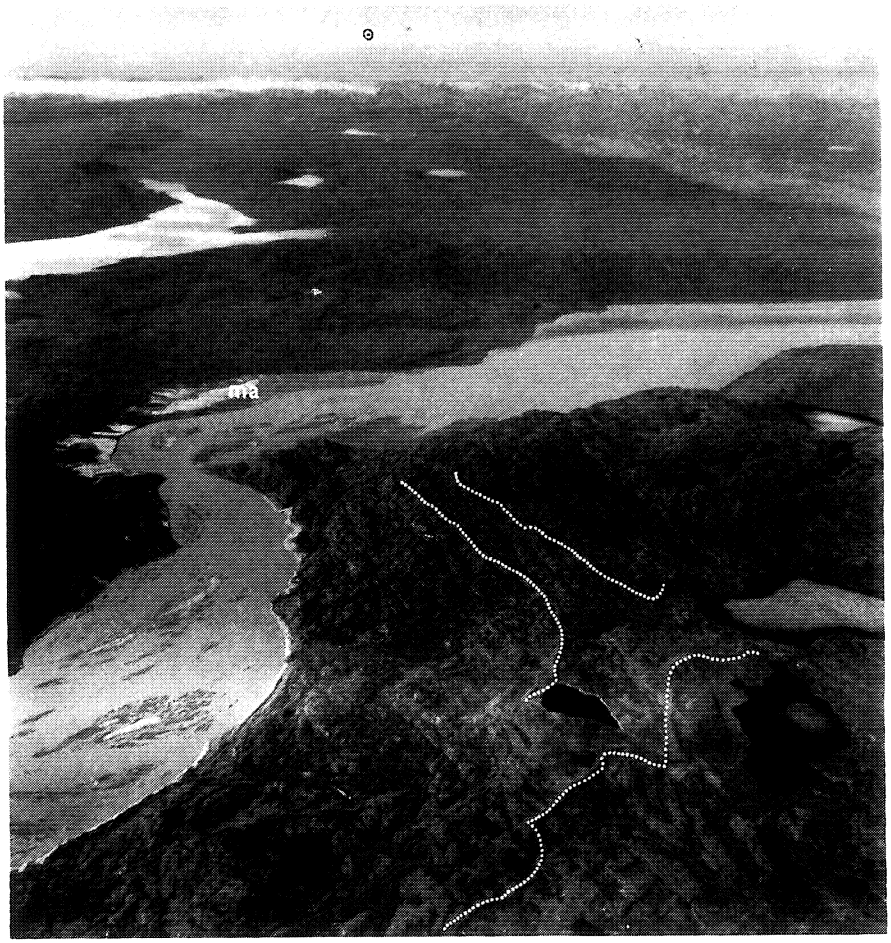

Fig. 43. Umîvît branch of Søndre Strømfjord. In the centre are two moraine ridges of the outer zone and at the left at sea level, a white coloured area of marine deposits (ma). Geodetic Institute's route 505 HV no. 4480 (17.6.1948). Copyright Geodetic Institute.

and 35 m a.s.l. is therefore younger than the moraines which extend along the valley out to Strømfjordshavn ("Camp Lloyd"). Terraces in the interior part of Søndre Strømfjord valley east of Ravneklippen are possibly connected with the deposits of the inner zone, described earlier.

Near Strømfjordshavn the eastern phase of the moraine system passes into a system of kame terraces around 60 m a.s.l. At this altitude, the material is still coarse, cross-bedded fluviatile gravel with rounded numerous boulders. The shallow inclination of these terraces relates their formation with a sea level at 50–60 m a.s.l.

As in other areas, several moraines were deposited during the recession of the Inland Ice from the outer zone, such as the especially well developed ones around Taserssuatsiaq ("Lake Ferguson").

8.5. Holsteinsborg and Egedesminde districts

The area is low and hilly with the present Inland Ice margin at 400–500 m a.s.l. in the south and 100–200 m a.s.l. in the north.

8.5.1. Isúnguata sermia to Ipiutârssûp nunâ

The southernmost part of the area around Isúnguata sermia was described by O. NORDENSKIÖLD (1910, 1914). He reported that the gneisses of the area were deeply weathered even close to the ice margin, which he took to be evidence for the existence of ice free areas throughout a long period of time (NORDENSKIÖLD 1914, p. 639). He mentioned the existence of eskers and "walls" (*i.e.* moraines) but gave no further information about them.

The aerial photographs show that between Søndre Strømfjord (Strømfjordshavn) and Isúnguata sermia glacier scattered moraine heaps rather then linear ice contact features proper are the dominant feature. Not until around Isúnguata sermia are fresher and more continous moraines met with. From their position relative to the present ice margin, it is possible that they belong to a younger phase or stage of the outer zone than the moraines further south. In the immediate vicinity of Isúnguata sermia, the deposits lie between 500 and 600 m above the present glacier front, which itself is situated near sea level. They imply that at the time of their deposition the front of Isúnguata sermia must have been 10–20 km further to the west (see fig. 44). Nothing is reported, or can be deduced from aerial photographs, about the possible relationships between marine and glacial features in the Nordre Isortoq valley west of Isúnguata sermia.

North of Isúnguata sermia, the ice margin deposits can be followed on aerial photographs as far as the northern part of Eqalungmiut nunât. In the central part of this stretch they are situated c. 700 m a.s.l. and 10–15 km from the present ice margin (cf. p. 88).

At the glacier of Inugpait qûat, the outer zone deposits descend towards the valley of Kûk. Here also, as in the valley of Nordre Isortoq, the valley sides are steep and the recent alluvial plains widespread and no remnants of older ice margin deposits are visible on the aerial photographs. A single terrace can be discerned c. 11 km north of the front of Inugpait qûat glacier. It has its surface situated between 50 and

Fig. 44. Isúnguata sermia glacier (loc. 35 of plate 2). On the left side of the picture are the moraines from the outer zone (dots). Geodetic Institute's route B 23 A–L, no. 92. Copyright Geodetic Institute.

100 m a.s.l., but the relationship between these deposits and the moraine system of the outer zone is unknown.

8.5.2. Usugdlûp sermia

The ice margin deposits plotted in this area on plate 3 have been mapped from aerial photographs. The morphology of the area between the lake of Tycho Brahes Sø and Usugdlûp sermia has been described by Jahn (1938). He reports the existence of abrasion terraces at 25–