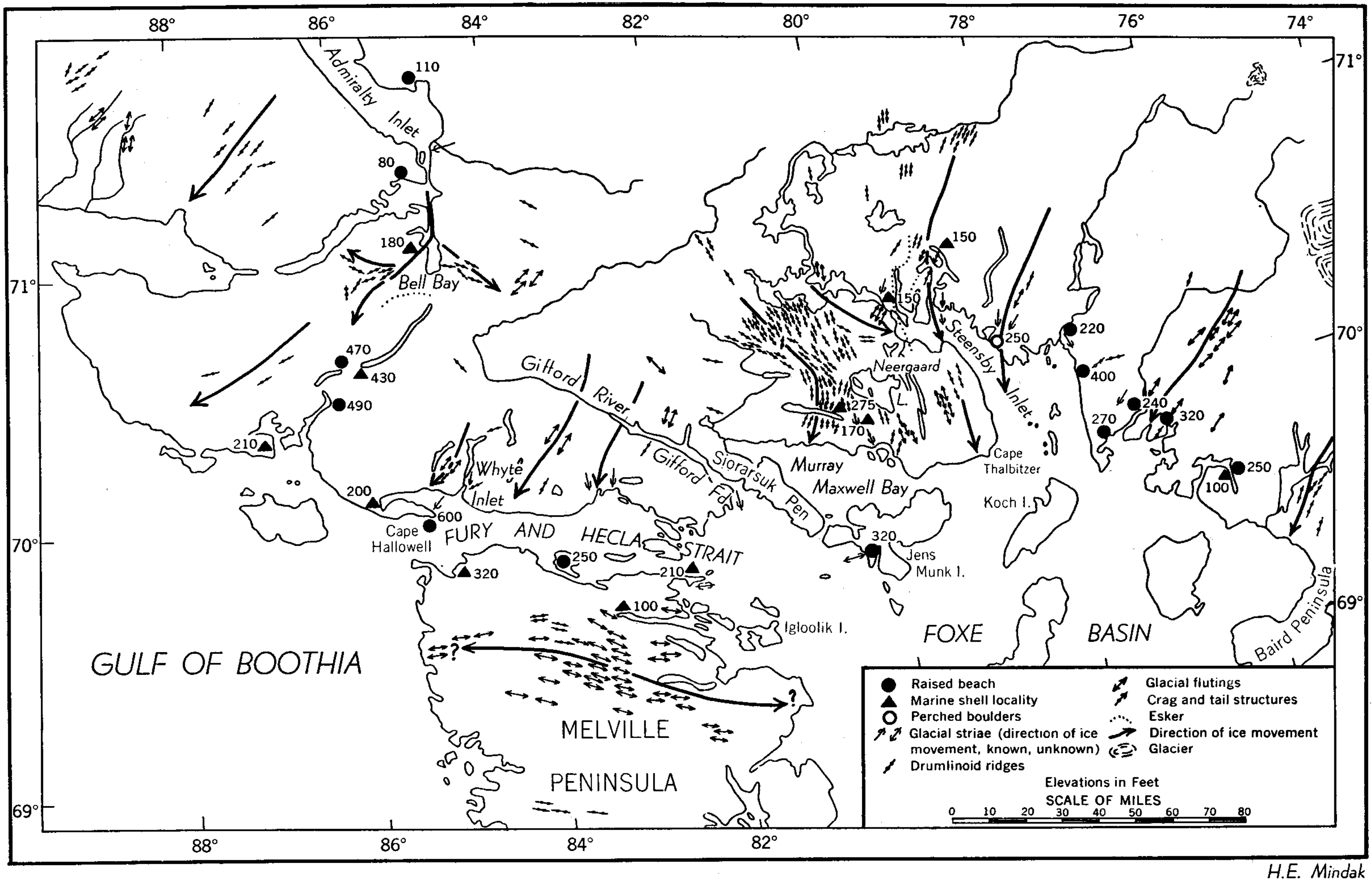

Fig. 1. Map showing features indicating marine transgression and ice movement.

PATTERNS RESULTING FROM GLACIER MOVEMENTS NORTH OF FOXE BASIN, N.W.T.*

R. G. Blackadar†

Introduction

Foxe Basin, a relatively shallow inland sea, is bounded on the north and east by Baffin Island and on the west by Melville Peninsula. It opens to the south into Hudson Bay by way of Foxe Channel; on the northwest, Fury and Hecla Strait, a narrow, deep channel, connects it with the Gulf of Boothia.

The first white men to see the part of the region to be discussed in this paper were members of an expedition under the command of Sir Edward Parry, R.N., who passed the winter of 1822-3 at Igloolik, just south of the eastern entrance to Fury and Hecla Strait. C. F. Hall, an American, visited the region in the late 1860's in the course of his expeditions in search of relics of the ill-fated Franklin expedition. In 1911 a Canadian expedition, based at Arctic Bay, several hundred miles to the north, explored part of the western limits of the region and in 1913 A. Tremblay, a member of a private prospecting expedition working out of Pond Inlet, travelled through much of the area. Members of the Danish Fifth Thule Expedition examined parts of this area between 1922 and 1924 and in the reports of T. Mathiassen are found the first precise comments on geology and physiography (Mathiassen, 1933, 1945). Parts of the area were examined by members of the British-Canadian Arctic Expedition in the years 1937-41 and by members of the *Nauja* Expedition in 1949.

This paper incorporates data collected by the author during two field seasons, 1956 and 1957, while conducting a mapping programme for the Geological Survey of Canada in the northern Foxe Basin district and expands information shown on the 1958 edition of the Glacial Map of Canada.

Physiography

The map-area includes uplands, plateaux, and lowlands. As outlined by Fortier (1957, p. 398) these are: on the east the Baffin uplands; in the south-central and western parts, the Foxe Basin lowlands and the Southampton-Melville uplands; in the northern part of the area the Jones-Lancaster plateaux and the Boothia-Regent lowlands.

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In general, the areas underlain by Precambrian rocks, granites and older sedimentary-volcanic rocks, and younger sandstones and slates, are high and form the uplands with some elevations in excess of 2,000 feet, whereas the parts of the district underlain by Palaeozoic strata form the lowlands, which rarely rise above 100 or 200 feet above sea-level. Thus both north and south of Fury and Hecla Strait the land rises steeply from the sea to form a rather rolling upland surface at between 1,000 and 1,500 feet in which drainage is well established. A similar condition prevails along the east coast of Foxe Basin whence the land rises steadily towards the mountains of eastern Baffin Island. In contrast, the islands in the northern part of Foxe Basin are very low, covered with innumerable small ponds and lakes and surrounded by extensive tidal flats.

Although Precambrian areas are generally high, north of Steensby Inlet a low valley floored by granitic gneiss extends northward, bounded on the east by the Baffin uplands of Precambrian rocks and on the west by Palaeozoic outliers of the Jones-Lancaster plateaux; north of Murray Maxwell Bay limestone plateaux rise above low Precambrian areas. These features may be the results of large northwest-trending block faults.

The greater part of the map-area is mantled by surficial deposits. In many cases these deposits form only a thin veneer over the bedrock. This is especially true of the raised beaches. Elsewhere, however, drift deposits composed of light-grey clay and angular limestone fragments appear to exceed several hundred feet in thickness. Such an area, south of Neergaard Lake is illustrated in Fig. 2. Here light-coloured, unconsolidated material lies unconformably above darker Precambrian granitic gneiss. In this locality the drift is about 200 feet thick.

Ice movement features

In the course of preliminary work for the geological reconnaissance in northern Foxe Basin district the writer examined about 1,600 trimetrogon air photographs. It soon became apparent that in many parts of the area terrain patterns were primarily the result of glaciation. Fig. 1 presents the results of the plotting of data from both air photo study and ground observations. Areas in the interior were not reached during the reconnaissance mapping programme but sufficient key areas were seen to warrant extrapolation by means of the air photographs to these inland stretches.

The features plotted include drumlinoid ridges, glacial flutings, crag-and-tail structures, and glacial striae. Of these the drumlinoid ridges are the most widespread and are best developed north of Murray Maxwell Bay near the centre of the map-area. Here a clayey soil containing angular slabs of limestone, some several feet in length, has been moulded into a series of long, parallel ridges. The size of the drumlinoids varies greatly throughout the area, ranging from those shaped like over-turned canoes, slightly steeper at one end than at the other and averaging a few hundred feet in length, to those illustrated in Fig. 2, which exceed a mile in length and are

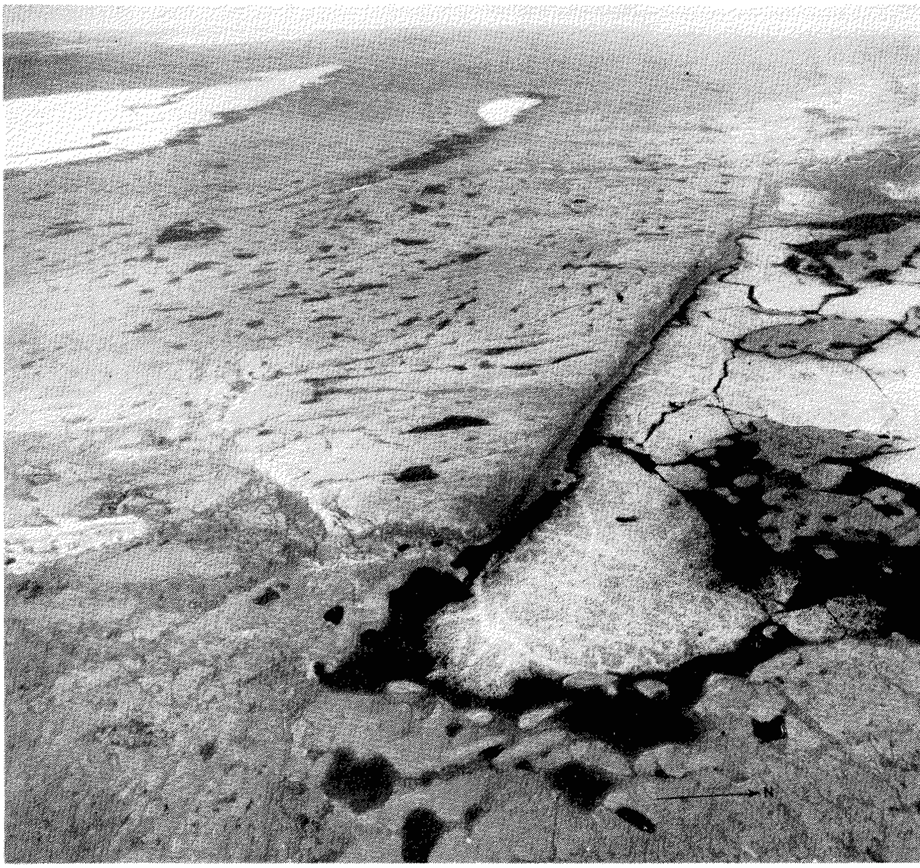

Photo: R.C.A.F.

Fig. 2. Looking west over Neergaard Lake, Baffin Island. Drumlinoid terrain lies south and west of the lake and occupies a 500-foot high plateau underlain by Precambrian rocks.

at least 50 feet high and may be 1,000 feet wide. These latter grade into glacial flutings, structures developed in drift deposits and differing from drumlinoids in that the relatively short *en echelon* pattern characteristic of drumlinoid fields is replaced by parallel ridges and furrows, which may extend for many miles.

Crag-and-tail structures were observed in several parts of the map-area. Southeast of Neergaard Lake isolated knobs of bedrock rise about 50 feet above a low, drift-covered plain. The northwest faces of these knobs are steep and rugged, whereas on the southeast side the bedrock is smooth and rounded, and beyond the outcrop a ramp or tail of drift merges the outcrop knob with the plain.

Fig. 2 primarily shows the pattern developed by the ice as it moved across the drift-covered area west of Neergaard Lake. The more regional trend of the ice-flow features is illustrated by Fig. 1. The Neergaard Lake photograph also shows other features of interest. The Precambrian rocks

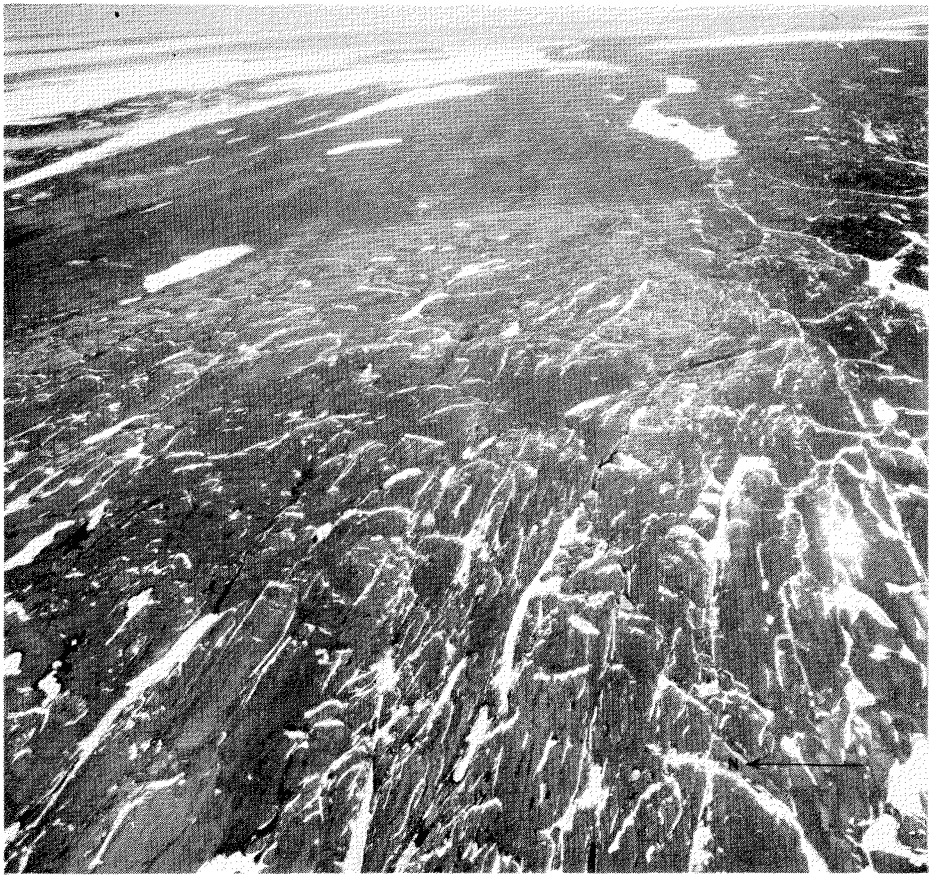

Photo: R.C.A.F.

Fig. 3. Northern Melville Peninsula, looking east toward Foxe Basin. Fluted drift and sculptured bedrock in foreground.

that form a steep, north-facing scarp, overlain by drift on the southwest side of the lake, have been mentioned. The light-coloured patch on the extreme left hand side of the illustration is a flat-topped, sandy moraine, which rises about 300 feet above the surrounding plain. The sides of this hill are steep, sloping at about the angle of repose of the sandy material. Just to the west, above this feature are curved traces of former beach-lines and to the east, in the foreground, can be seen the innumerable small ponds and lakes so characteristic of low, glaciated Precambrian bedrock terrain.

The glacial flutings developed south of Fury and Hecla Strait are shown in Fig. 3. The east-facing bedrock hills suggest, but by no means prove, that the ice movement here may have been from the southeast.

Areas of drift showing no pronounced orientation, such as that seen in Fig. 4, cover large expanses; they are not indicated on the maps accompanying this paper. In the foreground of Fig. 4 are a few patches of polygonal patterned ground, a feature commonly found in regions underlain by permafrost.

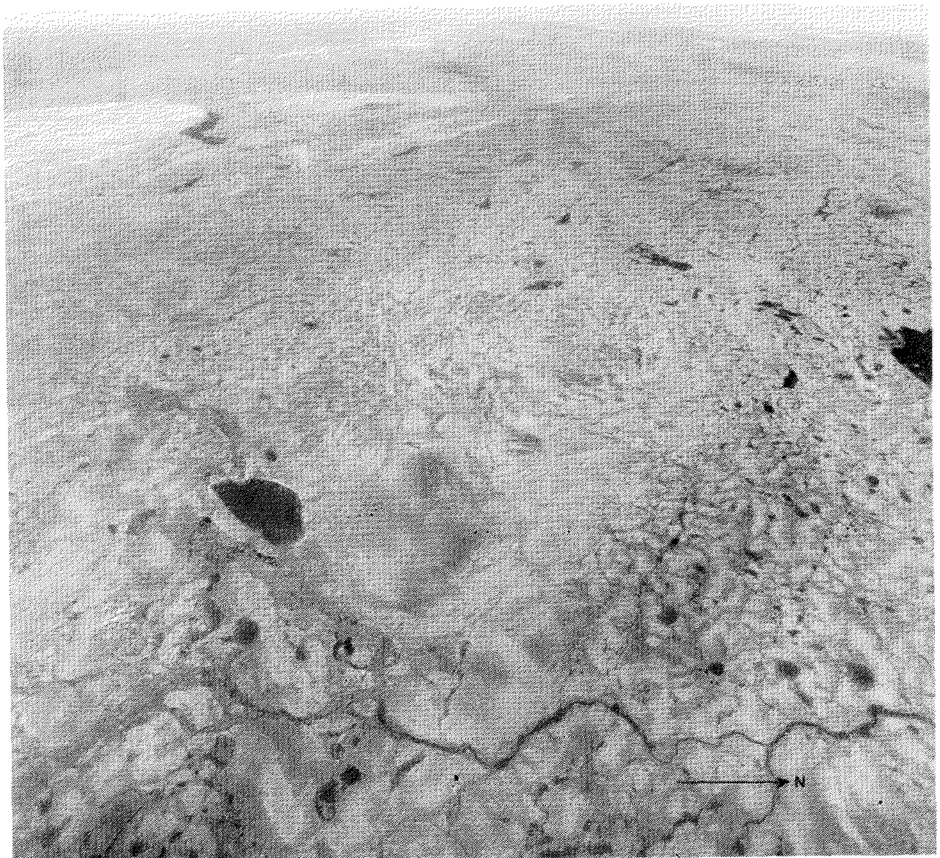

Photo: R.C.A.F.

Fig. 4. Unoriented drift east of Bell Bay, northern Baffin Island. Light coloured surface in upper left is presumed to be underlain by Palaeozoic sedimentary rocks.

Eskers are not abundant in the region but several prominent ones were mapped. That southwest of Bell Bay, in the northwestern part of the map-area, forms an outstanding landmark, rising 170 feet above the surrounding plain covered with numerous raised beaches. From a distance the esker presents a rugged, serrated skyline, so that it might easily be mistaken for a ridge of bedrock.

Ice movement patterns

At present small ice-caps exist on high land in the eastern and northeastern parts of the map-area. In the past these were undoubtedly more extensive, but the relationships between the present ice-caps and the ice-flow features in the different parts of the area, as illustrated in Fig. 1, are not known.

In the northwestern part of the area the trend of glacial features is southwest, whereas east of Admiralty Inlet it is mainly southeast. At the south end of Admiralty Inlet Mathiassen observed glacial striae at south 80° west and these data are plotted on Fig. 1.

North of Gifford River glacial features are few, but south of this river and north of Fury and Hecla Strait the trend prevailing in the northwestern part of the map-area is continued. Glacial striae at Cape Hallowell and Whyte Inlet parallel the trend of drumlinoids and other features, a trend that crosses Gifford Fiord and River at right angles. The fiord, apparently a true fiord, being more than 600 feet deep with a shallow bar at the mouth and with 700- to 800-foot cliffs rising abruptly from the sea, may have been formed by glacial action along a major fracture in the bedrock. This erosion may have taken place early in the period of glaciation that caused the ice-flow features in the map-area; later, for some reason, the ice could no longer escape from the depression, eventually the fiord became filled with ice and was overridden by ice moving in a southwesterly direction. This may be the explanation for the presence of such a prominent feature athwart the prevailing trend lines. Indeed, at the mouth of the fiord Mathiassen mapped striae at south 10° east (see Fig. 1), which may reflect this earlier down-fiord movement.

On the south side of Fury and Hecla Strait the prevailing trends of glacial flutings are southeast and these trends are in accord with striae at the eastern entrance to the strait and on Jens Munk Island. Insufficient evidence is available from northern Melville Peninsula to determine the direction of ice movement; there is no reason to assume that the ice moved into Foxe Basin. Indeed, certain features shown in Fig. 3 suggest that movement may have been from the southeast across Melville Peninsula.

North and especially east of Foxe Basin the land rises gradually and merges with the high, uplifted mountains of eastern Baffin Island. East of Steensby Inlet and north of Baird Peninsula glacial flutings and striae trend southwesterly and it is tempting to suggest that the ice moved from the highlands in the northeast; however, this is only speculation as directional features were not observed by the author.

North and west of Steensby Inlet several different trends are discernible. The source of the ice that caused them is unknown, but they may have been formed by lobes extending from ice centred in the highlands of northeastern Baffin Island. North of Steensby Inlet and Murray Maxwell Bay striae and crag-and-tail structures indicate movement from the north. It would appear that lobes of ice moving southward from northeastern Baffin Island may have converged in the vicinity of Steensby Inlet and thence moved southward into Foxe Basin.

Marine features

The most striking terrain features in the northern Foxe Basin region are the abundant raised beaches. Indeed, islands like Igloolik, Jens Munk, and Koch, are almost devoid of rock outcrops and are composed primarily

Photo: R.C.A.F.

Fig. 5. Eastern Jens Munk Island, showing numerous emerged strand-lines, innumerable ponds, and broad tidal flats, which characterize the low islands and coasts of Foxe Basin.

of reworked limestone and shale fragments. Fig. 5 is typical of this terrain. The light-coloured beach material is separated by shallow ponds or swampy ground, which shows as dark-coloured patches on the air photographs. More than forty successive emerged strand-lines were observed inland from Cape Thalbitzer across a distance of 8 miles. Raised beaches of dubious origin have been reported from the interior of the map region; in some cases these may be the result of deposition in glacial lakes, but others may be of marine origin. Too little information is available to consider these areas at present.

Fig. 6 is an attempt to portray the maximum extent of the last marine submergence. Data used to determine the upper limits are the presence or absence of strand-lines or spits, marine shells, perched boulders, wave-washed outcrops, wave-cut cliffs, and wave-washed drift areas. Fig. 7 illustrates this last criterion. Here well-formed beaches wrap around, but do not cover an elevated nose of drift showing south-trending flutings. Such a hill probably formed a point or island during the maximum submergence

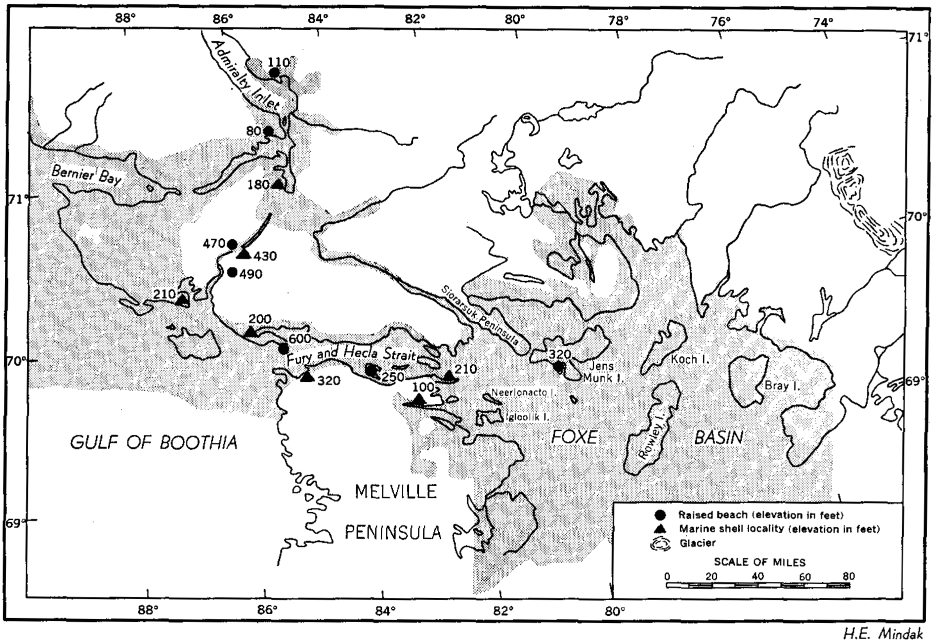

Fig. 6. Map showing presumed extent of marine transgression.

of the area. It is considered improbable that the flutings could be so well preserved had the land been covered by the sea. Areas such as that shown in Fig. 7 commonly are lower in elevation than the highest well-preserved beaches in the map area. It is possible that such places were covered by ice during the period of maximum submergence when the high-level beaches were being formed. On the other hand, land emergence may not be proceeding at equal rates over the entire region and although the highest beaches in the eastern part of the area are lower than those at Cape Hallowell on Fury and Hecla Strait, they may possibly be contemporaneous. In general, the elevations noted on Figs. 1 and 6 are those of the highest well-preserved beach in a particular area and the maps should not be considered as a representation of conditions at any specific time.

Rate of emergence

A radiocarbon dating is available from archaeological material collected by J. Meldgaard from a raised beach on Igloolik Island (Meldgaard, 1958). An age of 1750 B.C. ± 300 years is quoted for the material, which came from a beach 51 metres above present sea-level. This suggests a rate of emergence of about 4.5 feet per century. This value cannot, of course, be extended with any assurance to other parts of the region.

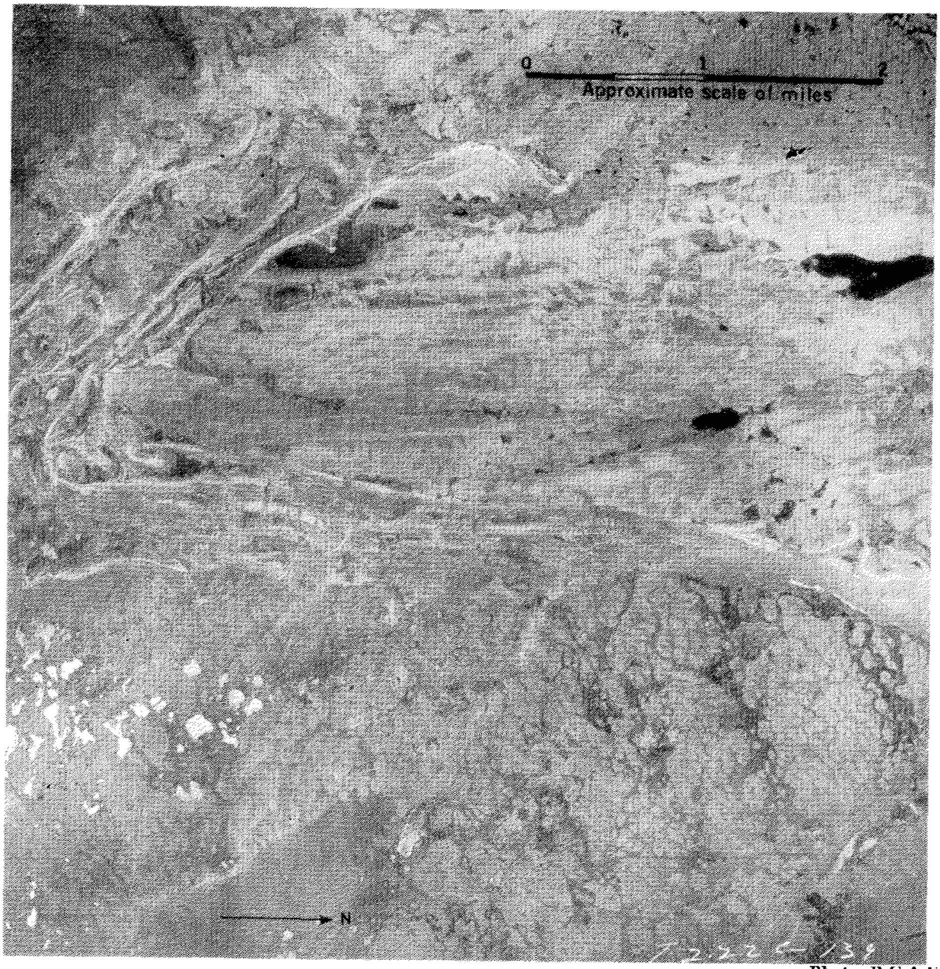

Photo: R.C.A.F.

Fig. 7. Emerged strand-lines formed around fluted drift ridge. Low outcrops of granite are visible on both sides of the hill. Note the unoriented drift areas in lower right, which are a few hundred feet lower than the top of the ridge. Six miles north of the east entrance to Murray Maxwell Bay, Baffin Island.

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