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G. Falconer

GEOGRAPHICAL BRANCH
Department of Mines and
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P R E F A C E

Although glaciological research in Canada was initiated long before 1957, the impetus given to such work by the International Geophysical Year has continued to the present time, when a number of projects concerned with various aspects of glaciology are in progress. A difficulty invariably arises in the discussion of glaciers in Canada because most of them are unnamed and often imprecisely mapped. It was partly to overcome these difficulties, and in response to a recommendation of the International Union of Geodesy and Geophysics, that an inventory of Canadian glaciers was begun during the International Geophysical Year. This work received support from the National Research Council and the Defence Research Board and was carried out at the Geophysical Laboratory of the University of Toronto under the supervision of Professor J.T. Wilson.

The work was begun by devising a reference system by which it became much easier to systematically acquire and file pertinent information on glacier variations in the form of records, photographs and maps. The Geographical Branch is now continuing and expanding this system as part of its analysis of terrain conditions in Canada and its glaciological research program. The work has been endorsed by the Sub-Committee on Glaciology of the Associate Committee on Geodesy and Geophysics of the National Research Council, which further recommended that the Geographical Branch become the national repository for all glaciological data in Canada.[1]

The objectives of the inventory are to compile material dealing with all glaciers, ice caps, and other forms of permanent snow and ice existing within the boundaries of Canada, and to use this material for the publication of regional inventories. To place these objectives on a practical basis the glacierized areas have been divided into working units, the first of which covers the area of Bylot Island and northern Baffin Island.

N.L. Nicholson,
Director,
Geographical Branch.

[1]Old and new photographs, maps and records which give information on glaciers in Canada will be gratefully accepted for permanent filing or on loan for copying and should be sent to The Director, Geographical Branch, Dept. of Mines and Technical Surveys, Ottawa.

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GLACIERS OF NORTHERN BAFFIN AND BYLOT ISLANDS

INTRODUCTION

Variations in the margins of glaciers have been studied for many years and it has long been recognized that the record of a glacier's advances or retreats, obtained from actual measurements or deduced from geological, botanical or historical observations and from a comparison of pictures, photographs, and maps, provides some indication of climatic change. However, the effect of climatic change on the volume of glacier ice is subject to many varying influences, and changes in the volume of glacier ice may not be fully reflected in the termini of glacier tongues or the edges of ice caps (Thorarinsson, 1940).

Unfortunately our knowledge of glacier variations is often derived from indirect sources, such as old maps, photographs, other pictures and descriptions not primarily concerned with the study of glaciers. Such sources are almost always concerned only with the terminal zones of valley glaciers. Nevertheless it has been possible to compile much of this indirect evidence of glacier activity so that for some parts of the world the record of marginal variations is reasonably complete, at least for the past 100 years. Particularly valuable have been the contributions made by the American Geographical Society whose Geographic Study of Mountain Glaciation in the Northern Hemisphere, compiled under the direction of Dr. W.O. Field, is of outstanding importance. Naturally areas which have been extensively travelled from early times have yielded most records of glacier activity while in others the paucity of information is in contrast to the widespread occurrence of glaciers. Few early records of glacier positions in Arctic Canada exist and there is little evidence on which to deduce any fluctuations in historical time; this is not the case in southwest Greenland, for instance, where records are much more numerous (Weidick, 1959).

This report attempts to bring together the sparse existing information on recent glacier variations relating to northern Baffin Island and Bylot Island. Thanks are due to the following organizations who kindly supplied photographs from their collections - the Public Archives of Canada, the National Museum of Canada, the Northern Coordination and Research Centre of the Department of Northern Affairs and National Resources, and the National Air Photographic Library.

Sources of Information

Comparatively few sources of information have been discovered relating to this area. Photographic records have not been found earlier than the first years of this century, and useful descriptions

prior to 1900 are quite rare. In recent years high altitude vertical air photographs have been produced and these can be compared with trimetrogon air photographs usually dating from ten years or so earlier. In cases where the vertical air photographs of the earlier and later series coincide in showing a glacier it has been possible to check for visible signs of glacier variation. The termini of some glaciers were visited and photographed in 1961.

A difficulty arises in referring to specific glaciers. Most glaciers in this area are unnamed, or the locally used Eskimo names do not appear on the maps. The maps are often inaccurate in the delineation of glaciers, although it is expected that improved contour maps of the area eventually will be available. To facilitate reference, glaciers specifically dealt with in this report have been numbered to correspond with an index map based on recent air photo mosaics (Figure 43). The Brodeur Peninsula, Borden Peninsula, Bylot Island, and part of northeast Baffin Island are dealt with in turn and reference is made only to those glaciers for which there exists some evidence for deducing possible fluctuations.

BRODEUR PENINSULA

The topography of the northern part of the Brodeur Peninsula is uniform. Mainly horizontally lying Palaezoic sedimentary rocks, including limestones, dolomites and sandstones, form a plateau approximately 550 metres above sea level. The plateau is dissected by a network of incised stream and river channels. The depth of incision and the intensity of the drainage pattern increases towards the edges of the plateau where there is an abrupt descent to the sea. The coastline is made up of prominent cliffs and talus slopes, but in places small cuspate forelands of beach material have been built up by wave action at the base of the cliffs.

Little is known about the small ice caps which occur in the northeastern part of this plateau and it has been summarized by Field, who refers to Mathiassen (1953) and Low (1906) (Field, et al. 1958). Only one other brief reference to these glaciers has been found (Blackadar, 1956).

The photographic data so far obtained are equally limited and consists of a set of oblique air photographs dated 1946, trimetrogon air photographs dated 1948 and vertical air photographs dated 1959. No ground photographs have yet come to light.

The glaciers are concentrated in five groups, each consisting of an apparently thin ice field with associated peripheral outlets and tenuously connected ice masses. All are on the plateau surface at

approximately 550 metres above sea level. Low refers to the Brodeur Peninsula glaciers in the following words - "a thin ice cap covers the northern part of the limestone plateau on the east side of Prince Regent Inlet" (Low, 1906, p. 123). It seems unlikely in spite of the recent wasting of the smaller ice fields on the plateau that a once continuous ice cap could have dwindled so much in the past 58 years as to produce the present distribution of ice in which the ice fields are separated by distances of up to 8 kilometres. Low's description should perhaps be taken as a generalization. The recent peripheral wastage of small and apparently stagnant ice masses on the western side of the northern group (determined from recent air photographs) has been approximately 23 metres a year. Even if this rate had persisted for the last 58 years and had equally affected the larger ice caps, the ice cover would not have been continuous in 1904. A more extensive snow cover in 1903-4 might explain Low's description.

In 1954 Blackadar carried out a geological reconnaissance in the area and mentions that "four small ice-fields cap the plateau west of Admiralty Inlet, the most southerly of these is in the latitude of Arctic Bay and is inland from the north end of Turner Cliffs" (Blackadar, 1956,p. 5). According to the air photographs of 1948 and 1959, however, there are five main ice fields. Blackadar further mentions that "small reportedly stagnant ice caps are present in the northern part of the map area, but there is widespread evidence that formerly ice covered much of the area" (Blackadar, 1956, p. 8); this refers also to the small ice caps on Borden Peninsula to the west. It was suggested that "small ice caps similar to, but more active than these found at present, probably developed following the retreat of the postulated continental ice sheet" (Blackadar, 1956, p. 20).

An examination of recent air photographs (1959) gives the impression that the Brodeur Peninsula ice caps are almost inactive and that they have exerted little erosive influence on the topography of the plateau, except probably as sources of seasonal meltwater feeding the streams which dissect the area in a widespread system of gullies and ravines. Some of the ice caps have outlet tongues which occupy deeply incised, often V-shaped, valleys, that show little sign of glacial erosion. Few crevasses or other evidences of ice movement are visible, and few well developed moraines can be detected on or off the glaciers. In reporting Freuchen's journey along the north coast of Brodeur Peninsula in 1924 Mathiassen mentions that "in two ravines glaciers were seen, and at their foot, large moraines" (Mathiassen, 1933, p. 35). This probably refers to the small outlet tongues (Nos. 3 and 4) of glacier No. 2. On oblique air photographs dated 1946, a number of small outlet glaciers and ice patches can be seen occupying the gullies and ravines

facing Lancaster Sound. In the case of Nos. 3 and 4, it seems possible that the moraine-like deposits at their termini are accumulations of debris which have slid over the steep glacier surface after breaking away from the valley sides. If this is the case then they are protalus ridges rather than true moraines, in the sense of resulting from direct transport and movement of material by the ice.

Notes on specific glaciers (see Figure 43)

No. 1 Assuming that the small glaciers reported by Low in north Somerset Island are a form of semi-permanent snow patch (Taylor, 1956, p. 49), ice field No. 1 is one of the most westerly on the south coast of Lancaster Sound. U.S. Navy coastal photographs of 1946 show distant views of the Brodeur Peninsula glaciers and the only other information concerning them is obtained from RCAF trimetrogon air photographs of 1948, and vertical air photographs of 1959. A comparison of air photographs taken after the interval of 11 years since 1948, indicates a distinct marginal and vertical wastage, averaging 180 metres around the edges of glacier No. 1 (Figure 1). The latest photographs taken on August 24th, 1959, show the higher surfaces of the glacier apparently water logged, with numerous small pools and slushy areas and a continuous system of surface drainage runnels.

No. 2 The only references to this glacier are by Mathiassen who reports that, in 1924, "the land between Cape Crawford and Cape York has a thin ice cap, from which three small glaciers run down through the ravines." (Mathiassen, 1933, p. 35). Referring to the coastal ravines immediately north of the ice cap he mentions Freuchen's observation of two glaciers with large moraines. As stated above, the existing air photographs suggest that the debris accumulations at the foot of these small steep outlets (Nos. 3 and 4) are not true moraines. Observations from a passing ship in 1961 support the latter interpretation. Ice cap No. 2 is the largest on the Brodeur Peninsula but judging from the oblique air photographs of 1946 the ice is probably rather thin (Figure 2).

No. 5 The ice cap inland from Cape Crawford was described by Mathiassen as scarcely moving in 1924. Associated with the main mass of the ice are numbers of small ice patches and semi-permanent snow patches occupying gullies and funnel-shaped embayments in the layered sedimentary rock sides of the ravines.

BORDEN PENINSULA

Borden Peninsula has a rougher and more diverse topography than Brodeur Peninsula. Although

the same plateau landscape occurs, it is much more dissected by larger river systems with wider valleys, older rocks being revealed in some places by the dissection of the sedimentary rocks of the plateau. Prominent dykes and structural weaknesses trending southeast - northwest have influenced the drainage pattern in the central part of the peninsula.

Long fiords and inlets occur on the east coast, and both east and west coasts have prominent cliffs. In the north however, the plateau slopes less abruptly to the sea. Dissection of the plateau, especially in the north where most of the ice caps are situated, has produced a hilly landscape with heights in places reaching 900-1200 metres above sea level.

With the exception of a small ice cap twenty miles west of Tremblay Sound and groups of small ice masses south of Adams Sound and north of the Alfa River, all the glaciers are in the northern half of the peninsula. The three largest ice caps are between Low Point in Navy Board Inlet and Elwin Inlet in Admiralty Inlet, and from the meagre data available it is believed the plateau on which the ice occurs is from 600 to 900 metres above sea level.

Few people have described the northern interior of Borden Peninsula; Low stated that "the northern land between Admiralty and Navy Board Inlets is ice-covered, with glaciers filling its seaward valleys, and with the separating rocky ridges rising dark and forbidding from the general field of white" (Low, 1906, p. 123). Mathiassen, reporting the work of the Fifth Thule Expedition in the area, does not make any direct reference to the Borden Peninsula glaciers, except those which reach the sea in Navy Board Inlet. Blackadar mentions that "two larger ice caps are present on the highland east of Elwin Inlet and several small snowfields are found south of Adams Sound." (Blackadar, 1956, p. 5).

Photographic information consists of oblique air photographs of the coast dated 1946, trimetrogon air photographs dated 1948 and 1949, and vertical air photographs dated 1958. In addition to these air photographs there are a few old photographs taken from ships travelling past the group of outlet glaciers that reach the sea in Navy Board Inlet.

Notes on specific glaciers (see Figure 43)

No. 6
1903-4

Two of the largest ice caps on Borden Peninsula are found due west of Low Point in Navy Board Inlet and from one of them (No. 6) outlet glaciers descend into Navy Board Inlet. Low's description of the Borden Peninsula glaciers in 1903-4, in which he mentions glacier-filled seaward valleys, therefore seems

to refer to ice cap No. 6. This is the earliest mention of this ice cap known so far.

1906

Bernier's account of the voyage of the C.G.S. "Arctic" in 1906 contains an indistinct photograph of the Navy Board Inlet glaciers flowing down from ice cap No. 6. (Figure 3). The photograph was made in August, 1906 and shows glaciers 8, 9, 10, and 11, apparently calving directly into the sea. Two small glaciers are visible in gullies north of Nos. 10 and 11 respectively. (Bernier, 1909, following page 10).

1909

Bernier sailed down Navy Board Inlet on August 31st, 1909 and noted, "At midnight, four glaciers were passed, having the appearance of four frozen rivers, running from a highway carved about 600 feet with higher land back of it. There is more freezing and thawing in that latitude, and the glaciers ever tending towards the coastline discharge into the inlet." (Bernier, 1910, p. 261). That all these glaciers calved directly into the sea in 1909 is proved by another statement from the same source - "fog obscured the view of the shore of Navy Board Inlet on September 1st. Several small glaciers discharged into the bay north of Low Point." (Bernier, 1910, p. 419).

1910

A distant photograph by Bernier indicates no major changes in the position of the glaciers since the photograph of 1906.

1921 - 1924

Unpublished photographs may have been taken by members of the Fifth Thule expedition. Mathiassen briefly refers to the Navy Board Inlet glaciers - "Still more to the south six glaciers run down, although the one on the north does not reach the sea" (Mathiassen, 1933, p. 44). It is difficult to account for the number of glaciers given here. The glacier reported as not reaching the sea may be No. 7.

1928

A photograph in the National Museum of Canada collection taken by R.M. Anderson in 1928 shows glaciers No. 10 and No. 11 (Figure 4). There appears to have been no significant change at all since Berner's photograph of 1906, nor do the small ice patches in gullies above the outlets show any signs of diminishing.

1944

In 1944 P.D. Baird photographed the termini of glaciers No. 10 and No. 11 (Figure 5). Baird's photograph, in the collection of the Department of Northern Affairs and National Resources, shows that parts of the termini of the glaciers still reached the sea.

1946

A series of excellent low level oblique air photographs taken in 1946 show glaciers No. 8 and

No. 9 (Figure 6). They are shown calving directly into the waters of Navy Board Inlet, displaying highly crevassed lower surfaces flanked by prominent moraines ending in the sea. The position of some lateral and terminal moraines of outlet glaciers flowing from this ice cap indicate a retreat from a former advanced position; this is also suggested by proglacial moraines elsewhere in northern Baffin Island, which have not yet been accurately dated. Perhaps the advanced moraines may be eventually correlated with the 'hochstands' of 1750 - 1800 identified in southwest Greenland and tentatively correlated by Weidick with glacier advances in the North Atlantic and Scandinavian area (Ahlmann, 1953), (Weidick, 1959). Recent glacier recession in southwest Greenland since the advanced positions of 1750 - 1800 seems to have been far more rapid than in northern Baffin Island and Bylot Island.

Dating from August 16th, 1946 is a series of U.S. Navy photographs taken from a ship in Navy Board Inlet showing all the east and northeast facing outlet glaciers of ice cap No. 6. No change in the position of the termini of Nos. 10 and 11 as they appear in Baird's photograph of 1944 can be detected. In this same series of air photographs glacier No. 7 also appears. The terminus of this glacier, which does not reach the sea, is fronted by an extensive outwash fan and the lateral and frontal remnants of two, and possibly three, old terminal moraines.

1948

A series of vertical air photographs taken in August 1948 from 9,000 ft. a.s.l. provides information on the position of the termini of Nos. 7, 8, 9, 10 and 11.

No. 7 No detectable changes took place between 1946 and 1948. Although the photograph shows only the extreme terminal part of the ice, the proglacial area is well shown. The white ice of the glacier seems to be superimposed on a bed of dead ice and morainic debris. Although stereoscopic photographs are not available it appears that the steep snout terminates abruptly, almost as a cliff. There are few conspicuous crevasses and little ablation debris is visible on the terminal ice surfaces. Moraines flank each side of the terminus and extend on each side of the outwash plain for about 400 metres.

No. 8 Compared with the low level oblique photographs of 1946 no changes could be detected. Even the details of surface markings, minute configuration of crevasses, etc. appear identical. The flanking moraines, as in No. 7, are visible and it can also be seen that the terminus definitely reaches the sea. A comparison with Bernier's 1906 photograph suggests slight thinning of the snout but no significant marginal retreat.

No. 9 Between 1946 and 1948 only very small detail changes appear to have taken place. The frontal

part of the glacier tongue seems to be afloat and the lower parts of the glacier are highly crevassed. Judging from Bernier's earlier photograph the snout was slightly thicker and extended farther out to sea in 1906, however the quality of the old photograph does not allow a safe estimate of the distance to be made.

No. 10 In the 1948 photographs, this glacier just reaches the sea at one point in its cliffed terminal face. No detectable alteration in position or surface configuration was observed in a comparison of the 1946 and 1944 photographs.

No. 11 No changes in the terminus of this glacier can be detected when comparing the photographs of 1946 and 1948.

1948

Trimetrogon photographs show only distant oblique views of this area and are consequently of limited value for purposes of comparison.

1958

Canadian Government airphotographs produced in 1958 (30,000 ft. a.s.l.) provide complete coverage of the glacier group (Figure 7).

No. 7 The extreme snout of this glacier receded slightly from its position in 1946 and now displays a terminal moraine not visible on the U.S. Navy photographs of 1946.

No. 8 Only slight marginal changes occurred between 1946 and 1948. The cliffed ice front still reached the sea.

No. 9 Similar slight recession is apparent but the major part of the glacier snout is apparently afloat.

No. 10 The southeast side of this glacier snout displays definite recession, a relatively large area of exposed moraine having appeared since 1946. Ice cover in the steep, crevassed areas at the valley heads of glaciers No. 10 and No. 11 appears thin and these tongues may eventually be isolated from their source areas on the plateau.

No. 11 Definite recession of the terminus between 1946 and 1958 can be detected, but it is less marked than in the case of the previous glacier. In 1946 parts of the tongue reached the sea as a cliff whereas in 1958 the tongue was smoothly rounded and entirely on land.

1961

Photographs of this group were obtained in 1961 which provide recent oblique views supplementing the 1958 vertical air photographs.

No. 8 No significant marginal changes can be detected since 1946 or 1958.

No. 9 In 1961 the calving terminus of this glacier was still apparently afloat but the abrupt cliffed front

seen on the oblique view of 1946 was less marked.

Nos. 10 and 11 Comparison of vertical air photographs made in 1958 with the 1961 sea level photographs does not reveal any marked variation in the position of termini, but comparison of details in the high level air photographs and ground photographs is difficult. Some of the 1961 photographs were taken from approximately the same position as those of Bernier (1906), Anderson (1928) and Baird (1944). Since Baird's photograph of 1944 the termini of both Nos. 10 and 11 have undergone distinct thinning and marginal recession, as have the smaller ice patches in nearby coastal gullies (Figure 8).

South and southwest of ice cap No. 6 are a number of small ice masses, most being less than 5 kilometres in length and breadth. They are situated in a belt between the head of Strathcona Sound and the entrance to Tremblay Sound. Nothing is known of them other than what can be seen on the air photographs of 1948 and 1958. The photographs of the group trending northwest from Tremblay Sound reveal a diminution in size of the glaciers over the ten year period similar to that observed in the case of some of the small ice fields and ice masses on Brodeur Peninsula.

The remaining glaciers of Borden Peninsula lie south of a line from Adams Sound to the head of Tremblay Sound, and consist of a small ice cap on the Magda Plateau and of a number of small fragmentary ice masses south of Adams Sound. The 1948 and 1958 air photographs also indicate a recession of the smaller ice masses similar to that described above.

BYLOT ISLAND

Broadly, Bylot Island consists of a central belt of mountains and nunataks completely dissected by glaciers, bordered, especially in the southwest, by extensive plains composed of younger rocks and unconsolidated material.

Although existing published maps suggest that the island is covered by an ice cap, the interior is actually an area of intermontane glaciers flowing from the central mountainous area. The pattern of existing glacier systems is shown in Figure 43 which is based on recent airphotograph mosaics. The elevation of the higher accumulation areas estimated from radar altimetric data average about 1200 metres above sea level, but peaks and ridges protrude above this to about 1800 metres above sea level. The axis of the mountainous source area is oriented in a northwest-southeast direction and the majority of the outlet glaciers flow northeastwards or southwestwards into the plains and lowlying areas.

Notes on specific glaciers (see Figure 43)

North coast of Bylot Island

No. 12 This glacier has an expanded foot with a broad front 5 kilometres in length which faces northeast and extends 3 kilometres out from the mountains into the coastal plain of northwest Bylot Island. The glacier rises very gradually inland and has a relatively level, uncrevassed and featureless lower surface. The edge of the ice is bordered by a prominent moraine and there is no detectable variation in the position of ice and moraine in the air photographs of 1948 and 1959. West of this glacier there are a number of small glacier tongues some of which are almost independent glaciers. The area in front of these glaciers is occupied by a belt of moraine ridges averaging 700 metres in breadth. As in the case of the large glacier No. 12, no change can be detected over the period 1948 - 1959.

No. 13
1851

A glacier immediately west of Cape Hay was described by Sutherland in 1851. Although the description places the glacier "to the eastward of Cape Hay" it is probable that Sutherland was referring to the glacier now shown on the National Topographic Series map situated immediately west of Cape Hay. Sutherland actually mentions two calving glaciers situated east of Cape Hay whereas at the present time Cap Hay is identified as lying between the only two glaciers which reach the sea. Examination of the air photographs suggests that no other glaciers on the north coast of Bylot Island have probably reached the sea in the 110 years since Sutherland's visit. Cape Hay, as understood by Sutherland, may have been the prominent cliffed coast some 8 miles to the northwest of the point now called Cape Hay.

Descriptions of glaciers in the Canadian Arctic are not common prior to the present century and Sutherland's description is fuller than usual:-

"To the eastward of Cape Hay, we observed a glacier, of not very large size, entering the sea from a valley, through which it could be traced until it was lost among the rugged, sharp-pointed, and bleak-looking almost inaccessible heights on both sides. The main valley appeared to be entered by smaller ones, which also contained ice; some of them entered at right angles while others seemed to be a sort of division of the main one into smaller branches. The edge of the glacier protruded into the sea considerably beyond the coast line, and it looked as if an iceberg was to be detached very soon. The water marked its side with lines corresponding with the high and low water marks, and in this respect there was a striking resemblance with what we had often observed, on the sides of icebergs, on the eastern shore of Davis Straits, which had

taken a firm lodgement on the bottom during very high tides. The protruding edge was quite perpendicular just as it had been left by the last iceberg that had floated away from it, and it rose to a height of forty to fifty feet above the water; this would give the part under water about three hundred and fifty or four hundred feet. In many parts of its surface the glacier was very dirty, and masses of rock could be seen resting upon it, but there appeared to be very little order in their arrangement, except that, about the middle, the larger fragments followed the direction of the valley, and, at the west side, there seemed to be a collection of a dark colour and muddy consistence, which also followed the direction of the valley, but gradually thinned away as it ascended, while the east side was perfectly white, from the very edge, until it was lost sight of in the distance. From the appearance of the mud, I had no other idea than that it had been brought down by water in a running stream, which must have made its escape into the sea over the edge of the glacier.

"These two glaciers, although extending to the bottom at a depth of sixty to seventy fathoms, appear in very humble contrast beside the towering cubes which escape annually, through the deep valleys, from the immense glacier range of the Greenland continent into Davis Straits, and which in some cases (Claushaven, Lat. 69°) rise to a height of nearly three hundred feet, and raise moraines at the bottom, at a depth of the same number of fathoms." (Sutherland, 1852, Vol. 2, p. 320).

A small engraving (on page 321, Vol. 2) in Sutherland's book is entitled "Glaciers, near Cape Hay", (Figure 9). Even allowing for possible exaggeration by the engraver, the two glaciers, Nos. 13 and 14, are shown definitely protruding into the sea just as in the quoted description.

1948

U.S. Navy photographs taken in the period 1946-8 provide oblique views of glacier No. 13 at Cape Hay. Although both glaciers shown in Sutherland's engraving still reached the sea and had cliffed fronts they no longer protruded significantly beyond the coastline and must have receded since Sutherland's visit in 1850.

1958

Recent vertical air photos support the view that a recession may have occurred since 1851, though probably not more than one kilometre. An exposed lateral moraine projects into the sea on the eastern side of the glacier whereas Sutherland notes the absence of moraine at the time of his visit.

No. 14
1851

As mentioned above, Sutherland also describes the tidewater glacier which is shown on modern maps about 14 kilometres east of Cape Hay, mentioning the greater height and breadth of the glacier where

it met the water as compared with glacier No. 13.

1873

Markham sailed along the same coast twenty two years after Sutherland and briefly mentions glacier No. 14. "At 8 a.m. we rounded Cape Liverpool, having a brisk southeasterly breeze in our favour. Passing a large glacier running down out of a deep gorge to the water's edge, off which several bergs probably fragments from this very glacier, were aground, we came abreast of Cape Hay, which appeared steep and precipitous" (Markham, 1874, p. 158). Referring to the glaciers on the north shore of Bylot Island, Markham comments, "I am quite surprised at the innaccuracy of our charts. The whole trend of the coastline is incorrect. Cape Liverpool being merely a long promontory jutting out into the sea. One distinct and high headland between Byam Martin and Fanshawe is altogether ignored on the chart, and this I have named Cape Sherard Osborn. I counted twelve large glaciers between Cape Fanshawe and Hay: but including small or embryo-glaciers, there are fully four and twenty. The largest one is directly behind Cape Liverpool, and is about five or six miles in breadth. None had the appearance of being discharging glaciers, and the depth of this one did not appear to be very considerable. I have named them the "Bartle Frere Glaciers", after the President of the Royal Geographical Society." (Markham, 1874, p. 222). Markham's book also contains an engraving entitled "The Bartle Frere Glacier" which apparently depicts glacier No. 14 (Figure 10). This glacier is shown as calving into tidewater. However, it is not possible to recognize similar topographic details when comparing recent oblique air photographs with Markham's engraving, nor is it possible to safely infer any variation in the position of the glacier terminus between 1851 and 1874 except that Markham does not describe the glacier as protruding from the coast, a fact which was specifically noted by Sutherland.

1921-24

Mathiassen noted that glacier No. 14 entered the sea in 1921-24 (Mathiassen,1933, p. 67).

1946-48

Oblique air photographs of the north coast of Bylot Island show glacier No. 14. The ice reaches the sea as a 3-kilometre-wide cliff, except on the western side where a moraine has been deposited next to the sea (Figure 11).

1958

Vertical air photographs of this date show that very little change had occurred since 1948.

It seems possible, therefore, that the glacier was at its most advanced recent position in 1851 or before that date and while some recession may have taken place between 1851 and 1874, little change has

occurred since 1874.

Nos. 15, 16, 17
1948-1958

Comparison of the vertical air photographs of 1948 and 1958 reveals only very small signs of recession in the termini of these glaciers. Details of the interlobate moraine occurring on No. 17 appear unchanged in shape and position over the ten year interval.

Nos. 18, 19, 20
1948-1958

Vertical trimetrogon air photographs dated 1948 permit direct comparison of these and adjacent glaciers with vertical air photographs taken in 1958. Few variations appear to have occurred in this period other than slight changes in the details of the steep cliffed terminus of No. 18 and some signs of recession indicated by the widening of the moraine covering the frontal part of No. 20 (Figures 12 and 13).

No. 21
1818

John Ross sailed along the coast in 1818 and provides a very brief and somewhat puzzling note on the glaciers of the northeast coast of Bylot Island between Cape Byam Martin and Cape Walter Bathurst, "we made for the most southern point we had seen yesterday, and in the morning we passed the two inlets to the southward of Cape Byam Martin, which had the appearance of harbours; but on a nearer approach, we discovered them to be filled with large glaciers of ice, and quite impenetrable. A cape, which appeared to the southward of these inlets, was named Cape Bathurst, and the bay between it and Cape Byam Martin, was named Bathurst Bay" (Ross, 1819, p. 187).

If Ross meant by this that his progress into the apparent harbours was impeded by tidewater glaciers, or by the icebergs which they had calved, then a considerable change has taken place since 1818. A glacier recession of about 6 miles or an equivalent emergence of land would be necessary to produce present day conditions, with the large glaciers lying considerable distances from the coast. Another possibility is that the positions of the various placenames on modern maps do not correspond with the features on Ross's maps or the features which he named on his voyage, in which case he could have been referring to the tidewater glaciers in the vicinity of Cape Hay. Ross's maps though showing a number of differences from modern charts are not so different as to support this interpretation. The map on page 174 of the first edition of his book shows some of the placenames mentioned in the quotation above and also shows what may be intended to represent a narrow glacier reaching the sea between Cape Byam Martin and Possession Bay. Another possibility is that the term 'glacier' was used to refer to large icebergs and

icefloes, and it is relevant that Parry reported having seen very long, low and flat-topped icebergs aground in Possession Bay in 1819.

1906-7

Bernier mentions, "in Latitude 73°27' N and Longitude 76°15' W there was an immense glacier bearing west of use in front of a high mountain." (Bernier, 1909, p. 47). This note may well refer to glacier No. 21.

1939

P.D. Baird who journeyed in Bylot Island in 1939 reached Bathurst Bay via glacier No. 21 reporting, "moraines are weakly developed, and the glacier which I descended on the crossing to Bathurst Bay had no terminal moraine, only slight median moraine, and vegetation growing up to its front at 260 feet above sea level." (Baird, 1955, p. 98). Baird's photograph shows the steep front of the glacier. Another report of the same journey mentions the steep face of the glacier and that the terminus was within 8 kilometres of the sea (Baird, 1940, p. 226).

1948-1958

The 5 kilometre wide terminus of No. 21 is well shown in vertical air photographs of 1948 and in the nearly coincident vertical air photographs of 1958 (Figures 14 and 15). The terminus appears uniformly steep and smooth, very little moraine being visible. A close examination of surface details clearly seen in both photographs suggests that little actual motion of the ice has taken place in the ten year interval. There are no signs of recession and the situation appears remarkably unchanged.

No. 22
1948-1958

A smaller glacier southeast of No. 21 is also well shown in the vertical air photographs. Essentially, the situation is similar to that observed in the case of No. 21. Almost no apparent change in the extent of the classic "expanded foot" of the glacier can be seen except for very slight signs of recession and accentuation of the moraine ridge on the eastern side (Figures 16 and 17).

South and west coasts of Bylot Island
No. 23
1934

A photograph in the collection of the National Museum taken by D. Leechman in 1934 shows the snouts of glaciers No. 23 and No. 25 on the south coast of Bylot Island.

1948

The same glaciers are distantly visible in a picture dated 1948 in the Geographical Branch collection, and no changes can be detected.

1958

Air photographs of 1958 reveal no change in the position of No. 23, although No. 25 had diminished as will be noted below (Figure 18).

No. 24 - Narsarsuk Glacier

1909-1910

Narsarsuk Glacier appears in a photograph taken on Bernier's expedition of 1910. As is often the case this is a distant view but it can be seen that the glacier was then close to the sea and that it appears to have had an abrupt front. In his report on the 1908-1909 expedition Bernier refers to the glaciers of south Bylot Island - "Glaciers occupy the mountain valleys north of Eclipse Sound. The most western of these, which discharges by a stream through the lowland along the shore exhibits a fine median moraine. The others discharge direct into Eclipse Sound. Some of these appear to be quite thin, while others, as the one near the narrows, have a considerable width and thickness." (Bernier, 1910, p. 419). This confirms the impression given by the photograph that the Narsarsuk Glacier was thicker at its terminus than at the present time and that it reached the sea in 1909.

1921-1924

Mathiassen refers to the Narsarsuk Glacier but does not provide any detailed information, mentioning only that medial moraines could be seen.

1928

An indistinct photograph taken by R.M. Anderson in 1928 gives the impression that the tongue had by that time receded from direct contact with the sea.

1948

R C A F trimetrogon photographs of 1948 show the exposed ice at approximately 360 metres from the shore and fronted by a moraine zone about 130 metres wide.

1958

The vertical air photographs of 1958 show that the glacier proper was some 400 metres from the sea. The white ice was fronted by about 180 metres of dirty ice and recent moraine which was in turn fronted by an outwash plain extending to the shore (Figure 18).

1961

Low level flights were made over this glacier terminus in 1961. The moraine covered zone immediately in front of the glacier definitely appears to be of recent origin. The actual ice margin is not steep and appears to be thinning and receding. This and the recent appearance of the moraine suggest that recession of possibly more than 90 metres has occurred since 1910 (Figure 19).

No. 25
1910

This small glacier flows towards the sea in a valley east of the Narsarsuk Glacier. Bernier's photograph of 1910 shows the ice descending directly into the sea and as in the case of the previous glacier it appears to have had an abrupt front. Bernier's note quoted above also proves that this glacier discharged directly into the sea.

1921-24

In 1924 this glacier still reached the sea according to Mathiassen (Mathiassen, 1933, p. 65).

1928

A photograph by R.M. Anderson in 1928 shows the tongue reaching the sea although it is possibly thinner than it appeared in Bernier's photograph of 1910.

1934

D. Leechman's photograph in the collection of the National Museum shows a distant view of the glacier which had apparently not yet retreated from the 1928 position (Figure 20).

1948

Air photographs show that by 1948 diminution of the terminus had commenced. The width of the glacier at the actual snout and for some distance up-glacier had decreased, but the actual glacier front still descended directly into the sea.

1958

The vertical air photographs of ten years later show that the recession, just beginning to be evident in the 1948 photographs, had continued (Figure 18). The lower portion of the tongue had narrowed and receded approximately 50 metres, and the glacier terminated entirely on land.

1961

Low level oblique air photographs obtained in 1961 do not show significant variation from the position of the glacier in 1958.

No. 26 - Kaparoqtalik Glacier
1958

In his account of the voyage of the "Fox", M'Clintock describes a visit which he made to this glacier in August 1858;- "After toiling round the base of a precipice, we came rather suddenly in view of a small semicircular bay; the cliffs on either side were 800 or 900 feet high, remarkably forbidding and desolate; the mouth of a valley or wide mountain gorge opens out into its head. Here, in the depth of the bay, upon a low flat strip of land, stood seven tents, - the summer village of Kaparoktolik. I never saw a locality more characteristic of the Esquimaux than that which they have here selected for their abode; it is widely picturesque in the true Arctic application of the term.

"Although August had arrived, and the summer had been a warm one, the bay was still frozen over; and if there was an ice-covered sea in front, there was also abundance of ice-covered land in the rear - a glacier occupied the whole valley behind and to within 300 yards of the chosen spot!

"The glacier's height appeared to be from 150 to 200 feet; its sea-face extending across the valley, - a probable width of 300 or 400 yards, - was quite perpendicular, and fully 100 feet high. All last winter's snow had thawed away from off it and exposed a surface of mud and stones, fissured by innumerable small rivulets, which threw themselves over the glacier cliff in pretty cascades, or shot far out in strong jets from their deeply serried channels in its face; whilst other streamlets near the base burst out through sub-glacial tunnels of their own forming." (M'Clintock, 1860, p. 141).

Accompanying M'Clintock's description is an illustration with the caption - "The Village and glacier of Kaparoktolik, Greenland" (Figure 21). In this engraving a large glacier with a vertical front occupies a valley betweennearly vertical cliffs. As in the description, the edge of the glacier is furrowed by streams, and other streams are flowing from holes in the ice face. In all obvious respects this illustration fits the description quoted above but as will be shown later it is difficult to equate the topography shown with the topography of the actual site. It is also puzzling that the caption refers to the 'Kaparoktolik' Glacier as being in Greenland. The drawing from which this engraving was made is attributed to Captain May who had previously published sketches of Arctic landscapes. However May's name does not appear in the list of officers and ships company of the "Fox", nor does M'Clintock include his name when listing his companions on the visit to the Kaparoqtalik Glacier. It is possible therefore that May's drawing was made imaginatively from M'Clintocks description in order to supply the need for an illustration.

1921-24

Mathiassen noted that the terminal moraine of the Kaparoqtalik Glacier reached the sea and mentioned the many medial moraines (Mathiassen, 1933, p. 65).

1948

An oblique air photograph of this date shows the glacier had altered somewhat since the time of M'Clintock's description. The steep front is no longer apparent and the whole glacier was fronted by a prominent terminal moraine probably masking stagnant ice.

1955

P.D. Baird, like Mathiassen, compared M'Clintock's description with his own observations and reported that the glacier was still within about 270 metres of the shore (Baird, 1955, p. 96).

1958

Vertical air photographs taken in 1958 allow approximate measurements to be made. At the time of the photographs the terminal moraine-covered area, some of which probably included stagnant ice, was

over 300 metres wide and reached the sea at the eastern side of the bay. The approximate width of the glacier near the terminus was 2,000 metres (Figure 18).

1961

A short visit was made to the end of the Kaparoqtalik Glacier in 1961 and a number of ground and air photographs were obtained (Figures 22 and 23). An attempt was made to photograph the glacier from the eastern side of the entrance to the valley which is probably the area to which M'Clintock's description refers. (M'Clintock approached the valley by travelling westwards along the coast). Ground observations and photographs thus obtained show that the appearance of the Kaparoqtalik Glacier has altered considerably since M'Clintock's visit. Although the recession in actual ground distance may not be very great, the general aspect of the glacier snout today bears little comparison with that described in 1858. Now a zone of ice-cored terminal morainic heaps and ridges extends over 300 metres in front of the white glacier ice. On each side of the terminus is a triangular shaped area of bouldery outwash with braided stream channels extending to the beach. The terminal moraine zone reaches the shore in the centre of the bay. On the east side the distance from the shore to the beginning of the moraine is another 270 - 360 metres which is approximately the distance given by M'Clintock. The suggestion is that this moraine zone had not formed in 1858 and that the glacier covered the area at its probable recent maximum extent. At present the ice slopes gently down to the moraine and there is certainly no abrupt edge such as M'Clintock describes. Comparison of the 1961 photographs with the oblique air photographs of 1948 also shows that the proglacial moraine-covered zone has increased in width and that slow thinning and recession of the snout is continuing at the present time.

One important and conflicting fact appears from a comparison of M'Clintock's estimate of the width of the Kaparoqtalik Glacier and the present width estimated from air photographs. Whereas M'Clintock gave it as "300 or 400 yards" it is difficult today, even measuring the narrowest portion, to arrive at a figure of less than 1800 metres (1970 yards). Furthermore, in order to reach the Kaparoqtalik Glacier M'Clintock's party would have had to pass the Narsarsuk Glacier about 6 miles to the east. The approximate width of the snout of the Narsarsuk is of the order of 650 metres and this may have been less in M'Clintock's day as the valley narrows towards the sea and the glacier may then have been further advanced in the valley. It is just possible that M'Clintock was actually describing the Narsarsuk Glacier in mistake for the Kaparoqtalik Glacier. On the other hand M'Clintock describes a semi-circular bay at the mouth of the valley. The Kaparoqtalik valley has such a bay, but not the Narsarsuk.

No. 27 - Sermilik Glacier

This is the largest glacier reaching the sea on the south coast of Bylot Island, the lower part of the tongue being approximately 3500 metres wide. The terminus is bordered by a belt of moraine ridges up to 700 metres wide except in the central part where a bay cuts into moraine and glacier; here the glacier appears to reach the sea along a front of 500 metres.

1948 - 1961

No photographs of the Sermilik Glacier earlier than the trimetrogon air photographs of 1948 have been discovered. The air photographs of 1958 show that no marked changes occurred in the 10 year period. Observations and photographs obtained in 1961 also fail to reveal any significant variation. However, it appears that some recession has taken place prior to 1948 as shown by the wide belt of moraines.

A number of large glaciers flow out from the central mountains into the plateau which forms the southwestern part of Bylot Island. Little is known of them other than what can be seen in the 1948 and 1959 photographs. Unfortunately, in 1959 the area was snow covered at the time of photographing and it is difficult to distinguish glacier margins, and consequently no safe estimate of possible glacier variation can be made. It is apparent, however, that no large scale variations have occurred.

No. 28 and No. 29

Vertical air photographs of these glaciers are available dating from 1946, 1948 and 1958. Only minor changes in the surface details of the termini can be detected over this period. Mathiassen mentions that in 1921-24 "North of Canada Point two glaciers run down to the coast." (Mathiassen, 1933, p. 67). At the present time the termini of these glaciers are approximately $2\frac{1}{2}$ kilometres from the sea so that it is unlikely that Mathiassen meant the actual sea.

NORTHEASTERN BAFFIN ISLAND (ALBERT HARBOUR TO COUTTS INLET)

Between Albert Harbour at the eastern end of Eclipse Sound, and North Arm, the coast is not greatly indented except at Erik Harbour. West of Erik Harbour steeply sloping and cliffed coasts are common, but to the east a foreland apparently composed of moraine and outwash material in front of a large piedmont glacier produces a low subdued coastline. North Arm which joins Coutts Inlet is a well developed fiord with steeply cliffed sides. Inland and southwest, the land consists of mountains and ice caps with heights of 1000-1600 metres above sea level. About 8 major accumulation zones can be distinguished on air photograph mosaics with a few large valley outlet glaciers and numerous other glaciers of lesser size. Farther southwest the coastal mountains and ice caps give way to an extensive interior plateau where many

small ice fields and ice patches occupy the interfluves of the predominately northwest - southeast flowing rivers. Between Albert Harbour and the middle reaches of Oliver Sound the mountains are replaced by a plain which extends to the shores of Eclipse Sound.

A Albert Harbour to Guys Bight

A group of small ice caps and glaciers is situated inland from the coast of Baffin Island between Albert Harbour and Guys Bight.

Apart from air photographs of the last 10 years, photographic information relates only to the small hanging tongues of ice which descend steeply seawards from the upland along the cliffed coast west of Guys Bight.

Notes on specific glaciers (See Figure 43)

1873

An early engraving shows a view of Pond Inlet seen from the eastern entrance. The sharp ridge of Beloeil Island forming Albert Harbour is clearly visible and on the coast east of that point six tongues of ice are shown descending steeply seawards, two of them apparently reaching the water (Markham, 1874, p. 220).

No. 30 This is a very small, steeply descending tongue of ice hanging down the face of the seaward facing cliffs and talus slopes. Photographs taken by L.T. Burwash in 1924 and the writer in 1961 reveal only slight diminution of the tongue (Figures 24 and 25).

No. 31 A small tongue occupying a gully to the east also shows only very slight thinning between 1924 - 1961. A photograph in Bernier's account of his 1910 voyage shows parts of glaciers No. 30 and No. 31 and the intervening coast. There is no sign of change in the ice cap feeding these glaciers.

No. 32
1910

This steeply descending tongue appears in a photograph by Bernier made in 1910. The ice almost reaches the sea, apparently terminating only a few feet above the water (Figure 26).

1921-24

Mathiassen refers to the same glacier in the report of the Fifth Thule Expedition of 1921 - 1924;

"The coast east of Albert Harbour is a high steep rock coast torn up by ice and water erosion. The country is of the plateau order, about 1,000 metres high and covered with an ice cap which sends steep

tongues down a slope with a grade of about 50° and reaches down to the sea; during the winter a quantity of ice that falls down accumulates on the sea ice outside." (Mathiassen, 1933, p. 60). A photograph also appears in the same source but it was taken in the same year as those of L.T. Burwash described below.

At about the same time as Mathiassen, L.T. Burwash visited this area and one of his photographs shows glacier No. 32 extending almost to the sea and terminating in an ice cliff showing signs of recent fracture (Figure 27). An area of ice free rock in the upper part of the glacier, which also appears in Bernier's photograph of 1910, appears to have become reduced in size in Burwash's photograph. The lower parts of the tongue also seem thicker in the 1924 photographs.

1958-1961

Both the vertical air photographs of 1958 and observations and photographs made in 1961 show that appreciable recession of this glacier occurred between 1924 and 1961. The ice no longer reaches the sea but ends farther up the gully in a smoothly thinning tongue. An exposed rock area near the point where the glacier outlet spills into its gully has increased in size (Figure 28).

No. 33

1910

The earliest photograph so far discovered of this small glacier was made by Bernier in 1910, at which date the glacier terminated a short distance above the sea.

1921 - 1924

Mathiassen noted that, "The glacier at Sadliaruseq ends up in the ravine about 100 m above sea level and has pushed the terminal moraine before it." (Mathiassen, 1933, p. 60). A photograph accompanying the note shows the glacier apparently still in contact with this terminal moraine. L. T. Burwash's photograph of the same year (1923) provides essentially the same information.

1958 - 1961

Air photographs of 1958 and observations and photographs made in 1961 show that the glacier had possibly receded 70 metres from the terminal moraine mentioned by Mathiassen (Figure 29).

No. 34

1910

Bernier's photograph of 1910 is so indistinct that all that can be determined concerning this glacier is that it terminated short of sea level.

1921 - 24

Mathiassen's photograph of 1921 - 24 shows the terminus of this glacier probably only a few tens of metres away from the shore (Mathiassen, 1933, p. 61).

1958 - 1961

Air photographs of 1958 and sea-level photographs made in 1961 reveal recession since 1924, possibly

exceeding 300 metres.

No. 35
1908-9

A rather indistinct photograph in Bernier's report of his expedition of 1908-9 shows part of the terminus of No. 35 in which it seems to be calving directly into the sea (Bernier,1910, following p. 262).

1910

Bernier's photograph of 1910 clearly shows that this glacier then extended almost to sea level (Figure 30).

1921 - 1924

Mathiassen describes the condition of this glacier in 1921 - 24 as follows, "it is another small glacier running in a gully, but not right down to the sea, ending in a perpendicular face about 3 m. high and about 5 m above the highwater mark: below it are some heaps of fallen lumps of ice, which at one or two places tumble out on to the beach." (Mathiassen,1933, p. 60). A photograph from the same source shows the ice front close to the sea as in Mathiassen's description. Since Bernier's visit in 1910 only minor changes in the form of the terminus had taken place.

1948

Oblique air photographs show that by 1948 the terminus had slightly diminished in size and retreated a short distance up-valley.

1958 - 61

The vertical air photographs of 1958 reveal a further small retreat, as do the sea level photographs obtained in 1961 (Figure 31). Between 1908-9 and 1961 total recession was probably not more than 100 metres.

No. 36
1948 - 1961

No detectable changes are apparent in a comparison of 1948 air photographs and the vertical air photographs and sea level photographs of 1958 - 1961.

B Guys Bight to Erik Harbour

Notes on specific glaciers (see Figure 43)

No. 37
1948 - 1961

Changes in the details of the terminus of this glacier between 1948 and 1958 can be detected on the air photographs suggesting a slight recession (Figures 32 and 33). Photographs of the terminus obtained in 1961 reveal no changes since 1958.

No. 38
1948 - 1961

Similarly, a slight reduction in the size of the terminus of this small glacier situated east of No. 37 has taken place although the recession probably amounts to only a few tens of metres.

No. 39
1907

Bernier's photograph of April,1907 shows this glacier calving directly into the sea.

1908 - 1909

In the report of Bernier's expedition of 1908-9, J.G. McMillan supplied a brief note which may refer to this glacier. "About 10 miles from Erik Harbour, a small glacier reached nearly to the water's edge. The overhanging end was fissured and apparently ready to fall. Lines of flowage were well shown on the convex surface. Several others were seen in the next 5 miles, and on the high land on the opposite side of Erik Harbour." (In Bernier, 1910, p. 420).

1948

Vertical trimetrogon air photographs of this date show that while the glacier still reached the sea, the width of the terminus had diminished and that the ice was no longer in close contact with its lateral moraines at the actual terminus (Figure 32).

1958

Further slight diminution of the terminus can be detected on the 1958 vertical air photographs (Figure 33).

1961

Photographs made from a passing ship in 1961 do not reveal any changes in the glacier terminus since 1958.

No. 40
1907 - 1961

This glacier which lies east of No. 39 also appears in the same photographs used to determine that glacier's recent variation and similarly shows only a very slight recession over the same period.

C Erik Harbour

Notes on specific glaciers (See Figure 43)

Nos. 41 and 42
1948 - 1958

Vertical trimetrogon air photographs dated 1948 and vertical air photographs of 1958 show the termini of this glacier and the adjacent glaciers (Figures 34 and 35). Slight marginal diminution can be detected on No. 41, and in the case of the small outlet glacier No. 42, definite recession of the terminus of approximately 360 metres. All the glaciers coming together at this spot have well developed terminal

moraines from which they had begun to recede by 1948.

No. 43
1818

A large glacier, No. 43, reaches the sea at the head of Erik Harbour. The first reference to this is probably given by John Ross and relates to conditions in 1818. After describing his voyage down the east coast of Bylot Island, Ross goes on to say, "To the southward of this we opened out a wide inlet, which had, at first, the appearance of a strait, but it was soon discovered to be occupied by a large glacier, which extended a considerable distance into the sea; to this I gave the name of Pond's Bay, in compliment to the Astronomer Royal" (Ross, 1819, p. 190). Ross may be referring to the glacier in Erik Harbour as it is almost impossible that Pond Inlet, as we understand it today, could have been occupied by a large glacier as recently as 1818. If Ross had intended to refer to Pond Inlet, as we understand it today, he would have described it as appearing on the west as he sailed south, whereas Erik Harbour appears due south to a vessel travelling southwards along the coast of eastern Bylot Island. From this brief mention it is not possible to estimate the size of the Erik Harbour glacier in 1818 but it may well have been farther advanced than it is today.

1903

Although Erik Harbour was often visited by whaling ships following 1818, the next reference to the glacier appears in A.P. Low's report of the expedition which he led to the Arctic in 1903-4; "A landing was made to collect specimens of the granites and their associated rocks, which form the hills surrounding the harbour, and to visit the glacier which fills over two-thirds of its head. The glacier is a mile wide where it empties into the harbour, the ice along the front being about a hundred feet thick. As there is now very little motion to the ice, few icebergs break off, and those that do are too small to cause danger to the vessels in the anchorage. The southern corner of the bay is free of ice, and a small river discharges there from a southern valley. The glacier comes down from the northwest valley, leaving its rocky wall about a mile inland; thence to the sea it is bounded by a steep ridge of glacial drift full of large boulders; the crest of this ridge gradually falls from two hundred feet to fifty feet as it approaches the water. There are large quantities of mud on and through the ice, so that all the streams discharging from it are very dirty. At some former time this glacier filled the entire valley extending to its mouth 5 miles away, and depositing drift to a height of four hundred feet above the present level of the sea." (Low, 1906, p. 60). In another part of the same report Low notes, "At Erik Harbour, on the south side of Pond's Inlet, there is evidence that the glacier which now terminates at the head of the harbour once extended five miles

farther seaward, and filled the valley to a height of 400 feet above the present level of the sea." (Low, 1906, p. 234).

Is is quite possible that the glacier receded in the period between 1818 and 1903 as Low definitely refers to the glacier being at the head of the harbour while Ross states that the inlet was soon discovered to be occupied by a glacier. Whether this glacier had retreated the 5 miles estimated by Low subsequent to the visit of Ross it is impossible to tell.

1906-7

Bernier described Erik Harbour after his visit in 1906-7, "The measurements of Erik Harbour are as follows: 38,500 feet deep, 13,600 feet wide at the entrance: there are two good anchorage grounds, in about 9 or 10 fathoms of water, at the bottom of the bay, on the S.W. side, opposite a large glacier." (Bernier, 1909, p. 45). Approximate measurements on modern air photographs show that the glacier is about 41,200 feet from the entrance but this measurement depends on which point is taken as the entrance and also on which part of the glacier is taken to be the head of the inlet. At all events it is likely that the position of the glacier has either remained unchanged or that recession has not exceeded 200 metres between the years 1906 and 1958.

The photographer accompanying Bernier's 1906-7 expedition made panoramic photographs of Erik Harbour from which it can be seen that the ice terminated in a sharp cliff, showing signs of recent iceberg calving. These photographs were probably made from a point on the extreme seaward end of the western lateral moraine.

1908-9

Bernier observes in his account of the 1908-9 voyage of the "Arctic"; "The harbour is about 5 miles at its mouth and 6 miles in. Glaciers discharge in Erik Harbour, making it unsafe to winter in or anchor there in summer". The dimensions of the inlet are not in accordance with those quoted in the report of the 1906 expedition. Certainly the entrance of the harbour is not 5 miles wide, and the length of 6 miles quoted would imply a very great and improbable advance of the glacier in the intervening year.

1948

Various distant photographs dating from 1948 shed little light on the activity of the glacier but suggest possible recession of the eastern part of the face. Trimetrogon air photographs show the terminus but in west-facing oblique views only (Figure 36). A prominent lateral moraine, not visible in Bernier's photographs of 1907, extends beyond the ice front on the eastern side, suggesting that some recession had occurred. In this photograph it can also be seen that only a portion of the glacier presents a cliffed face to

the sea and that the ice is for the most part fronted by a moraine which almost blocks the valley.

1958

Vertical air photographs taken in 1958 permit farther comparison (Figure 37). There has been an approximate average retreat of 500 metres along the seaward face of the terminus - less on the western side, and more on the east. On the part of the glacier surrounded by a long moraine west of the tidewater front, the ice has receded over 150 metres leaving a water-filled depression between the inner part of the moraine and the actual glacier toe.

D North Arm - Coutts Inlet

Notes on specific glaciers (See Figure 43)

No. 44 and No. 45
1948-1958

These glaciers are situated at the head of North Arm. In each case ice flows down to the main valley through narrow openings in the northwest side. The highly crevassed snouts expand to completely block the valley forming two lakes drained by lateral channels.

Vertical air photographs and some ground photographs dated 1948 are available for comparison with high level air photographs taken in 1958. No important variations occurred in the 10 year interval. In both sets of photographs the glacier is seen to be damming up a large lake in the valley to the south. Judging from high water marks visible in the photographs, the depth of the lake appears to have been greater in 1948 and previous years. Near the outlet, however, the details of terracing and deposition at the valley sides appear unchanged, probably indicating that no sudden variations of level or outflow have occurred and that the lowering of the lake level has taken place steadily.

Other glaciers in the same area, Numbers 46, 47, 48, 49 and 50, show either no apparent change or only slight recession between 1948 and 1958 (Figures 38 and 39).

E Interior of Northern Baffin Island (southwest of North Arm - Tay Sound)

South of the ice caps and glacier systems between Tay Sound and North Arm are 40 - 50 very small ice fields forming two belts trending northwest - southeast occupying the interfluves of the predominant regional drainage. A notable fact concerning these fragmentary ice masses is the relatively rapid recent diminution which can be detected in a comparison of air photographs dated 1948 and 1958-9. The amount of recession thus measured is comparable with that measured on some of the smaller ice fields of the Brodeur and Borden peninsulas.

Approximate measurements of the recession during the nine or ten year period can be conveniently made in the case of those ice fields which appear in both the earlier trimetrogon vertical photographs and the more recent vertical air photographs. Oblique air photographs taken in 1948 are not so convenient because of the various corrections needed. The results of some comparisons are shown below.

Notes on specific glaciers (See Figure 43)

Nos. 51, 52, 53.
1948-1958

The margins of these small ice fields receded an average of 140 metres between 1948 - 1958. The recession has varied from 55 to 270 metres.

No. 54 and No. 55
1949 - 1958

A comparison of the 1948 and 1959 air photographs provides evidence of the recession of these ice fields (Figure 40). The average marginal recession has amounted to about 180 metres in nine years. A striking feature of this group is that patterned ground almost surrounds the ice fields and occupies much of the neighbouring terrain. The patterned ground apparently consists of high-centred tundra polygons some with diameters of about 50 metres. An examination of the ice margins visible on both 1949 and 1958 photographs shows that large undisturbed polygons are apparently being uncovered as the ice recedes. The ice margin in places appears 'scalloped' apparently due to the fact that the centres of the polygons melt out first, leaving small tongues of ice in the peripheral fissures. Almost all the area uncovered in the nine year period is covered by tundra polygons which do not appear to have undergone deformation, suggesting that the icefields have negligible direct erosive capacity.

Three possibilities concerning the origin of the patterned ground may be considered.

1. That the polygons predate the formation of the ice fields.
2. They are at present being formed or have previously formed under the ice.
3. They are being formed immediately after recession of the ice margin.

The second possibility seems unlikely owing to the large size of the polygons and the fact that they are of the high-centred type. The ice would presumably have to be sufficiently thin to allow temperature fluctuations to penetrate and cause the formation of ice wedges by the accretion of ice in contraction cracks and the consequent polygonal deformation of the ground. It is conceivable that the margins of the ice may be thin enough to allow this process to take place. The third possibility, that the polygons form immediately following recession of the ice, is doubtful as they can be seen on the photographs half emerged from the ice.

There is also little marked variation in size between polygons close to the ice edge and those some distance away and little evidence of the progressive development of polygons into smaller and more numerous forms which has been described in some patterned ground areas. The first possibility that the polygons predate the formation of the ice cap seems most likely in view of the size of the features and the fact that they can be seen melting out of the ice. If this is the case then it must be assumed that these small ice fields have little direct erosive capability. The noticeable recession observed contrasts with the relatively slight recession seen in the larger ice caps and valley glaciers of northern Baffin Island and Bylot Island. At the present rate some of the smaller icefields might disappear in a few decades.

No. 56
1948 - 1958

Comparison of the 1948-1958 air photographs reveals an approximate marginal recession of 120 metres in many places during the 10 year interval (Figure 41).

No. 57
1948 - 1958

This is probably the largest of the small icefields in the area, measuring approximately 16 kilometres in width. Portions of the southern end of the icefield appear on vertical air photographs of 1948 and 1958. During the 10 year interval parts of the glacier margin receded by varying distances up to 200 metres (Figure 42).

Nos. 58 and 59
1948 - 1958

Marginal recession averaging approximately 150 metres is apparent on comparing the 1948 and 1958 air photographs.

The rapid wastage of the small icefields of northern Baffin Island has been discussed by J.D. Ives who has found geomorphological evidence of the greater extension of the northern part of Barnes Ice Cap in recent times. Studies of lichen growth and the distribution of lichen free areas north of the Barnes Ice Cap and partly within the area dealt with in this report point to the conclusion that as recently as the past 200 - 350 years over 70% of the area was covered by permanent snow and ice patches similar to the small icefields mentioned above (Ives, 1962 A).

CONCLUSION

A reliably clear picture of recent glacier activity in north Baffin Island and Bylot Island cannot be obtained solely from a study of the limited photographic and written information so far discovered. It is

hoped that more information in the form of old photographs may come to light, and that geomorphological investigations in the area will extend our present knowledge.

On the basis of the data available no marked marginal variations in recent decades can be detected except in the margins of certain small icefields and some small valley glaciers and hanging ice tongues. Signs of marginal thinning and recession occurring after 1948 have been found in the case of some small valley glaciers, but the more strongly marked recession of the interior icefields of northern Baffin Island was in progress probably before the time of the earliest photographs which date from 1948. The larger valley glaciers which in many cases have remained remarkably stable for at least the last 15 years, are often bordered by morainic ridges and as there are very few signs of older moraines situated any significant distance away from the present limits of the ice, the termini of these glaciers may be close to their most advanced positions in postglacial time. A small recession may have commenced after the mid 19th century when there is slight evidence that certain termini were thicker and farther advanced than at present. The possibility also exists that the moraines date from an earlier maximum extension of the valley glaciers, later recessions and readvances having brought them almost up to the moraines marking the previous maximum advance. Glaciers Nos. 44, 45, 46, 47, 48 and 49 in North Arm however, appear to have breached older lateral moraines probably associated with a major system of end moraines which can be traced over a wide area of eastern Baffin Island in a nearly continuous belt west of the coastal mountains. This end moraine system, with its local extensions into the fiords of eastern Baffin Island, has been taken to represent the maximum extent of an inland ice cap in a late-glacial period (Ives, 1962 B).

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Figure 1

Glacier No. 1. Brodeur Peninsula. Vertical air photograph dated 1948. Black line shows approximate position of the ice margin in August 1959. (Scale 1:40,000) (RCAF airphoto).

Figure 2

Glacier No. 2. Brodeur Peninsula. Oblique air photograph dated August 1946. The small outlet glaciers Nos. 3 and 4 appear from right to left. (U.S. Navy airphoto).

Figure 3. Glaciers Nos. 8, 9, 10, 11, from right to left. Borden Peninsula. Date of photograph August 1906. (Photo G.R. Lancefield)

Figure 4. Glaciers Nos. 10 and 11 from right to left. Borden Peninsula. Date of photograph 1928. (Photo R.M. Anderson).

Figure 5. Glaciers Nos. 10 and 11 from right to left. Borden Peninsula. Date of photograph 1944. (Photo P.D. Baird).

Figure 6. Glacier No. 8. Borden Peninsula. Date of photograph 1946. (U.S. Navy airphoto).

Figure 7. Glaciers Nos. 7, 8, 9, 10 and 11, shown from right to left. Borden Peninsula. Date of photographs 1958 (Scale 1:60.000) (RCAF airphotos).

Figure 8. Glaciers Nos. 10 and 11, shown from right to left. Borden Peninsula. Date of photograph 1961. (Geographical Branch photo).

Figure 9. Glaciers Nos. 13 and 14, shown from right to left. Bylot Island. Engraving reproduced from "Journal of a voyage in Baffins Bay and Barrow Straits in the years 1850-1851." P.C. Sutherland.

Figure 10. Glacier No. 14. Bylot Island. Engraving reproduced and enlarged from "A Whaling cruise to Baffin's Bay" A.H. Markham. Picture shows conditions in 1873. In the original caption this glacier is named "The Bartle Frere Glacier".

Figure 11. Glacier No. 14. Bylot Island. Date of photograph 1946-1948. (U.S. Navy airphoto).

Figure 12. Glaciers Nos. 18, 19 and 20. Bylot Island. Date of photograph 1948. (Scale 1:40,000) (RCAF airphoto).

Figure 13

Glaciers Nos. 18, 19 and 20. Bylot Island. Date of photograph 1958. (Scale 1:60,000) (RCAF airphoto).

Figure 14

Glacier No. 21. Bylot Island. Date of photograph 1948. (Scale 1:40,000) (RCAF airphoto).

Glacier No. 21. Bylot Island. Date of photograph 1958. (Scale 1:60,000). Area shown in Figure 14 is outlined. (RCAF airphoto).

Figure 16. Glacier No. 22. Bylot Island. Date of photograph 1948. (Scale 1:40,000) (RCAF airphoto).

Figure 17

Glacier No. 22. Bylot Island. Date of photograph 1958. (Scale 1:60,000) (RCAF airphoto).

Figure 18. Glaciers Nos. 24, 25 and 26. Bylot Island. Date of photograph 1958 (Scale 1:60,000) (RCAF airphoto).

Figure 19. Glacier No. 24, Narsarsuk Glacier, Bylot Island. Date of photograph 1961. Showing part of glacier terminus and moraine (Geographical Branch photo).

Figure 20. Glaciers Nos. 24 and 25. Bylot Island. Date of photograph 1934. (Photo D. Leechman).

Figure 21. Glacier No. 26, Kaparoqtalik Glacier, Bylot Island. Reproduced from engraving in "The Voyage of the Fox" by F.L. M'Clintock, showing conditions in 1858. (This picture was probably drawn on the basis of M'Clintock's description).

Figure 22. Glacier No. 26, Kaparoqtalik Glacier, Bylot Island. Date of photograph 1961. View of terminus looking southeast towards Eclipse Sound (Geographical Branch photo).

Figure 23. Glacier No. 26. Kaparoqtalik Glacier, Bylot Island. Date of photograph 1961. Part of the eastern side of the terminus (Geographical Branch photo).

Figure 24. Glacier No. 30. N. Baffin Island. Date of photograph 1924. (Photo L.T. Burwash).

Figure 25. Glacier No. 30. N. Baffin Island. Date of photograph 1961. (Geographical Branch photo).

Figure 26. Glaciers Nos. 32 and 33. N. Baffin Island from right to left. Date of photograph 1910. (Photo by J.E. Bernier (?) in collection of Public Archives of Canada).

Figure 27. Glaciers Nos. 32 and 33. N. Baffin Island. Date of photograph 1924. (Photo L.T. Burwash).

Figure 28. Glacier No. 32. N. Baffin Island. Date of photograph 1961. (Geographical Branch photo).

Figure 29

Glacier No. 33. N. Baffin Island. Date of photograph 1961 (Geographical Branch photo).

Figure 30

Glacier No. 35. N. Baffin Island. Date of photograph 1910 (Public Archives of Canada photo).

Figure 31

Glacier No. 35. N. Baffin Island. Date of photograph 1961 (Geographical Branch photo).

Figure 32

Glaciers Nos. 37, 38, 39 and 40. N. Baffin Island. Date of photograph 1948 (Scale 1:40,000) (RCAF airphoto).

Figure 33

Glaciers Nos. 37, 38, 39 and 40. N. Baffin Island. Date of photograph 1958. (Scale 1:60,000) (RCAF airphoto).

Figure 34. Glaciers Nos. 41 and 42. N. Baffin Island. Date of photograph 1948. (Scale 1:40,000) (RCAF airphoto).

Figure 35. Glaciers Nos. 41 and 42. N. Baffin Island. Date of photograph 1958. (Scale 1:60,000) (RCAF airphoto).

Figure 36

Glacier No. 43. N. Baffin Island. Date of photograph 1948. (Scale 1:40,000) (RCAF airphoto).

Figure 37. Glacier No. 43. N. Baffin Island. Date of photograph 1958. (Scale 1:60,000) (RCAF airphoto).

Figure 38. Glaciers Nos. 46 and 47. N. Baffin Island. Date of photograph 1948 (Scale 1:40,000) (RCAF airphoto).

Figure 39

Glaciers Nos. 46 and 47. N. Baffin Island. Date of photograph 1958. (Scale 1:60,000) (RCAF airphoto).

Figure 40

Glaciers Nos. 54 and 55. N. Baffin Island. Date of photograph 1958 (Scale 1:60,000). Black line shows the approximate position of the ice margins in 1949. (RCAF airphoto).

Figure 41. Part of Glacier No. 56. N. Baffin Island. Date of photograph 1948 (Scale 1:40,000). Black line shows the approximate position of the ice margins in 1958. (RCAF airphoto).

Figure 42. Part of Glacier No. 57. N. Baffin Island. Date of photograph 1948. (Scale 1:40,000). Black line shows the position of the ice margin in 1958. (RCAF airphoto).

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