GEOLOGICAL SURVEY OF CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

MEMOIR 378

GEOLOGY OF BATHURST ISLAND GROUP AND BYAM MARTIN ISLAND, ARCTIC CANADA

(Operation Bathurst Island)

J. Wm. Kerr

Price, $5.00

Ottawa
Canada
1974

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1400-1973-6358-10

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MARGUERITE RAFUSE

Text printed on Georgian offset smooth (brilliant white)
Set in Times Roman with
captions in 20th Century, medium

Artwork by CARTOGRAPHIC UNIT, GSC

199046

PLATE I. Piper Super Cub aircraft used in field work; landed on felsenmeer of the Hecla Bay Formation.

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Price: $5.00 Catalogue No. M46-378

Price subject to change without notice

Information Canada
Ottawa, 1974

Southam Murray
02KX-23387-6455

PREFACE

Bathurst Island was discovered and named during the remarkable voyage of W. E. Parry in 1819. It lies near the geographic centre of the Canadian Arctic Archipelago and encompasses the north magnetic pole.

This work provides a comprehensive description of the more than 20,000 feet of Paleozoic and Mesozoic rocks that are exposed in Bathurst Island and neighbouring small islands. The area was part of the Franklinian Geosyncline until mid-Early Devonian time, when the eastern part was uplifted and deformed into the Cornwallis Fold Belt. Facies changes that developed along the margin of these two sedimentary provinces are of both academic and economic importance.

The right angle intersection of the Cornwallis and Parry Islands Fold Belts on eastern Bathurst Island is an unusual, if not unique, phenomenon. It has been shown here that the former originated from a basement uplift, whereas the latter overlies a décollement. Moreover the two fold belts are separated by a zone of left lateral tear faults.

D. J. McLAREN,
Director, Geological Survey of Canada

OTTAWA, July 1973

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GEOLOGY OF BATHURST ISLAND GROUP AND BYAM MARTIN ISLAND, ARCTIC CANADA (OPERATION BATHURST ISLAND)

Abstract

The Bathurst Island group and Byam Martin Island together have an area of about 8,000 square miles. They are situated near the geographic centre of the Canadian Arctic Archipelago and encompass the north magnetic pole. Most of the area is covered by sedimentary rocks of Ordovician to Late Devonian age, with a composite exposed thickness of about 20,000 feet. Exposures of younger rocks are limited to small areas in the northwest and southeast.

The oldest rocks exposed are Ordovician evaporites and carbonates; these are overlain by Upper Ordovician to Lower Devonian black graptolitic shale which, in turn, is followed by increasingly coarse-grained clastic rocks, including turbidites, of Early Devonian age. Unconformities and marked facies changes indicate three pulses of Devonian uplift of eastern Bathurst Island. Middle Devonian rocks consist mainly of carbonate grading basinward to shale, whereas the Upper Devonian is represented by a thick sequence of paralic and nonmarine quartz-rich clastic sedimentary rocks, which blanket the whole island group. The next record of sedimentation consists of a few hundred feet of Permian and Mesozoic strata, which occur on Cameron and Helena Islands, in the northern part of the area. A small exposure of Lower Cretaceous sand occurs in Central Bathurst Island. Upper Cretaceous plant-bearing shale and sandstone with an interbedded basalt flow occur in a graben in southeastern Bathurst Island; nearby dykes and plugs probably are related to the flows.

Two fold belts intersect nearly at right angles in eastern Bathurst Island: the north-south trending Cornwallis Fold Belt along the east coast that first developed in Early Devonian time, and the east-west Parry Islands Fold Belt that developed later. The younger belt had its first and main deformation in the Ellesmerian Orogeny between Late Devonian and Early Permian time. A third period of deformation affected the entire area during the Late Cretaceous and probably Tertiary time. Included in this episode were faulting, intrusion, and further folding of both the Cornwallis and Parry Islands Fold Belts.

The Cornwallis Fold Belt largely resulted from differential vertical movement in the underlying Precambrian basement. The Parry Islands Fold Belt is an allochthon that moved southward above a décollement that apparently is in the Ordovician evaporites. A zone of left lateral strike slip movement in the western part of the Cornwallis Fold Belt delimits the eastern boundary of the allochthon. Western parts of the Cornwallis Fold Belt were involved in the décollement.

Résumé

Le groupe des îles Bathurst et Byam Martin ont ensemble une superficie d'environ 8,000 milles carrés. Elles sont situées près du centre de l'archipel Arctique canadien et encerclent le pôle nord magnétique. Presque toute la région est couverte de roches sédimentaires qui s'échelonnent de l'Ordovicien au Dévonien supérieur, et elles présentent une épaisseur d'ensemble d'environ 20,000 pieds. Les affleurements de roches plus récentes se limitent à de petites régions du nord-ouest et du nord-est.

Les roches les plus anciennes sont des évaporites et des carbonates de l'Ordovicien; elles sont recouvertes de schiste graptolitique noir qui date de l'Ordovicien supérieur au Dévonien inférieur et qui, à son tour, est recouvert de roches clastiques à grains de plus en plus gros, y compris des turbidites, du Dévonien inférieur. Les discordances et les transformations marquées du faciès indiquent que trois mouvements brusques ont soulevé le côté oriental de l'île Bathurst durant le Dévonien. Les roches du Dévonien moyen consistent principalement en carbonate qui se transforme vers le bassin, en schiste, alors que le Dévonien supérieur est représenté par une succession épaisse de sédiments paraliques et de sédiments clastiques riches en quartz, d'origine continentale, qui couvrent toute la surface du groupe des îles. On retrouve ensuite quelques centaines de pieds de sédimentation, qui appartiennent au Permien et au Mésozoïque, dans les îles Cameron et Helena dans la partie septentrionale de la région. Un petit affleurement de sable du Crétacé inférieur se trouve dans la partie centrale de l'île Bathurst. On rencontre des grès fossilifères et des schistes du Crétacé supérieur, comportant une coulée de basalte interstratifiée, dans un fossé de la région sud–est de l'île Bathurst; les dykes et culots avoisinants sont probablement apparentés à ces coulées. Deux faisceaux de plis s'entrecroisent presque à angle droit dans la partie orientale de l'île Bathurst; il s'agit de la zone de plis Cornwallis, du Dévonien inférieur, à orientation nord–sud, le long de la côte est, et la zone de plis des îles Parry, plus jeune et à orientation est ouest. La zone la plus récente a subi sa première et principale déformation au cours de la phase orogénique ellesmérienne, entre le Dévonien supérieur et le Permien inférieur. Au cours du Crétacé supérieur et probablement au cours du Tertiaire, une troisième période de déformation a touché toute la région. Au cours de cette période, il y a eu formation de failles, intrusions et plissements subséquents des zones de plis des îles Cornwallis et Parry.

La zone de plis de Cornwallis est le résultat surtout du mouvement vertical différentiel du soubassement précambrien. La zone des îles Parry est un ensemble allochtone qui s'est déplacé vers le sud au-dessus d'un décollement qui se trouve apparemment dans les évaporites de l'Ordovicien. Une zone à mouvement de rejet latéral vers la gauche, dans la partie occidentale de la zone de plis de Cornwallis délimite la frontière orientale de l'allochtone. Le décollement a touché les parties occidentales de la zone de Cornwallis.

Chapter I

INTRODUCTION

Location and Field Work

This report records the results of a study of the bedrock geology of the Bathurst Island group and Byam Martin Island, a land area totalling about 8,000 square miles (Fig. 1). Bathurst Island group is an informal term first used by Dunbar and Greenaway (1956) to include Bathurst Island proper, Cameron, Vanier, Massey, Alexander, and Helena Islands, as well as nearby named and unnamed smaller islands.

Field work for Operation Bathurst Island was carried out in 1963 and 1964; a Piper Super Cub aircraft supplied by Bradley Air Services Ltd., of Carp, Ontario, was used in the operation. Special oversized, low-pressure tires permitted the aircraft to land on unprepared terrain including soggy or rough ground (Pl. I). Base camps were established during both seasons on east-central Bathurst Island, about midway between the head of Bracebridge Inlet and the head of Goodsir Inlet. Numerous small fly camps were set up at widely separated points in the study area and these were occupied for varying lengths of time by one or two men.

There are no settlements within the study area and no permanent human habitation. Scattered ruins of stone dwellings and occasional artifacts indicate that Eskimos once lived there. Eskimos occasionally travel to Bathurst Island on hunting expeditions from Resolute, about 100 miles to the east. Four temporary oilwell drilling camps and drilling rigs have been established in the Bathurst Island group (*see* Map 1350A, *in pocket*) but these either have been moved or are now unoccupied.

The area is normally reached by travelling through Resolute (Fig. 1), a centre operated principally by the Ministry of Transport. Resolute, which serves as the main distribution centre for groups working north of about 73°N, has a weather station operated by the Meteorological Branch of the Ministry of Transport, a detachment of the Royal Canadian Mounted Police, and a gravel air strip that is serviceable throughout the year. The community is accessible by ship for a part of the summer and fall. Nordair Ltd. provides twice-weekly air passenger and freight service from Montreal; Pacific Western Airlines provides a similar link with Edmonton. Atlas Aviation Ltd. and Bradley Air Services Ltd. provide local charter and contract air services out of Resolute. An Eskimo village has been situated on the shore of Barrow Strait some 3 miles southeast of the airport since 1953.

From early June to late August or early September, the Bathurst Island group is accessible by light aircraft equipped with oversized, low-pressure tires. The rest of the year the area can be reached by ski-equipped aircraft. Ships can reach the southern and eastern coast of Bathurst Island during the short shipping season in the late summer and early fall, but the northern and western coasts generally are ice-locked the year around.

Original MS. received 16th June, 1970
Final version approved July 1973

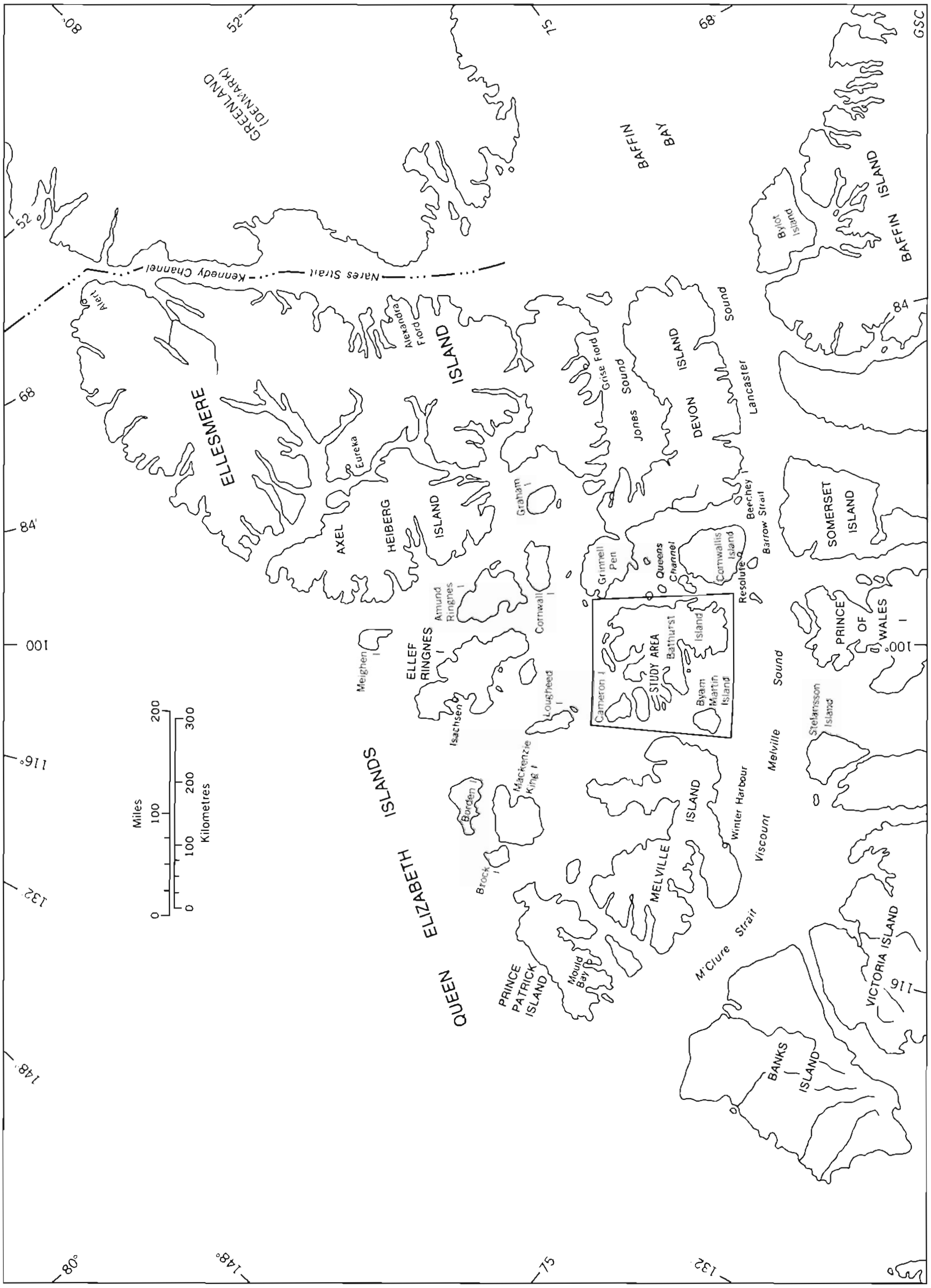


FIGURE 1. Index map of Canadian Arctic Islands, showing location of Bathurst Island group and Byam Martin Island.

The climate is variable. Weather records from Resolute indicate that the mean annual temperature is about 0°F; mean temperatures are above freezing during only two to three months of the year. The warmest month, July, has a mean of about 40°F. Winter snows usually cover the ground by the end of August or early in September; this normally begins to melt rapidly in June and by the middle of July most of the ground is bare. During the field seasons of 1963 and 1964, however, low temperatures and overcast skies occurred for about three-quarters of the time, and in 1964 the snow did not leave the higher parts of Bathurst Island. When the sun is out, however, the summer climate is very pleasant. Between May and mid-August the midnight sun is constantly above the horizon, but from November to February is constant night.

Vegetation does not exceed a few inches in height and is restricted to hardy species that can exist in the very short growing season. Lichen and various kinds of mosses grow sporadically even on the most exposed ridges. Sandstone formations are commonly covered by black and green lichen; whereas the limestone and dolomite are nearly barren. Shale and siltstone support various species of grass, sedge, and Arctic willow. In late June and July, small bright red saxafrage flowers are abundant in the tundra-covered areas and add splashes of brilliant colour to an otherwise bleak and desolate scene.

Vegetation grows best on the Bathurst Island, Stuart Bay, and Griper Bay Formations. Widespread exposure of these units has given Bathurst Island one of the most prolific wildlife populations of any Arctic Island. Musk-oxen and caribou are particularly abundant, and 1963 saw a population explosion of lemming. Snowy owls, jaegers, gulls, and numerous varieties of ducks and geese use Bathurst Island as a nesting area.

Seal, walrus, and beluga seemed most common along the east coast. Polar bears were seen often; in late summer they commonly migrate westward through Polar Bear Pass, the isthmus between Goodsir Inlet and Bracebridge Inlet, presumably in search of more abundant ice and better seal hunting.

Acknowledgments

The field studies for Operation Bathurst Island were carried out during both summers by J. Wm. Kerr and P. G. Temple. The latter wrote a doctoral thesis at Princeton University on part of the material collected (Temple, 1965); data and conclusions from the thesis are incorporated in the present report. In 1963 Doug MacDougall was field assistant, Don DeCecco cook, the late Bob Warnock pilot, and Dave Sellers radio operator. In 1964 Blair Amundsen was field assistant, Dennis Maier cook, John Bryant pilot, and Fred Affleck radio operator.

W. Blake, Jr. studied the surficial geology of the Bathurst Island group and made numerous observations that contributed to the report. W. W. Nassichuk, H. P. Trettin, and J. G. Fyles were associated with the operation for short periods of time in connection with independent studies in this area and elsewhere.

History of Geographical and Geological Exploration

Summaries of geographical exploration of this area have been made by Blackadar (1963, p. 579–80), and Dunbar and Greenaway (1956, p. 253). The following five paragraphs largely paraphrase relevant parts of those two works. Bathurst Island (Fig. 1) was discovered by Lieutenant (later Admiral Sir) W. E. Parry in 1819 during his westward penetration of Parry Channel. No landing was made at the time and nearly 30 years elapsed before the island was visited again. From the available records it appears that Sir John Franklin, before wintering his ships at Beechey Island in 1845–46, ascended Wellington Channel and returned south along the east coast of Bathurst Island.

In late August of 1850, two British squadrons entered Barrow Strait in the search for the missing Franklin Expedition. One of these units, commanded by Captain Horatio Austin, took up winter quarters near Griffith Island; the other, commanded by the former whaler, Captain William Penny, wintered on the south coast of Cornwallis Island. From April until early June of 1851, several man-drawn sledge parties travelled west from Griffith Island along the south shore of Bathurst Island. The party led by Lieutenant R. D. Aldrich charted much of the western coast of the island but, due to the snow cover, was unable to recognize the narrow straits separating the small islands northwest of Bathurst Island. Lieutenant F. L. M'Clintock examined the south coast of the island and explored Graham Moore Bay, while G. F. M'Dougall travelled along the east coast of Bathurst Island as far north as Neal Island.

This expedition returned to England in the autumn of 1851. The next year, five ships were dispatched under the command of Sir Edward Belcher. The *Resolute* and *Intrepid*, under the command of Captain Henry Kellett, proceeded to Melville Island; the *North Star* remained at Beechey Island; and the *Assistance* and *Pioneer* proceeded up Wellington Channel to the western coast of Grinnell Peninsula where they wintered in Northumberland Sound. Between April and July 1853, travelling parties from the *Assistance* and *Pioneer*, under Commander G. H. Richards, traversed and charted the entire north coast of Bathurst Island, and Lieutenant Sherard Osborn made a journey by boat from Cape Lady Franklin south to Goodsir Inlet.

Three expeditions under the command of Captain J. E. Bernier visited the Arctic Islands before World War I. These were dispatched by the Canadian Government to patrol arctic waters and to annex the islands granted to Canada by Great Britain in 1880. Bernier made three brief stops on Bathurst Island, one at Cape Cockburn in 1906, and the others near Cape Aldrich and Schomberg Point in 1909.

V. Stefansson made a short stop at Success Point, northwest Cameron Island, on his return from the Sverdrup Islands in the spring of 1917. In the course of one of the longest of all RCMP arctic patrols, Inspector A. H. Joy traversed the south shore of Bathurst Island in the spring of 1929.

Until July 1947, when the true nature of the Bathurst Island group was noted by the USAF and RCAF observers on a reconnaissance flight, the group was thought to be all one island, with the exception of the Berkeley Islands in the northeast. The northwest peninsula was found at this time to be divided into five islands. The northernmost island was named Cameron Island in 1952, after the late Chief Cartographer of Canada, who was responsible for the first large-scale mapping of the Arctic Archipelago during the Second World War. On February 1, 1962, the three largest of the remaining four islands were named Alexander, Massey, and Vanier, after the three most recent Governors General of Canada. These three islands together are informally called the Governors General group. A fourth island near these three is Ile Marc, named after the late Marc Boyer, former deputy minister of the then Department of Mines and Technical Surveys. The strait between Alexander and Massey Islands is Boyer Strait, also in honour of Dr. Boyer. In May 1963, a small island between Massey and Vanier at the west end of Pearse Strait was approved as Ile Pauline after the wife of General Vanier.

Few observations on the geology of the Bathurst Island group were made until recent years. Some of the fossils collected during searches for Franklin were described by Haughton (1857) and Adams (1875). McMillan (1910), on Bernier's second trip, also made a few important observations. Aerial photography of the archipelago in recent years, and a few observations made either on the ground or from aircraft, permitted Jenness (1952a, b) and Taylor (1956) to deal with some aspects of the physical geology of the region, and enabled Fortier and Thorsteinsson (1953) to include most of Bathurst Island in the Parry Islands Fold Belt.

Geological studies of a systematic reconnaissance nature were begun in the Canadian Arctic Islands in 1950 by the Geological Survey of Canada, when Y. O. Fortier and R. Thorsteinsson of the Survey and T. Harwood at the Defence Research Board circumnavigated Cornwallis Island in a canoe. The study of that island was continued by canoe-supported field parties headed by Thorsteinsson in the summers of 1951, 1952, and 1953. In 1955, the Geological Survey of Canada undertook Operation Franklin, a major helicopter-supported operation in the Arctic Islands. The report on this project (Fortier *et al.*, 1963) provided a framework of the areal and stratigraphic geology of the Queen Elizabeth Islands. Six small isolated regions of the Bathurst Island group were examined and reports of those areas are included in the volume (Thorsteinsson and Glenister, 1963; McLaren, 1963b; McMillan, 1963b; Norris, 1963; Greiner, 1963b; and Tozer, 1963b). A preliminary geological map of the Bathurst Island group was made (*in* Fortier *et al.*, 1963) to show the six areas that had been examined on the ground. The reports of Tozer (1963b) and Greiner (1963b) were relied upon heavily for information on the Permian and younger rocks of Cameron Island, and the comments herein mainly paraphrase those two reports. Eastern parts of Bathurst Island were studied in 1959 and 1960 by A. H. McNair (1961) who wrote on the intersecting relationship of the Parry Islands and Cornwallis Fold Belts.

In the winter of 1963–64, the Dominion Explorers Group of companies drilled an unsuccessful wildcat well on the Caledonian River Dome in south-central Bathurst Island (Fig. 2, Sec. 38). The completion report of this well (Dominion Explorers Group, 1964) is on open file with the Department of Indian Affairs and Northern Development, and is available to the public. Three other wells have been drilled within the study area (*see* Map 1350A), but at the time of writing the information was still confidential.

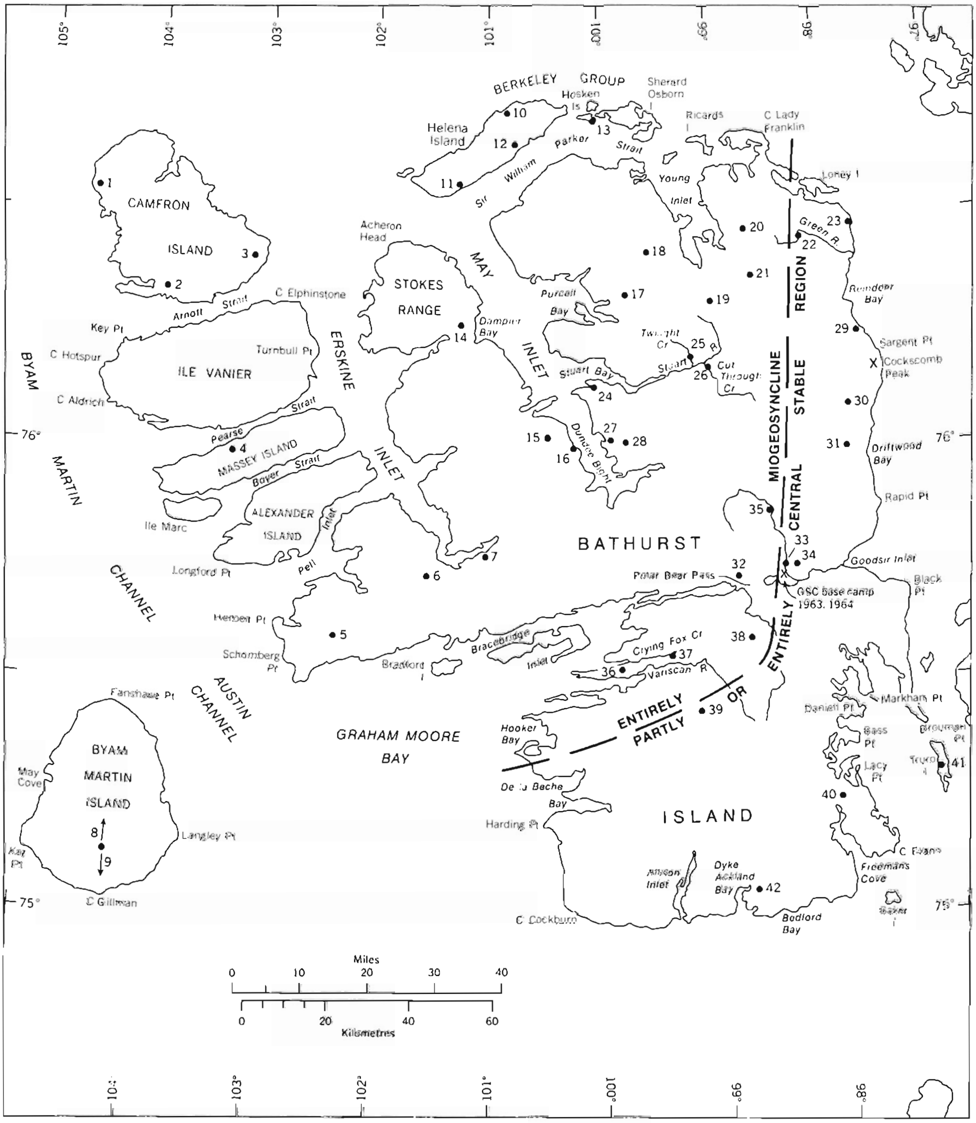
Recent publications by officers of the Geological Survey of Canada concerning the present study area include summary reports of field work by the writer (Kerr, 1964; Kerr and Temple, 1965); thickness and facies data in regional compilation of the petroleum potentialities of Northern Canada (Douglas, Norris, Thorsteinsson, and Tozer, 1963); an account of the glacial history of the island (Blake, 1964); description of an unconformity between Middle and Upper Devonian (Kerr, McGregor, and McLaren, 1965); interpretation of the tectonic history of eastern parts of Bathurst Island that lie within the Cornwallis Fold Belt (Kerr and Christie, 1965); and discussion of Devonian rocks of the islands in a regional paper (Kerr, 1967a).

Physiography

The physiography of the Bathurst Island group is influenced greatly by the underlying geological structure. It is an area of rather low relief with few parts being more than 1,000 feet above sea level; however, much of the topography is rugged with deeply incised streams and V-shaped valleys, and is in a stage of late youth or early maturity.

The three main physiographic divisions of the Bathurst Island group designated by Roots (1963) are:

1. A low plateau principally underlain by horizontal to gently dipping carbonate beds constitutes the southern quarter of the area. This plateau is rather flat, featureless, and desolate in the central part, and is dissected into narrow, steep-walled valleys and bluffs to the south and along the east coast. The drainage pattern is dendritic. Two sandstone buttes occur along the west coast.



1. Northwestern Cameron Island (Tozer, 1963b)
2. Southwestern Cameron Island (Greiner, 1963b)
3. Southeastern Cameron Island
4. Central Massey Island
5. South of Pell Inlet
6. Erskine Inlet
7. Head of Erskine Inlet (Norris, 1963)
8. Southern Byam Martin Island (north flank)
9. Southern Byam Martin Island (south flank)
10. Northern Helena Island
11. Southwestern Helena Island
12. Central Helena Island
13. Hosken Islands
14. Stokes Range
15. Dundee Bight, west
16. Dundee Bight, central
17. Purcell Bay
18. Young Inlet, west
19. Young Inlet, south
20. Young Inlet, east
21. Young Inlet, southeast
22. Green River
23. Cape Kitson
24. Head of Stuart Bay
25. Twilight Creek (McLaren, 1963b)
26. Cut Through Creek (McLaren, 1963b)
27. Half Moon Bay, west
28. Half Moon Bay, east
29. Reindeer Bay
30. Moses Robinson River
31. Driftwood Bay (composite)
32. Head of Bracebridge Inlet
33. Polar Bear Pass
34. Head of Goodsir Inlet
35. Scoresby Hills, west
36. Heart Lake
37. Crying Fox Creek (McMillan, 1963b)
38. Caledonian R. J-34 well (Dominion Explorers Group - Canso et al., 1964
39. Misty River
40. Head of Freemans Cove
41. Truro Island
42. Dyke Ackland Bay

FIGURE 2. Index map of Bathurst Island group and Byam Martin Island showing location of stratigraphic sections.

2. The central and northern parts of Cameron Island comprise an area of lowland where the elevation is generally less than 300 feet. Gently dipping, soft, and poorly consolidated shale and sandstone underlie this region. The land slopes gently northward; streams are short and braided, and have wide gravel fans at their mouths.

3. The largest physiographic division includes all but the northwestern and southeastern parts of the island group. It is mainly a ridged upland with broad folds that are reflected to various degrees in the topography and drainage pattern.

A strip of the ridged upland division along the east-central and northeast coast of Bathurst Island, about 10 to 15 miles wide, is characterized by low hilly topography which seldom exceeds 600 feet in elevation. The underlying geological structure is complex since the Cornwallis Fold Belt and also its intersection with the Parry Islands Fold Belt are located here. The topography only moderately reflects structure; irregular hills with a subtle northerly grain are developed on northerly trending structures of the Cornwallis Fold Belt. Much of this region is covered by felsenmeer or by glacial sands and gravels; exposures of bedrock are restricted to stream valleys and to a few northerly trending ridges.

The ridged upland area is part of the Parry Islands Fold Belt, an area of elongate, westerly trending folds that have influenced conspicuously the topographic development. The synclines have developed into broad ridges, whereas the anticlines have been preferentially eroded into narrower valleys. The ridges are remarkably regular and continuous; they commonly extend from west to east across the whole island group, without change or offset even at the straits and inlets. The ridge crests are smooth in profile and average from 700 to 900 feet in elevation. The western part of the ridged upland area has a rectangular drainage pattern with the large trunk streams flowing along the east-west valleys, carved from the anticlinal cores. Tributaries enter the trunk streams at right angles, parallel to and apparently controlled by joints that are perpendicular to the strike of the bedrock (Pl. IV). Some of the tributary streams have cut rocky gorges as much as 500 feet deep.

Erskine, May, and Young Inlets (Fig. 2) indent the Bathurst Island group from the north-northwest, and are at right angles to the regional strike of the strata. Roots (1963, p. 583) considered the larger two inlets to be erosional features. In contrast, Workum (1962) suggested that the inlets result from erosion of northerly trending anticlines (Cornwallis Fold Belt) that existed prior to the westerly trending structures of the Parry Islands Fold Belt. The northerly trending anticlines became the loci of interference of fold trends. Erosion resulted in an inversion, whereby the structural highs became topographic lows. This inversion is clear in the westerly trending folds but only suggestive in those with northerly trends. The writer is in basic agreement with Workum's suggestion, and elaborates on it in a later chapter.

Exposure of rock within the island group is variable. On aerial photographs it appears excellent, but on the ground this is not always so. In the larger tributary stream-cuts, exposure is usually excellent. In large flat areas underlain by limestone or sandstone, however, outcrops are virtually nil, and the surface is composed entirely of frost-shattered, coarse felsenmeer (*see* Pl. I). In extensive flat areas where the bedrock is shale and shaly siltstone, the surface usually is covered by very fine rock fragments, and by much soil and plant cover.

The glacial history of Bathurst Island was summarized by Blake (1964) and the following four paragraphs are taken from his abstract.

> Bathurst Island, in the central part of the Arctic Archipelago, lacks the prominent glacial landforms such as drumlins and eskers that characterize certain more southerly islands. It does not appear to have been overridden by the continental North American (Laurentide) ice sheet during the last glaciation (classical Wisconsin). Nonetheless Bathurst Island bears undoubted evidence of glaciation in the form of till, erratics, and meltwater channels. Erratics, commonly of a quartzose sandstone that outcrops on the island, are widespread and occur at altitudes up

to at least 1,100 feet (335 m), far above the limit of marine submergence. Other important features indicating glaciation are: striae, lakes in bedrock basins, areas of streamlined drift, end moraines, and areas of dead-ice topography.

Apparently most of these features are related to locally-centred ice cap(s), but the occurrence of till containing shells above the marine limit at several localities along the east coast may possibly be the result of a glacier tongue in the straits having impinged upon the island.

The rapid uplift that has taken place in postglacial time, as determined by radiocarbon dating of marine shells from the raised beaches, is believed to have resulted from glacial rebound. Thus the last glaciation of Bathurst Island is inferred to have taken place during Wisconsin time. The altitude of the marine limit is close to 300 feet (90 m) along the east–central and south-east coasts, but it reaches 400 feet (120 m) in the long inlets that indent the north coast, suggesting that the ice may have been thicker in the latter area.

The radiocarbon dates on marine shells, plus one on peat, also indicate that much of the island was ice-free by 9,000 years ago. Since then peat deposits have formed in many localities, but in two places buried peats are more than 35,000 years old, suggesting that they are inter-glacial, or possibly interstadial, in age.

Regional Geological Setting

Stratigraphic–structural provinces in the Arctic Islands were outlined by Thorsteinsson and Tozer (1960) and with minor modification are shown in Figure 3. Several major salients of the Precambrian Canadian Shield strike into the Arctic Islands beneath and between younger sediments. One of these, the Boothia Uplift (Kerr and Christie, 1965), lies just to the south of Bathurst Island and trends toward the island. Since Proterozoic time, various pulses of tectonic activity of the Boothia Uplift have had profound effects on Bathurst Island; these are discussed in a later section.

Bordering and overlying the Shield to the north and west is a province designated the Central Stable Region (*after* King, 1959) consisting of horizontal to gently dipping Paleozoic sediments, principally of carbonate facies. Farther north the Franklinian Miogeosyncline contains a thick sequence of lower Paleozoic clastic and carbonate rocks, which were deformed into the Parry Islands Fold Belt in the west and the Ellesmere–Greenland Fold Belt in the east (Fortier, McNair, and Thorsteinsson, 1954). The fold belts are parallel to the miogeosyncline and extend for about 900 miles from western Melville Island to northwest Greenland. A period of folding, which marked the end of the miogeosyncline, probably occurred between Late Devonian and Middle Pennsylvanian (Thorsteinsson and Tozer, 1960; Kerr and Trettin, 1962). The Cornwallis Fold Belt (Thorsteinsson, 1958) trends north and is intersected at right angles by the Parry Islands Fold Belt on eastern Bathurst Island. It has been known for some time that the Cornwallis Fold Belt developed somewhat earlier than the Parry Islands Belt (Thorsteinsson and Glenister, 1963, p. 596). The present field work on Bathurst Island showed that there were three periods of Devonian uplift within the Cornwallis Fold Belt, and these have been summarized briefly by Kerr and Christie (1965).

On northern Axel Heiberg and Ellesmere Islands, a thick assemblage of lower Paleozoic sedimentary, igneous, and metamorphic rocks has been called the Franklinian Eugeosyncline by Thorsteinsson and Tozer (1960). The geology of the eugeosyncline has been further described by Trettin (1967, 1970, 1971).

The Sverdrup Basin (Thorsteinsson and Tozer, 1960) is a deep sediment-filled depression that is superimposed unconformably on the older Franklinian Geosyncline and occupies a large part of the central and northern Arctic Islands. The thickness of strata in places is as great as 40,000 feet, and includes rocks of upper Paleozoic, Mesozoic, and Tertiary ages. A deformational episode of Late Cretaceous and Tertiary age produced diapirs, folds, and thrusts in the Sverdrup Basin. Within the study area the southernmost part of the Sverdrup Basin is exposed on Cameron and Helena Islands.

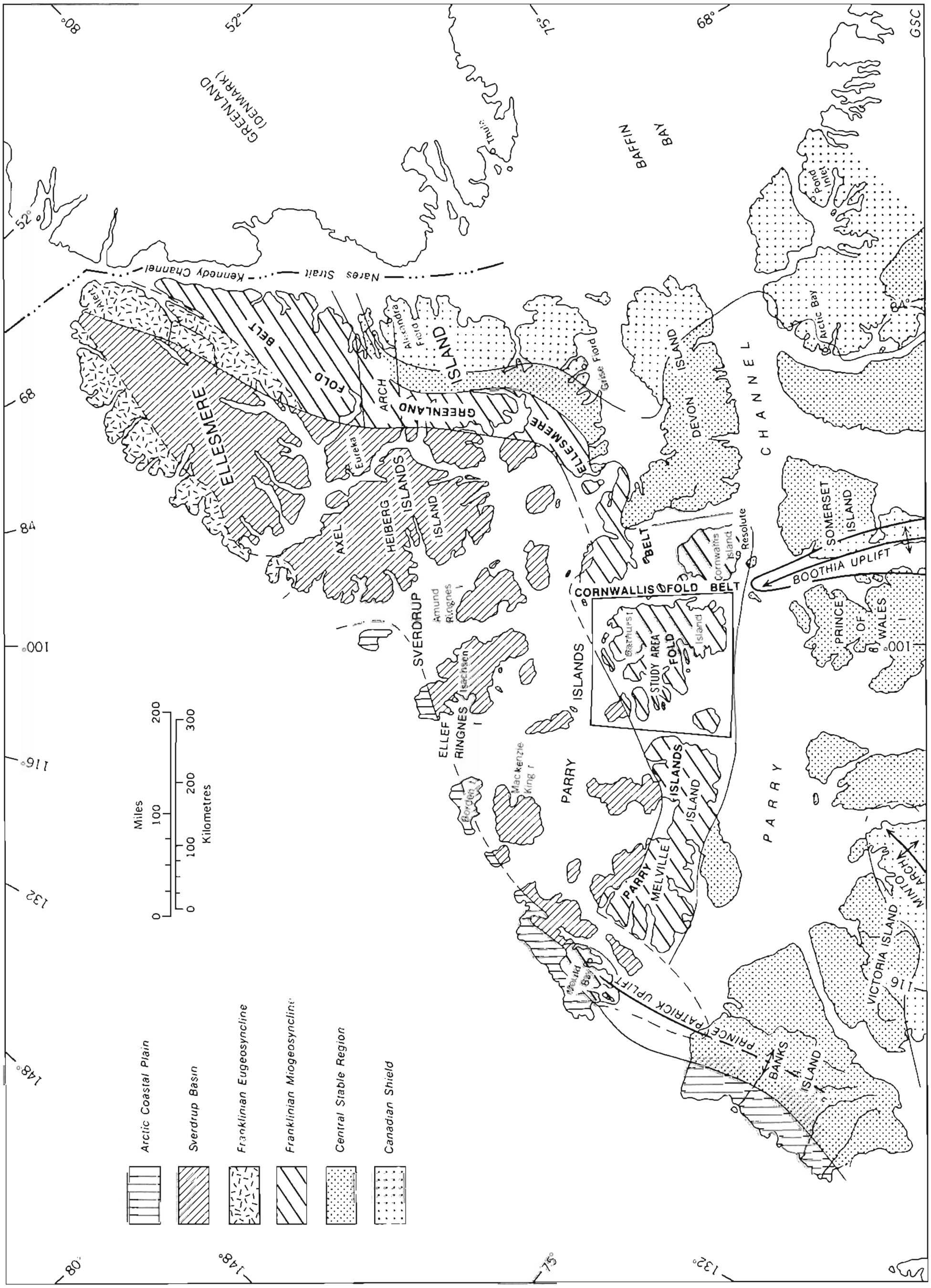


FIGURE 3. Stratigraphic-structural provinces in Canadian Arctic Islands; *after* Thorsteinsson and Tozer (1960), and Kerr (1967a).

Chapter II

STRATIGRAPHY

Rocks of the Bathurst Island group were first examined systematically in 1955 during Operation Franklin, when several isolated small areas were visited. D. J. McLaren (1963b) studied the Paleozoic section of the Stuart Bay area in the central part of Bathurst Island (Secs. 25 and 26, Fig. 2). Thorsteinsson and Glenister (1963) described the rocks from the Driftwood Bay area along the east coast of the island (Secs. 30 and 31). Greiner (1963b) examined the rocks on southwestern Cameron Island (Sec. 2), and Tozer (1963b) examined the northern part of that island (Sec. 1). In addition, two reconnaissance traverses were made: one in the Crying Fox Creek area at Section 37 (McMillan, 1963b) and the other from the head of Erskine Inlet to Bracebridge Inlet at Section 7 (Norris, 1963). This work resulted in the setting up of several type and reference sections. The findings of Operation Franklin served as a framework for the present study, but this framework now must be modified to some extent.

Ordovician to Upper Devonian sedimentary rocks outcrop over almost the entire study area (Map 1350A). They were deposited in parts of two geological provinces; the most satisfactory dividing line between them is shown in Figure 2. During deposition of the early parts of this sequence, the entire Bathurst Island group and the region shown on Figure 4 was within the Franklinian Miogeosyncline. Later, commencing with deposition of the Lower Devonian Stuart Bay Formation, the eastern region was deformed into the Cornwallis Fold Belt; thenceforth it subsided less and became part of the Central Stable Region. The region to the north and west of this line was part of the Franklinian Miogeosyncline throughout its Devonian and older Paleozoic history. The stratigraphic sections in these two regions are generalized in Table I. Deposition of this thick and widespread Paleozoic sequence was terminated by an extensive major mid-Paleozoic orogeny. Angular unconformities within the sequence mark tectonic events of lesser significance.

The oldest rocks exposed in the map-area are gypsum and anhydrite assigned to the Bay Fiord Formation of the Cornwallis Group. These rocks are in intrusive contact with younger rocks in the cores of two anticlines in the northern part of the area. A thick unit composed mainly of halite, which is the oldest unit penetrated by the Caledonian River well (Dominion Explorers—Canso *et al.*, Bathurst Caledonian R. J-34)[1] also is assigned to the Bay Fiord Formation (Sec. 38, *see* Appendix). The two younger formations of the Cornwallis Group are, in ascending order, the thick limestone and dolomite of the Thumb Mountain Formation, and the thin argillaceous limestone of the Irene Bay Formation.

Conformably overlying the Cornwallis Group is the Cape Phillips Formation, a unit composed predominantly of black graptolitic shale and shaly limestone. This formation grades upward into the Bathurst Island Formation of Lower Devonian age, which consists predominantly of calcareous, graptolitic shale and siltstone with some interbedded carbonate,

[1]Dominion Explorers—Canso *et al.*, Bathurst Caledonian R. J-34, completion report; on open file with Canada's Department of Indian Affairs and Northern Development.

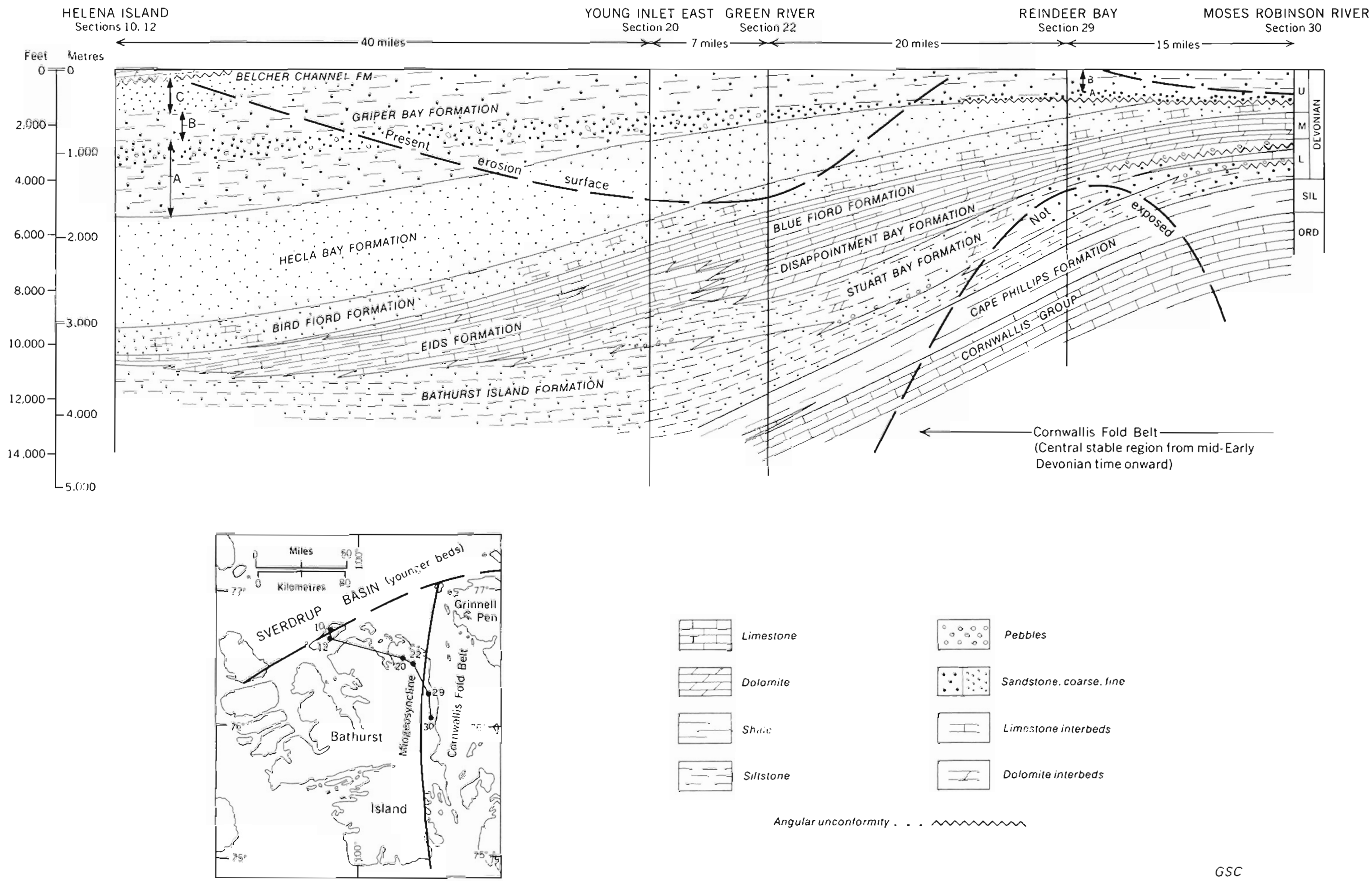


FIGURE 4. Restored stratigraphic cross-section of Ordovician to Upper Devonian rocks in northeastern parts of Bathurst Island group. On Helena Island the Belcher Channel Formation is shown in Section 10 and older rocks in Section 12. Members of the Griper Bay Formation are shown in Sections 12 and 29. Until mid-Early Devonian time the entire region was part of the miogeosyncline; after that time the eastern parts became transformed into the Cornwallis Fold Belt.

TABLE I

Table of formations, Bathurst Island group and Byam Martin Island; formational symbols are those used on the map. The Thumb Mountain and Irene Bay Formations are combined on the geological map and indicated by Octi. A small outcrop of Lower Cretaceous Isachsen Formation has not been shown.

ERA	SYSTEM	SERIES OR STAGE	NORTH AND WEST OF DIVIDING LINE: FORMATION AND THICKNESS (IN FEET)	NORTH AND WEST OF DIVIDING LINE: LITHOLOGY	SOUTH AND EAST OF DIVIDING LINE: FORMATION AND THICKNESS (IN FEET)	SOUTH AND EAST OF DIVIDING LINE: LITHOLOGY
CENOZOIC	QUATERNARY	PLEISTOCENE AND RECENT	UNNAMED (Q)	*Alluvium, sand, gravels, clay, muds*	UNNAMED (Q)	*Alluvium, sand, gravels, clay, muds*
MESOZOIC	CRETACEOUS	MAESTRICHTIAN	UNKNOWN		UNKNOWN / *Eureka Sound 50+* KTe	*Sandstone, shale, coal (interbedded lava flow and related intrusives shown on map as Kt)*
MESOZOIC	JURASSIC	MIDDLE	*Jaeger* Jj	*Sandstone, quartzose*	*Angular unconformity*	
			Angular unconformity			
MESOZOIC	TRIASSIC	UPPER	*Heiberg 70+* Trh	*Quartz sandstone, minor ferruginous sandstone and coal*		
MESOZOIC	TRIASSIC	MIDDLE	*Schei Point 60+* Trs	*Calcareous sandstone, bioclastic limestone*		
MESOZOIC	TRIASSIC	LOWER	*Bjorne 200±* Trb	*Quartz sandstone, crossbedded*		
			Unconformity			
PALEOZOIC	PERMIAN	UPPER	*Trold Fiord 75-140* Ptf	*Sandstone, glauconitic, minor chert*		
			Unconformity			
PALEOZOIC	PERMIAN	LOWER	*Belcher Channel 510* Pbc	*Limestone, dolomitic, porous to vuggy; minor chert*		
			Angular unconformity			
PALEOZOIC	DEVONIAN	UPPER: FAMENNIAN	Melville Island Group: *Griper Bay 1.500-4.875* Dmg	*Quartz sandstone, siltstone, shale, commonly greenish weathering*	*Griper Bay 980-1.500* Dmg	*Quartz sandstone, siltstone, shale, commonly greenish weathering*
					Angular unconformity	
PALEOZOIC	DEVONIAN	UPPER: FRASNIAN	Melville Island Group: *Hecla Bay 1.235-4.080* Dmh	*Quartz sandstone, resistant to recessive*	*Hecla Bay 500-700* Dmh	*Quartz sandstone, resistant to recessive*
PALEOZOIC	DEVONIAN	MIDDLE: GIVETIAN	*Bird Fiord 1.100-2.300* Dbi	*Limestone, quartz sandstone, siltstone, commonly greenish*	*Bird Fiord 600-1,000* Dbi	*Limestone, quartz sandstone, siltstone, commonly greenish*
PALEOZOIC	DEVONIAN	MIDDLE: EIFELIAN	*Eids 300-2.000* De	*Limestone, siltstone, shale, fissile, recessive in north and west, resistant in east and south*	*Blue Fiord 600-1,700* Dbl	*Limestone, micritic on shelf, biostromal to the west*
PALEOZOIC	DEVONIAN	LOWER: EMSIAN			*Disappointment Bay 600-2,000* Ddb	*Dolomite, porous to vuggy, resistant, light cream*
					Angular unconformity	
PALEOZOIC	DEVONIAN	LOWER: SIEGENIAN	*Stuart Bay 0-2.400* Dst	*Siltstone, shale, limy; minor conglomerate and limestone interbeds (local angular unconformity at base)*	*Stuart Bay 0-1.850* Dst	*Dolomite, siltstone, limestone reef and boulder conglomerates*
					Angular unconformity	
PALEOZOIC	DEVONIAN	LOWER: GEDINNIAN	*Bathurst Island 1.150-3.600* Dba	*Siltstone, fine-grained sandstone, thin-bedded dolomite*	*Bathurst Island 0-2.200* Dba	*Dolomite, siltstone, minor limestone*
PALEOZOIC	SILURIAN	PRIDOLIAN, LUDLOVIAN, WENLOCKIAN, LLANDOVERIAN	*Cape Phillips 1.020-1,500* O-Dcp	*Siltstone, shale, argillaceous limestone; graptolitic; minor dolomite*	*Cape Phillips 1.400-2.704* O-Dcp	*Siltstone, shale, argillaceous limestone graptolitic; minor dolomite*
PALEOZOIC	ORDOVICIAN	UPPER: RICHMOND				
PALEOZOIC	ORDOVICIAN	UPPER: MAYSVILLE	Cornwallis Group, Octi: *Irene Bay 50-180*	*Limestone, thin-bedded; green limy shale interbeds; recessive*	Cornwallis Group, Octi: *Irene Bay 30-50*	*Limestone, thin-bedded; green limy shale interbeds; recessive*
PALEOZOIC	ORDOVICIAN	UPPER: EDEN; MIDDLE: BARNEVELD	Cornwallis Group, Octi: *Thumb Mountain 1.600-2.000*	*Limestone, thick-bedded, bluff-forming; minor dolomite*	Cornwallis Group, Octi: *Thumb Mountain 1,500-1.800*	*Limestone, thick-bedded, bluff-forming; in places largely dolomitized*
PALEOZOIC	ORDOVICIAN	MIDDLE: WILDERNESS	Cornwallis Group: *Bay Fiord 300+* Ocb	*Anhydrite and anhydritic shale; caprock of limestone and limy dolomite*	Cornwallis Group: *Bay Fiord 3.233+* Ocb	*Halite, gypsiferous shale, dolomite, siltstone, anhydrite*

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and which is slightly coarser and more calcareous than the Cape Phillips Formation. The Cornwallis Group, and the Cape Phillips, and Bathurst Island Formations probably were deposited throughout the mapped area but now are missing in certain regions due to post-depositional erosion.

A marked change in the pattern of sedimentation first becomes apparent with the Lower Devonian Stuart Bay Formation (Fig. 5). It is coarser than preceding units, being composed generally of sandstone, limestone, and siltstone. In eastern parts of the area it contains coarse boulders and patch reefs, and the base is an angular unconformity; to the west it grades to calcareous shale and siltstone with pebbles here being only at the base.

The Stuart Bay Formation in western parts of the area gradationally overlaps the Bathurst Island Formation and is in turn overlain by the Lower and Middle Devonian Eids Formation, a recessive calcareous shale and shaly limestone unit. The Eids grades eastward to siliceous dolomite and limestone and then into the Disappointment Bay dolomite. The Disappointment Bay Formation overlaps eastward onto an angular unconformity (Fig. 5). The Eids and Disappointment Bay Formations are overlain conformably by the Blue Fiord Formation, a Middle Devonian limestone unit that grades westward into calcareous shale of the Eids Formation. These rocks are conformably overlain by the Bird Fiord Formation, a widespread Middle Devonian unit of alternating calcareous sandstone and sandy limestone. The Melville Island Group consists of quartz sandstone and minor shale, and is separated into the Hecla Bay and overlying Griper Bay Formations.

Upper Paleozoic and Mesozoic rocks of the Sverdrup Basin occur in the northern part of the map-area. On Helena Island, the Permian Belcher Channel Formation is preserved as a small erosional remnant comprising several hundred feet of limestone and dolomite that unconformably overlies the Melville Island Group. On Cameron Island, the Upper Devonian Griper Bay Formation is overlain by several hundred feet of younger Permian to Jurassic sediments, predominantly sandstone and shale. Mappable units in this succession on Cameron Island include the Permian Trold Fiord Formation, the Triassic Bjorne, Schei Point, and Heiberg Formations, and the Jurassic Jaeger Formation. The youngest bedrock formation so far found within the island group is the Eureka Sound Formation, which here consists of shale with interbedded sandstone and volcanics of Late Cretaceous age. It outcrops in a graben in southeastern Bathurst Island. Nearby to the west are numerous basic dykes that are probably contemporaneous with the lava flows.

Description of Formations

Middle and Upper Ordovician

Cornwallis Group

The name Cornwallis Formation was provisionally used on Cornwallis Island by Thorsteinsson and Fortier (1954). It was later defined by Thorsteinsson (1958, p. 33), who established a type section of three members on the north tip of the island. In ensuing years two older rock units were mapped as the Cornwallis Formation on Ellesmere Island (Fortier *et al.*, 1963; Christie, 1967). Kerr (1967b) redefined the Cornwallis Formation as the Cornwallis Group, and retained the original type section of Thorsteinsson as the type section of the new group. He elevated the three members to formations and designated type sections of these three new formations on Ellesmere Island.

The three formations of the Cornwallis Group can be traced in a belt extending some 600 miles from Bathurst Island (Table I) to North Greenland. The formations maintain

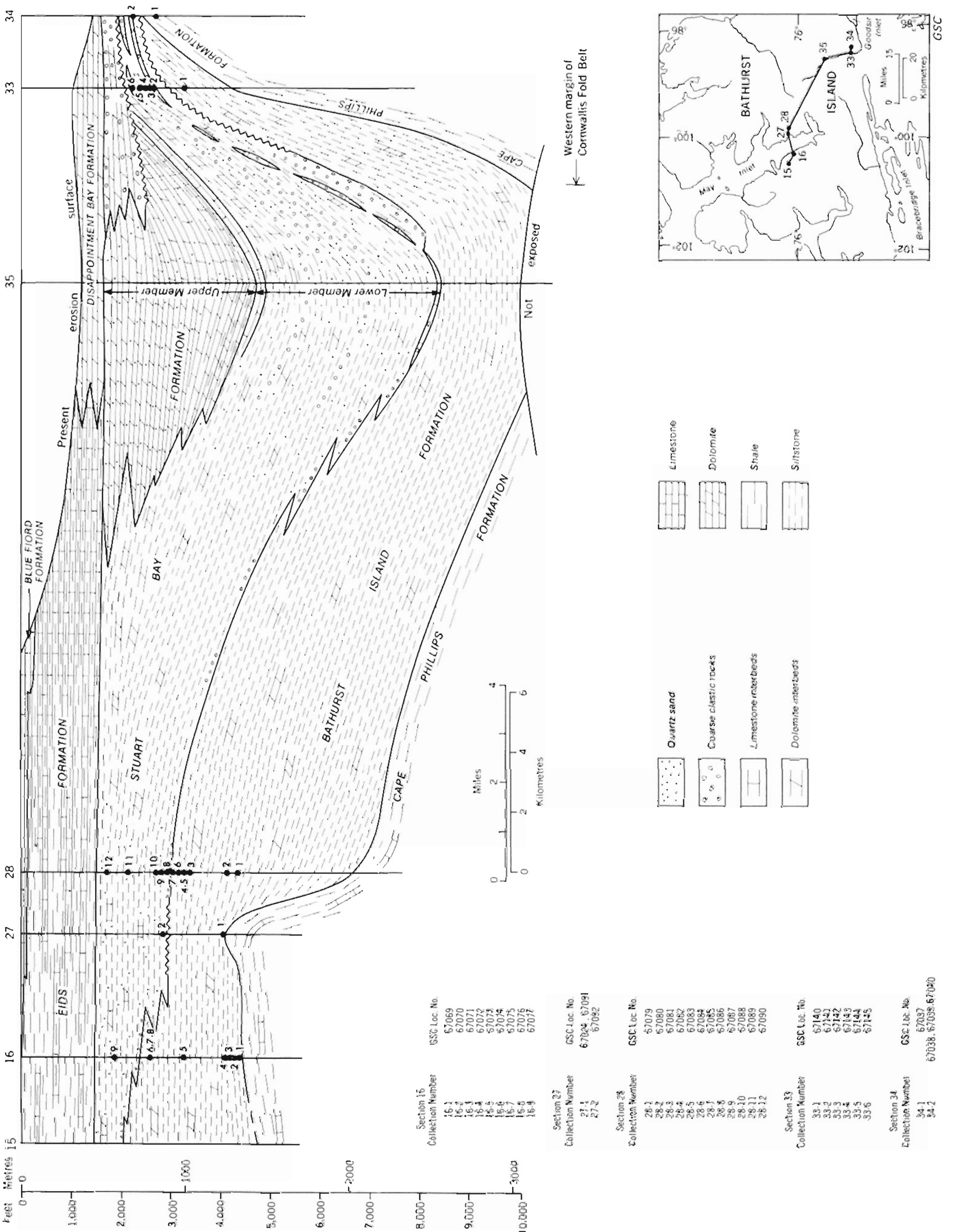

FIGURE 5. Restored stratigraphic cross-section of Silurian and Devonian rocks from the Scoresby Hills area to west of the head of May Inlet, Bathurst Island, showing stratigraphic relationships on the western side of the Cornwallis Fold Belt.

considerable lateral uniformity in the central and shelfward parts of the miogeosyncline. They have distinctive lithology, thickness, and topographic expression and are, in descending order:

Irene Bay—greenish weathering shaly limestone; recessive; 30 to 200 feet thick.

Thumb Mountain—rusty weathering, dark grey limestone; forms massive bluffs; about 1,700 feet thick.

Bay Fiord—thinly bedded, shaly limestone, siltstone, anhydrite, dolomite; recessive; 1,000 to 2,000 feet thick.

The lowermost age limit of the group, about Ashby, is based on the probability that the upper part of the underlying Eleanor River Formation on Cornwallis Island is Mohawkian, and also on the Wilderness fossils in the upper part of the Bay Fiord Formation on Ellesmere Island. The uppermost formation, the Irene Bay, contains fossils of Caradocian age (about Maysvillian), which are abundant on most of the islands but rare on Bathurst Island. Lithologies and faunas of the Cornwallis Group indicate marine deposition in a widespread platform environment. Normal marine circulation was restricted at first, with Bay Fiord evaporites being deposited in a very long and broad basin. As normal circulation was later restored, carbonates were deposited. The preponderance of lime mud (micrite) in the Thumb Mountain Formation of Bathurst Island suggests deposition in a calm environment.

Bay Fiord Formation

The Bay Fiord Formation (Kerr, 1967b), the lowest unit of the Cornwallis Group, is a widespread recessive unit of Middle Ordovician age. Its thickness at the type section northeast of the head of Irene Bay on Ellesmere Island is 1,650 feet, and thicknesses remain of that order of magnitude on most of Ellesmere Island. The Bay Fiord Formation contains evaporites, silty and shaly limestone, gypsiferous shale, dolomite and calcareous siltstone, and exhibits marked lateral lithic variations. During deposition of the formation, an evaporitic basin developed along the shelfward side of the miogeosyncline. In the lower part of the formation on Ellesmere Island, gypsum and anhydrite are prevalent in a narrow belt. The evaporite basin seems to have been much broader southwest of Ellesmere Island and to have contained halite, for on Bathurst Island thick halite in a drilled well (Sec. 38) has been assigned to the Bay Fiord Formation.

On Cornwallis Island, evaporites of this formation outcrop sporadically and are restricted to gypsum-anhydrite. Where the Bay Fiord Formation is exposed, the overlying Thumb Mountain Formation is collapsed and brecciated; this led Thorsteinsson (1958) to suggest that large amounts of evaporites had been leached from the Bay Fiord Formation. A thick section of halite subsequently was encountered in a well on Bathurst Island (Sec. 38) in what most likely is the Bay Fiord Formation. This probably is equivalent to halite that was leached to produce the collapse on Cornwallis Island. The Bay Fiord Formation does not outcrop in normal stratigraphic position in the map-area, nevertheless rocks from two different settings within the study area have been assigned to that formation, and are described below.

On northern Bathurst Island two breached anticlines, the Purcell Bay structure and the May Inlet structure (Fig. 11), contain cores of intrusive evaporites that are in tectonic contact with younger rocks. In the Purcell Bay structure (Pl. II; Sec. 18), an oblong mass of highly contorted light grey anhydrite and anhydritic shale is present in an area about 2 miles long and 1 mile wide. About 300 feet of evaporite is overlain by a caprock, about 100 feet thick, of highly fractured, dark grey, shaly limestone and limy dolomite infilled with anhydrite. The evaporite is recessive but is protected from erosion by the resistant caprock. It is not certain whether the non-evaporitic material in the caprock came from the underlying evapor-

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PLATE II. Gypsum-anhydrite of the Bay Fiord Formation constituting an intrusive core in the axis of the Purcell Bay anticline, northern Bathurst Island (Sec. 18, Fig. 2).

itic formation or from a younger unit that was carried along by the evaporites. Farther north in the May Inlet structure (Pl. XVII; Sec. 19), an area of about 1 square mile is underlain by gypsum–anhydrite in exposures more than 300 feet high.

The two intrusive evaporites described above are considered to be of Ordovician age for the following reasons:

(a) They must be older than the Cape Phillips Formation, which they intrude.
(b) Evaporites are known in two older formations in the general region, the Bay Fiord and Baumann Fiord.
(c) The Bay Fiord Formation exposed on Cornwallis Island (Thorsteinsson and Kerr, 1968) and on nearby Grinnell Peninsula (Kerr, 1967b) contains anhydrite.
(d) The Baumann Fiord Formation is a Lower Ordovician gypsum and anhydrite unit that is 2,400 feet thick on Cornwallis Island (Thorsteinsson and Kerr, 1968).

These evaporites may have come from either or both of the above-mentioned Ordovician formations; however, it is more probable that they came from the Bay Fiord Formation, and they are tentatively assigned as such in this paper.

In the Caledonian River well on south-central Bathurst Island (Sec. 38), the oldest unit penetrated is evaporite and is at least 3,233 feet thick. It was first penetrated at a depth of 6,727 feet and extended continuously to the bottom of the hole at 10,000 feet. It was described as follows by A. J. Froelich in the well completion report (*see* footnote p. 10).

The 'Main Evaporite' series consists of alternating beds of rock salt interbedded with and permeating fractures in gypsiferous shale, dolomite, siltstone, and anhydrite. Most of the 'dolomites' are silty, argillaceous, anhydritic and very dense; however some dolomites between 6,800 and 8,100 feet are slightly to moderately porous and in part bituminous. One dolomite

> zone was tested but yielded only mud. Below 8,100 feet the interbedded dolomites are essentially dense. Three cores taken between 7,800 and 8,800 feet consist of interbedded salt, gypsiferous shale, and dolomite which are fractured, brecciated and have steeply inclined bedding. Contortions in the laminated shales and dolomites suggest that the salt series has been injected into position by flowage.

The main evaporite unit in the Caledonian River well is probably the lower evaporitic part of the Bay Fiord Formation. It is probable that this extremely contorted part of the formation has been thickened considerably by tectonics. Overlying the main evaporite in the Caledonian River well between depths of 6,715 and 6,305 is a unit, 410 feet thick, which was described as a dense barren sequence of interbedded shale, anhydrite, and dolomite. This is probably the upper member of the Bay Fiord Formation, which has a similar lithology on nearby Cornwallis Island where it is 500 feet thick.

Thumb Mountain Formation

The Thumb Mountain Formation (Kerr, 1967b) is an extensive, bluff-forming limestone unit of Middle Ordovician (Barneveld and Eden) age, which occurs in the middle part of the Cornwallis Group and lies conformably between recessive formations. The type section of the formation on Ellesmere Island is 1,500 feet thick. In the central part of the miogeosyncline, the formation is normally characterized by thick-bedded, dark grey-brown, argillaceous limestone, which weathers slightly rusty grey and forms bluffs. In the type section of the Cornwallis Group on northern Cornwallis Island, it comprises at least 1,700 feet of rock (the upper part of which is dolomitized). Fossils, always sparse in the formation, occur mainly in the upper part, and all are representatives of the 'Arctic Ordovician fauna' of Middle or Late Ordovician age.

Distribution, thickness, and lithology. The Thumb Mountain is the oldest formation exposed in normal stratigraphic position in the study area; its base is not exposed. Exposures are restricted to the region north of Bracebridge Inlet and east of Erskine Inlet. In the extreme northeastern part of Bathurst Island (Sec. 22), 320 feet of micritic, light to medium grey limestone of the uppermost Thumb Mountain Formation is exposed in the hanging wall of a northerly dipping thrust fault. The thickest section of the formation is at Moses Robinson River (Sec. 30) where it consists of 1,800 feet of dense, light to medium grey, thick-bedded, micritic limestone, with minor amounts of skeletal limestone, light grey, sugary dolomite, and dolomitic limestone. The formation weathers yellowish grey with some rusty staining. At the top are greenish, shaly interbeds. At Driftwood Bay (Sec. 31) the formation is a little more than 1,700 feet thick, and comprises predominantly light grey, sugary to vuggy, medium-bedded resistant dolomite, with only minor amounts of limestone. Still farther south, at the head of Goodsir Inlet (Sec. 34), the entire Thumb Mountain Formation is dolomite. The lowest exposure consists of 425 feet of tan to brown dolomite, sugary, finely porous to vuggy, with a strong petroliferous odour. These beds are overlain by 1,000 feet of sugary, finely porous to vuggy, light to medium chocolate brown, thick-bedded to massive dolomite. The Thumb Mountain Formation may have been dolomitized locally when overlain by an unconformable cover of Lower Devonian Disappointment Bay Formation that has since been removed by erosion.

At the mouth of Stuart Bay (Sec. 24), 1,345 feet of the Thumb Mountain Formation is exposed on the north flank of a dome. The lowermost 450 feet of this exposure is composed of petroliferous and fetid dolomite that is porous and slightly limy; it is dark chocolate brown, weathering chocolate brown mottled with light tan. The dolomite-limestone contact seems to be everywhere at the same stratigraphic level in this structure, thus the dolomite probably is not a local replacement of limestone, but could have a large areal extent. Successively younger units include: 670 feet of dark chocolate brown, light grey-brown and light grey, thick-bedded shaly limestone; and 225 feet of thin- to medium-bedded, medium grey-brown shaly and silty interlayers which weather light grey-green. The formation is overlain abruptly but conformably by a recessive greenish shale, the Irene Bay Formation. At Section 14, west of May Inlet, the Thumb Mountain Formation is mainly limestone, but contains an interval, about 475 feet thick, composed of fetid bedded dolomite (*see* Appendix).

Irene Bay Formation

The Irene Bay Formation (Kerr, 1967b) is a thin succession of generally recessive, thinly bedded limestone with some interbedded shale which is extensively represented in the Arctic between Melville and Ellesmere Islands. The type section is in the reference section of the Cornwallis Group northeast of Irene Bay on Ellesmere Island. The greenish weathering and recessive nature are distinctive characteristics of the formation. Prolific faunal collections of very large specimens have been made in this formation, including coiled and straight cephalopods, brachiopods, receptaculitids, gastropods, and colonial and solitary corals. These have been referred to widely as the 'Arctic Ordovician fauna' of about Edenian and Maysvillian age. In general, the Irene Bay Formation, about 200 feet thick and abundantly fossiliferous, occurs over wide regions in the Queen Elizabeth Islands. It is similar on northern Bathurst Island where the thickness ranges from 125 to 180 feet and fossils are abundant. However, in other exposures in the central and eastern parts of the Bathurst Island, fossils are rare and thicknesses range from 30 to 65 feet. Because of its extreme thinness, the Irene Bay Formation is combined with the Thumb Mountain Formation on the geological map (Map 1350A). Both upper and lower contacts are everywhere conformable, and usually abrupt.

Distribution, thickness, and lithology. The Irene Bay Formation in the report area is a thin, widespread sheet of soft limestone with abundant, interbedded greenish shale layers. It is quite distinctive in its weathering behaviour, occupying a thin recessive interval between the underlying thick, resistant Thumb Mountain Formation and a thin, resistant dolomite or limestone interval at the base of the overlying Cape Phillips Formation.

At Section 22 in the extreme northeast of the map-area, the recessive Irene Bay Formation is 125 feet thick and consists of thin-bedded, medium grey limestone with fossil fragments, interbedded with greenish weathering shaly interlayers. The limestone weathers rusty grey. Large fossils of the Arctic Ordovician fauna lie loose on the formation. Farther west, in the Stokes Range (Sec. 14), the lithology of the formation is again typical. Thickness there is 180 feet and fossils of the Arctic Ordovician fauna are abundant.

In Section 30 at Moses Robinson River, the Irene Bay Formation is 30 feet thick and consists of fossiliferous, recessive, green, calcareous shale, with thin limestone interbeds. A few beds of green calcareous shale are intercalated in the upper part of the underlying Thumb Mountain Formation. The upper contact of the Irene Bay Formation with a basal dolomite of the Cape Phillips Formation is abrupt but conformable. About 5 miles to the south at Driftwood Bay (Sec. 31), the lithology is similar and the thickness is 40 feet. At the head of Goodsir Inlet (Sec. 34), the Irene Bay Formation is 50 feet thick and recessive. There it is mainly dolomite that is finely crystalline, thin bedded, medium grey, with greenish shale interbeds. It is probable that this formation has been dolomitized, for the entire underlying Thumb Mountain Formation also is dolomite in this section. At the mouth of Stuart Bay (Sec. 24), the Irene Bay Formation consists of 50 feet of very soft, non-calcareous green shale with minor shaly limestone interbeds and scattered pyrite crystals. About 8 miles to the south (Sec. 27), the formation is 65 feet thick and has its typical lithology.

Age and correlation. In the study area the Irene Bay Formation contains large fossils, mainly cephalopods, corals, receptaculitids, gastropods, and brachiopods. These are not listed here because collections from this formation at numerous other localities have been published earlier (Kerr, 1967b, 1968a). These fossils belong to the Arctic Ordovician fauna, which generally is considered to be of boreal origin. It is typified by the faunas of the Red River Formation of Manitoba, Cape Calhoun Formation of northwest Greenland, Bighorn Formation of Wyoming, and several other well-known formations of North America. Because of the uncertainty of precise dating of shelly faunas at this level of the geologic column, the writer will follow Thorsteinsson (1963a, p. 38; *see also* Kerr, 1967b), who tentatively regarded the fauna as late Caradocian (about Edenian and Maysvillian) in age, and the top of the Irene Bay Formation as the boundary between the Caradocian and Ashgillian. The top of the Irene Bay Formation and Cornwallis Group is at the boundary of the Middle and Upper Ordovician according to the European standard section whereas, according to the North American standard section, it lies within the lower Upper Ordovician (Table I).

The Irene Bay Formation is very widespread in the Canadian Arctic Islands, extending over 900 miles from eastern Ellesmere Island to Melville Island. It is a thin unit, with a sharp but conformable upper boundary. Because the Irene Bay Formation is so thin yet widespread, it is probable that its upper boundary, more than any other boundary in the lower Paleozoic rocks here, may approximate a time horizon. It marks a pronounced change in the sedimentary pattern within the study area, and also over an extensive area in the southern and eastern Queen Elizabeth Islands. Below this boundary there are widespread carbonate and evaporite formations in which lateral variations in thickness and lithology are gradual. Above the Irene Bay Formation the entire succession of rocks up to and including Upper Devonian shows great lateral variations in facies and thickness.

Upper Ordovician, Silurian, and Lower Devonian

Cape Phillips Formation

The type section of the Cape Phillips Formation is at Cape Phillips on northern Cornwallis Island, and was first described by Thorsteinsson (1958), who divided it into three members. The lower, Member A, comprises mainly dolomite, argillaceous limestone, fetid shale, and cherty argillaceous limestone. A persistently developed stratum of dolomitic limestone, 30 to 50 feet thick, marks the base of this member; this is overlain by fissile shale, and then by argillaceous limestone. Member B, overlying Member A with gradational contact, is composed mainly of cherty argillaceous limestone, argillaceous limestone, cherty calcareous shale, cherty limestone, limestone, calcareous shale, and minor amounts of shale. Member B grades imperceptibly into the overlying Member C, which consists of an extremely monotonous succession of alternating calcareous shale, argillaceous limestone, limestone, and shale. Concretions with graptolites occur throughout this member but are most common in the lower beds. Member C accounts for roughly three quarters of the aggregate thickness of the formation. The thickness of the Cape Phillips Formation at its type section on the north coast of the island is 7,500 feet with no upper contact exposed (Thorsteinsson and Kerr, 1968). Based on information obtained from correlations with other sections, those authors concluded that the maximum thickness of the Cape Phillips Formation in the general area may be about 9,800 feet. Graptolites in the Cape Phillips Formation throughout nearly its entire span indicate that it was deposited under long-persisting euxinic conditions. On Cornwallis Island, the entire Cape Phillips Formation grades southward into a thicker succession comprising two formations composed almost entirely of carbonates: the Allen Bay Dolomite and overlying Read Bay Limestone.

The Cape Phillips Formation of Bathurst Island is equivalent, both lithologically and faunally, to Members A, B, and a lower part of Member C of Cornwallis Island.

Distribution, thickness, and lithology. The Cape Phillips Formation on Bathurst Island is composed generally of dark grey, graptolitic shaly rock, whose thickness ranges from 1,020 to 2,704 feet. Near the base it is usually more calcareous and contains interbedded black limestone and dolomite; it becomes increasingly silty toward the top. The formation outcrops only in the cores of the more deeply dissected anticlines where it is poorly exposed except in narrow, crosscutting stream valleys. The Caledonian River well has penetrated the entire formation. The Cape Phillips Formation is an easily recognizable unit in outcrop because the shale weathers to distinctive grey, paper thin, brittle flakes; dark yellowish orange streaks occur where dolomite is present in the section.

The most complete and best exposed section of the Cape Phillips Formation in the report area is at Twilight Creek (Sec. 25, *see* Appendix and Pl. III). McLaren's (1963b) description of this key section is supplemented by new data and interpretations. The age range shown for the Cape Phillips Formation on Table I is that of the Twilight Creek section. The formation consists of black calcareous shale and mudstone with some argillaceous limestone beds and minor amounts of dolomite. Members were not distinguished but several distinctive lithological units were recognized. There is a marked difference in thickness between the type section on northeastern Cornwallis Island where a maximum of 9,800 feet was reported, and the Twilight Creek development where little more than 1,500 feet was measured. It is concluded that this is partly because the formation on Cornwallis Island includes younger beds and partly because deposition was more rapid there.

The lowest beds exposed at Twilight Creek in the core of the Stuart Bay anticline consist of 75 feet of black and grey, variably argillaceous fine-grained limestone, with interbedded black calcareous mudstone and shale. Some of the limestone beds are strongly fetid and others are nodular, mottled, and micritic. These beds present a strongly banded appearance in the valley sides.

The succeeding 130 feet consists of black calcareous shale with varying amounts of interbedded argillaceous, fine-grained and laminated limestone; this rock weathers to thin flagstones. Above is 360 feet of predominantly black, calcareous mudstones and shales with thin beds of argillaceous limestone in the lower 20 feet. Weathered surfaces are pale yellowish brown to orange-brown.

The upper part of the formation is 950 feet thick. In these beds the faunal zones are more widely spaced and the fossils are less well preserved, indicating more rapid deposition than for the lower strata. The succession consists of black mudstone and shale, which are largely non-calcareous, although dolomitic in the lower part. In the upper 200 feet of the formation the shales are interbedded with equal amounts of thin-bedded and laminated, dark grey, argillaceous to calcareous siltstone that weathers to a pale reddish brown.

The Cape Phillips Formation is overlain by the Lower Devonian Bathurst Island Formation at Twilight Creek. The contact is gradational and is drawn where silt and sand begin to become important rock constituents, and shale becomes subordinate. In fresh exposures in valley bottoms the contact is far from obvious, but where the beds are weathered there is a marked contrast between the thin-bedded shaly character of the typical Cape Phillips beds and the more blocky brown flagstones of the Bathurst Island Formation.

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PLATE III. The well-exposed Twilight Creek section in the Stuart Bay anticline (Sec. 25), containing the type sections of Bathurst Island and Stuart Bay Formations. View looking east.

Thorsteinsson and Glenister (1963) described the Cape Phillips Formation in the Driftwood Bay area of eastern Bathurst Island (Secs. 30 and 31) where the principal rock types are dark grey to black, calcareous shale, shale, and aphanitic to fine-grained, thin-bedded, argillaceous limestone. Minor constituents include beds of dark grey to black, aphanitic to fine-grained, thin-bedded, cherty limestone and limestone; dark grey to black, cherty, calcareous shale; medium dark grey, fine-grained, medium-bedded, porous dolomite; and medium dark grey siltstone. The chert occurs as nodular replacements and as interbeds of irregular to regular, very thin individual strata. The Cape Phillips Formation is approximately 1,400 feet thick in the Driftwood Bay area. The three members that were recognized in the Cape Phillips Formation on Cornwallis Island probably occur in this part of Bathurst Island. They grade into one another as on Cornwallis Island with only Member A being clearly discernible. Noticeably less chert and only rare limestone concretions are present on Bathurst Island as compared with Cornwallis Island. Thorsteinsson and Glenister (1963, p. 589) summarized the members in ascending stratigraphic order as follows:

Member A comprises an alternating series of thin-bedded argillaceous limestone, calcareous shale, shale, cherty limestone, limestone, cherty calcareous shale, dolomitic limestone and dolomite.

Member B is similar to Member A but distinguished from it by the predominance of cherty limestone and cherty calcareous shale, as well as by the absence of dolomite and dolomitic limestone.

Member C consists of calcareous shale and shale with minor amounts of argillaceous limestone and siltstone.

The writer has re-examined and redescribed the section of Driftwood Bay (Sec. 31). A unit of dolomite, 50 feet thick, at the base of the Cape Phillips Formation is the lower part of Member A. It is sugary, mottled, dark grey and grey-brown, and fetid. Lower and upper contacts are sharp. This unit is overlain by a poorly exposed interval, 550 feet thick, that includes at the base a thin black fissile shale that is still part of Member A and which contains *Pseudogygites* sp., and biserial graptolites. The remainder of the unit is composed of thin-bedded, very shaly, medium to dark brownish grey cherty limestone which weathers to a light tan brown; it is interbedded with considerable amounts of calcareous, dark brownish grey, graptolitic shale and siltstone. The unit is recessive and becomes progressively more shaly toward the top. An overlying unit, 800 feet thick, consists of dark grey shale that is very limy. It contains limestone interbeds at the base but is non-calcareous in upper parts. At the top it grades sharply into the overlying Bathurst Island Formation as indicated by the appearance of siltstone with a calcareous matrix, and a colour change to moderate brown on fresh surfaces and tan-brown on weathered surfaces. The sections at Twilight Creek (Sec. 25) and Driftwood Bay (Sec. 31) are similar in thickness, lithology, and faunal distribution.

West of Goodsir Inlet (Sec. 34), the Cape Phillips Formation is 1,775 feet thick and comprises four units in ascending order as follows. Unit 1 is 155 feet thick, consists of dark chocolate brown dolomitic shale, calcareous dolomitic siltstone with tan sugary dolomite interbeds, and contains limestone nodules up to a foot in diameter. Unit 2 is a resistant unit, 320 feet thick, consisting of thin- to medium-bedded and often nodular shaly chert as well as medium to chocolate brown, cherty dolomite and interbeds of siltstone. The quantity of chert in this unit decreases upward. Unit 3 is 400 feet thick, and consists of siltstone that is dolomitic, slightly calcareous and cherty. It is medium dark brown on fresh surfaces and weathers tan; the rock is thinly bedded and outcrop is poor and rubbly. Unit 4 is 900 feet thick and consists of thin-bedded to fissile siltstone, that is medium chocolate brown on fresh surfaces and weathers rusty brown; interbeds of medium to light brown dolomitic siltstone are present. The entire Cape Phillips Formation in Section 34 is much more dolomitic and cherty than the shales and siltstones characteristic of the formation farther north. The formation grades to typical calcareous siltstones of the conformably overlying Bathurst Island Formation by the intercalation of increasing numbers of calcareous quartz siltstone interbeds.

The Cape Phillips Formation was penetrated in the Caledonian River well (Sec. 38, *see* Appendix) and was described in the well completion report by A. Froelich (*see* footnote p. 10). The formation was subdivided into three members which are tentatively correlated with the three members described earlier in the present report. The lower Member A has 44 feet of porous dolomite at the base; the remainder of the member consists of bituminous shale and limestone, cherty dolomite, cherty limestone, and cherty shale, totalling 720 feet. Member B consists of marl, limestone, and cherty shale totalling 605 feet. Member C consists of shale, limestone, and siltstone, and is 1,325 feet thick. The contact with the underlying member is abrupt and apparently conformable. At the top, the formation is transitional into the overlying Bathurst Island Formation. The total thickness of the Cape Phillips Formation encountered in this well is 2,694 feet which is considerably greater than to the north. Also, considerably more carbonate occurs in the lower part here than to the north.

On the Hosken Islands (Sec. 13) north of Bathurst Island, the Cape Phillips Formation is only 1,020 feet thick, and five field units were recognized as follows. Unit 1, 30 feet of dark shale containing biserial graptolites, rests conformably on typical rocks of the Irene Bay Formation. Unit 2 comprises 70 feet of rubbly, fetid limestone. Unit 3, 230 feet thick, consists of fissile, sooty, black, recessive shale; in the upper part it grades to thin- to medium-bedded hard siltstone. Unit 4, 600 feet thick, consists of thin- to medium-bedded, very resistant siltstone. Unit 5, 90 feet thick, consists of fissile and recessive shale. Conformably overlying the Cape Phillips Formation in this section is at least 500 feet of the typical Bathurst Island Formation.

On Bathurst Island, the Cape Phillips Formation everywhere rests abruptly but conformably upon the Irene Bay Formation. The base of the Cape Phillips Formation usually is marked by a thin carbonate unit that comprises about 35 feet of sugary, fetid, mottled, dark grey and grey-brown dolomite. This carbonate unit is probably a northerly carbonate tongue connected with the Allen Bay Formation. These beds are succeeded conformably by very limy dark grey shales and siltstones in the main part of the formation. In Section 27, a discrete limestone bed 25 to 43 feet thick occurs within the main shale part of the formation about 75 feet above the base. In Section 24, a similar limestone bed is 25 feet thick and occurs 195 feet above the base of the formation. Even greater amounts of discrete limestone occur in the Cape Phillips Formation in a briefly examined section at Purcell Bay. Several thin sections of typical Cape Phillips shale were found to be very finely laminated and composed of fine silt- or clay-sized particles of quartz and calcium carbonate in a matrix of brown organic material. The proportion of quartz to calcium carbonate varies considerably, the rock varying from shale to almost pure limestone. Some of the calcium carbonate is detrital, occurring as discrete particles among the grains of quartz.

Age and correlation. Following field investigations on Bathurst Island in 1955, Thorsteinsson (*in* McLaren, 1963b, p. 599) dated the Cape Phillips Formation at Twilight Creek (Sec. 25) as Ashgillian to Ludlovian. At that time (1955), three subseries of the Ludlovian (lower, middle, and upper) were believed to constitute the Late Silurian (*see* Munch, 1952). The "middle subseries" is now included in a new Late Silurian series, the Pridolian (Bouček *et al.*, 1968; Martinsson, 1969). The "upper" Ludlovian is now regarded as basal Devonian. Thus, the lower age limit for the formation still holds, but the worldwide revisions have necessitated changes in the upper age limit (Tables I and II).

The lowest fossil collected from the Cape Phillips Formation at Twilight Creek is a graptolite that was collected about 15 to 25 feet above the lowest exposure. It was assigned to *Orthograptus* n. sp. by R. Thorsteinsson. This species occurs in the basal beds of the formation on Cornwallis Island and Little Cornwallis Island in association with the Arctic Ordovician fauna, and is dated as Late Ordovician. The writer confirms from comparison with more complete sections that the basal beds of the Twilight Creek section indeed probably are the basal limestone beds of the Cape Phillips Formation.

Graptolites from upper parts of the Cape Phillips Formation have been examined by Thorsteinsson (pers. com., 1971), and certain revisions of identification and dating have been made from those originally reported by him (*in* McLaren, 1963b). At 760 feet above the base of the Cape Phillips Formation at Twilight Creek there is a lower Ludlovian fauna containing *Monograptus bohemicus* (GSC loc. 25815). At 970 feet above the base of the forma-

TABLE II — *Series and faunas near the redefined Silurian-Devonian Boundary* (after Bouček *et al.*, 1968; Martinsson, 1969).

	SERIES	ZONE
DEVONIAN	GEDINNIAN	*Monograptus yukonensis* *Monograptus uniformis*
SILURIAN	PRIDOLIAN (DOWNTONIAN)	*Monograptus angustidens* *Monograptus ultimus*
	LUDLOVIAN	*Monograptus fecundus* *Monograptus nilssoni*

tion (GSC loc. 25820) *Monograptus* cf. *M. transgradiens praecipuus* occurs. At 1,500 feet above the base of Section 25 (*see* Appendix), *Monograptus* cf. *M. uniformis* Přibyl (GSC loc. 25824) is found. *M. uniformis* is now regarded as the index fossil of the lowermost Devonian (Gedinnian). The youngest fossils in the Cape Phillips Formation, occurring at a height of 1,510 feet above the base (GSC loc. 25824), also were identified as *Monograptus* cf. *M. uniformis* Přibyl. There is doubt about exact placement of the intersystemic boundary at Twilight Creek (Sec. 25); however GSC locality 25824, which occurs at the 1,500-foot level in the Cape Phillips Formation and which contains *M.* cf. *M. uniformis* Přibyl, clearly is close to the boundary. Thus the Silurian–Devonian boundary is probably between GSC localities 25824 and 25820, which occur respectively at heights of 1,500 feet and 970 feet in Section 25 at Twilight Creek. Based upon the above considerations, the maximum age range of the Cape Phillips Formation in the report area, represented at Twilight Creek (Sec. 25) is from Upper Ordovician (Ashgillian) to Lower Devonian (Gedinnian).

Three facies belts of the Cape Phillips Formation occur in the report area. On the Hosken Islands in the north (Sec. 13) the formation is only 1,020 feet thick and probably does not include beds as young as it does farther south. It is gradationally overlain by the Bathurst Island Formation. In central parts of the area, as at Twilight Creek (Sec. 25) and Driftwood Bay (Sec. 31), the Cape Phillips Formation is of intermediate thickness: 1,400 to 1,500 feet. It comprises mainly graptolitic shale, siltstone and fissile shaly limestone, ranging in age from latest Ordovician to early Devonian, and is overlain conformably by the Bathurst Island Formation. Farther south at the Caledonian River well (Sec. 38), the thickness of the Cape Phillips Formation is considerably greater, being 2,694 feet. Its age range there is less certain but it probably occupies about the same span of time as the Cape Phillips Formation in the intermediate belt. In Core No. 2 from Member C, at a height of 1,580 to 1,598 feet in the formation, *Monograptus transgradiens* Perner, and *Linograptus* sp. were identified by R. Thorsteinsson and dated as the penultimate zone of the Pridolian. The section in the well is thicker and contains considerably more dolomite and chert than it does farther north; it resembles the formation on Cornwallis Island (Thorsteinsson, 1958) and Truro Island (Sec. 41). It would appear that the Bathurst Island Formation gradationally overlaps the Cape Phillips Formation from north to south. Also the Cape Phillips Formation grades southward on Bathurst Island into a more dolomitic section.

The absence of any benthonic fossils or of any other evidence of bottom-dwelling life within this sequence indicates that stagnant conditions were prevalent; normal marine circulation was cut off over wide areas during the time from the Late Ordovician to Devonian. Several factors could account for this. Perhaps the growth of carbonate banks on the south and east prevented the normal circulation of the sea, resulting in large areas with stagnant bottom conditions. Another possibility is that the underlying crust began downwarping here more rapidly than in areas to the south and east which remained as carbonate platforms while the developing basin became starved. It is possible also that both factors combined to produce this isolated euxinic basin.

The lack of coarse clastics in the Cape Phillips Formation indicates the absence of nearby land with appreciable relief. Detrital quartz increases in amount to the north and is presumably from some unknown area now covered by the Sverdrup Basin. Carbonate increases to the south and east where the formation is thickest, while in central regions the rock is predominantly shale of an euxinic environment and contains dark organic material.

The Cape Phillips Formation is exposed in central Melville Island, more than 200 miles to the west (Tozer and Thorsteinsson, 1964). To the east it is present on northern Cornwallis Island (Thorsteinsson and Kerr, 1968), and to the northeast on Ellesmere Island (Thorsteinsson and Kerr, 1962). On central Cornwallis Island, the Cape Phillips Formation changes abruptly southward to dolomite of the Allen Bay Formation (Thorsteinsson, 1958). Similar abrupt facies changes to carbonates occur in southwest Ellesmere and on western Melville Island (Tozer and Thorsteinsson, 1964). On Grinnell Peninsula of Devon Island, a few miles to the northeast of Bathurst Island, equivalent rocks are also in a carbonate facies (Thorsteinsson, 1963c) as they are on Prince of Wales Island (Blackadar and Christie, 1963). Thus, the black shale facies of the Cape Phillips Formation on Bathurst Island is enclosed, at least to the east and south, by a carbonate facies.

Lower Devonian

Sherard Osborn and Driftwood Bay Formations (abandoned)

A brief review of some aspects of Lower Devonian stratigraphy is necessary because early work of Thorsteinsson and Glenister (1963) is revised in this paper (*see* Fig. 6). Thorsteinsson and Glenister (op. cit.) measured two sections in the Driftwood Bay area of eastern Bathurst Island, and set up a composite stratigraphic column for the region that is shown in Figure 6A. Because of structural complications, their interpretation of stratigraphic relationships of Devonian rocks was incorrect. The revised section for this area is shown in Figure 6B.

At Ptarmigan Creek, Thorsteinsson and Glenister (1963, Fig. 50) interpreted a contact at their locality G to be an angular unconformity separating the Ordovician Cornwallis Formation from an overlying Silurian or Devonian sandstone which they called the Driftwood Bay Formation. The Driftwood Bay Formation in turn was regarded as being overlain conformably by Middle Devonian limestone of the Blue Fiord Formation. They thought that this unconformity dated the orogeny that produced the Cornwallis Fold Belt. The writer has reinterpreted their unconformity as a fault. The sandstone unit, or Driftwood Bay Formation, at their locality G is preserved in a small graben, and is separated from both the Cornwallis Formation and the Blue Fiord Formation by faults. It probably is part of the Griper Bay Formation for, when traced to the north, it is seen to rest unconformably on the Bird Fiord Formation. The name Driftwood Bay Formation is therefore discarded, and the sandstone unit is regarded as probably part of the Griper Bay Formation.

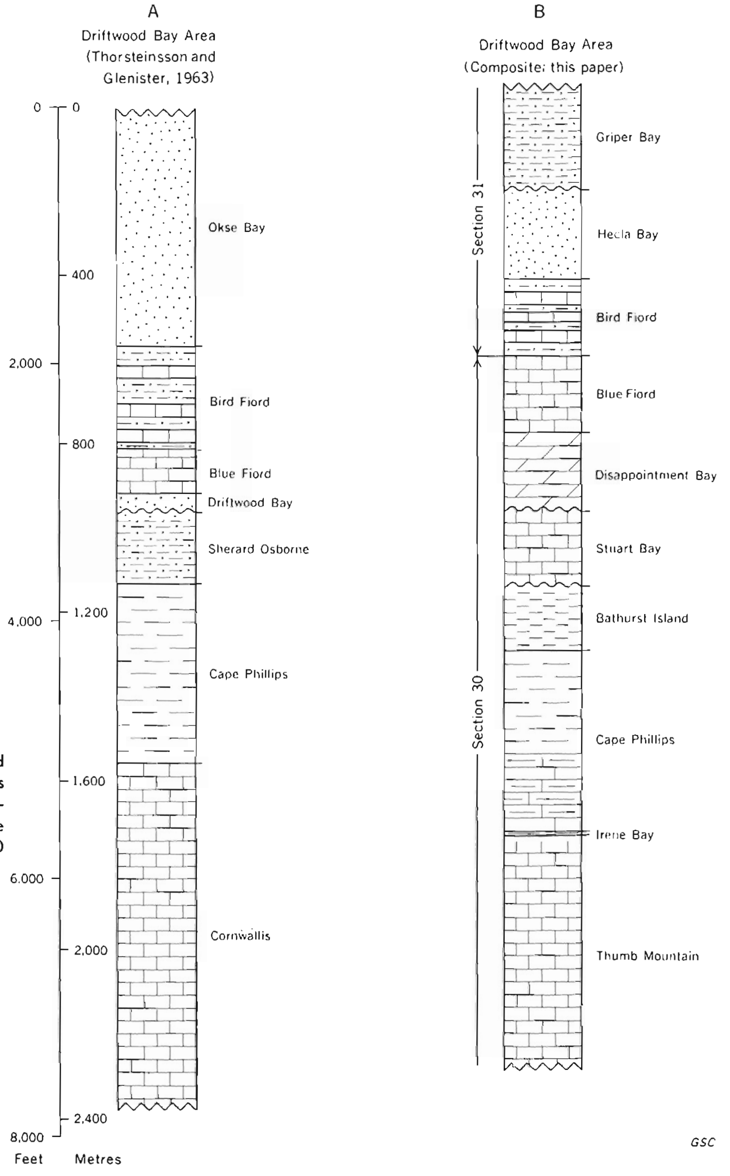

FIGURE 6

Columnar sections in the Driftwood Bay area showing; (A) the section as reported by Thorsteinsson and Glenister (1963), and (B) the composite section from parts of Sections 30 and 31.

Thorsteinsson and Glenister (1963, p. 591–2) also included in the Sherard Osborn Formation a sequence of mixed rock types resting on the shales of the Cape Phillips Formation at Nightfall Creek (a branch of Moses Robinson River). It is now felt that the lower part of the Sherard Osborn Formation is part of the Bathurst Island Formation (McLaren, 1963b), and the upper part is the Disappointment Bay Formation of Thorsteinsson (1958). The two are separated by an unconformity in the valley of Nightfall Creek. The name Sherard Osborn Formation is abandoned because it is now unnecessary and because of the unconformity that is now known to exist in the original type section.

Bathurst Island Formation

The Bathurst Island Formation is widely exposed in the eastern part of the report area. Its type section is at Twilight Creek (Sec. 25), where the formation was originally described by McLaren (1963b, p. 604) as comprising fine-grained, variably argillaceous and calcareous, quartzose sandstones, and calcareous mudstones. The thickness in the Twilight Creek section is 3,410 feet.

The base of the type section is of Early Devonian age, since the formation rests on Lower Devonian rocks of the Cape Phillips Formation, and also has yielded Early Devonian graptolites (*see* Appendix). The type section is succeeded with apparent conformity by the Stuart Bay Formation, which resembles it in gross lithology. The contact is drawn at the base of the lowest of three limestone pebble beds. The top of the Bathurst Island Formation is diachronous, and is youngest in the west (Figs. 4 and 5). In eastern Bathurst Island the formation is of Lower Devonian age; it is thinner than farther west and contains westerly projecting tongues of thin limestones and pebble beds in the upper part. These shallower water features are the first evidence that a new pattern of sedimentation was beginning, in which the Cornwallis Fold Belt was active. On the eastern side of the island, the Bathurst Island Formation is overlain unconformably by the Lower Devonian Stuart Bay Formation. In westerly exposures this interval was represented by widespread continuous sedimentation, except in one local area, and perhaps more, where a local angular unconformity separates it from the overlying Stuart Bay Formation.

Distribution, thickness, and lithology. The Bathurst Island Formation is widely exposed in the eastern and central parts of the report area, where it forms rounded, grey-brown hills and ridges. Good exposures are restricted to crosscutting stream valleys. Due to the thickness of this unit, both the base and the top of very few sections are exposed, so that complete thicknesses were rarely obtained.

In central parts of the Bathurst Island group, the Bathurst Island Formation is composed almost entirely of silt-sized detrital material, but ranges in grain size from shale to sand with minor amounts of carbonate cement. It is a rather monotonous alternation of clastic rock types (Pl. IV). The rock types alternate between paper thin, olive-brown to black, calcareous and micaceous shales, and flaggy 2-inch to 1-foot beds of fine-grained, lithic arenite, siltstone and shale, with minor interbeds of dolomite and limestone. The formation is a flysch-like deposit exhibiting graded bedding. It is sparsely fossiliferous, containing only a few graptolites, tentaculitids and small amounts of calcareous skeletal debris.

In eastern parts of Bathurst Island, marked facies variations in the upper part of the Bathurst Island Formation and overlying Stuart Bay Formation signify major tectonic events in and surrounding the basin. At Scoresby Hills to the west (Sec. 35, Fig. 5), only the uppermost 1,600 feet of the Bathurst Island Formation is exposed above a fault. The section consists predominantly of graded beds. The lowest layers of each bed consist of a mixture of coarse sand-sized quartz grains, and calcareous skeletal debris of various types (including crinoid stems, tentaculitid, mollusc, and other shell fragments). Each grades upward to silt-sized quartz particles and finally to dark brown or black, calcareous shale (*see* Pls. Va, b, and c). Ungraded intervals of well-laminated, grey to black, calcareous shale, siltstone, and fine-grained quartz sandstone also occur throughout. In the upper part of Bathurst Island Formation, distinctive but gradational changes in lithology and texture take place, as graded units decrease in abundance and are finally absent. Thin layers of detrital skeletal limestone and rare intervals of lump-pellet limestone are interbedded with the clastics. In these eastern areas (e.g., Secs. 33 and 35), the contact with the overlying Stuart Bay Formation is drawn beneath the oldest patch reef or conglomerate bed. The reefs are discontinuous bodies,

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PLATE IV. Characteristic exposure of the Bathurst Island Formation in a stream-cut on the north flank of the Purcell anticline. Yellowish brown weathering beds of siltstone and fine-grained sandstone, 6 inches to a foot thick, are interbedded with shale.

usually less than 40 feet thick, containing stromatoporoids, corals, and brachiopods, and including dolomite, chert and limestone boulders up to 4 feet in diameter.

In Section 30, the Bathurst Island Formation rests gradationally on the Cape Phillips Formation and is 525 feet thick. It is composed of chocolate brown, fine-grained, argillaceous and calcareous, quartzose siltstones, and calcareous mudstones.

At the head of May Inlet there was local erosion of the Bathurst Island Formation from a small domal uplift before deposition of the Stuart Bay Formation. This is shown by the great thickness contrast in a distance of 2½ miles between Sections 27 and 28 (Fig. 5).

The lowest rocks exposed on Helena Island (Sec. 12) are assigned to the Bathurst Island Formation. This section is 1,000 feet thick and consists of thin-bedded quartzose, calcareous siltstone that is dark grey to slightly brownish grey weathering, and in places contains limestone nodules. These rocks, which are overlain by the Eids Formation, were assigned to the Bathurst Island rather than to the Stuart Bay Formation because there is no evidence of pebble or reefal intervals. Moreover, this assignment is in keeping with observed trends, which show that the Stuart Bay Formation thins and probably disappears to the north (Fig. 4) and to the west (Fig. 5).

For the most part, the Bathurst Island Formation is a generally uniform unit of fine-grained calcareous quartz siltstone, which was spread widely throughout the report area. It varies greatly in thickness (Figs. 4 and 5) largely because of the greatly varying age of its upper contact. The formation represents a basinal, deep water deposit of graded beds, and only in the upper part of the formation in the southeastern parts of the area is shallowing evident.

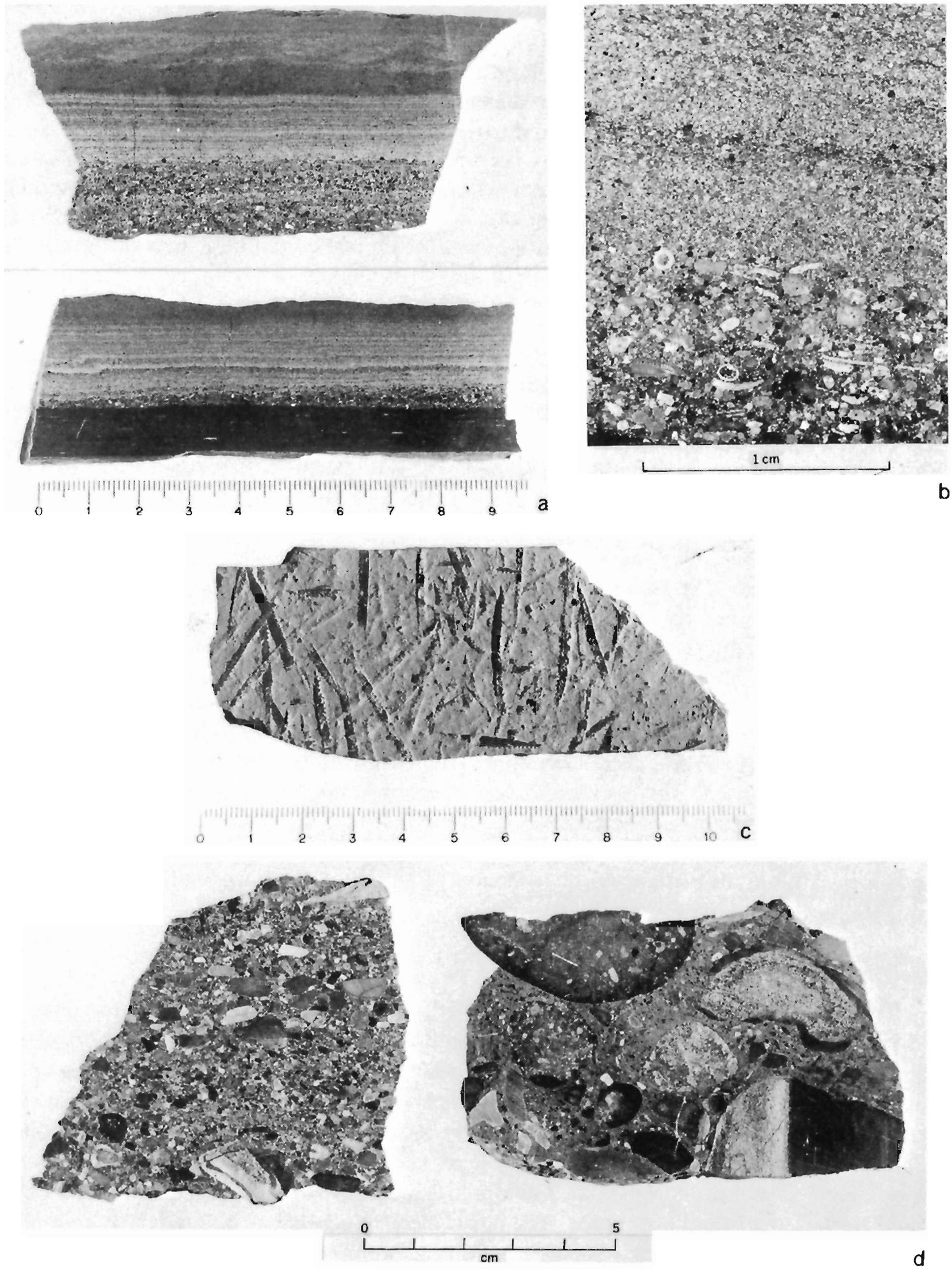

PLATE V. Typical lithologies of Bathurst Island and Stuart Bay Formations. Scale in centimetres. (a) Bathurst Island Formation; graded beds showing fine laminations and convolutions in the finer grained layers. (b) Bathurst Island Formation; thin section illustrating composition of the graded sediments of (a); black, calcareous, micaceous shale at base is overlain by coarse sand-sized skeletal detritus and quartz, which grade into silt-sized particles of the same material. (c) Bathurst Island Formation; calcareous silty shale containing graptolites. (d) Stuart Bay Formation; polished and etched specimen of a pebble-conglomerate composed of generally well rounded clasts of black and grey chert and grey limestone (of various types including pellet, lump, and skeletal limestone) in an argillaceous calcareous matrix.

The largely pelagic nature of the Bathurst Island Formation indicates a deep basinal environment into which much of the sediment was transported by turbidity currents. The origin of the skeletal debris found in the graded sediments is probably from shelf areas to the east and south, where material was periodically swept off into the basin, perhaps as a result of the unstable nature of this area which was undergoing uplift. The black organic material within the shale probably originated in place but could have been carried from any direction. The origin of the clastic quartz grains, which make up a large part of the formation, is problematical. Much of it could have been derived from the north, because equivalent rocks to the east, west, and south, are at least in part in a carbonate facies.

Age and correlation. Thorsteinsson (*in* McLaren, 1963b, p. 605) identified two new species of monograptids from the Bathurst Island Formation at Twilight Creek (Sec. 25). One species occurring 3,000 feet above the base of the formation was identified as *Monograptus* n. sp. aff. *M. hercynicus* Perner. *M. hercynicus* was formerly regarded as indicative of an upper Ludlovian age but is now considered Siegenian (Early Devonian) (Jaeger, 1962, p. 127). The other species, occurring at heights of from 2,490 to 3,310 feet above the base, was originally called *Monograptus* n. sp. A; however, Thorsteinsson now (pers. com., 1971) regards the species as *Monograptus yukonensis* Jackson and Lenz, 1963, which is of late Siegenian to early Emsian age. The Gedinnian and Siegenian age assignment of the Bathurst Island Formation at Twilight Creek is based in part on the monograptids, and in part on the stratigraphic position of the Bathurst Island Formation which is above the Cape Phillips Formation and below the Stuart Bay Formation.

In Section 20, McGregor and Uyeno (1972), from microfossil identification, dated the Bathurst Island Formation as probably Siegenian. In the north and west, the formation includes much younger rocks, there containing equivalents of the Stuart Bay Formation. In the west (Sec. 15, Fig. 5), this was determined largely by lateral tracing of beds, while in the north (Sec. 12, Fig. 4) it was determined from the fact that the Bathurst Island Formation is overlain directly by the Eids Formation and lies within 300 feet of the Eifelian and Givetian Bird Fiord. Thus in the extreme north at Section 12, the age of the Bathurst Island Formation probably ranges into the Emsian Stage.

Stuart Bay Formation

The Stuart Bay Formation is composed largely of dark grey, calcareous, quartz siltstone, fine-grained sandstone, and evaporitic dolomite; usually with a pebble or boulder conglomerate or reef conglomerate at the base. The formation has yielded shelly faunas and graptolites of late Early Devonian (Siegenian and Emsian) age. In eastern Bathurst Island, the formation can be divided into two members. The lower comprises siltstone and thin-bedded dolomite with coarse boulders of chert, dolomite, and limestone as well as reefoid horizons, red dolomitic siltstone, and other shallow-water features. It is unconformable on the Lower Devonian Bathurst Island Formation. The upper member consists of dolomite and dolomitic siltstone containing much quartz sand.

Both lower and upper members grade westward and northward to a mainly siltstone section, of which Twilight Creek (Sec. 25) is typical. Farther west the formation grades into and is inseparable from the Bathurst Island Formation. The basal unconformity disappears westward where the Stuart Bay Formation is concordant with the Bathurst Island Formation except for a small area at the head of May Inlet. There the Stuart Bay Formation rests with local angular unconformity on the Bathurst Island Formation and is separated from it by an unconformity within the Lower Devonian (Fig. 5).

Distribution, thickness, and lithology. The type section of the Stuart Bay Formation, described by McLaren (1963b), is at Twilight Creek (Sec. 25) near Stuart River. The formation resembles the underlying Bathurst Island Formation in gross lithology, and consists largely of calcareous, argillaceous sandstones, with some sandy mudstones and siltstones, and irregular beds of bioclastic limestone. The base of the formation was drawn beneath the lowermost pebble beds; the pebbles are of well-rounded grey chert and brown aphanitic limestone in a calcareous sandy matrix. They mark a change from graded beds of the Bathurst Island Formation to slightly coarser and more limy rocks. Along strike the pebble beds grade into irregular beds of pale brown, fine-grained limestone. The upper contact is sharp, but conformable with the overlying Eids Formation.

In western parts of the area, the Stuart Bay Formation is similar to the underlying Bathurst Island Formation in rock type, weathering characteristics, and physiographic expression. The two formations have been mapped separately because of the intervening pebble-conglomerate and because the Stuart Bay consists of somewhat coarser detritus which, when traced eastward, rests unconformably on progressively older rocks. The base of the Stuart Bay Formation is drawn, as defined by McLaren (1963b), at the lowest pebble beds. Where the pebble beds are absent locally, the contact shown on Map 1350A was projected from points where it is known along the strike. In eastern and southern parts of Bathurst Island, the Stuart Bay Formation rests with angular unconformity on older rocks; the top of the formation also is at an unconformity with the overlying Disappointment Bay Formation.

In central and western parts of Bathurst Island (Secs. 25 and 28), the Stuart Bay Formation consists of tan, brown and grey, one- to six-inch beds of calcareous and argillaceous, fine-grained quartzose siltstone, interbedded with sandstone and grey to black, micaceous, sandy mudstone. Lenses of dark grey, micritic to skeletal limestone that abruptly pinch and swell from less than a foot to several feet in thickness are interbedded with the mudstone, siltstone, and sandstone. Conglomerate beds, from 6 inches to 2 feet thick and containing chert and limestone pebbles, are present near the base of the formation. The type section at Twilight Creek (Sec. 25) is marked by three of these horizons which do not persist laterally for any great distance. Indeed, this entire sequence of varied rock types has no distinctive horizons that can be traced very far. The different rock types grade into one another or are lenticular and pinch out in short distances. A thick interval of sandstone or limestone may be observed on one flank of a fold but may be absent on the other.

In the southern part of the map-area at Dyke Ackland Bay (Sec. 42), the Stuart Bay Formation is 1,850 feet thick, and both lower and upper contacts are unconformities. In ascending order it comprises: (1) dolomitic quartz sandstone (100 feet); (2) quartz sandstone, grading up to dolomitic siltstone (125 feet); (3) dolomite, with limestone interbeds (575 feet); (4) light coloured dolomite (200 feet); (5) dark coloured dolomite (150 feet); and (6) dark weathering dolomite (700 feet). It is not known just which part of the total original formation the preserved interval represents.

A restored section drawn from west to east illustrates stratigraphic relationships in the Stuart Bay Formation (Fig. 5). East of May Inlet on the south limb of the Half Moon Bay structure (Sec. 27), the Stuart Bay Formation is 1,460 feet thick. At the base is a conglomerate, about 100 feet thick, with pebbles of white chert and crinoidal fragments in a siltstone matrix. The underlying Bathurst Island Formation was eroded locally prior to Stuart Bay deposition and is 2,000 feet thinner than a mile or two to the east where the conglomerate is absent. This angular unconformity probably is quite local, because traverses across the contact farther west failed to show any evidence of a break in sedimentation. Limestones, pebble beds and coarser clastic sediments are the result of an influx from the east. These units die out westward and are absent at Dundee Bight (Secs. 15 and 16) where, accordingly, it is difficult to separate the Stuart Bay and Bathurst Island Formations. In the west the rocks of the Stuart Bay Formation represent, with a minor exception (Sec. 27), a continuation of the siltstone sedimentation of the Bathurst Island Formation, with only minor influxes of pebbles from the uplifted and deformed Cornwallis Fold Belt to the east.

The thickest section of the Stuart Bay Formation is 6,892 feet and occurs just off the west flank of the Cornwallis Fold Belt (Sec. 35, *see* Appendix and Fig. 5). The contact with siltstones of the underlying Bathurst Island Formation is below the lowest reef limestone and conglomerate interbed, which ranges in thickness from 0 to 40 feet. Two members are present in this section. The lower is composed of dolomitic siltstone with interbeds of limestone and chert boulder conglomerate, reef limestone, and dolomite. The upper member is mainly dolomite, with quartz sandstone and pebble-conglomerate interbeds that increase in abundance upward. In this section the sediments reflect a change stratigraphically upward to progressively shallower water conditions which culminated, finally, in emergence and subsequent erosion. The Disappointment Bay Formation was deposited unconformably on this eroded surface. In Section 34, only the lower member of the Stuart Bay Formation is present. The formation there is composed of dolomitic siltstone and contains abundant patch reefs at two levels; these now form lines of tall erosional remnants resembling stacks (Pl. VI). The formation is thin and transgresses eastward; it is underlain by a marked angular unconformity. Conglomerate lenses composed of chert and limestone pebbles are present.

At Moses Robinson River (Sec. 30), the Stuart Bay Formation is 550 feet thick and is separated from underlying and overlying formations by unconformities. The formation comprises mainly shaly, bioclastic limestone that is thin to medium bedded, light grey to

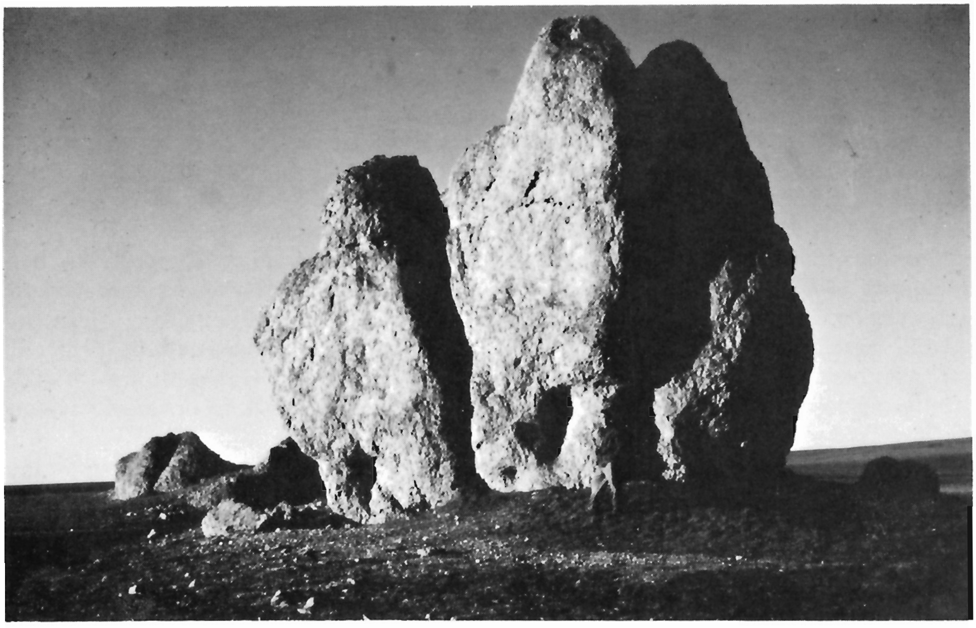

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PLATE VI. Patch reef composed of algae, stromatoporoids, and corals, interbedded in the Stuart Bay Formation along the west flank of the Scoresby Hills structure (Sec. 34). The vertical as well as the nearly horizontal breaks are joints. Bedding dips steeply to the west (left). This outcrop yielded GSC locs. 67038, 67039, and 67040.

slightly brownish or dark grey-brown; interbeds of chocolate brown, calcareous shaly siltstone are abundant.

At Young Inlet east (Sec. 20, Pl. VII, and Fig. 4), the Stuart Bay Formation includes numerous conglomerate lenses that contain pebbles and boulders of chert and limestone. Most of the limestone boulders are composed of algae, stromatoporoids, corals, and other reef building fossils. There are rare layers of conglomeratic mudstone; the internal structure suggests that they are soft sediment mud flows. Beds of fine- to medium-grained quartz sandstone, 6 to 12 inches thick and locally ripple-marked, are interbedded with light grey skeletal, pelletoid and detrital limestone. In some areas quartzitic dolomite forms an important part of the section. Many limestone clasts contain corals, pellets, oölites, and other evidence of shallow-water origin.

The chert, making up a large part of the conglomerate of the Stuart Bay Formation, probably had its source in the Cape Phillips Formation which is very cherty in the area of

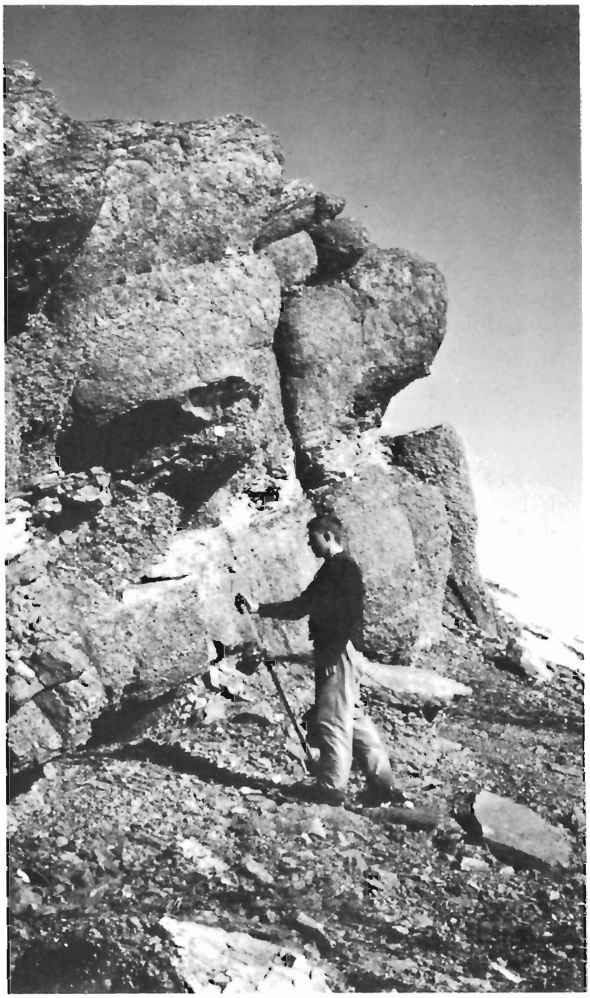

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PLATE VII

Conglomerate horizon in the Stuart Bay Formation at Young Inlet, southeast (Sec. 21); containing pebbles and boulders of chert, limestone, and siltstone. Beds of siltstone and sandstone are intercalated.

the Cornwallis Fold Belt. The reefoid limestone boulders probably are the product of reefs that fringed the Cornwallis Fold Belt and were eroded during subsequent uplift.

The variety, succession, and distribution of rock types in the Stuart Bay Formation (Fig. 5) indicate unstable tectonic conditions within the Cornwallis Fold Belt. The Cornwallis Fold Belt is an area that was topographically high relative to flanking regions. At times the entire area may have been uplifted, with the fold belt being uplifted more than the flanking basins. At other times there may have been general subsidence, with the fold belt subsiding less and still behaving relatively as a positive feature. Uplift began while the Bathurst Island Formation was being deposited, and accelerated during the deposition of the Stuart Bay Formation. Unusually great thicknesses of the sedimentary units just west of the Cornwallis Fold Belt (Sec. 35) suggest that considerable topographic relief existed there at that time. The fold belt and uplift plunged more gently to the north, for the northward increase in thickness of the Stuart Bay Formation is much more gradual. The Stuart Bay Formation was deposited only on and near the Cornwallis Fold Belt. Farther north and west of the report area, rocks of equivalent age are included in the Bathurst Island Formation. The first sign of uplift was shallowing of water, shown by interbeds of conglomerate and/or limestone at the base of the Stuart Bay Formation. As uplift continued, erosion removed parts of older formations in the east, spreading the detritus westward as conglomerates of the Stuart Bay Formation. As relative uplift diminished, younger sediments of the Stuart Bay Formation encroached eastward onto the fold belt. Stratigraphic relationships suggest local and erratic pulses of uplift and accompanying erosion, rather than a constant and uniform rise of a single large landmass.

Age and correlation. Faunas collected from limestone and pebble beds between the base and 570 feet above the base in the type section of the Stuart Bay Formation (Sec. 25; GSC locs. 25834, 25836, and 25835) were regarded by Cumming as of Early Devonian age (McLaren, 1963b, p. 607). Boucot, Johnson, and Harper confirm an Early Devonian age and date them more precisely as probably Emsian (pers. com., 1971; *see* Appendix). This type section has not been shown on a restored section but it probably is similar in stratigraphic relationship to Section 20 (Fig. 4) and Section 28 (Fig. 5). In Section 34 (*see* Appendix), three collections were made from a 60-foot-thick reef knoll at a height between 100 and 160 feet above the base (Pl. VI and Fig. 5, GSC locs. 67038, 67039, and 67040). These collections were identified by J. G. Johnson who dated them as early Siegenian; or more precisely as *Quadrithyris* Zone age. Shelly faunas from Sections 32 and 33 have been identified by Boucot and Johnson (pers. com., 1971). In Section 33 a prolific fauna occurs 350 feet above the basal unconformity (GSC loc. 67141), and was dated as Early Devonian (probably early Siegenian, *Quadrithyris* Zone). Another prolific shelly fauna, occurring 705 feet above the base of the formation in Section 33 (GSC loc. 67145), is probably of early Emsian age. Three graptolite faunas (GSC locs. 67142, 67143, and 67144) are interbedded between the shelly faunas of Section 33, but have not yet been studied. In Section 32 (*see* Appendix) a collection at 95 feet above the presumed base of the formation (GSC loc. 59035) is Siegenian or Emsian; a collection 485 feet above the base (GSC loc. 59036) is probably early Emsian; and a silicified faunule 1,030 feet above the base (GSC loc. 59037) is of Emsian age.

At the base of Section 30 (GSC loc. 67004), *Leptaenopyxis* cf. *bouei* Barr., and *Icriodus pesavis* occur. Johnson and Uyeno (pers. com., 1971) date these as Siegenian. Shelly faunas dated by Boucot and Johnson as Early Devonian (*see* Appendix) are found higher in this section. McGregor and Uyeno (1972) have collected spores and conodonts in the Stuart Bay Formation at Section 20 which they dated as mostly Emsian, with possibly some late Siegenian fossils at the base (*see* Appendix). Thus, the age of the Stuart Bay Formation is

Siegenian and Emsian (Table I). The rocks immediately overlying the lower contact apparently are diachronous; they are oldest just west of the Cornwallis Fold Belt in deeper parts of the basin, and become younger toward the west as far as the formation can be traced.

Lower and Middle Devonian

Disappointment Bay Formation

The type section of the Disappointment Bay Formation was designated by Thorsteinsson (1958, p. 105) on northern Cornwallis Island, where it rests on an angular unconformity. The formation on Cornwallis Island was restudied by Thorsteinsson and Kerr (1968) who differentiated three principal lithofacies that generally represent the formation: a basal conglomerate ranging from 0 to 400 feet in thickness and containing chert clasts; a middle unit that is mainly dolomite with minor amounts of quartz sandstone and conglomerate; and an upper unit that is mainly dolomite and commonly porous. Thorsteinsson and Kerr (1968) considered the formation to be Middle Devonian; however, since that time, Thorsteinsson has collected fossils from the formation on Cornwallis Island and these have been dated by J. G. Johnson as Emsian (pers. com., 1971). The Disappointment Bay Formation on Bathurst Island is strikingly similar to the same formation on Cornwallis Island. On Bathurst Island it is dated as late Early Devonian (Emsian) and probably Middle Devonian (Eifelian), by identification of fossils in enclosing and equivalent formations. The Disappointment Bay Formation of Cornwallis Island probably has a similar Emsian and Eifelian age.

Distribution, thickness, and lithology. A complete section of the Disappointment Bay Formation is well exposed at Moses Robinson River (Sec. 30, Fig. 4), where it is 610 feet thick. It lies unconformably upon the Stuart Bay Formation, and has a basal sandstone 10 feet thick. The remainder of the formation is composed of finely crystalline, medium- to thick-bedded dolomite, which is very light grey to cream, and weathers light yellowish cream. It grades upward into limestone of the overlying Blue Fiord Formation. The basal clastics vary greatly in thickness; 3 miles south of Section 30 conglomerate as much as 100 feet thick is present. Farther south near Polar Bear Pass (Sec. 33), the basal clastics are 500 feet thick and are interbedded with dolomite. Northward from Section 30, thickness of the Disappointment Bay Formation increases gradually; it is 1,300 feet at Section 22. The cream-coloured dolomite is generally porous throughout, being vuggy at the base and more finely porous upward. Both lower and upper contacts are conformable. No fossils were found in the above sections.

South of Bracebridge Inlet, two sections of the Disappointment Bay Formation were examined. At Misty River (Sec. 39), the formation is very poorly exposed and is represented almost entirely by felsenmeer. The basal contact is not exposed, but regional mapping suggests that it probably is an angular unconformity. Estimated thickness is 1,150 feet. The lower unit, which is 650 feet thick, is composed of dolomite and quartz sandstone. The dolomite makes up about 80 per cent of the unit and is very light tan, fine grained, and has quartz sand in the upper part. The remaining 20 per cent is made up of fine-grained, dolomitic and slightly calcareous quartz sandstone. An upper unit, 550 feet thick, is composed of sandy dolomite with dolomitic sandstone interbeds. The upper contact with the Eids Formation is covered but is probably conformable. At Dyke Ackland Bay (Sec. 42), the Disappointment Bay Formation comprises 2,000 feet of dolomite. This abnormally great thickness may be explained by the fact that the partly equivalent Eids Formation is not present and the entire interval is probably represented by the Disappointment Bay Formation.

The Disappointment Bay Formation is a distinctive, resistant unit on Bathurst Island. In the north, exposure is good along creeks; however, in the southern part of the island it is nearly all felsenmeer (Pl. VIII), and underlies wide areas of the plateau country. The formation is commonly entirely dolomite, with textures that vary considerably from place to place. The base of the formation varies from being gradational to having a thin to thick discrete basal clastic unit. Where there are basal clastics they grade upward into dolomite. The dolomite varies in texture from very fine grained to microcrystalline, to coarse grained and vuggy. Porous beds are common and in places are stained with bitumen and give off a fetid odour. Rare beds are brecciated, typical of carbonate deposits from which evaporite horizons have been leached. Fossils are preserved in places as vague outlines or internal casts but, in general, the dolomitization has obliterated all primary structures and textures. Near the top of the formation, beds of micritic and pelletoid? limestone are interbedded with the dolomite and, within a few tens of feet, the formation grades to limestone of the overlying Eids or Blue Fiord Formation.

In the present study area, the Disappointment Bay Formation is restricted to areas on and near the Cornwallis Fold Belt. It grades westward into the Eids Formation. In the extreme south and east, the lower contact is an angular unconformity or disconformity, but becomes a conformable contact to the north and west (Figs. 4 and 5). The upper contact with the Blue Fiord Formation apparently is gradational and conformable everywhere. The Disappointment Bay Formation, consisting mainly of dolomite, is a shallow-water facies with a basal conglomerate that filled pre-existing topographic lows. The formation was deposited on and near the Central Stable Region in the south, but near the eastern shore of the island it extends well toward the northern coast where its distribution roughly coincides with the position of the elevated Cornwallis Fold Belt (Fig. 7).

The basal unconformity and facies patterns clearly indicate that the Disappointment Bay Formation was deposited by a sea that transgressed from the west and finally covered

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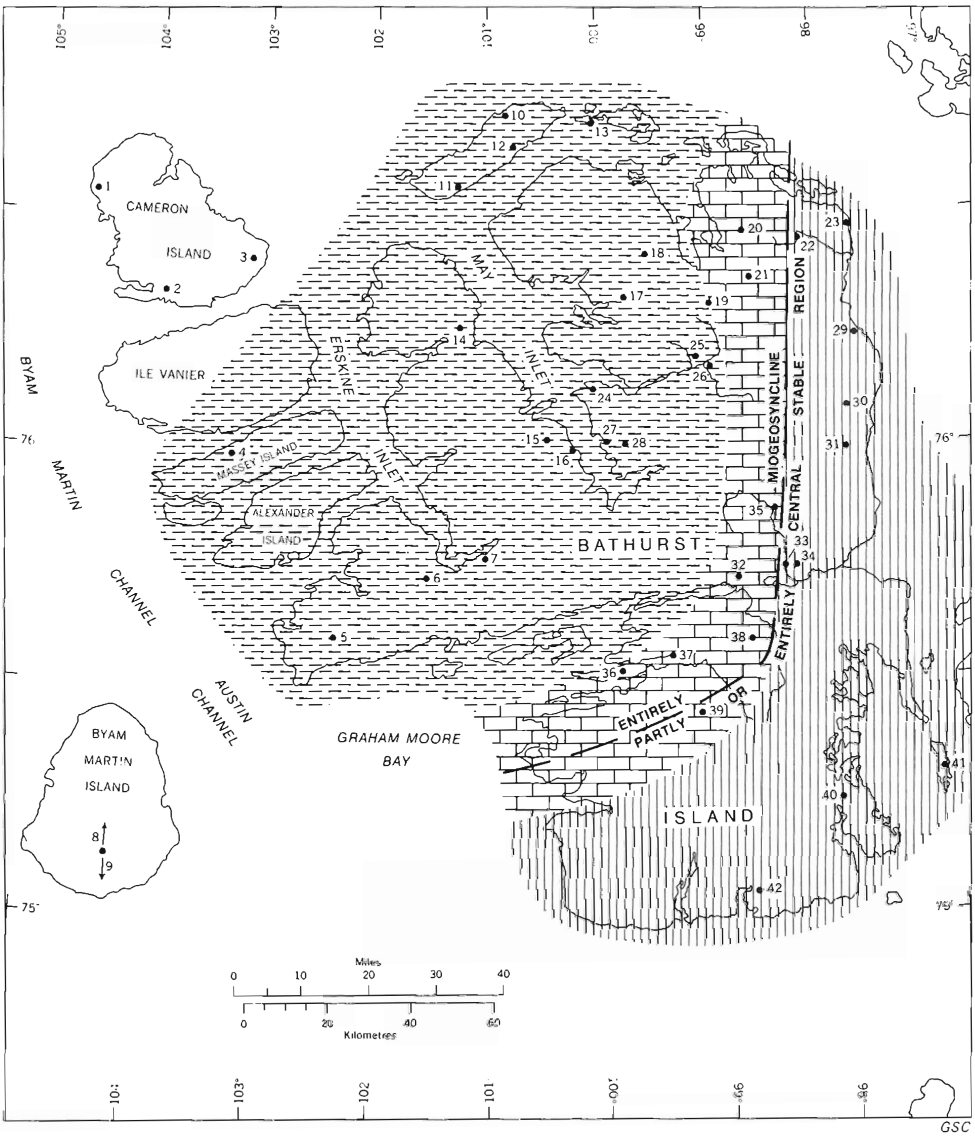
PLATE VIII. Disappointment Bay Formation in the south part of Bathurst Island, typical felsenmeer. It is cut by dark coloured dykes shown in the background.



DISAPPOINTMENT BAY FORMATION: dolomite, resistant

EIDS FORMATION: transitional facies, shaly limestone, shaly and siliceous dolomite, mudstone; resistant and clinkery underfoot; in places an interfingering of other two lithologies

EIDS FORMATION: typical facies, limy mudstone, limy siltstone, limy shale, shaly limestone; recessive and crumbly underfoot

FIGURE 7. Distribution of the Disappointment Bay Formation, and the two facies of the Eids Formation. Section locations are shown by number.

the older structural highs along the east coast of Bathurst Island (Figs. 4 and 5). Primary textures and structures indicating the depositional environment are very sparse, but available evidence suggests that the Disappointment Bay is a very shallow marine sequence. The dolomite grades westward to shaly and dolomitic limestone of the Eids Formation. These facies relationships indicate a change from a shallow platform in the east to a gradually deepening basin to the west.

Age and correlation. Although the Disappointment Bay Formation of Bathurst Island lacks diagnostic fossils, it is dated as Emsian and Eifelian because of the known ages of enclosing and equivalent fossiliferous formations. The Eids Formation of Section 20 at Young Inlet has been dated by McGregor and Uyeno (1972) as late Emsian and Eifelian. The lower part of this formation can be traced laterally into the upper part of the Disappointment Bay Formation of Section 22 (*see* Fig. 4). The underlying Stuart Bay Formation of Section 20 also has been dated by McGregor and Uyeno as Siegenian–Emsian. Therefore, it can be stated that the Disappointment Bay Formation of Section 22 is of Emsian and Eifelian age. Trilobites were discovered by Ormiston (1967, p. 18) in the Eids Formation at Twilight Creek, and on this evidence he favoured an Emsian age for the Eids Formation of eastern Bathurst Island. Apparently, what he regarded as the Eids Formation at that time includes both Eids and Disappointment Bay Formations as now considered.

Because the basal Disappointment Bay Formation and upper parts of the Stuart Bay Formation of eastern Bathurst Island are Emsian, it is possible to date as Emsian the angular unconformity that separates them (Table I), as well as the short pulse of deformation of the Cornwallis Fold Belt that it reflects. As submergence of the fold belt occurred and the Disappointment Bay Formation was deposited upon it, the basin evidently became deeper toward the west where the Eids Formation was deposited. Whereas the Disappointment Bay Formation is a shallow-water, shelf-type of deposit, the Eids is composed predominantly of shaly and silty limestone and calcareous shale indicating deeper water.

Eids Formation

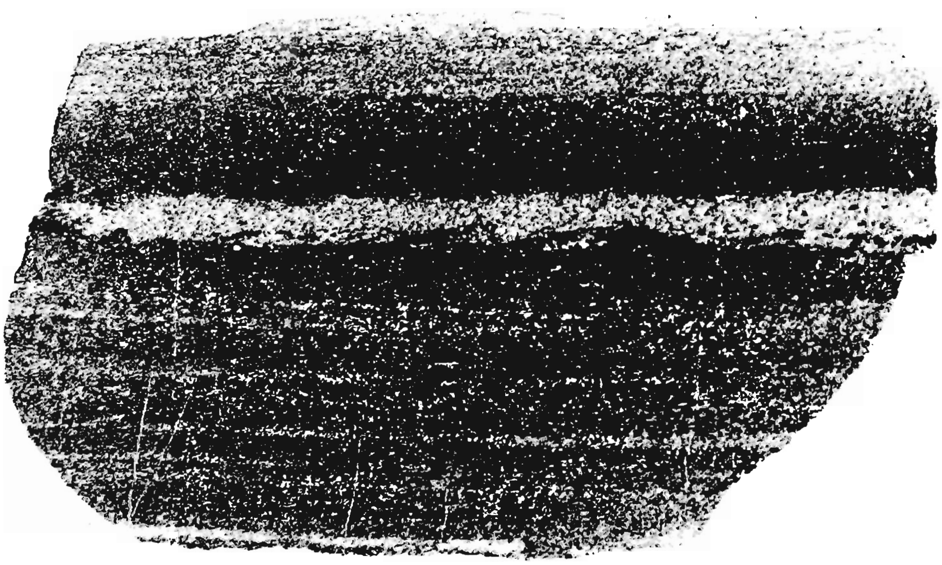
The Eids Formation at its type section on southwestern Ellesmere Island (McLaren, 1963a) is composed largely of limy shale, limy siltstone, black calcareous mudstone, minor dolomitic and minor bioclastic limestone. The formation is recessive and forms low-lying, gently undulating terrain. It is underlain by dark grey shales of the Cape Phillips Formation (Kerr, 1968b); the contact is gradational. The top of the type section, which is transitional into the overlying Blue Fiord Formation, is at the base of the lowest well-developed limestone, and is a diachronous boundary.

The Eids Formation also was reported on Bathurst Island (McLaren, 1963b), and is 1,050 feet thick at Twilight Creek (Sec. 25). The Eids Formation there is recessive, consisting largely of grey limy mudstone and shale, with some beds of argillaceous limestone. It is gypsiferous in some places. The contact with the underlying Stuart Bay Formation is fairly sharp; however, the upper contact with the Blue Fiord Formation is gradational.

The Eids Formation is of late Early and early Middle Devonian age on Bathurst Island (Table I). It is the basinal equivalent of nearly all of the Disappointment Bay and Blue Fiord Formations of the shelf. Two facies of the formation have been separated on Bathurst Island: in the deeper western parts of the basin the formation is composed mainly of recessive limy shales; farther east, where the Eids Formation grades into the Disappointment Bay Formation, it is composed of resistant, siliceous, dolomitic limestone. Both facies are thin bedded, but the western facies is recessive and the eastern is resistant.

Distribution, thickness, and lithology. The Eids Formation, restricted to the north–central and northwestern parts of the report area, constitutes two facies, the typical and the transitional, that interfinger each other (Figs. 5 and 7). Thin sections of rocks representing both facies are shown in Plate IX. The typical facies occurs in the western or deeper parts of the basin, and comprises thin-bedded, calcareous siltstone, limy shale, soft grey to green calcareous micaceous shale, and minor shaly limestone. Gypsiferous layers are present in basal parts of this sequence west of Young Inlet. The recessive facies of the formation readily breaks underfoot with a soft crumbly sound and is characterized by valleys eroded along strike. Solifluction slopes are common and there are few fresh exposures except in crosscutting streams. The type section of the formation of southwestern Ellesmere Island (McLaren, 1963a) and also the key section of the formation of Bathurst Island at Twilight Creek (Sec. 25) belong in this facies. X-ray analysis of a specimen of this facies (Pl. Xa; *see also* Appendix, Sec. 28) shows the composition: calcite 49%, quartz 34%, dolomite 6%, illite 5%, feldspar 3%, kaolinite 2%, pyrite 1%, and a trace of chlorite.

A



B

PLATE IX. Thin sections of the Eids Formation: (A) typical facies, (B) transitional facies.

The transitional facies of the Eids Formation is composed largely of thin-bedded, resistant carbonate. Westward it grades into the typical facies of the Eids Formation and eastward into the Disappointment Bay Formation (Fig. 7). The transitional facies is characterized by thin-bedded, shaly and siliceous limestone, shaly and siliceous dolomite, and limy mudstone. It is very resistant and breaks underfoot with a clinking sound. In the transitional facies on central Bathurst Island, the lower part consists of resistant thin-bedded to fissile, tan to black, siliceous dolomite, whereas the upper part is more limy. Still farther east along the eastern coast of Bathurst Island, the lower part grades to dolomite of the Disappointment Bay Formation, and the upper to limestone of the Blue Fiord Formation. X-ray analysis of specimens from the transitional facies of the Eids Formation in Section 20 (*see* Appendix) shows the following: Specimen 8385–calcite 66%, quartz 28%, dolomite 3%, illite 2% and kaolinite 1%; Specimen 8386—calcite 80%, quartz 17%, and dolomite 3%.

The incompetent nature of the Eids Formation in the west and its gradation to resistant beds farther east has had an important bearing on subsequent structural deformation within the study area as is pointed out in a later chapter. The two facies were not differentiated on the geologic map (Map 1350A) but have been shown in plan view (Fig. 7) and in a restored section (Fig. 5).

A key section of the typical facies is at Twilight Creek (Sec. 25), where McLaren (1963b) described the formation as being 1,050 feet thick and consisting largely of grey calcareous mudstones and shales with some beds of argillaceous limestone that weather pale grey-brown. Together with the Blue Fiord Formation, it forms a prominent marker on aerial photographs. A similar section of the typical facies of the Eids Formation occurs at Half Moon Bay west (Sec. 27). There the Eids is about 1,400 feet thick, lies conformably on the Stuart Bay Formation, and is overlain conformably by the Blue Fiord Formation. The formation comprises quartz siltstone and mudstone that is very limy, medium grey to tan, crumbly, and recessive with gypsiferous intervals. Limestone interbeds occur near the top and the formation grades abruptly to limestone of the overlying Blue Fiord Formation. Cross-laminae occur near the base, where it is gradational with the underlying formation.

At Young Inlet east (Sec. 20, *see* Appendix), the entire Eids Formation is of the transitional type, and is 1,845 feet thick. The lower 1,000 feet consists of thin-bedded to fissile shaly limestone that is very siliceous. The limestone contains occasional chert nodules, is dark brown on fresh surfaces, and weathers very light brownish grey. It emits a sharp clinking sound upon being struck with a hammer or stepped upon. The upper 845 feet, gradational with the lower, is similar except that the formation there is thin to medium bedded. It comprises dark chocolate brown, shaly and siliceous limestone and calcareous mudstone, which exhibits a conchoidal fracture on broken surfaces, and weathers light brownish grey. The transitional facies of the formation is a prominent marker on aerial photographs because of its light weathering colour and because it stands out as a resistant unit compared to the overlying and underlying formations. This resistant characteristic contrasts with the recessive behaviour of the typical facies of the Eids.

Certain sections contain substantial representation of both facies through interfingering. A good example is at Heart Lake (Sec. 36) where the formation is 1,900 feet thick. There the lower 600 feet of the Eids Formation is part of the transitional facies, the succeeding 1,025 feet of rock belongs to the typical facies, and the uppermost 275 feet belongs to the transitional facies. Both upper and lower contacts are gradational in all sections.

Age and correlation. The Blue Fiord Formation grades into the Eids Formation in such a way that the contact is younger to the west and north (Fig. 4). It seems clear that the Cornwallis Fold Belt continued to be relatively high, but was covered with shallow water which allowed the Disappointment Bay Dolomite and Blue Fiord Limestone to be deposited upon it. McLaren (1963b) reported two fragmentary faunas in the Eids Formation at Twilight Creek (Sec. 25) and dated the formation there as Early or Middle Devonian. In the same section, Ormiston (1967, p. 18) discovered trilobites 90 feet above the base and regarded the formation as Early Devonian (probably Emsian). Conodont collections from the base and at a height of 20 feet in the Twilight Creek section are regarded by Uyeno (pers. com., 1971, and *see* Appendix) as Emsian. A lower age limit of Emsian for the base of the Eids Formation at Twilight Creek is thus obtained reliably from the contained fossils, and from the Emsian dating of fossils in the underlying Stuart Bay Formation (*see* Appendix).

Conodonts and spores collected at various levels in the Eids Formation at Young Inlet east (Sec. 20; Fig. 4) led McGregor and Uyeno (1972) to date the formation there as late Emsian and Eifelian and to state that at least the upper two thirds is of Eifelian age. The formation commonly contains *Tentaculites* sp. and *Styliolina* sp., which at Young Inlet southeast (Sec. 21) are particularly abundant. Stratigraphic evidence suggests that the basal beds of the Eids Formation at Twilight Creek and Young Inlet east may be the oldest beds of the formation on Bathurst Island (Fig. 4).

The Eids Formation of Helena Island (Sec. 12; Fig. 4) is thin, but probably contains the youngest beds of the formation exposed in the map-area. No fossils were found but a tentative upper age limit of Eifelian is assigned for the following reasons: The formation lies conformably below the Bird Fiord Formation, which is generally of Eifelian and Givetian age; moreover, it is the lateral facies equivalent of the uppermost part of Blue Fiord Formation, which is as young as Eifelian.

In the present map-area, the Eids Formation is of Emsian and Eifelian age, but its exact age span varies from place to place. The formation is equivalent to dolomite of the Disappointment Bay Formation and limestone of the Blue Fiord Formation farther east and south in the report area. To the west and north it appears largely to grade into the Bathurst Island Formation (Figs. 4 and 5).

Blue Fiord Formation

The type section of the Blue Fiord Formation on southern Ellesmere Island is 3,800 feet thick (McLaren, 1963a). The lower limestone and shale member, 2,400 feet thick, consists of brown to brownish grey nodular limestones, as much as 400 feet thick, interbedded with grey calcareous mudstones and shales. It becomes more shaly downward and grades into the underlying Eids Formation, the contact being drawn beneath the lowest well-developed limestones. The upper brown limestone member, 1,400 feet thick, consists of brown and brownish grey limestone that is normally very bioclastic and coarse grained. It is overlain with probable conformity by the Bird Fiord Formation. Farther south the Blue Fiord Formation is 1,900 feet thick and was not divided into members. There, it consists of dolomite, limestone, and shale. The Blue Fiord Formation in southwest Ellesmere Island was dated as probably early Middle Devonian (Eifelian) by McLaren (op. cit.). Recent revisions in age assignments of fossils led J. G. Johnson (Harper *et al.*, 1967, p. 430, footnote) to suggest that the lower part of the type section of the Blue Fiord Formation should more properly be assigned an Emsian age.

On Bathurst Island the Blue Fiord Formation is a variable limestone unit containing micrite, micritic skeletal, skeletal, and pelletoid limestone. Outcrops in the Driftwood Bay area are typical of the formation and consist mainly of micrite which is thick bedded and resistant, very light grey to cream-coloured and contains little argillaceous or quartzose material. It is best developed on the Central Stable Region and Cornwallis Fold Belt (Fig. 8), where complete thicknesses range from 600 to 900 feet. Thicknesses vary but generally increase to the north and west at the margin of the Central Stable Region. Westward the formation also becomes much more shaly and thin bedded, and then grades very gradually into shaly and silty limestone of the Eids Formation. Uppermost beds of the Blue Fiord Formation generally are the most extensive. The Blue Fiord Formation is restricted to an Eifelian age throughout most of the study area. In the extreme northeast of the area, it also is in part of late Emsian age.

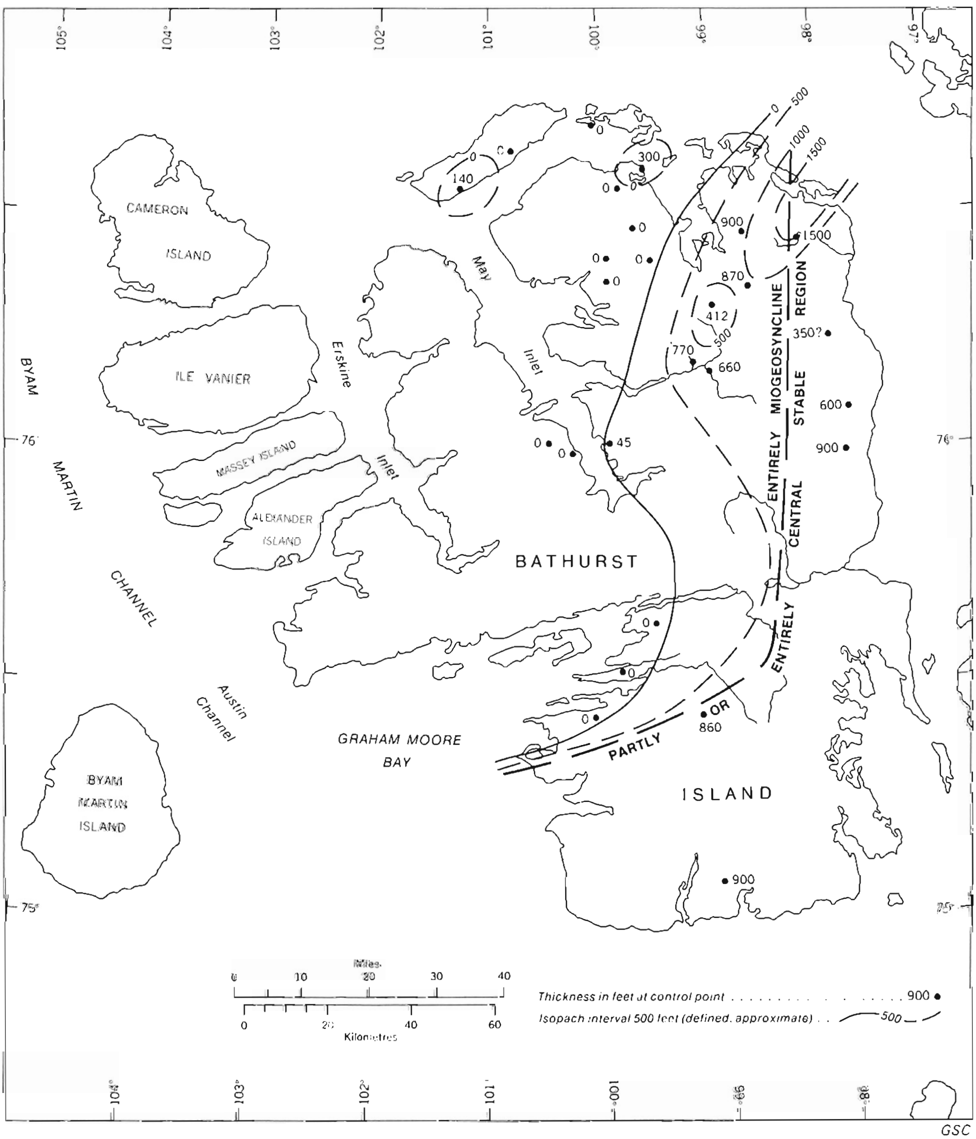


FIGURE 8. Isopach map of the Blue Fiord Formation. Little information is available on much of the Central Stable Region, so that although thicknesses at control points are shown there, no isopachs have been drawn.

Distribution, thickness, and lithology. The Blue Fiord Formation was deposited in eastern and southern parts of the map-area (Fig. 8). Within that area it is well exposed on the flanks of westerly trending folds of the Parry Islands Fold Belt. It is preserved in fault blocks and synclines of the Cornwallis Fold Belt.

The lateral variations of the Blue Fiord Formation can be outlined by describing Sections 20, 22, and 30 (*see* Fig. 4). Section 20 is representative of westerly sections. It is of intermediate thickness (905 feet) and well bedded; some beds contain an abundance of brachiopods. The lower unit, 347 feet thick, is composed of shaly, medium brown, medium-bedded, light brown weathering limestone that is crinoidal in places. The remainder is largely covered but is composed of medium light grey to dark grey, shaly, fossiliferous limestone. To the west the formation disappears through lateral gradation, and to the east it increases in thickness. This section is rather similar to the one at Twilight Creek (Sec. 25), and probably lies in a similar position relative to depositional basins.

Section 22, in the Green River anticline, is the thickest (1,500 feet) reported section of the Blue Fiord Formation on Bathurst Island. It typifies the thick limestone development on the margin of the depositional basin adjacent to the Central Stable Region. A lower unit, 900 feet thick, is composed of micritic, cream-coloured, medium-bedded limestone, with very little argillaceous material. It grades westward into the Eids Formation. The upper unit, 600 feet thick, is thin- to medium-bedded, brown, shaly limestone. Brachiopods are abundant in this unit and are concentrated in certain beds. This upper unit is on strike with Section 20, some 9 miles to the northwest; the two are very similar lithologically.

Section 30 at Moses Robinson River is typical of the Blue Fiord Formation of the Central Stable Region, where shale is scarce, micrite is common, and beds containing abundant brachiopods do not occur. The section, 600 feet thick, consists of very light grey to light cream limestone that weathers very light grey. It is thick bedded and micritic at the base, but becomes medium bedded and slightly fragmental toward the top. The upper and lower contacts are gradational.

A key section of the Blue Fiord Formation at Twilight Creek (Sec. 25) is 770 feet thick (McLaren, 1963b). It is composed of well-bedded, variably bioclastic limestones, and black and grey calcareous shales; the entire rock weathers light brown. This section grades upward from the underlying Eids Formation without a sharp break, but the contact with the overlying Bird Fiord Formation is well marked and abrupt as seen on both the ground and aerial photographs. In this section the formation is poorly to fairly resistant, being more recessive where it is more shaly; it has a light weathering colour resembling that of the Eids Formation. Westward from this section, the shaly interlayers of the Blue Fiord Formation increase in proportion to the limestone, the change taking place most rapidly in the lower part of the formation; finally most of the formation grades into the upper part of the Eids Formation. This section is typical of western exposures of the formation and lies in approximately the same position with respect to depositional belts as Section 20 (Fig. 4).

The thickness of the Blue Fiord Formation decreases to a feather edge and disappears northward from the shelf and westward from the Cornwallis Fold Belt. It does this by gradation into the Eids Formation, which is a shaly limestone, limy siltstone and shale deposit of the deeper parts of the basin. Beds of the typical Blue Fiord limestone extend varying distances westward into the Eids Formation. For mapping purposes, those exposures in which medium-bedded and moderately resistant limestone predominates are considered to be Blue Fiord by the writer. Exposures composed mainly of fissile, recessive limy shales and shaly limestone are regarded as Eids Formation. When the Blue Fiord is traced westward its colour darkens, the lower part of the sequence becomes progressively more argillaceous and it grades into the underlying and equivalent Eids. The fissile interbeds become more common until the Blue Fiord Formation can no longer be recognized.

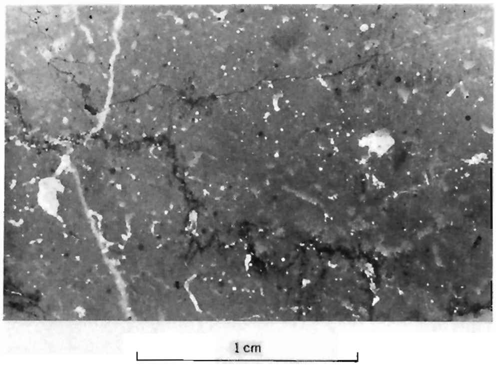
At Half Moon Bay (Sec. 27; Fig. 2), the Blue Fiord Formation is less than 100 feet thick due to the lower part grading into the Eids. At Helena Island (Sec. 11), as much as 140 feet of the formation occurs near the southeast coast, while elsewhere on the island it is absent, or very thin and covered. In southern parts of the report area south of Bracebridge Inlet, this formation thickens and does not grade to the shale facies to the southwest. At Sections 39 and 42, for example, it remains a light grey micritic and micritic skeletal limestone, with detrital skeletal limestone interbeds.

Several types of limestone are found within the Blue Fiord Formation along the east coast of Bathurst Island. The lower part of the formation is composed of light grey to tan, micritic and micritic skeletal limestone (Pls. Xa and b). The skeletal material is usually nonfragmental, and colonies of corals, with Bryozoa and brachiopods, occur little disturbed within the micrite. Part of this sequence commonly has a 'birds-eye' texture with patches of sparry calcite scattered through a structureless micritic matrix (*see* Pl. Xa). Rare beds of pellet and pellet-lump limestone occur. Upward, the formation changes to a detrital–skeletal limestone (Pl. Xc), with fragmental skeletal material making up the bulk of the deposit. The Blue Fiord Formation has the characteristics of a shallow marine facies deposited during a time of relative tectonic quiescence. The lower part of the unit, at least along the east coast, indicates quiet, lagoonal or back reef deposition. Within the Cornwallis Fold Belt, where this formation is rather thin and consists of evenly bedded micritic limestones, relatively slow deposition persisted. Westward and northwestward, along the margin of the miogeosyncline, the formation grades to thicker, biostromal limestones. Still farther from the fold belt it grades into deeper water shales and shaly limestones of the Eids Formation. The increasingly clastic nature of the upper part of the formation indicates a return to turbulent conditions.

Age and correlation. In the Stuart River area (Secs. 25 and 26) McLaren (1963b) regarded the Blue Fiord Formation as Eifelian. Ormiston (1967), on the basis of trilobite identification, also considers that the Blue Fiord Formation of Bathurst Island is Eifelian and does not include Emsian rocks as it does on Devon and Ellesmere Islands. His studies, however, were limited to central Bathurst Island west of the longitude of Young Inlet, and his Eifelian dating for the formation in that area is probably correct. This date is supported by conodonts collected by the writer from low in the formation in southwest Bathurst Island (Sec. 39, *see* Appendix), which were dated by Ormiston (pers. com., 1971) as Eifelian.

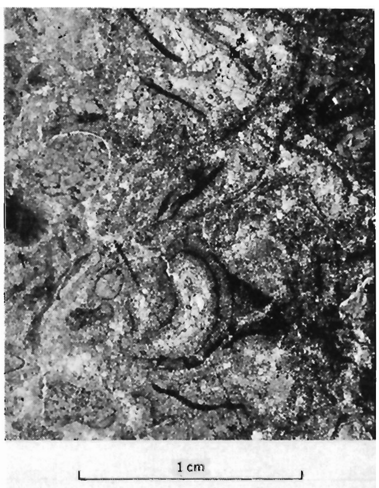
McGregor and Uyeno dated spores and conodonts from the Blue Fiord Formation of Section 20 and determined that the formation there is Eifelian. The present writer traced this section a few miles to the east into Section 22, where the formation contains substantially older rocks. A few miles farther east, 2 miles west of Paine Point, outcrops regarded as probable Blue Fiord Formation yielded fossils (GSC loc. 67146) of late Emsian age. The dating is by Ormiston (pers. com., 1971), who states that the collection contains *Dechenella paragranulata*, *Ancyropyge* aff. *arcticas*, and *Spathognathodus exiguus* Philip (the last species was identified by Klapper). Thus the base of the Blue Fiord Formation becomes older eastward on northeast Bathurst Island, where it probably contains rocks as old as late Emsian.

The upper age limit of Eifelian for the Blue Fiord Formation of Bathurst Island is based on the fact that both it and the overlying Bird Fiord Formation contain Eifelian fossils at widely separated localities. The lower limit of an Emsian age is compatible with the finding of Klapper and Ormiston that the basal part of the Blue Fiord Formation of Devon Island is of Emsian age.



a

b



c

PLATE X. Typical carbonate rock types from the Blue Fiord Formation.

(a) Thin section of the lower part of the Blue Fiord Formation, from the peninsula southeast of Goodsir Inlet, eastern Bathurst Island. It shows a structureless micritic limestone with patches of sparry calcite probably filling shrinkage cracks, and several stylolites; probably indicating a mud-flat environment.

(b) Acetate peel, an oriented specimen from the middle part of Blue Fiord Formation in same area as (a). It is a micritic skeletal limestone. Coral and other fine skeletal material are preserved, little disturbed, below a brachiopod valve, above which is lime mud. Sedimentation with little current activity is indicated here—perhaps a lagoon or back reef environment.

(c) Acetate peel, a sample from the upper part of Blue Fiord Formation, in same area as (a) and (b). It is detrital skeletal limestone made up entirely of fragmental skeletal debris with sparry calcite cement. The texture points to more turbulent water conditions than either (a) or (b).

Middle and Upper Devonian

Bird Fiord Formation

The type section of the Bird Fiord Formation at Bird Fiord on southwestern Ellesmere Island (McLaren, 1963a) is 2,950 feet thick. It is composed of limestone, in places nodular and sandy, with common interbeds of calcareous quartz sandstone, argillaceous limestone, and sandy and micaceous mudstone. Limestone is predominant at the base; in upper parts sandstone increases in abundance and approaches in appearance that of the overlying Okse Bay Formation. The top of the Bird Fiord Formation was drawn at a gradational contact below the soft varicoloured shales with thin coal beds of the basal Okse Bay Formation.

On Bathurst Island, the Bird Fiord Formation is a unit of fossiliferous, marine, commonly micaceous, calcareous quartzose sandstone, and arenaceous limestone, interbedded with sandy mudstone. It overlies abruptly but conformably the Blue Fiord Formation and grades upward into the Melville Island Group. The sandstone beds commonly are dark green, light greenish grey, or dark brown; generally they are resistant and weather light yellowish brown. The interbedded shales are much more recessive and generally weather dark green. The formation, comprising alternating light weathering resistant and dark weathering recessive beds, presents a characteristic banded appearance from the air and on aerial photographs. This formation was deposited over the entire report area. It is about 600 feet thick in the southern part of the Driftwood Bay area and thickens gradually both westward and northward.

The Bird Fiord Formation of Bathurst Island was dated by McLaren (1963b) as late Mid-Devonian (Givetian) and possibly early Mid-Devonian (Eifelian). This age range was substantiated by Ormiston (1967), and the present writer agrees.

Distribution, thickness, and lithology. The Bird Fiord Formation has a wide distribution in the map-area, which suggests that it was deposited over the entire region occupied by the Bathurst Island group. In the east, it occurs around synclines and in fault blocks of the Cornwallis Fold Belt; in the Parry Islands Fold Belt it occurs on the flanks of anticlines; and, in the western parts, is the oldest rock in the cores of anticlines.

A complete section of the formation, 1,620 feet thick, was reported (McLaren, 1963b) at Cut Through Creek on Bathurst Island (Sec. 26). The lower 850 feet is alternating sandy, bioclastic limestone, calcareous sandstone, argillaceous sandstone, and sandy mudstone. These beds are overlain by a large covered interval, 640 feet thick, with a few outcrops of brown sandstone in the lower 100 feet of the interval. The succeeding 30 feet is composed of medium-grained calcareous sandstone. The uppermost 400 feet of the formation comprises yellow, thick-bedded sandstone alternating with thin-bedded argillaceous and micaceous sandstone with worm trails and some plant fragments. The succeeding Okse Bay Formation appears to grade up from the Bird Fiord conformably and without a sharp break.

The Bird Formation was reported by Thorsteinsson and Glenister (1963) to occur also at Driftwood Bay (Sec. 31), where the present writer believes it to be 600 feet thick. It is a poorly exposed, alternating sequence of very limy quartz sandstone, soft dark greyish green shale, and brownish green sandy limestone. Prevailing fresh surface colours of the coarser clastic rocks and limestone include light grey and pinkish grey. The shale weathers mainly dark greenish grey; it is recessive and supports more plant growth than the other rock types. This alternation has imparted a distinctive banded appearance to the formation that is especially apparent on aerial photographs (Pl. III).

The Bird Fiord Formation is a sequence of green to brown, medium- to thick-bedded calcareous, micaceous, quartzose sandstone, and sandy skeletal limestone, interbedded with thin-bedded, green, calcareous, micaceous shale. The basal contact is sharp and is drawn where quartz sand and shaly interlayers appear. Shale and mudstone intervals are more frequent near the base of the section. Both the finer grained clastics and calcium carbonate decrease in the younger beds, the formation becoming sandier until it grades into the orthoquartzite of the overlying Hecla Bay Formation. The upper contact is gradational and is drawn at the uppermost limit of calcareous cement. Little systematic variation in the overall general lithology could be distinguished within the report area except that sand increases to the north and west. The resistance to erosion varies from place to place. In western and northwestern parts of the report area, the Blue Fiord and Disappointment Bay Formations are absent but the resistant Bird Fiord Formation is fairly well exposed. To the east, resistant Devonian and Ordovician carbonates are common but the Bird Fiord Formation is much thinner, is relatively recessive, and occupies the low-lying areas. Thicknesses are greatest in the western and central parts of the island group, reaching 2,300 feet at Section 6, and more than 2,300 feet at Section 27. Thicknesses decrease gradually eastward, the formation being 1,620 feet at Cut Through Creek (Sec. 26), and still less in the Cornwallis Fold Belt where at Driftwood Bay it is 600 feet (Sec. 31). Thicknesses also decrease to the north, being approximately 1,000 feet at Section 29, and 1,104 at Section 20. In the extreme north on Helena Island, thicknesses again are less, being 1,450 feet at Section 11 and 1,120 feet at Section 12.

Age and correlation. Fossils are abundant especially in the more calcareous beds, with brachiopods, molluscs, corals, and trilobites present, as well as trails and tracks. The abundant benthonic fauna indicates deposition in a well-aerated, shallow marine environment. The Bird Fiord Formation is distinguished from the underlying Blue Fiord Formation by a major influx of detrital quartz sand. This sand continued throughout the Devonian and is the principal constituent of the thousands of feet of additional clastic sediment that occur above the Bird Fiord Formation in the map-area. Lack of major facies changes within the formation, coupled with its increased thickness to the west, suggests that subsidence of the basin relative to the Central Stable Region continued and that subsidence kept pace with sedimentation.

Ormiston (1967) regarded the basal 200 feet or so of the Bird Fiord Formation at Twilight Creek as Eifelian in age with younger parts being Givetian. This largely agrees with the earlier suggestion of McLaren (1963b).

New evidence supports the suggestion that the Bird Fiord Formation extends down to include Eifelian rocks. McGregor and Uyeno dated spores and conodonts of Section 20 as Eifelian–Givetian (*see* Appendix). On Helena Island (Sec. 11) the formation contains three spore florules at heights of 275 feet, 500 feet above the base, and in the upper 250 feet. All are regarded by McGregor as Eifelian or Givetian, and more likely, Givetian. About 9 miles to the east (Sec. 12), no fossils were collected from the Bird Fiord Formation, but the overlying Hecla Bay Formation yielded spore assemblages at two levels (*see* Appendix), and McGregor regarded them as of probable Givetian age. Thus the top of the Bird Fiord Formation, at least in the north, is Givetian. There have been suggestions by McLaren (1963b) and Ormiston (1967) that the base of the Bird Fiord Formation is time transgressive. This seems probable because the great range in thickness of the underlying Blue Fiord Formation is in part at the expense of the Bird Fiord; however, little has been added from paleontological dating in the present study to clarify the matter. Tozer and Thorsteinsson (1964, Fig. 6) suggested that the Bird Fiord Formation of Bathurst Island is a lateral equivalent of the Weatherall Formation of Melville Island.

Melville Island Group

The Melville Island Group was established on Melville Island (Tozer and Thorsteinsson, 1964) to include three formations which are, in ascending order, the Weatherall, Hecla Bay, and Griper Bay. The sequence is entirely clastic and attains a thickness of about 15,000 feet. Much of the rock is probably of nonmarine origin, but late Middle Devonian (Givetian) fossils occur in the middle of the Weatherall, and a marine band in the Griper Bay Formation contains Famennian invertebrates (op. cit., p. 84).

The two youngest formations of the Melville Island Group, the Hecla Bay and Griper Bay, are widespread in the Bathurst Island region, occurring generally as the youngest unit of the synclines (Pl. XI). The Weatherall Formation as such is not present; however, its equivalents are considered to be present in the lower clastic rocks including the Bird Fiord, Eids, and possibly even the Bathurst Island, Formations. These rocks formerly were assigned to the Okse Bay Formation (Fortier *et al.*, 1963), which McLaren (1963a, p. 328) established on southern Ellesmere Island. In the present report they are reassigned to the Melville Island Group because of the close similarity in age and lithology.

On central Helena Island (Sec. 12), a well-exposed section composed of both the Hecla Bay and Griper Bay Formations is 8,875 feet thick. It rests conformably on the Bird Fiord Formation, and is overlain with angular unconformity by the Permian Belcher Channel Formation.

The Hecla Bay and Griper Bay Formations probably were deposited over the entire Bathurst Island group and Byam Martin Island, for their exposures are scattered throughout the entire report area (Map 1350A). Locally, between Driftwood Bay and Reindeer Bay on the east coast of Bathurst Island, the Griper Bay Formation is unconformable upon older rocks including the Hecla Bay Formation. Correlation within these two formations has been discussed by Kerr, McGregor, and McLaren (1965) and is elaborated below.

Hecla Bay Formation

The type section of the Hecla Bay Formation, about 2,600 feet thick, is on southeastern Melville Island (Tozer and Thorsteinsson, 1964, p. 75). It is composed of light grey to white, fine- to medium-grained sandstone and sand, and is regarded as a nonmarine deltaic deposit. The range of thickness on Melville Island is considered to be 1,700 to 2,600 feet.

The Hecla Bay Formation in the Bathurst Island group is divisible into two members (Pl. XI). The lower member is a massive and crossbedded, pink to reddish orange orthoquartzite; it is a moderately resistant, ridge-forming unit. The upper member normally consists of unconsolidated, white quartz sand that is very recessive and apparently was deposited by wind. It weathers to sand-covered valleys or locally forms hoodoos. Few complete uneroded thicknesses of these members are known.

The Hecla Bay Formation is preserved primarily in synclines of the Parry Islands Fold Belt, where it occurs as the surface formation over large areas, especially in the northern and western part of the Bathurst Island group. It is present also, but of smaller extent, along the eastern coast of Bathurst Island. It lies conformably and gradationally above sandstone of the Bird Fiord Formation and either conformably or unconformably beneath sandstone of the Griper Bay Formation.

Distribution, thickness, and lithology. The Hecla Bay Formation covers wide areas of the western part of the report area where both lower and upper members commonly are preserved. A few exposures occur in the eastern part of the area; there only the lower member is preserved. Frost action has shattered and broken this formation into fields of felsen-

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PLATE XI. Oblique aerial view of the Hecla Bay and Griper Bay Formations in a syncline of the Parry Islands Fold Belt, looking eastward from Erskine Inlet.

meer so that fresh undisturbed outcrops are rare and reliable dips are difficult to obtain. An exception is in the extreme southwestern part of the area where flat-lying areas of the upper member form mesas (Pl. XII).

It is not possible with the data available to construct an isopach map of the Hecla Bay Formation; however a general thickness pattern is evident (*see* Fig. 9). The thicknesses of complete sections are shown. Thicknesses of partial sections where the formation is partly removed, or only partly exposed, also have been shown and these are regarded as minima for the areas they represent. In the western part of the Bathurst Island group, north of Bracebridge Inlet, thicknesses commonly are on the order of 3,500 feet. Thickness decreases abruptly across Massey Island from 2,900 feet at the south to only 1,235 feet at the north. A similar pattern of northward thinning exists on eastern Melville Island (Tozer and Thorsteinsson, 1964), where the thickness is 2,600 feet in the extreme southeast and

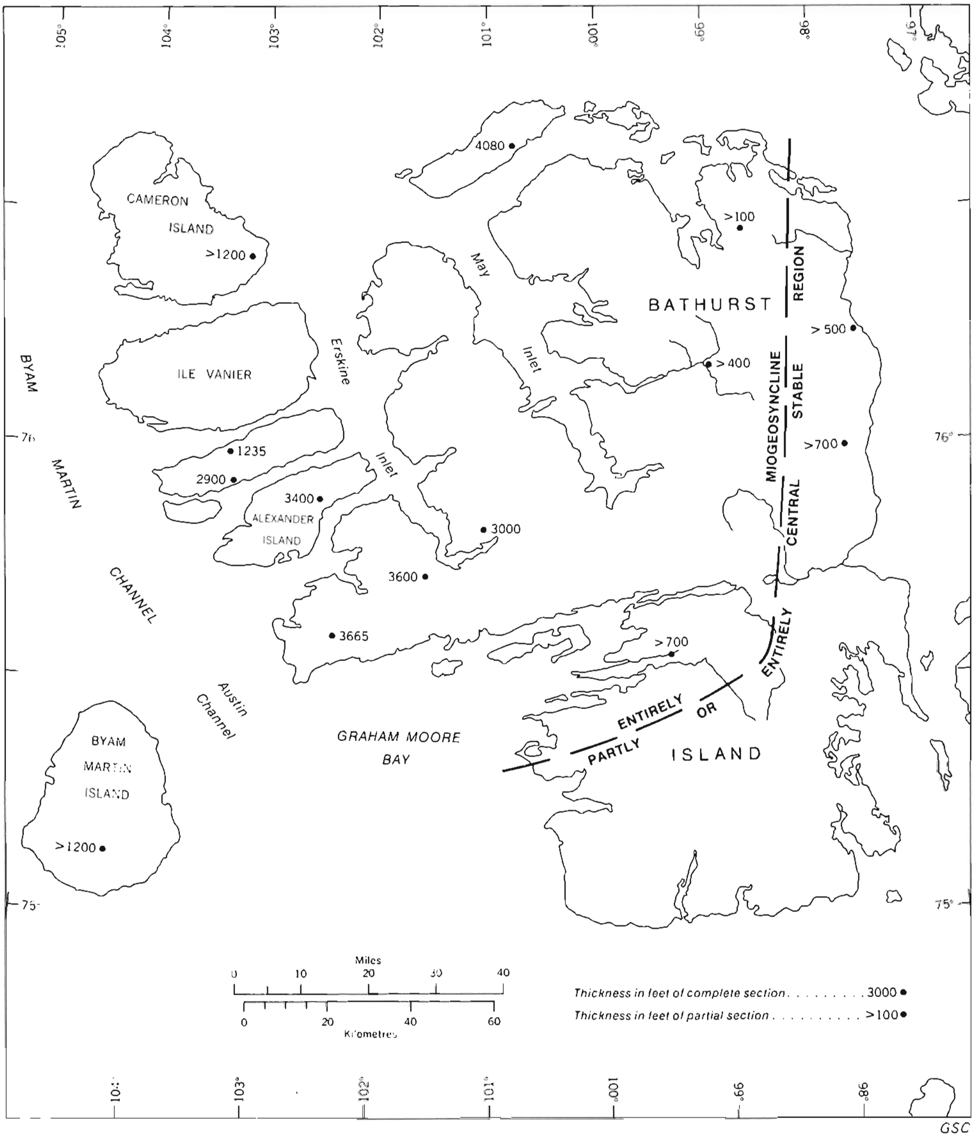

FIGURE 9. Thicknesses of the Hecla Bay Formation in the Bathurst Island group and Byam Martin Island.

1,800 feet farther north. The thickest section of the Hecla Bay Formation (4,080 feet) is on Helena Island. It appears that there is a line of maximum thickness curving from Helena Island through the sections north of Bracebridge Inlet. No information is available on the original thickness pattern immediately adjacent to and within the Cornwallis Fold Belt because of the limited preservation of these rocks, but Figure 9 indicates that thinning takes place in that direction, as is so with other Devonian formations.

The lower member of the Hecla Bay Formation is composed of tightly packed, fine to medium, angular to subrounded quartz grains, stained very light red, yellow, reddish orange or reddish brown. The rock is cemented either by yellow clayey material (it gives a kaolin trace on the X-ray diffractogram) or more commonly by limonite or hematite. Commonly, the ferruginous material occurs as secondary bands or veins up to several inches wide that penetrate the sandstone in a seemingly random nature (*see* Pl. XIIIc). Except for the concentration along these bands, there is little cement and excellent intergranular porosity.

The upper member of the Hecla Bay Formation, gradational with the lower, is composed almost entirely of fine grains of quartz that are, for the most part, completely uncemented (Pl. XIIIb). It outcrops only rarely except in two mesas in the southwest, where large planar crossbeds are present (Pl. XII). Several thin sections made by impregnating hand specimens with epoxy resin show a mosaic of fine, subangular to rounded grains of unstrained quartz and up to 10 per cent chert. A few of the grains are frosted, but most are not. Mica is present but very rare. The grains of quartz are very tightly packed, some of the contacts are sutured and show evidence of pressure solution along grain boundaries.

Where the section is complete, both members of the Hecla Bay Formation can be distinguished. On Helena Island (Sec. 12, *see* Appendix), the formation is 4,080 feet thick. The lower member, 2,380 feet thick, is composed of slightly feldspathic and micaceous, resistant quartz sandstone with a few intercalated greenish sandy and shaly interlayers.

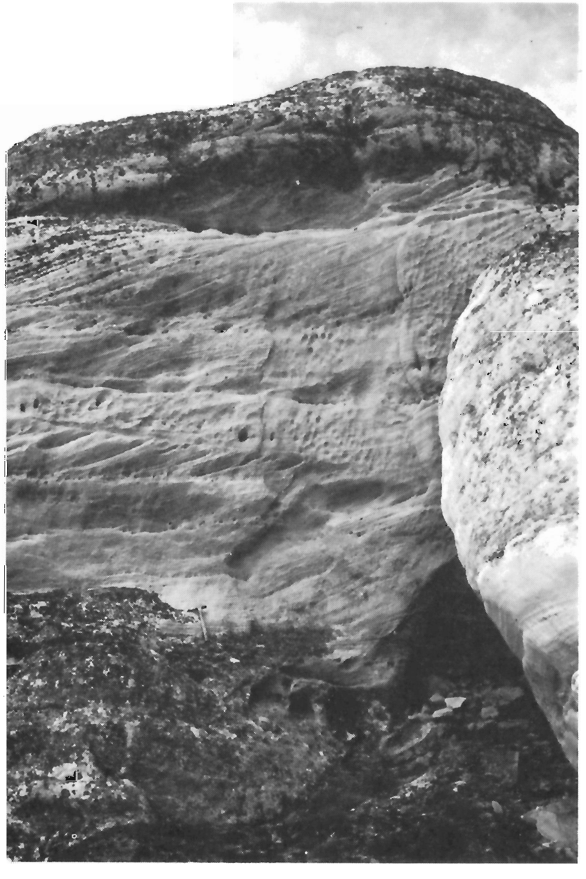

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PLATE XII

Rare exposure of the upper member of the Hecla Bay Formation, in a mesa called Mount Bullock in the southwestern part of Bathurst Island. Note the numerous crossbeds, and the geological pick in centre foreground.

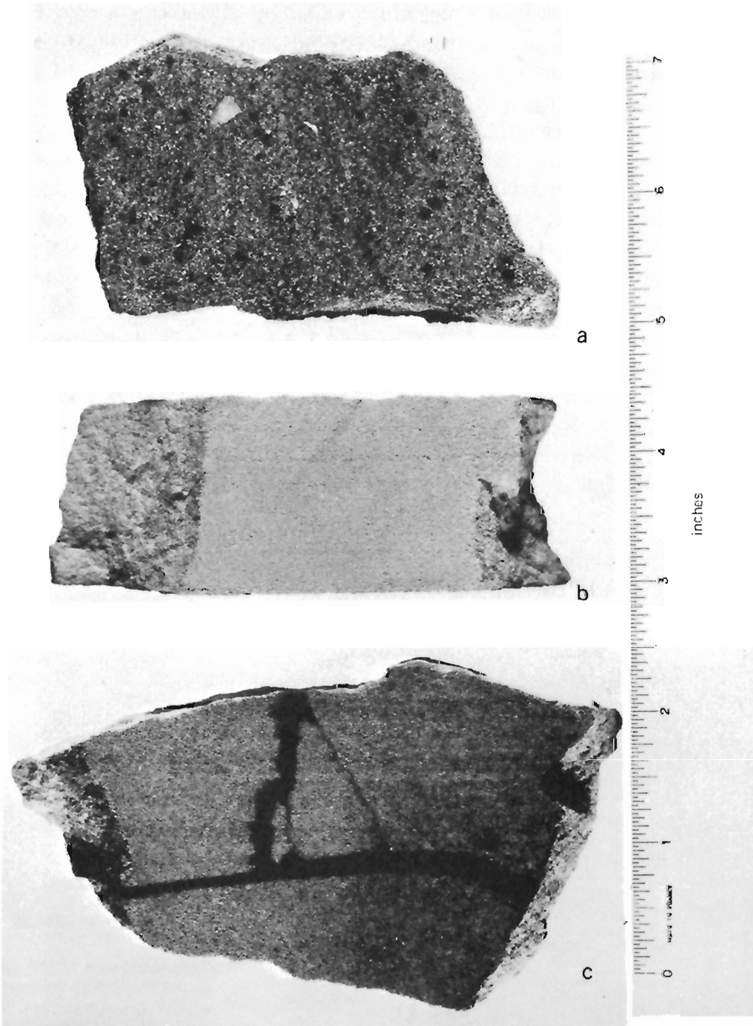


PLATE XIII. Lithic types from Hecla Bay and Griper Bay Formations: (a) Griper Bay Formation; greyish green lithic arenite with large white grain of feldspar and dark lithic fragments. (b) Upper member of the Hecla Bay Formation; white, fine-grained quartz arenite. (c) Lower member of the Hecla Bay Formation; reddish brown quartz arenite with dark dusky red veins of hematite cement.

The upper member, 1,700 feet thick, comprises soft quartz sandstone and sand that is very pure, and light cream-coloured on both fresh and weathered surfaces.

As much as 700 feet of rocks assigned to the lower member of the Hecla Bay Formation is present at Driftwood Bay (Sec. 31). The top is not preserved, so the original thickness is unknown. The formation comprises very light grey to white, moderately soft and friable quartzose sandstone, weathering slightly rusty light grey. It is predominantly medium grained and medium bedded; about 10 per cent of the rock is ferruginous and ranges in colour from very pale orange to dark yellowish orange. Crossbedding is common.

Large quartz sand bodies such as the Hecla Bay Formation usually are associated with either desert or littoral environments, but distinguishing between the two is difficult. In modern sands, plots of mean grain size against skewness resulted in a complete separation of the fields representing dune and beach sands (Friedman, 1961; Mason and Folk, 1958). According to Friedman (1961), beach sands had negative skewness, whereas dune sands had a positive skewness; moreover, of his 114 dune sand samples, none had a mean grain size diameter above 0.35 mm (1.50 phi).

Four samples of the large unconsolidated sand of the upper member of the Hecla Bay Formation were analyzed by Temple in the manner of Mason and Folk (1958). For each sample about 30 grams were weighed and sieved, using sieves at intervals from 1.50 to 4.00 phi. Residues were weighed to the nearest 0.01 gram; weight percentages were calculated, cumulative curves plotted and mean and skewness values were thus obtained (Fig. 10).

Textural analyses of modern sands cannot be applied with certainty to the Hecla Bay Formation; however, the mean and skewness values still suggest that this member is aeolian. Diagenetic effects such as solution along grain boundaries and breakdown of feldspar grains would tend to reduce the mean grain size of the ancient rocks, increase the tail of fines, and shift the original skewness toward more positive values.

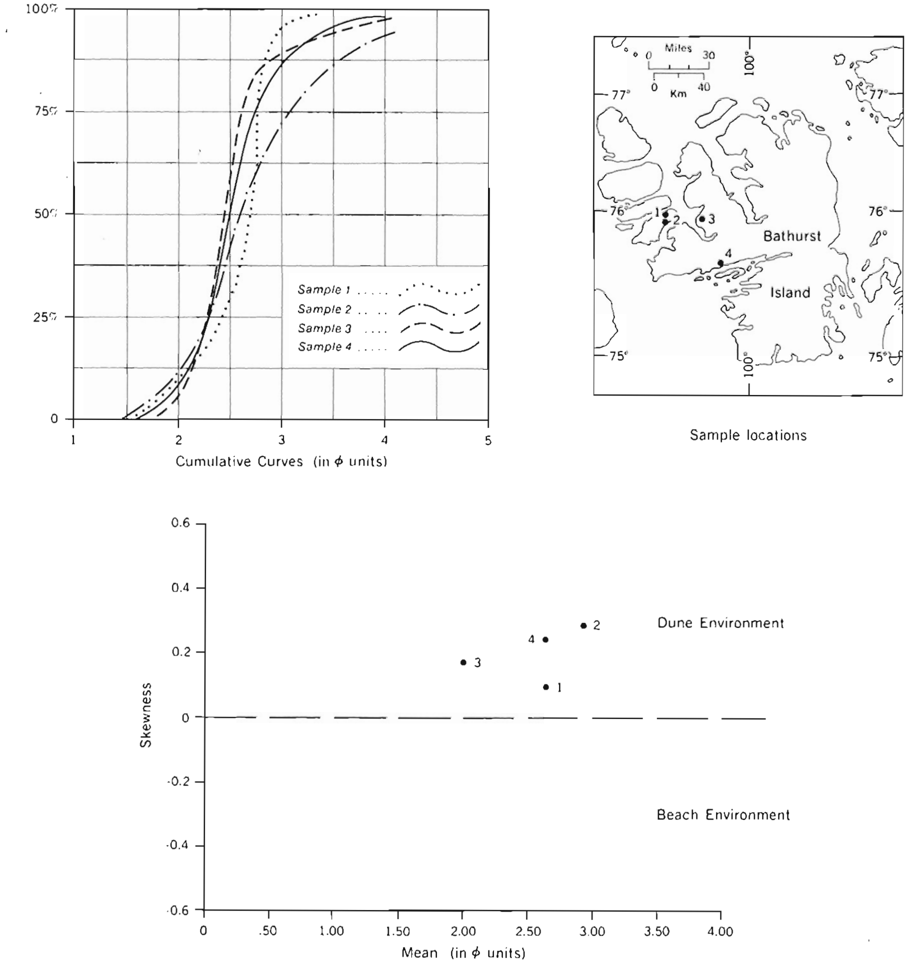
Any subsequent alteration of the Hecla Bay Formation would have shifted mean and skewness values toward the "dune environment," so the conclusion is tentative. It is, however, supported by the aeolian-type crossbedding (Pl. XII). Moreover, the spatial and sequential relationships of the Hecla Bay Formation (*see below*) reinforce the suggestion of an aeolian origin for its upper member.

Age and correlation. The age of the Hecla Bay Formation in the report area is Givetian and Frasnian. It rests conformably on the Bird Fiord Formation that is as young as Givetian. Spores at two levels in the lower member near the centre of Helena Island (Sec. 12, *see* Appendix) are of late Givetian or Frasnian age; more probably late Givetian. The overlying Griper Bay Formation on Helena Island contains early Frasnian spores. The Hecla Bay Formation of Bathurst Island can be correlated with lower parts of the Okse Bay Formation of southern Ellesmere Island (McLaren, 1963a; Kerr, 1968b) while the formation on Melville Island (Tozer and Thorsteinsson, 1964) has a similar thickness and thickness pattern to that on Bathurst Island.

Griper Bay Formation

The type section of the Griper Bay Formation on northeastern Melville Island is about 3,000 feet thick, and consists mainly of sandstone, siltstone, and shale, but with some intercalated thin coal seams and conglomerate beds (Tozer and Thorsteinsson, 1964, p. 83). The most distinctive feature of the formation is its colour; it is mainly dark green, with minor amounts of dusky red, pink, grey, and white.

In the report area, four members are distinguishable and persist widely as recognizable units. All fossils so far collected from this formation are of Late Devonian age (Kerr, McGregor, and McLaren, 1965). The formation is widespread and thick in the western part of the report area, but is thin and only locally preserved in the east. It is unconformable on folded older rocks; an unconformity that is most extreme in the east but disappears westward. No apparent stratigraphic break occurs beneath or within the formation in western parts of the report area, or in the type section on eastern Melville Island. Tectonism producing the unconformity probably occurred within Frasnian time during a period of relative uplift of the Cornwallis Fold Belt. Basal beds of the Griper Bay Formation transgressively overlap eastward.



Formulas used in calculations (after Mason and Folk 1958)

$$\text{Mean} \quad \frac{\phi 16 + \phi 50 + \phi 84}{3}$$

$$\text{Skewness} = \frac{\phi 16 + \phi 84 - 2\phi 50}{2(\phi 84 - \phi 16)} + \frac{\phi 5 + \phi 95 - 2\phi 50}{2(\phi 95 - \phi 5)}$$

GSC

FIGURE 10. Mean versus skewness of four sand samples from the upper member of the Hecla Bay Formation, as an indicator of depositional environment.

Distribution, thickness, and lithology. Total depositional thicknesses of the Griper Bay Formation are not known because the upper contact everywhere is erosional. On Helena Island, the maximum thickness is 4,875 feet, whereas about 3,000 feet is preserved on the Governors General group of islands and western Bathurst Island. Generally less than 1,000 feet remains on eastern Bathurst Island.

This formation is the youngest of the Franklinian Geosyncline preserved in the report area. It outcrops in scattered areas of eastern Bathurst Island, but for the most part is confined to areas farther west in the cores of the Parry Islands synclines where they plunge westward into the sea. Like the underlying Hecla Bay, the Griper Bay Formation is widely distributed and, although now eroded from many areas, probably was deposited throughout the entire report area.

The formation is composed predominantly of greyish green and olive-brown, fine- to medium-grained lithic arenite (Pl. XIIIa), interbedded with medium- to coarse-grained, olive-green to dusky yellow feldspathic arenite[1]. Interbeds of green shale containing plant remains, worm burrows, and trails are intercalated with the sandstone, as are lenses of pebble-conglomerate. The mineralogy of the sandstones and conglomerates from various areas is rather uniform. Detrital quartz grains, including 10 to 20 per cent chert, make up from 60 to 70 per cent of the rock; feldspar and lithic grains average 10 to 25 per cent, but in one or two samples occur in amounts up to 40 per cent; there is usually less than 10 per cent of matrix material. Lithic fragments are usually dark greyish green and, where large enough to be determined, are consistently of volcanic origin. All of the feldspar fragments are plagioclase. Several X-ray determinations of matrix material gave characteristic kaolin peaks and in one chamosite was indicated.

The four members are best represented south of Pell Inlet (Sec. 5). The preserved rocks of the formation are 2,450 feet thick and are assigned as follows: Member A (350 feet) is resistant and blocky quartzose sandstone; Member B (950 feet) is sandstone, siltstone and shale intimately interbedded, recessive, dark weathering; Member C (450 feet) is light weathering, moderately resistant, arkosic sandstone and pebbly sandstone; and Member D (700 feet) is recessive, dark weathering sandstone with minor amounts of shale.

An important reference section of the Griper Bay Formation at Reindeer Bay (Sec. 29; Fig. 4) on the northeast coast of Bathurst Island was established by Kerr, McGregor, and McLaren (1965). Two members of the formation were distinguished in this section. Member A, which rests with angular unconformity on the Hecla Bay and older formations, comprises 200 feet of light cream-coloured quartz sandstone that forms a prominent, resistant ridge. On fresh surfaces it is cream-coloured with faint rusty bands, and weathers to a faintly rusty tan; it is thick bedded with medium, subrounded grains.

Member B of the Griper Bay Formation in the Reindeer Bay reference section is a variable rock of grey-green, argillaceous quartz sandstone, and dark grey-green, siltstone and shale. At the base of this member is an argillaceous quartz sandstone unit about 300 feet thick that is gradational with the rather pure quartz sandstone of Member A. The interval from 150 to 250 feet above the base is covered. A northerly trending normal fault, whose displacement diminishes northward, is exposed to the south of the reference section. This normal fault probably dies out before reaching the reference section; however, it may be present with minor displacement in the short covered interval in the lower unit of Member B. The remainder of the section, about 660 feet, is argillaceous quartzose sandstone, weathering grey-green, alternating with dark grey-green shale.

The Griper Bay Formation is exposed at Driftwood Bay (Sec. 31) where it rests with marked angular unconformity upon older Devonian rocks. Only Member A is present in this area. It is 1,500 feet thick, and bounded at the top by a fault.

On Helena Island (Sec. 12), the Griper Bay Formation is more than 4,795 feet thick and overlies abruptly but with apparent conformity the Hecla Bay Formation. It contains various rock types, but is generally medium to dark greenish grey. The three lower members are present in this section. Member A comprises two parts here. At the base is 2,175 feet of variably argillaceous quartzose sandstone and siltstone interbedded with shale, medium to dark greenish grey throughout. Crossbedding, ripple-marks, chert-pebble beds, and

[1]Following the Williams, Turner, and Gilbert sandstone classification (1954); a subgreywacke and subarkose following Pettijohn (1957).

plant fragments are common, suggesting shallow-water, nearshore deposition. This is succeeded by a prominent coarse pebbly sandstone 500 feet thick, which contains angular black and white chert fragments throughout and a pebble-conglomerate at the base. At the base of Member B is 120 feet of coaly, dark grey-green shale, with medium-grained, greenish grey, impure quartzose sandstone; a particularly coaly shale at the base yields spores (GSC plant loc. 7014). Separated from the shale by a fault of minor displacement is an overlying unit, about 800 feet thick, comprising greenish grey, impure quartzose sandstone, showing shaly interlayers throughout and bearing carbonized plant fragments. Member C constitutes the uppermost 1,200 feet of the Griper Bay Formation and is composed of rather pure quartzose sandstone, which is medium-grained, varicoloured, mainly orange to very light grey. It is overlain with slight angular unconformity by the Permian Belcher Channel Formation.

The Griper Bay Formation is primarily a nonmarine sequence with coaly beds containing plants and spores. Evidence of marine deposition is known from the few limy sandstone and shale interbeds near the top of the formation that contain a marine shelly fauna. Available evidence suggests that the formation is a product of paralic sedimentation along coastal plains and deltas, with occasional marine incursions.

In Middle and Late Devonian times, a regressive marine sequence developed. The shallow marine Bird Fiord Formation is overlain by a beach and dune sequence in the Hecla Bay, and then by a deltaic coastal plain sequence in the Griper Bay as the deltaic environment encroached progressively southward and the basin filled up. The Melville Island Group and underlying Bird Fiord Formation form a clastic sequence 10,000 to 12,000 feet thick and covering thousands of square miles of the Arctic Archipelago.

Age and correlation. The age of the Griper Bay Formation is Frasnian and Famennian, as discussed by Kerr, McGregor, and McLaren (1965). Two key sections that have diagnostic spore assemblages as well as shelly faunas are at Helena Island (Sec. 12) and Reindeer Bay (Sec. 29), and the relationships of these two sections are shown on Figure 4. Spores were identified and dated by McGregor (pers. com., 1971) and the shelly faunas, except where otherwise stated, were identified and dated by McLaren (pers. com., 1971).

On Helena Island, spores from a height of 950 feet above the base of Member A (GSC plant loc. 7026) are probably early Frasnian, and those from a height of 1,800 to 2,175 feet in the member (GSC plant loc. 7027) are mid- to late Frasnian (*see* Appendix). A carbonaceous shale at the base of Member B (GSC plant loc. 7014) yielded a spore assemblage assigned an age of middle or probably late Frasnian.

In the reference section at Reindeer Bay (Sec. 29), only the upper sandstone of Member A is present. Member B has yielded spore assemblages at several levels. The oldest, at a height of 305 feet in Member B (GSC plant loc. 7254), was dated as late Frasnian or early Famennian, probably early Famennian. Successively younger collections were all dated as probably early Famennian. In the next major stream 4 miles to the south of the reference section and about 3 miles inland from the coast, a collection was made in Member B at about 1,300 feet above the base of the formation (GSC loc. 59040). A marine invertebrate fauna from this locality has been assigned an early Famennian age by McLaren (pers. com., 1971); spores from the same locality were assigned a Famennian, probably early Famennian, age by McGregor. In view of the foregoing fossil evidence and its unconformable relationship with the Hecla Bay Formation, the entire Griper Bay Formation at the reference section is considered to be of Frasnian and Famennian age.

There is little doubt from the foregoing dates that Section 12 contains older beds than Section 29. The faunal and stratigraphic evidence show conclusively that there was a mid-

Frasnian uplift of the Cornwallis Fold Belt, producing erosion and unconformity at Reindeer Bay, and that by late Frasnian or early Famennian time the fold belt once more had been encroached upon from the west (Fig. 4).

The Griper Bay Formation occurs widely on Melville Island (Tozer and Thorsteinsson, 1964, p. 84) where the lithology and age apparently are similar to those on Bathurst Island. It also has been reported on Cornwallis Island (Thorsteinsson and Kerr, 1968) where it is very thin and unconformable on underlying beds. The latter occurrence is within the Cornwallis Fold Belt and probably is similar to the occurrence at Reindeer Bay. The uppermost member of the Okse Bay Formation of southwestern Ellesmere Island (McLaren, 1963a; Kerr, 1968b) has lithology and stratigraphy similar to the Griper Bay Formation, and may be correlative.

Permian

Belcher Channel Formation

The type section of the Belcher Channel Formation, which was described by Thorsteinsson (1963c), is on northern Grinnell Peninsula. Nassichuk (1965) redescribed the Belcher Channel Formation of that area and reported two sections, with thicknesses of 600 and 650 feet, that comprise limestone, dolomite, and minor interbeds of sandstone. On Grinnell Peninsula, the Belcher Channel Formation conformably overlies the Canyon Fiord Formation; however, at Sabine Bay on Melville Island, the two are separated by a disconformity. The upper contact of the formation at Grinnell Peninsula is a regional unconformity, and at Sabine Bay is a disconformity. Harker and Thorsteinsson (1960) dated the Belcher Channel Formation as Permian, but Nassichuk (1965) assigned it more exactly to the Lower Permian, including Asselian, Sakmarian, and early Artinskian.

A small erosional remnant of the Belcher Channel Formation occurs on northern Helena Island and 11 units were identified (Sec. 10, *see* Appendix). The formation rests with slight angular unconformity on Griper Bay rocks (*see* Map 1350A) and has a total preserved thickness of 510 feet. Outcrops are sparse, the exposed rock being mainly felsenmeer and consisting almost entirely of dolomitic limestone that commonly is porous to vuggy. Fresh surface colours are variable, usually light grey to brownish grey, but the weathering colour consistently is very light grey. Corals and a few brachiopods occur at several horizons and commonly have been replaced by chert. They were identified by E. W. Bamber and dated as Lower Permian (*see* Appendix).

Trold Fiord Formation

The Trold Fiord Formation (Thorsteinsson and Tozer, 1970; Nassichuk and Christie, 1969) has its type section at Cañon Fiord, Ellesmere Island, where it comprises green glauconitic sandstone with minor amounts of skeletal limestone beds. It is widespread and of variable thickness in the Sverdrup Basin; it is best developed near the southern and southeastern margins of the basin where it consists of pale green, glauconitic sandstone, with some limestone and chert. The Trold Fiord Formation is of Late Permian (early Guadalupian) age. It transgresses south and southeast, and overlies several formations, including lower Paleozoic strata.

Within the report area, the Trold Fiord Formation occurs only on Cameron Island. These rocks were assigned to the Assistance Formation by Greiner (1963b), but have been reassigned to the Trold Fiord Formation (Nassichuk, pers. com., 1971). Greiner described the formation as poorly exposed, fossiliferous, medium-grained glauconitic sandstone, containing a thin chert zone near the top. From graphic measurements he estimated the maximum thickness to be about 140 feet in the northern part of the area of exposure, and perhaps 75 feet in the southwest. The formation rests with angular unconformity on the Griper Bay Formation. Nassichuk, Furnish, and Glenister (1965, p. 10) reported that the Trold Fiord Formation of Cameron Island yielded the holotype of *Neogeoceras macnairi*, and those authors regarded the formation to be of Late Permian (Guadalupian) age. According to Nassichuk (pers. com., 1971), two collections from the Trold Fiord Formation of Cameron Island (GSC locs. 73151 and 73153) yielded Guadalupian brachiopods identified and dated by R. E. Grant.

Triassic

Bjorne Formation

At its type locality on Bjorne Peninsula, southern Ellesmere Island, the Bjorne Formation is about 1,700 feet thick and consists of medium- to fine-grained, medium- to thick-bedded, and locally crossbedded sandstone (Tozer, 1963a, p. 367). The sandstone is essentially quartzose, commonly with fragments of light brown ferruginous material mostly of sand size, but occasionally forming flakes up to half an inch in diameter. It is of Early Triassic age (Tozer, 1963c).

Tozer (1963b, p. 641, footnote) assigned about 200 feet of rock on northwestern Cameron Island to the Bjorne Formation, and described it as being light olive-grey, fine-grained, quartzose sandstone that commonly is soft and has well-developed crossbedding. The beds are irregularly indurated and contain discontinuous bands, up to a foot thick, of dark, dusky red sandstone that shows white weathering grains of kaolinized feldspar on weathered surfaces. Calcareous nodules and intraformational conglomerate were noted in one section.

Greiner (1963b) reported an unnamed unit of poorly exposed, mainly unconsolidated sands in the southwestern part of Cameron Island. On what was regarded as the lower part of the unit were loose blocks yielding Permian fossils. The writer suggests that these blocks probably came from the underlying formation. Exposure is poor and no unquestionable contact could be determined. The upper part of this unnamed unit resembles the Bjorne Formation farther north, and the writer has assigned the entire unit to the Bjorne Formation (Map 1350A).

Schei Point Formation

At its type section on Bjorne Peninsula of Ellesmere Island, the Schei Point Formation is 600 feet thick and includes very calcareous siltstone that locally grades into bioclastic, crinoidal, silty and sandy limestone (Tozer, 1963a, p. 368). Light grey phosphatic nodules occur in the lower part. Poor outcrops of dark grey calcareous shale were observed near the base but the basal contact was not observed. The Schei Point Formation is of Middle and Late Triassic age (Tozer, 1963c).

Tozer (1963b) described the Schei Point Formation of Cameron Island as consisting of calcareous sandstone overlain by bioclastic limestone. The contacts with the underlying Bjorne Formation and the overlying Heiberg Formation were not observed. The whole unit is abundantly fossiliferous on Cameron Island where it is of Late Triassic and also probably of Middle Triassic age.

Heiberg Formation

The type section of the Heiberg Formation on Axel Heilberg Island has two lithological divisions and is several thousand feet thick (Souther, 1963, p. 432). The lower member comprises predominantly thin-bedded sandstone and interbedded shale, whereas the upper member consists of predominantly thick-bedded to massive sandstone with less shale and much carbonaceous material.

In the present map-area, the Heiberg Formation is confined to northern Cameron Island, where it is a poorly exposed sequence of grey, crossbedded, fine-grained quartz sandstone with thin, hard bands of red ferruginous sandstone. A 3-foot band of coal is present. Tozer (1963b) stated that the thickness of the Heiberg Formation on northern Cameron Island exceeds 70 feet, but the total thickness is unknown. He described a section of the Heiberg Formation as follows:

	Thickness (feet)	
	Unit	Total
1. Sand: quartzose, grey, fine-grained, crossbedded, with thin grey clay partings and some carbonized wood; lower part is locally indurated to form thin bands of dark dusky red weathering ferruginous sandstone; fossil wood present	50	50
2. Coal: deeply weathered and very friable	3	53
3. Sand: quartzose, grey, fine-grained, crossbedded, with thin carbonaceous laminae	15	68

Overlying sediments of the Jaeger Formation apparently rest unconformably on the Heiberg as there is evidence of truncation along the contact. The formation was dated as Late Triassic because of its similarity to the type section of Late Triassic age and because Late Triassic fossils were found in float nearby.

Jurassic

Jaeger Formation

The type area of the Jaeger Formation is on Jaeger River, eastern Cornwall Island, where it is 1,000 feet thick (Greiner, 1963a, p. 535). It consists mainly of medium to dark reddish brown to dusky red-purple consolidated sandstone. Some beds contain pebbles, others are glauconitic; ironstone nodules are common. Dusky red conglomerate and sandstone beds occur at the base of the formation. The type section of the Jaeger Formation was dated as belonging to the upper part of the Early Jurassic (Toarcian) on the basis of ammonites identified by Frebold.

Tozer (1963b) reported very poorly exposed beds on Cameron Island that he assigned to the Jaeger Formation. The only outcrops occur about half a mile northeast of Rendezvous Hill where about 5 feet of hard olive-grey, dusky red weathering, fine-grained sandstone, containing small grey phosphatic nodules, unconformably overlies the soft sands of the Heiberg Formation. Above this sandstone is a covered interval upon which mudstone concretions and loose pelecypods and belemnites are abundant. On Cameron Island the formation was dated as early Middle Jurassic (Bajocian) on the basis of ammonoids identified by H. Frebold. The Jaeger Formation is considered to have overstepped older formations on Cameron Island.

Lower Cretaceous

Isachsen Formation

A single small exposure of a white sand formation occurs in a terrace on the south side of the Stuart River Valley. Its location is at latitude 76°11.2′N, longitude 99°05′W, about 9 km east–northeast of the head of Stuart Bay and 1 km west of the mouth of Cut Through Creek. The exposure was discovered by McLaren (1963b, p. 616), who stated that its age was unknown. He described the formation as consisting of white and brown coarse to very coarse, poorly sorted, quartz sand, in which vague bedding is apparent. Pebble beds up to 2 feet thick occur at several horizons, and highly irregular thin beds of dark grey clay, discontinuous along strike, increase upwards in the succession. A few lumps of soft black coalified wood occur irregularly in the sands.

A discontinuous clayey material occurs at the top of the white sand unit and beneath Pleistocene gravels, according to W. Blake Jr. (pers. com., 1973), who collected some clay and had it analyzed for pollen (GSC loc. No. 49427). The material was reported by S. Lichti-Federovich to contain the following:

Lycopodiumsporites austroclavatidites
Cicatricosisporites sp.
Gleicheniidites cf. *G. cercinidites* (U. Jur.–L. Cret.)
Bitresporites potonei
Vitresporites pallidus (Jur. and Cret.)
Classopollis sp. (Jur.–Cret.)
Alisporites grandis (U. Cret.–L. Cret.)
Phyllocladites
Taurocusporites cf. *T. segmentatus* (L. Cret.)
Cerebropollenites mesozoicus (Jur.–Cret.)

She considered this pollen assemblage to indicate an Upper Jurassic to Lower Cretaceous age.

A further examination of the same material was made up by W. S. Hopkins (pers. com., 1973), who reported the following assemblage:

Deltoidospora sp.
Gleicheniidites senonicus Ross
Sphagnum antiquasporites Wilson and Webster
Osmundacidites wellmanii Couper
cf. *Neoraistrickia* sp.
Cicatricosisporites dorogensis Potonié and Gelletich
Cicatricosisporites spp.
Verrucosisporites sp.
cf. *Lycopodiacidites* sp.
cf. *Staplinisporites* sp.
Lycopodiumsporites austroclavatidites (Cookson) Potonié
Lycopodiumsporites sp.
Baculatisporites cf. *B. comaumensis* (Cookson) Potonié
Leptolepidites sp.
Trilobosporites cf. *T. canadensis* Pocock
Trilobosporites apiverrucatus Couper
Appendicisporites sp.
Pilosisporites cf. *P. trichopapillosus* (Thier.) Del. and Sprum.
Cingulatisporites sp.
cf. *Sestrosporites* sp.

Vitreisporites pallidus (Reissinger) Nilsson
Miscellaneous bisaccate conifer pollen
Classopollis classoides (Pflug) Pocock and Jansonius
Classopollis cf. *C. itunensis* Pocock
Tsugaepollenites sp.
Inaperturopollenites sp.
cf. *Glyptostrobus* sp.
Podocarpidites sp.
cf. *Spheripollenites* sp.
Eucommiidites troedssonii Erdtman
cf. *Clavatipollenites* sp.
Aquilapollenites sp. (one specimen, probably laboratory contaminant)

Hopkins dated the assemblage as definitely Lower Cretaceous, probably pre-Albian, and suggested that the unit is equivalent to the Isachsen Formation. He further noted that the absence of phytoplankton, and the unusually good preservation of the palynomorphs indicate a non-marine environment of deposition. The structural setting of the exposure is unknown. If the unit is indeed the Isachsen Formation, which is a transgressive unit, its presence here indicates that the unit transgressed farther south than is generally assumed.

Upper Cretaceous

Eureka Sound Formation

Troelsen (1950, p. 78) proposed the name Eureka Sound Group for deposits of sandstone, shale, and lignite that had been reported in widely separated localities on Ellesmere Island. He considered the group to be of Cenozoic age, and younger than the last orogeny. As a result of field work in 1955 Tozer (1963c) suggested that the Eureka Sound be called a formation, and Souther (1963) designated as the type section 8,200 feet of rocks on central Axel Heiberg Island. Souther described the formation in that region as being structurally conformable upon the Kanguk Formation, and comprising light yellowish grey and yellowish brown sandstone and siltstone, with intercalated shale, mudstone, and coal. Shale is most abundant in the lower part of the formation, where there are individual shale members up to 250 feet thick interbedded with greenish grey, fine-grained sandstone. On the basis of plant fossils Souther dated the Eureka Sound Formation of central Axel Heiberg Island as Upper Cretaceous(?) and Tertiary.

Subsequently, after field work in 1956, Thorsteinsson and Tozer (1957) determined that the Eureka Sound Formation is concordant with underlying Mesozoic rocks on western Ellesmere Island, and oversteps eastward onto an unconformity that cuts down gradually through Mesozoic and upper Paleozoic rocks and finally onto lower Paleozoic rocks of the miogeosyncline and Central Stable Region. From this Thorsteinsson and Tozer concluded that there had been no folding between Cretaceous rocks and the Eureka Sound Formation, and that the formation had been deposited prior to the latest episode of folding and faulting. Later Thorsteinsson and Tozer (1970) determined that in much of eastern Axel Heiberg Island and northern Ellesmere Island the Eureka Sound Formation rests unconformably upon folded rocks that are as young as Lower Cretaceous.

Balkwill (1973) reports that the Cornwall anticlinorium was established during Late Cretaceous or early Tertiary, while the Eureka Sound Formation was being deposited. On southwestern Amund Ringnes Island, which is on the flank of the Cornwall anticlinorium, the Eureka Sound Formation, with latest Cretaceous (Maestrichtian) rocks at the base, is conformable on the Upper Cretaceous Kanguk Formation. On the axis of the Cornwall anticlinorium the Eureka Sound Formation is Paleccene at the base and rests unconformably upon Triassic and Jurassic rocks. The Eureka Sound Formation then encroached unconformably onto the Cornwall anticlinorium between Maestrichtian and Paleocene times. Thus it is clear that the Eureka Sound is a complex formation. It apparently is partly syntectonic, and contemporaneous with broad uplifted ridges in the Sverdrup Basin. It is partly post-tectonic in that it encroaches widely onto the unconformity produced over these uplifts. The formation also was deformed later by folding on Ellef Ringnes Island, and by folding and faulting on Axel Heiberg Island and Ellesmere Island.

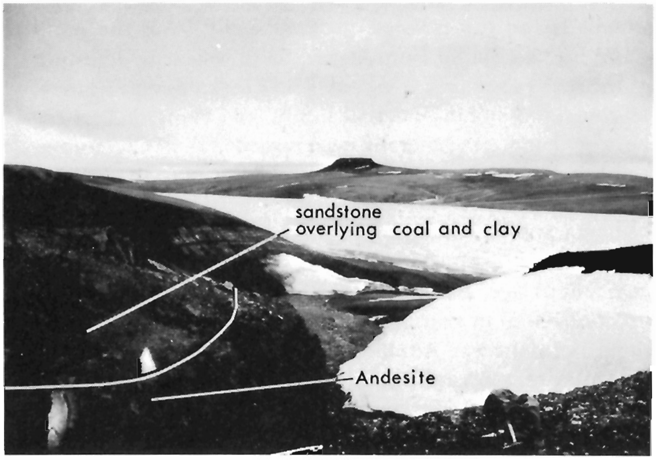
When Souther (1963) originally erected the Kanguk Formation and the overlying Eureka Sound Formation, the Kanguk Formation was regarded as mainly marine shale, with at least one substantial interbed of sandstone in the upper part. The Eureka Sound Formation was regarded as mainly sandstone with substantial shale interbeds in the lower part, and the two formations were ccnsidered to be conformable. After wider study of these units Balkwill (pers. com., 1973) suggests that the Kanguk Formation be restricted to marine shale, and that the base of the Eureka Sound Formation should be drawn at the base of the first important sandstone interval. Thus the Eureka Sound Formation, although a thick sequence of almost exclusively sandstone, would include at the base sandstone interbedded with marine shale.

On Fosheim Peninsula, Ellesmere Island, McMillan (1963a) reported that the Eureka Sound Formation contains at least one hundred layers of shale, each with sandstone beds at the base and overlain by underclay and coal. He regarded the repetition of such layering as the result of cyclical deposition.

On Bathurst Island, the Eureka Sound Formation comprises mainly shale and sandstone, with an interbedded andesite flow, and is present only as a small exposure in a graben (Sec. 40). The base is not exposed, but probably the formation rests unconformably on dolomite of the Devonian Disappointment Bay Formation; the top forms the present erosional surface. Outcrops in the report area were dated as Late Cretaceous (probably Maestrichtian) by Hills and Wallace (1969), and subsequently Hills (pers. com., 1973) stated that they are definitely Maestrichtian.

Distribution, thickness, and lithology. The Eureka Sound Formation occurs in the report area only as a north-dipping remnant in a downfaulted block at the head of Freemans Cove on southeastern Bathurst Island (Sec. 40, Pls. XIV and XV). At the base of the section (Pl. XIV), a few feet of coal contains whole tree trunks; the coal is overlain by white, medium- to fine-grained, uncemented quartz sand with stringers of brown lignitic shale. The next unit is composed of about 2 feet of tan, slightly feldspathic quartzose sandstone that contains leaves and stems of fossil plants. Above the sandstone is 15 feet of dark grey to black micaceous organic shale. A 10- to 20-foot thick unit of andesite lies above the foregoing succession, and in turn, is capped by several inches of yellow clay, 6 inches of black coal, and 5 to 10 feet of shale and sand (Pl. XV). Preservation of the formation on Bathurst Island is very limited, but evidence suggests that sedimentation there was of a cyclic nature in a paralic environment. Abundant marine dinoflagellates in the shales indicate marine deposition for those rocks. The sand intervals with plant remains and the coaly layers indicate either continental deposition or nearshore marine deposition.

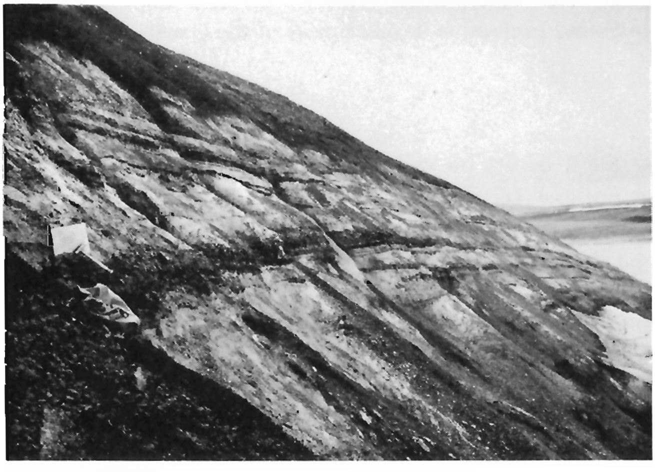
Age and correlation. On Bathurst Island, the Eureka Sound Formation has yielded abundant microflora and marine dinoflagellates from both above and below the interbedded volcanics (*see* Appendix, Sec. 40). These have been identified and dated by Hills (pers. com., 1973), who states that they are of Late Cretaceous, Maestrichtian age. In a sandstone



Kerr, 9-3-64

PLATE XIV

The Eureka Sound Formation at the head of Freemans Cove (Sec. 40) showing an interbedded andesite flow. The sediments in the background are shown in closeup on Plate XV, and dip beneath the flow and overlying sediments shown in the foreground. An intrusive plug stands above the surrounding terrain in the centre background.



Kerr, 9-4-64

PLATE XV

Lower part of the Eureka Sound Formation (Sec. 40) showing white sand and black shale, and the plant-bearing sandstone bed.

bed slightly lower in the section, plant megafossils were collected by Temple (GSC loc. C-4323, *see* Appendix). Dorf and Hickey (pers. com., 1970) state that this flora by itself indicates a Late Cretaceous or Early Tertiary age; however, because of the Late Cretaceous microflora slightly higher in the section they consider that this flora also is Late Cretaceous.

The Eureka Sound Formation of Axel Heiberg and Ellesmere Islands was regarded as Tertiary by Tozer (1963c), although it had earlier been described as Upper Cretaceous (?) and Tertiary (Tozer, 1963d, p. 92). Dating of the Eureka Sound Formation of Bathurst Island was the first conclusive evidence that the formation is in part of Late Cretaceous age (Kerr and Christie, 1965, p. 916). Rocks assigned to the formation on Griffith Island south of Resolute have been dated also as Late Cretaceous (Thorsteinsson and Kerr, 1968). Lower Tertiary sediments of the Eureka Sound Formation have been found on many of the Arctic Islands, including north of Intrepid Bay on western Cornwallis Island (Thorsteinsson and Tozer, 1960, p. 8) and, in places, such as on Ellesmere and Axel Heiberg Islands, they are several thousands of feet thick.

Because the outcrops on Bathurst Island are isolated geographically from the main body of exposures of the Kanguk and Eureka Sound Formations, there was some question as to which of these two formations the rocks should be assigned. The Eureka Sound Formation generally has been regarded as containing nonmarine rocks only, and being of Tertiary age. The Kanguk Formation, on the other hand, has generally been regarded as of Cretaceous age, and marine. Despite the predominance of shale, these rocks were assigned to the Eureka Sound Formation, for the following reasons. The formation almost certainly rests upon an angular unconformity, and the Eureka Sound Formation commonly does that elsewhere. The rocks are mainly marine shale interbedded with continental or nearshore marine sands, and are of Late Cretaceous (Maestrichtian) age. Balkwill and Hopkins (pers. com., 1973) report that mixed marine shale, and continental or marine sands of Maestrichtian age occur in the lower part of the Eureka Sound Formation of Amund Ringnes Island.

A volcanic flow interbedded in the Eureka Sound Formation of southeastern Bathurst Island indicates that volcanic activity was concurrent with sedimentation there in Late Cretaceous time. The source of this volcanic material may have been the dyke swarm nearby that is related to normal faulting. Thus the Eureka Sound Formation of Bathurst Island apparently was associated with igneous activity and faulting. Volcanics have not been observed interbedded with the Eureka Sound Formation in other parts of the Queen Elizabeth Islands.

Igneous Rocks

A swarm of basic dykes and plugs occurs on southeastern Bathurst Island, within the region of late Cretaceous and possible Tertiary normal faulting. The largest plug is approximately a quarter of a mile in diameter, but many are only a few tens of feet in size. Usually they are circular in plan and the dip is steep to vertical. The dykes, steeply dipping and commonly 2 to 3 feet wide, are closely associated with plugs, and commonly radiate out from them. The country rock, almost invariably dolomite of the Disappointment Bay Formation, shows little evidence of alteration except for a bleached zone a few feet wide.

Radiogenic age determinations using the whole rock K–Ar method were made of samples from two dykes (Wanless *et al.*, 1967, p. 53–54). Sample descriptions are by H. P. Trettin. The first determination (GSC 65–60) is from a small dyke at latitude 75°03′54″N, longitude 98°13′W, about 8 miles northeast of Bedford Bay. On aerial photograph A16203–87, the locality occurs 3.7 cm E and 0.2 cm N of the photograph centre. The rock is a dark (but light greenish weathering), massive to slightly vesicular keratophyre, consisting of microphenocrysts of clinopyroxene in a groundmass of feldspars, clinopyroxene, iron ore and some quartz. There is some alteration, but this is considered to be magmatic to early post-magmatic and therefore should not influence the age determination. An age of 48 ± 11 m.y. was obtained on this specimen. Wanless (pers. com., 1965) pointed out that the rock contains a large proportion of K-feldspar and is considerably altered. Thus it is not a suitable specimen for K–Ar age determination, and the "age" quoted is questionable. Age determination GSC 65–61 was made on a small dyke at latitude 75°10′48″N, longitude 98°15′W, 2 miles northwest of the head of Freemans Cove. On aerial photograph A16203–6, this point occurs 7.75 cm W and 9.15 cm N of the photograph centre. This sample is a light greenish grey keratophyre consisting of phenocrysts of clinopyroxene, iron ore, red-brown oxy-hornblende, orthopyroxene and sanidine, in a groundmass of plagioclase laths, clinopyroxene, iron ore, potash feldspar and quartz. It was assigned an age of 47 ± 8 m.y. (Wanless *et al.*, 1966, p. 54). A dyke that occurs a few miles northwest of Round Hill at latitude 75°13′N, longitude 98°27′W was dated by Geochron Laboratories for Imperial Oil Limited. The age determined was by the K–Ar method and is 60 ± 3 m.y. (de Mille, pers. com., 1971). The age determinations of 47 ± 8 and 48 ± 11 m.y. suggest an Eocene age according to the time scale of the Geological Society of London (1964, p. 260–262). The determination of 60 ± 3 m.y. that was reported by de Mille suggests a Paleocene age.

The flow interbedded in the Eureka Sound Formation at the head of Freemans Cove was confidently dated by Hills (pers. com., 1973) as Late Cretaceous (Maestrichtian) based on the microfloras that occur both above and below it stratigraphically. Independent evidence indicates that the igneous intrusives and flows are of similar age and may be part of the same episode of igneous activity. The discrepancy in age between the flows and dykes is not great, and may reflect unreliable radiogenic age datings due to rock alteration.

The close proximity of plugs and dykes to the flow interbedded in the Eureka Sound Formation and the closeness in ages suggest that the intrusions were feeders for the flow. On this line of evidence, the igneous rocks and faults of southeastern Bathurst Island are considered to belong to a tectonic event of Late Cretaceous to Tertiary age that was partly contemporaneous with deposition of the Eureka Sound Formation. Basic intrusions of the Bathurst Island group may be related to older basalts that Blackadar (1964) reported to intrude Mesozoic sediments of islands to the north and west in the Sverdrup Basin.

Summary of Basin Development

The evolutionary development of the Franklinian Miogeosyncline in the Bathurst Island group from Middle Ordovician through Late Devonian time can be divided conveniently into four broad phases as follows:

1. Until Late Ordovician time (pre-Ashgillian), there was widespread tectonic stability with the deposition of a platform facies of carbonate and evaporite (Cornwallis Group). Sedimentation kept pace with subsidence.

2. From Late Ordovician to Early Devonian time, relative tectonic stability continued to prevail, but circulation became restricted and a starved basin resulted. Subsidence exceeded sedimentation, and euxinic black graptolitic shales, shaly limestone, and chert of the Cape Phillips Formation were deposited.

3. In Early Devonian time, a period of considerable tectonic instability began; as a result the rate of sedimentation increased and overtook subsidence. This produced the Bathurst Island through Eids Formations. During this phase, the north–south trending Cornwallis Fold Belt developed as a topographic and structural high along the east coast of Bathurst Island. Two pulses of relative uplift exposed and denuded this high. After each period of denudation, the seas advanced and sediments were deposited unconformably on the eroded surface. Throughout this time, however, the Cornwallis Fold Belt remained a relatively positive feature.

4. In Late Devonian time there was even more marked increase in both the rate of subsidence and sedimentation. A great influx of sand occurred resulting in deposition of the Bird Fiord Formation and the Melville Island Group. Sedimentation exceeded subsidence in this phase, and was followed by uplift, emergence, and southward-directed folding of the Ellesmerian Orogeny.

This long evolutionary pattern of sedimentary development with its four broad phases, successively a platform facies, starved basin facies, flysch facies, and molasse facies, is very similar to successions in other Paleozoic geosynclines.

Chapter III

STRUCTURAL GEOLOGY

Pre-Permian rocks of the report area are deformed into two separate sets of folds, the east–west trending Parry Islands Fold Belt (Fortier and Thorsteinsson, 1953), and the north–south trending Cornwallis Fold Belt (Thorsteinsson, 1958). These intersect along the east side of Bathurst Island and their relationships were discussed by McNair (1961). The intersection resulted in some complicated and unusual structures (*see* Map 1350A and Fig. 11). The two fold belts are described separately, as is the intersection of the two where it is best exposed at Driftwood Bay and the Scoresby Hills. The factual descriptive treatment will be followed by an interpretation of the origin and structural history. Certain of the ideas which follow were suggested earlier by Temple (1965).

The folds of Bathurst Island developed very largely by concentric or flexural slip folding. By a study of the intersection of the fold belts on Bathurst Island it was possible to arrive at a single satisfactory solution that explains adequately the observed geometry in terms of movement and stress field in folds deformed by this mechanism.

Parry Islands Fold Belt

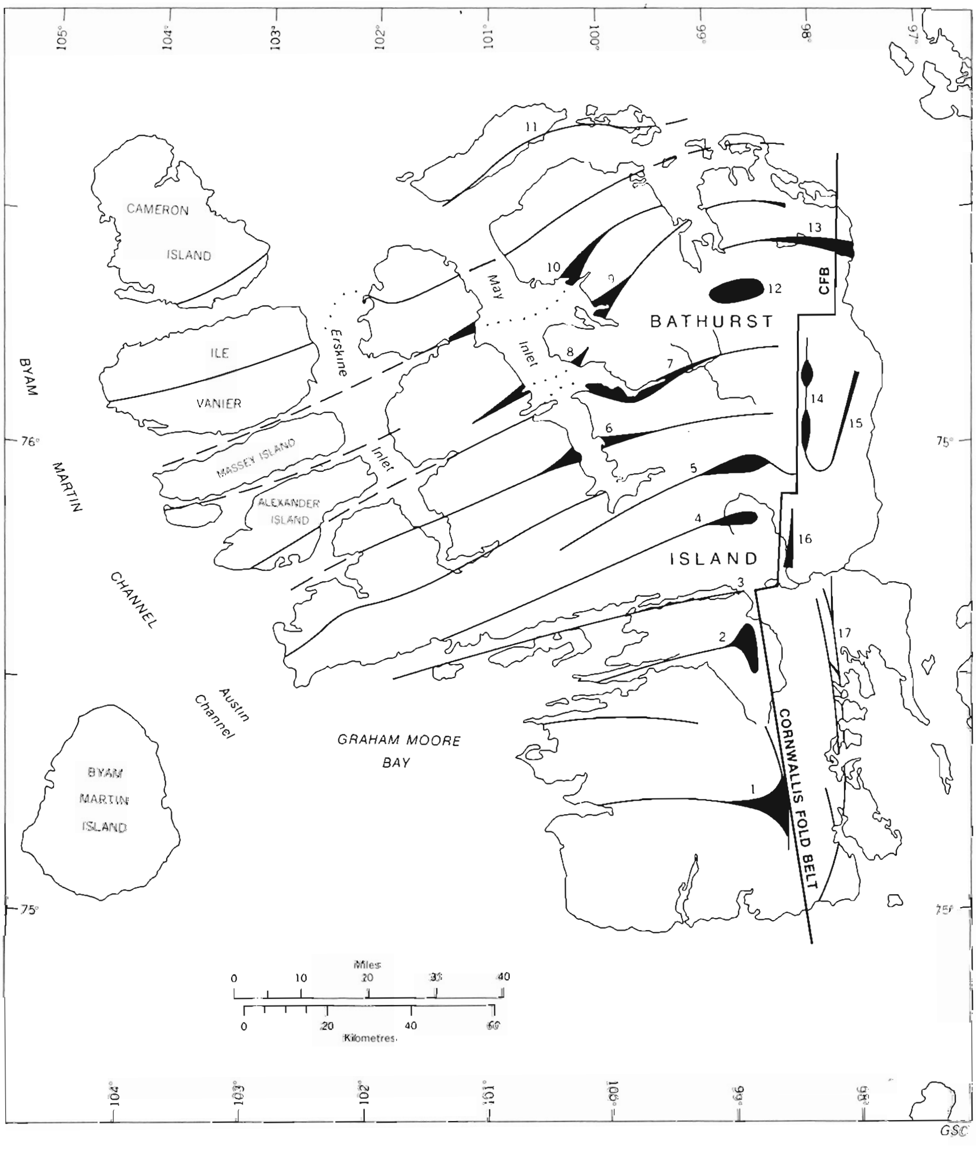
Introduction

The Parry Islands Fold Belt (Fig. 3), about 350 miles long, covers most of the Bathurst Island group and continues westward to include Byam Martin Island and most of Melville Island. Farther east, the Ellesmere–Greenland Fold Belt extends from Devon Island northeastward through Ellesmere Island to North Greenland, a distance of more than 600 miles. These two are similar and are part of a single fold system that is interrupted by the Cornwallis Fold Belt. The Parry Islands Fold Belt is at least 120 miles wide, for it covers the entire north–south extent of Bathurst Island. It probably is wider, for on the north and south it is covered either by younger sediments, or by sea.

The Parry Islands Fold Belt was deformed by a major orogeny that Thorsteinsson and Tozer (1970) named the Ellesmerian Orogeny. It probably varied in age somewhat from place to place. The youngest rocks beneath the unconformity are the Upper Devonian (Famennian) rocks of the present report area, whereas the oldest rocks above the unconformity are Middle Mississippian (Viséan) rocks of northern Axel Heiberg Island (Kerr and Trettin, 1962). The deformation of the Parry Islands Fold Belt that resulted from the Ellesmerian Orogeny is bracketed on Helena Island by an unconformity separating the Famennian Griper Bay Formation from the Lower Permian Belcher Channel Formation.

Description

The Parry Islands Fold Belt in the Bathurst Island group is a subparallel succession of anticlines and synclines that strikes east–northeast (Pls. III and XVI; *see also* cross-sections



1. Misty River anticline
2. Caledonian River anticline
3. Polar Bear Pass anticline
4. Bracebridge Inlet anticline
5. Dundee Bight anticline
6. Half Moon Bay anticline
7. Stuart Bay anticline
8. Thornton Point anticline
9. Purcell Bay anticline
10. May Inlet anticline
11. Helena Island anticline
12. Young Inlet dome
13. Green River anticline
14. Queens Channel anticline
15. Driftwood Bay anticline
16. Scoresby Hills anticline
17. Southeast Bathurst fault zone

FIGURE 11. Structural index map of the Bathurst Island group, showing major folds and faults mentioned in the text. The western step-like boundary of the Cornwallis Fold Belt is shown.

ABC, and DE, Map 1350A). Northeastward the folds gradually take a more easterly trend before the whole system terminates abruptly against the north–south striking Cornwallis Fold Belt. The geometry of individual folds in the Parry Islands Fold Belt varies considerably. Most are narrow and elongate and continue through the width of the island group, but some are dome-shaped and terminate abruptly. Some have sharp culminations along their axes, while others undulate only slightly and plunge more or less consistently to the west. The fold geometry varies also, depending on the level of beds exposed. The anticlines usually are asymmetrical; commonly the asymmetry changes from north to south along strike. Folds are more highly deformed in the northern part of the report area. The distance between anticlinal axes is remarkably uniform, being about 10 miles. Normal faults trend along the belt but their direction of dip varies. High angle reverse faults all strike east–west, and dip either north or south; however all but one of the thrusts dip north.

Several generalizations can be made about folds of the Parry Islands Fold Belt, despite the variations:

1. The folds are almost exclusively of the flexural slip type (Donath and Parker, 1964), characterized by uniformity of formation thickness. An exception occurs where the incompetent western facies of the Eids Formation is involved in folding. That facies was deformed by flexural flow, and is characterized by marked variations in formational thickness. In this latter the Eids is thickened in the axes of some folds and, in places, is thin or missing on the

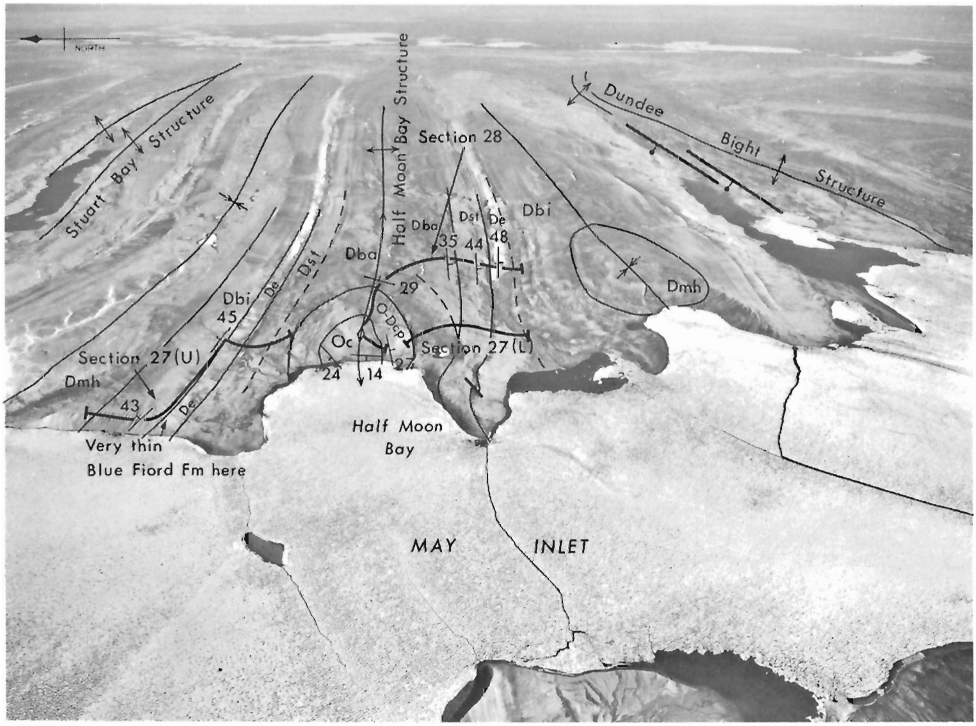


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PLATE XVI. View of the Parry Islands Fold Belt on north-central Bathurst Island, looking eastward from May Inlet along the Half Moon Bay structure. In centre foreground is a local dome that developed in the Bathurst Island and older formations; it is overlain unconformably by the Stuart Bay Formation. Formation symbols are those of Map 1350A. Section 27 (composite) occurs on the dome, and Section 28 off the flanks; both are described (see Appendix).

flanks. The formation acted as a layer of discontinuity between intensely folded beds below and less intensely folded beds above, this being particularly so in the Purcell Bay and May Inlet structures (Fig. 11).

2. Anticlines of the Parry Islands Fold Belt gradually increase in complexity northward. In the southern part of the Bathurst Island group the folds are relatively simple, but in the north they are so complex that it is only in gross geometry that they are anticlines at all. Northward they become multiple folds, evaporite intrusions appear, dips steepen, and faults are more numerous and more intense.

3. Two distinctive patterns of fold geometry are repeated in several structures; these are described in the following paragraphs. The first is a pattern exemplified by the Caledonian River, Polar Bear Pass, and Bracebridge Inlet structures (*see* Fig. 11 and Map 1350A). These are elongate, asymmetric, westward-plunging anticlines which flare out at their eastern ends, culminate in domes, and merge into north-trending structures of the Cornwallis Fold Belt. On the north flank of each of these three anticlines is a fault that begins in the west as a bedding plane fault in the soft facies of the Eids Formation. Presumably, all of these faults merge westward in a zone of flexural flow in the incompetent Eids Formation. Where they are bedding plane faults, they separate the gently dipping, mainly carbonate and sandstone beds of the syncline to the north from the more steeply dipping shale and siltstone beds of the anticlinal core to the south. Traced eastward, these faults abruptly cut across formations, cutting down into older units and terminating in the domes.

Another distinctive pattern is that of double anticlines, exhibited in four structures farther north: the Dundee Bight, Stuart Bay, Purcell Bay, and May Inlet anticlines (Fig. 11 and Map 1350A). Although deformation increases in intensity northward, these all have very similar gross geometry.

The southernmost of these, the Dundee Bight anticline, is composed simply of two parallel anticlines that start from two small, west-plunging anticlines at Driftwood Bay and continue to the west for at least 40 miles. Both folds die out westward against a system of east–west striking faults with relative down-throw on the north side. Another anticline *en echelon* with the Dundee Bight anticline continues westward to the end of the island.

The Stuart Bay anticline also is composite east of Erskine Inlet, where it includes two anticlines separated by a narrow faulted syncline. Essentially, there are two large anticlinal limbs with a contorted axial zone depressed between them.

The Purcell Bay anticline is a broad, complex structure broken by faults and having an intrusive evaporite core. It includes two and locally three parallel anticlines separated by sets of oppositely directed reverse faults with a common depressed footwall. The central part of the structure contains a network of faults that have broken the Silurian and Devonian shales and siltstones into narrow, tight folds and steeply dipping blocks. Each pair of faults embraces an anticline. The intrusive evaporitic core consists of diapiric gypsum with a limestone caprock (Pl. II). To the north, the Purcell Bay anticline is bounded by a fault and an anticline; to the south, it is bounded by a fault and by rocks dipping towards it. This indicates collapse probably by removal of an evaporite core by solution. The southern limb rolls over and dips north before being broken by a large east–west striking reverse fault that has a dip separation of several thousand feet. A large reverse fault forms the southern boundary of the northern sequence. On the northern side, the soft Eids Formation contains a steep dip-slip bedding plane fault. The Purcell Bay structure plunges both east and west, and the faults die out in both directions. East of Young Inlet, it is a relatively simple anticline. Westward on the east shore of May Inlet the structure plunges suddenly and apparently does not continue west of the inlet.

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PLATE XVII. Oblique aerial view of the May Inlet structure on northern Bathurst Island, illustrating relationship of diapirism to faulting. View westward toward May Inlet. Symbols are those of Map 1350A.

The May Inlet anticline exposes diapiric gypsum about 3 miles southwest along the strike from cross-section ABC (*see* Map 1350A). This structure consists of a pair of anticlines that are separated by diapiric gypsum in the east and by a thrust fault farther west. Near the point where the forelimb of the fold breaks and begins to ride out southward over younger sediments, a southeast-striking transverse fault begins, at right angles to the thrust (Pl. XVII). This is either a normal fault with the west side down or, more probably, a left lateral wrench fault. Extremely contorted diapiric gypsum–anhydrite occurs west of this fault. The May Inlet structure continues as a thrust west of May Inlet, where it brings Thumb Mountain Formation to the surface and exposes sheared gypsum–anhydrite along the fault trace.

Genesis

Workum (1965) outlined a developmental history of the various kinds of structures in the Parry Islands Fold Belt in the Bathurst Island group and was the first to suggest that a décollement occurred in lower Paleozoic evaporites. The present writer concurs with many of Workum's ideas and conclusions. The following is a developmental history of Parry Islands folds (Fig. 12), and includes considerable paraphrasing of Workum, with certain reinterpretation.

The oldest rocks reported to date in the Bathurst Island group are the evaporites, mainly halite, in the well that was drilled in the Caledonian River dome (Sec. 38). The evaporites, which are regarded as the Bay Fiord Formation, contain the zone of décollement. The nature of the structure beneath these evaporites is unknown. It is probable that the Eleanor River and Baumann Fiord Formations, which are exposed on Cornwallis Island (Thorsteinsson and Kerr, 1968), are present deep in these structures, and may be folded into more gentle structures than are the exposed rocks of the map-area.

A typical column of Ordovician to Upper Devonian rocks in the Parry Islands Fold Belt on Bathurst Island is shown (Fig. 12a). This column does not contain unconformities, except locally, between the Bathurst Island and Stuart Bay Formations. An unconformity has been documented at only one locality, and that is at Half Moon Bay where a local dome developed in Early Devonian time and is overlain conformably by the Stuart Bay Formation. This probably resulted from salt and evaporite flowage that occurred in Early Devonian time. Other such local unconformities may be present in the subsurface. This may have been initiated by an intra-Early Devonian folding which produced the northerly trends of the Cornwallis Fold Belt. Thus weak northerly trends probably were produced within the Parry Islands Fold Belt at this same time.

The predominant structures of the Parry Islands Fold Belt were formed by younger north to south compressional events and trend east–west. The first of these episodes was in post-Late Devonian, pre-Middle Pennsylvanian time, and a later one was of Late Cretaceous or Tertiary age. It has not been possible to separate the effects of these two north–south compressional episodes, for they apparently are coincident in structural trend, with the second amplifying the first. The following developmental history is proposed, and it spans the two deformational episodes.

With the beginning of compressive stress, the section overlying the salt was gently folded (Fig. 12b). Salt flowage is thought to have begun almost as soon as folding was initiated. All units but the Eids Formation were folded by a flexural slip mechanism, the Eids being folded by a flexural flow mechanism. Thinning of the Eids is most extreme on the back or north limbs, where locally it was thinned to zero or faulted (Fold A, Fig. 12b). Faults on back limbs that have allowed the Eids to be thinned to zero are seen in the May Inlet, Purcell Bay, Stuart River, and Bracebridge Inlet structures.

As lateral compression continued, salt flowage was accentuated (Fig. 12c). Competent units were folded concentrically, while the less competent Eids Formation yielded to flow, with thinning and secondary folds developing within it. Tectonic thinning was not observed in the Cape Phillips Formation and probably was not significant. Although it contains substantial shale and thin-bedded limestone, the Cape Phillips Formation is much harder and more strongly lithified than the Eids Formation. As compression continued, the evaporites migrated into the axes of the folds and began to intrude upward. In Fold A (Fig. 12c), a discrete plug began to ascend as a diapir. Where amplitudes of the folds were less extreme, diapirism was minor, but still normal faults developed along the crest of some anticlines (Fold B, Fig. 12c). In these stages because of the developing salt cores, the anticlines became narrower and more compressed than the intervening synclines.

As salt flowage continued, some of the anticlines developed high angle strike faults along their crests through which evaporites were leached out. This allowed collapse of the overlying strata (Fold B, Fig. 12d), with a resulting pair of anticlines separated by a fault. The Stuart Bay structure is now in this stage. Where deformation was more extreme and a

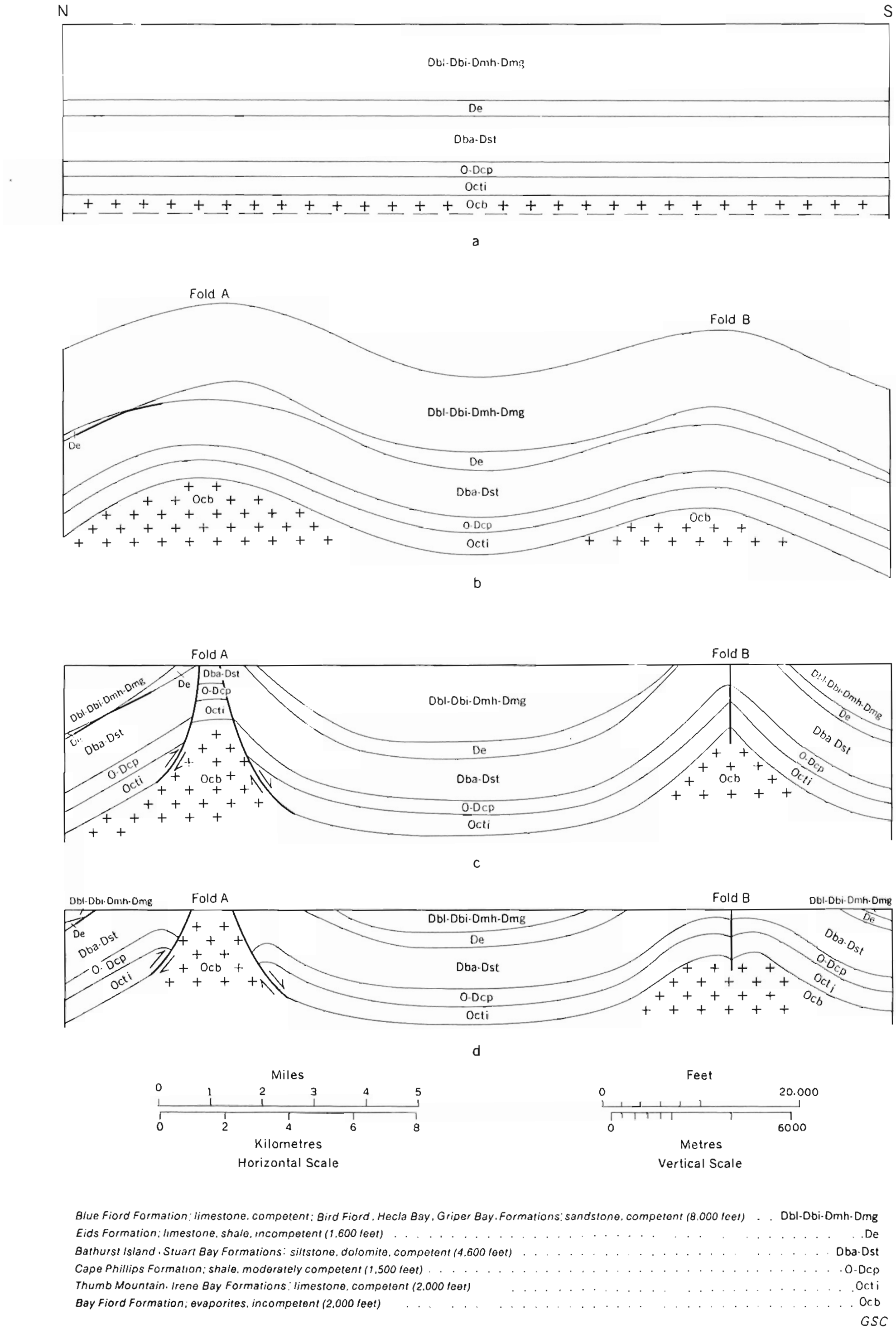

FIGURE 12. Structure cross-sections showing the hypothetical development of folds of the Parry Islands Fold Belt in the Bathurst Island group (see Fig. 3).

discrete diapir developed, leaching of the evaporitic core resulted in collapse and down-buckling of the overlying formations to produce a pair of flanking anticlines (Fold A, Fig. 12d). This situation represents the present Purcell Bay anticline. Where still more folding occurred subsequent to this stage, thrust faults developed. Such a thrust is present within the evaporitic core of the May Inlet structure west of May Inlet. This fault dips northerly.

Cornwallis Fold Belt

The Cornwallis Fold Belt extends from the Central Stable Region northward across the trend of the Franklinian Miogeosyncline (Kerr and Christie, 1965). North of Parry Channel, the fold belt is about 90 miles wide (Fig. 3) and extends eastward from eastern Bathurst Island to include most of Grinnell Peninsula and all of Cornwallis Island. South of Barrow Strait, it is a band of deformed sediments flanking both sides of the Boothia Uplift, in part separated from the uplift by faults. The inner boundary of the fold belt and the outer boundary of the Boothia Uplift are arbitrarily defined where the sedimentary cover is folded or faulted against the Precambrian crystalline rocks. The Cornwallis Fold Belt is a folded sedimentary cover draped over the Boothia Uplift, and not only flanks the uplift south of Barrow Strait, but also continues northward beyond it. The structure of this belt represents the response of the sedimentary cover to the deeper uplift.

Part of the fold belt occupies eastern Bathurst Island where it contains parts of four well-defined, northerly trending anticlinal structures. They occur *en echelon*; the more easterly ones extending farther north. The western boundary is at the line of culminations or domes that are at the intersection of the Cornwallis Fold Belt with the Parry Islands Fold Belt (Fig. 11). The boundary is drawn to include in the Cornwallis Fold Belt those areas where the predominant trend of structures is northerly. Thus it includes the eastern flanks of the Misty River structure and the Caledonian River structure in the south. Farther north it includes the Scoresby Hills structure, Queens Channel structure, and the Driftwood Bay structure.

Gentle northerly trends that produced Young, May, and Erskine Inlets farther west on Bathurst Island lie far west of conspicuous surface expression of the Cornwallis Fold Belt. These trends may be related to the Cornwallis Fold Belt, but structures occurring along them are largely obscured by a younger east–west trend. Thus the areas where these inlets lie are included in the Parry Islands Fold Belt, for the east–west trend is dominant.

The Cornwallis Fold Belt is a faulted anticlinorium with abrupt margins. Steeply dipping anticlines at the western margin of the belt on eastern Bathurst Island are asymmetrical toward the west, and one of these, the Queens Channel structure, is locally overturned to the west. The western margin also is faulted substantially. Tightly folded, north–south trending anticlines and associated faults in the fold belt are parallel with the overall trend of the fold belt itself. The asymmetrical structures at the western margin align with the reverse fault, uplifting the crystalline basement to form the Boothia Uplift south of Barrow Strait. It is probable that reverse faults uplifting the basement caused the fold belt to develop in the overlying zones. South of Barrow Strait, the thin limestone cover reacted to reverse faulting of the basement by reverse faulting and flexure. North of Barrow Strait, a thick column of limestone, dolomitic limestone, evaporites, and shale probably contains fault displacement in lower parts that decreased toward the surface and changed to distributed flow in the evaporites and other weak horizons. The result in this area is that asymmetrical folds rather than faults are predominantly at the surface.

Overall uplift of the Cornwallis Fold Belt is demonstrated by the unconformities that occur within it, and by the fact that it periodically provided a source of sediments. Where they can be dated, the pulses of the uplift and times of inundation coincide with similar activity of the Boothia Uplift (Kerr and Christie, 1965). On Bathurst Island, two periods of relative uplift occurred in Early Devonian time and one in Late Devonian time. These produced the northerly trending folds.

Several north-trending zones of normal faults occur in the Cornwallis Fold Belt of eastern Bathurst Island. The Eureka Sound Formation is cut by the southeast Bathurst fault zone, so an Upper Cretaceous or younger faulting episode is substantiated. It is not known whether the faults of that zone were partly or wholly developed at earlier times. It seems most probable that at least some of the faults now exposed at the surface in the Cornwallis Fold Belt of eastern Bathurst Island are the result of reactivation of deeper basement faults.

Intersection of the Parry Islands and Cornwallis Fold Belts

This intersection is exposed for about 100 miles along eastern Bathurst Island. Two areas of exposure are particularly instructive for unravelling the structure of both belts: the Scoresby Hills and west of Driftwood Bay. Both are described below.

Scoresby Hills Area

The Scoresby Hills anticline, about 8 miles west of Goodsir Inlet, is a north-striking structure at the western margin of the Cornwallis Fold Belt. Two Lower Devonian deformations of this fold belt are documented by unconformities on this anticline. One occurred between deposition of the Bathurst Island and Stuart Bay Formations, and the other between deposition of the Stuart Bay and Disappointment Bay Formations (*see* Fig. 5). The Cornwallis Group and the Cape Phillips and Bathurst Island Formations are exposed in the core of the anticline, which is asymmetrical with the steep flank to the west. Two younger sequences that lie above and that are bounded by unconformities are less intensely deformed, the higher one being the least deformed. On the south, the Scoresby Hills anticline is cut off abruptly by a prominent east–west trending lineament which is probably a fault trace. An oblique aerial photograph of the Scoresby Hills anticline (Pl. XVIII) shows the structural relationships at the intersection of the fold belts, and a restored section (Fig. 5) shows the stratigraphic relationships. The Scoresby Hills anticline, asymmetrical and with the steep flank on the west, formed during three pulses of deformation which are dated by unconformities. It probably was caused by uplift of the underlying Precambrian basement. The anticline is presumed to drape over a steep basement fault in which the east side was uplifted and at high levels thrust slightly westward. An analogous uplifted structure has been documented farther south on the edge of the Boothia Uplift, and is in alignment with the Scoresby Hills anticline (Kerr and Christie, 1965, Fig. 3).

Driftwood Bay Area

The composite structure in the Driftwood Bay area presents a complicated array of folds and faults radiating in several different directions (Map 1350A). A northerly trending synclinal structure is bounded on the west by a northerly striking structure called the Queens Channel anticline, and on the east by a complicated breached anticline called the Driftwood Bay structure (Fig. 11). They are linked on the south by an east–west striking overturned anticline. Lower Devonian facies relationships indicate that these structures were approxi-

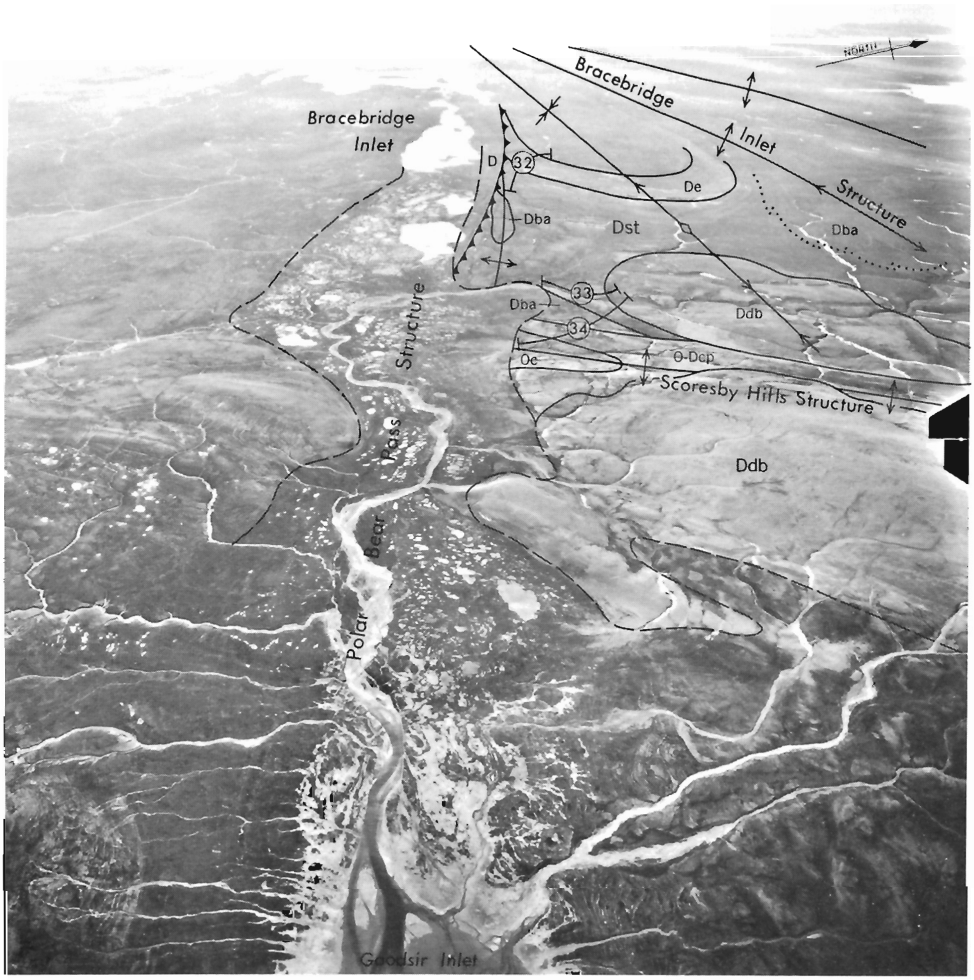

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PLATE XVIII. Oblique aerial view of the Scoresby Hills structure, showing the intersection of the Cornwallis and Parry Islands Fold Belts. Sections 32, 33, and 34 shown by number are illustrated (Fig. 5), and described (see Appendix). Formational symbols are those of Map 1350A.

mately contemporaneous in development with the Scoresby Hills anticline. These folds all are part of the Cornwallis Fold Belt and developed earlier than the intersecting Parry Islands Fold Belt.

Several folds of the Parry Islands Fold Belt meet the Queens Channel anticline approximately at right angles; these are the Dundee Bight, Half Moon Bay, and Stuart Bay anticlines, all of which are interrupted and do not continue farther east. The Queens Channel structure thus has anticlinal culminations where it is intersected by anticlines of the Parry Islands Fold Belt. At its junction with the Stuart Bay anticline, the Queens Channel anticline widens in a culmination, with overturning to the west. A steep to vertical fault occurs along the crest, but dies out southward. The eastern termination of the Half Moon Bay anticline is similarly marked by a slight widening of the north–south structure which is the surface expression of a local culmination. The intersection with the Dundee Bight structure is more complex and here two tight folds plunge westward. The Cornwallis Group and parts of the Cape Phillips Formation of the Queens Channel anticline are here overturned to the west. On its southern end the Queens Channel structure bends sharply to the east, breaks along a small fault, and continues east as a tight, almost isoclinal, overturned fold whose axial plane dips north at about 50 degrees. The fold abruptly abuts the Driftwood Bay fault striking a few degrees east of north and continues for about 20 miles to the north as the Driftwood Bay structure, a breached anticline. Northward, the western flank of this structure is cut off by another fault which strikes oblique to the Driftwood Bay fault and ends against it. Between the two is a graben of younger rocks of the Upper Devonian Griper Bay Formation. East of the fault, Devonian beds also have a regional strike parallel to the fault and generally dip gently away from it toward the sea.

The Driftwood Bay fault is a key to the interpretation of structure at the intersection of the fold belts. Vertical movement has taken place along it as shown by displacement of stratigraphic units; however, the sense of vertical movement differs along the strike. For most of its length, rocks on the west have moved up relatively in the south and down in the north. In the south, the Driftwood Bay fault ends in an overturned east–west trending fold; however, it probably continues into a nearby parallel fault farther south. In the north, a graben is adjacent to and west of the Driftwood Bay fault. The structural pattern strongly suggests that this fault is primarily a left lateral strike slip fault, and that much of the vertical displacement across it is the result of strike slip movement.

The following interpretation is proposed for the area of intersection of the Cornwallis and Parry Islands Fold Belts in the Driftwood Bay and Scoresby Hills areas (Fig. 13). Early deformation had resulted in three north–south striking *en echelon* folds of the Cornwallis Fold Belt (Fig. 13a). In the north, in the Driftwood Bay area, were two anticlines, at least one plunging to the south. Farther south a third anticline plunged north. The area between apparently remained less folded. As pointed out earlier, these early folds probably developed in response to basement uplifts. In the Parry Islands deformation a new stress pattern existed (Fig. 13b), with the principal compressive stress oriented north–south. This produced the Parry Islands Fold Belt in the west, where no substantial folding had occurred before. The west flank of the Queens Channel anticline thus was refolded and shortened along an axial fault; however, the east flank apparently was not shortened significantly. The east flank was part of the Cornwallis Fold Belt, which acted as a buttress; deformation within it diminished eastward. Ruptures took place within the western part of the belt along pre-existing lines of weakness parallel to structure.

An allochthonous block west of the main Driftwood Bay fault, which included the Queens Channel anticline, moved to the south as a single unit relative to the autochthonous block to the east. The southern end of the allochthonous block rolled up into an overturned east–west fold (Fig. 14b). The tight folds and wrench faults in front of the major overturned fold may be the result of the couple arising from the two northern anticlines moving toward the south (Fig. 13). The graben containing the Griper Bay Formation north of Driftwood Bay, shown in the northern part of Figure 13, is located where the Driftwood Bay fault curves. This graben probably is the result of extension during left lateral offset of the allochthonous block.

The entire Queens Channel anticline and the folds of the Parry Islands Fold Belt to the west of it comprised part of the allochthonous block that moved relatively southward. Shortening in a north–south direction took place within this block. The Queens Channel anticline acted as a line of juncture, separating a region to the east, which did not develop east–west folds, from a region to the west where such folds developed prominently. The

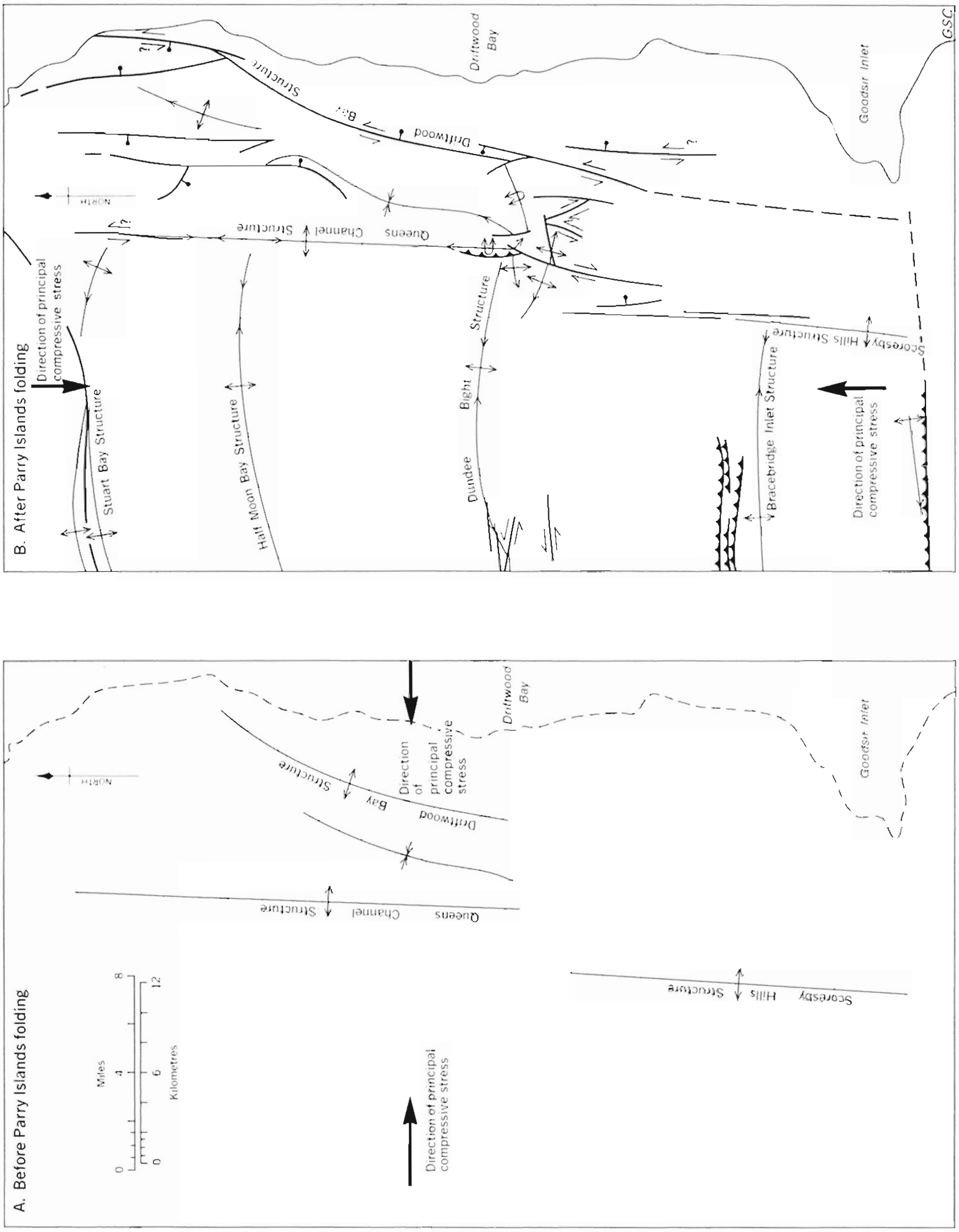

FIGURE 13. Development of structures at the intersection of the Cornwallis and Parry Islands Fold Belts, northeastern Bathurst Island.

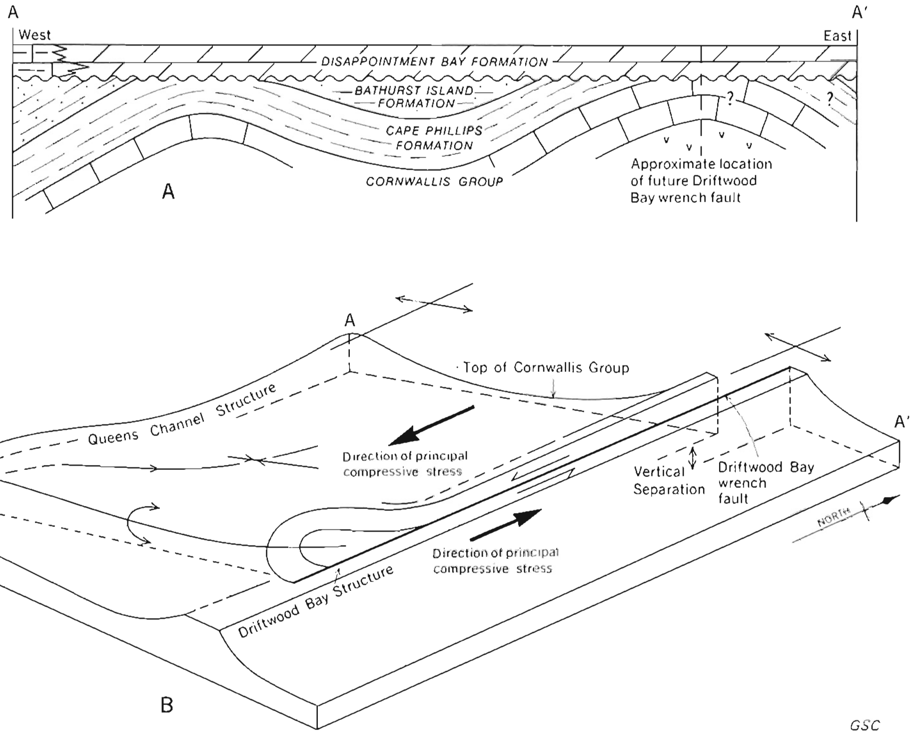

FIGURE 14. Schematic diagrams showing development of the Driftwood Bay and Queens Channel structures; (A) cross-section before wrench faulting, (B) oblique view after wrench faulting. The Driftwood Bay wrench fault has had left lateral separation, and the west block was raised relative to the right block.

shortening on the west side was accomplished by development of the Parry Islands Fold Belt. This shortening was the cause of the peculiar culminations on the Queens Channel anticline.

The several culminations on the Queens Channel anticline are located at the intersection of that structure with Parry Islands Fold Belt anticlines. The intersection with the Stuart Bay anticline (Fig. 15) shows the mechanism of formation of these culminations. The Queens Channel anticline was the westernmost fold of the Cornwallis Fold Belt in this latitude. As such, it marked the boundary between rocks to the west which would yield readily to folding by a north–south compression and those to the east which would not. The axis of the Queens Channel anticline became the locus of left lateral transcurrent movement, producing several anticlinal culminations. At the intersection with the Stuart Bay anticline a fault developed, presumably with left lateral offset (Fig. 15). At the intersection with the Half Moon Bay anticline, only folding occurred. The very tight folds south of the area of intersection with the Dundee Bight anticline presumably resulted from this same mechanism. It appears that the undeformed rocks on the west were folded readily by the late Paleozoic north–south stresses to form the Parry Islands Fold Belt, but folds of the Cornwallis Fold Belt could not be refolded, except for a small strip on the western flank.

This lack of further deformation of the north–south folds is readily understandable when it is recalled that movement within a concentric or flexural slip fold is confined to planes of

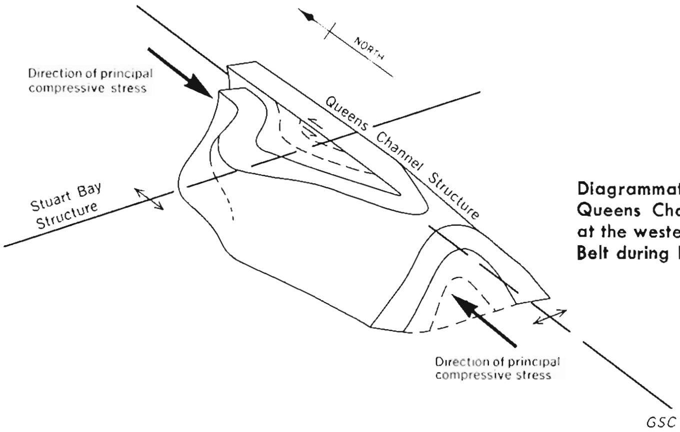

FIGURE 15

Diagrammatic sketch of intersection of the Queens Channel and Stuart Bay structures at the western margin of the Cornwallis Fold Belt during Parry Islands folding.

anisotropy along bedding planes. After a first folding, the extent to which additional movement can take place along the bedding planes depends on (a) the tightness of the original fold, (b) the competence of the rocks involved, and (c) the angle between the original and the new stress directions. Relatively tight folds composed of competent strata would tend not to refold, at least by flexural slip, in reaction to a principal stress imposed parallel to the axes of the pre-existing folds. This apparently happened on eastern Bathurst Island, where folds of the Cornwallis Belt acted as a buttress to the later folding, and strata within it were not folded to the same extent as the previously unfolded strata to the west. Assuming that the same north–south external stresses were applied everywhere in the region, then the relatively unfolded area to the west yielded much more readily. Of course, there may have been gentle north–south folds along the sites of the present Erskine and May Inlets as suggested earlier; however, these probably were very gentle undulations and could have been refolded along the new trend.

The mechanics of movement outlined above require a décollement beneath the entire area west of the Driftwood Bay fault, with the western block moving south relative to the eastern. The Queens Channel anticline lies entirely within an allochthonous block and it forms a zone of small differential movement within that block. The rocks west of the Queens Channel anticline migrated farther south than those on the east. The most likely plane of detachment for the décollement is within evaporites of the Bay Fiord Formation.

South of the Driftwood Bay area, the intersection of the Parry Islands and Cornwallis Fold Belts may have the same general pattern as described above. This is very tentative, however, because of the widespread Quaternary cover. Two northerly striking faults that begin southeast of the Driftwood Bay fault (Map 1350A and Fig. 13) also may be left lateral wrench faults. The prominent east–west lineament through Polar Bear Pass that cuts the Scoresby Hills anticlines (*see* Pl. XVIII) could very well mark a thrust along which that north–south structure also has moved some distance southward. It then could be expected to connect with the supposed wrench faults to the east (Fig. 13).

Southeast Bathurst Fault Zone

The Southeast Bathurst fault zone, containing steep to vertical northerly striking faults, extends for about 50 miles from the Polar Bear Pass region to the southern extremity of

Bathurst Island. This complexly interlocking fault system is not yet entirely understood but it probably had at least two and possibly three periods of deformation.

The earliest deformation that can be shown with certainty by the distribution of formations in the immediate area was in post-Hecla Bay – pre-Eureka Sound time. Cretaceous sediments with intercalated volcanics at the head of Freemans Cove lie unconformably on the Disappointment Bay Formation. It is probable that the Hecla Bay Formation was deposited there and eroded prior to deposition of the Eureka Sound Formation, for it is known to be present just a few miles to the north, west of Daniell Point. Farther north (Pl. XIX) to the west of the main fault zone, the Disappointment Bay Formation is widely exposed and is deformed very little. The most probable time of this pre-Eureka Sound deformation would be as part of the post-Devonian, pre-Middle Pennsylvanian orogeny which produced the Parry Islands Fold Belt. The Southeast Bathurst fault zone has had well-documented vertical movements, but probably also was a zone of wrench faulting during the Parry Islands folding. The theory that wrench faulting occurred is based on the zone being aligned with wrench faults at Driftwood Bay and being near the western margin of the Cornwallis Fold Belt. It is not

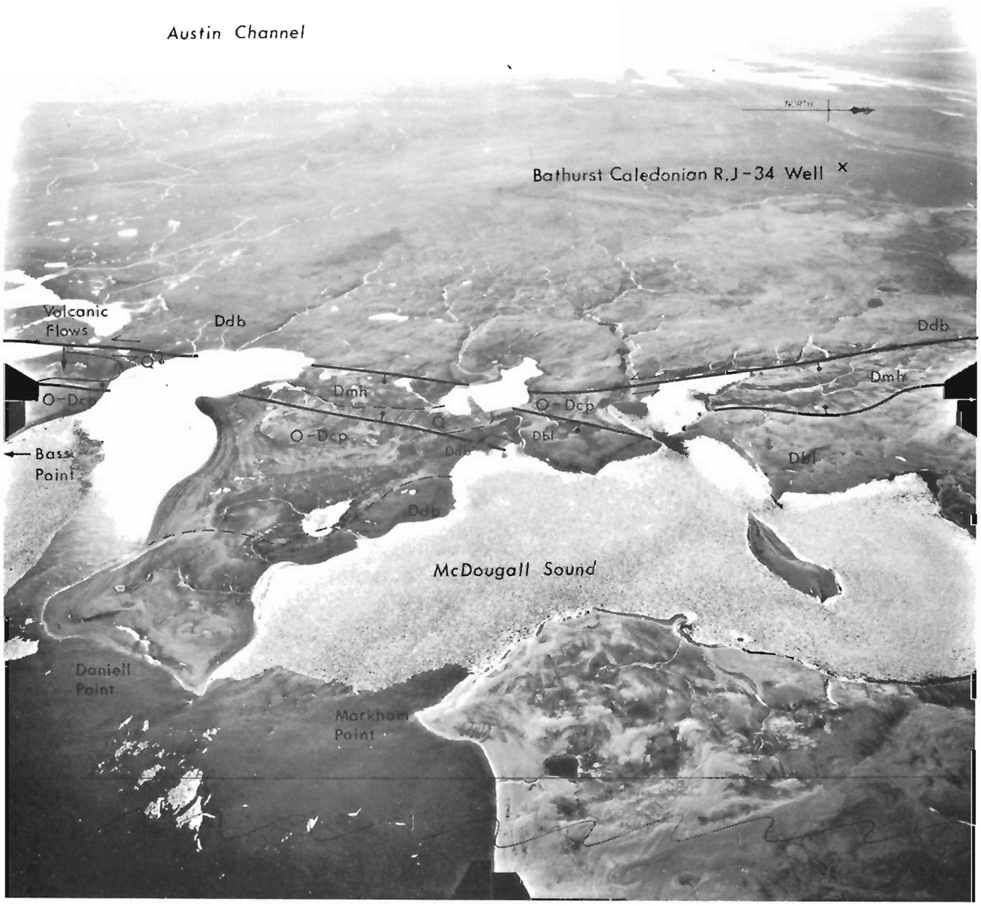

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PLATE XIX. Oblique aerial view of the Southeast Bathurst fault zone, looking westward. In the right background is the site of the Bathurst Caledonian R. J-34 well, at the apex of the Caledonian River dome.

possible to determine from exposures south of Polar Bear Pass whether the Southeast Bathurst fault zone had an element of wrench faulting, but there is no evidence that it did not. Thus, in the post-Late Devonian, pre-Middle Pennsylvanian orogeny, the Southeast Bathurst fault zone was probably a continuation of the more northerly wrench fault system, marking the eastern boundary of a major décollement.

An important deformation of the Southeast Bathurst fault zone occurred in Late Cretaceous time and probably continued also in Tertiary time. This episode included the formation of a major graben containing rocks of the Eureka Sound Formation. Igneous plugs and dykes in certain faults of the zone are essentially synchronous with flows that are interbedded in the Eureka Sound Formation. Thus faulting occurred simultaneously with deposition, and subsequently was recurrently active. This deformation was part of an orogeny of Late Cretaceous and Tertiary age that was widespread in the Canadian Arctic Islands.

The three pulses of Devonian uplift described earlier, which produced the Cornwallis Fold Belt, probably affected southeastern Bathurst Island and gave rise to a northerly structural trend. These Devonian uplifts are known to have produced the northerly grain of northeastern Bathurst Island and of eastern Prince of Wales Island to the south of the report area. There may have been faulting of parts of the Southeast Bathurst fault zone at that time, but this could not be shown from surface mapping. It seems certain that the fault zone was located along the earlier trends.

Interpretation of the Parry Islands Fold Belt

Strong evidence exists that the Parry Islands Fold Belt and western parts of the Cornwallis Fold Belt north of Polar Bear Pass are underlain by a décollement. Those parts of the Parry Islands Fold Belt farther west, to the north of Bracebridge Inlet, are underlain also by this décollement. The décollement probably affected the region south of Polar Bear Pass and Bracebridge Inlet as well, but there the evidence is less conclusive. In this latter area, a décollement is suggested by the thickened evaporites in the core of the Bathurst Caledonian R. J-34 well, and by the fact that the Parry Islands folds south of Bracebridge Inlet appear to be a continuation of those to the north. These folds become less compressed in southern Bathurst Island indicating that displacement on the décollement diminished in the south.

From geometrical considerations, it is known that concentric folding cannot continue downward indefinitely, but must be underlain by a plane of detachment. Evaporites of the Bay Fiord Formation, mainly halite, probably acted as the zone of detachment for the folding in the entire Parry Islands Fold Belt in the report area. These evaporites apparently occur beneath the entire report area, for they are present in the Caledonian River dome, as well as in the Purcell Bay and May Inlet anticlines 60 miles farther north. Evaporites assigned to the Bay Fiord Formation also outcrop widely on Cornwallis Island (Thorsteinsson and Kerr, 1968).

Interpretation of foreland fold belts has been split into two opposing schools of thought, which differ on the origin of the deformation. These are respectively the "basement" and "no-basement" hypotheses (Rodgers, 1964) that have used the Appalachian region as the main area of discussion. The first school of thought holds that the deformation originated at great depth and was transmitted upward. The other holds that the deformed rocks have been stripped completely off a rather undeformed basement and transported as an allochthonous block along one or more great bedding-plane thrust faults. The term basement as used in the "no-basement" hypothesis includes sedimentary rocks and refers to all the rock beneath the supposed décollement. Rodgers (1964) outlined how the structure of the Appalachians supports the "no-basement" hypothesis, and that hypothesis was elucidated and supported by Gwinn (1964). A décollement does not necessarily mean, however, that the rocks beneath it are not involved in the folding; it means only that the structures in the sub-décollement rocks did not cause the structures above, and that the geometry below and above the plane of décollement will be different. The "basement" hypothesis, put forth by Lees (1952) and Cooper (1964), holds that the structures observed in foreland fold belts resulted mainly from vertically acting tectonic forces originating in the basement that operated over a long period of time including much of the time during which the sediments were deposited.

The Parry Islands Fold Belt formed as a superficial phenomenon above a plane of décollement in the manner outlined by Rodgers (1964) and Gwinn (1964). The structure at the intersection of the Parry Islands and Cornwallis Fold Belts leads to the conclusion that the Parry Islands Fold Belt is a true cover phenomenon with little or no accompanying folding necessary in the rocks underlying the décollement. The most important piece of evidence that the sub-décollement rocks remained relatively undisturbed during the folding process is that the Parry Islands Fold Belt does not continue beyond its juncture with the Cornwallis Fold Belt. If the east–west folds were controlled by deep-seated deformation below the décollement, surely its influence would be seen east of the intersection. The east–west trend of structures in the décollement constituting the Parry Islands Fold Belt is clear evidence that the principal compressive stresses were aligned north–south. The structures have greater amplitude in the north and die out southward, indicating that the compressive stresses were more intense in the north, and suggesting that there was mass movement of the décollement that was indicated at the intersection of the fold belts west of Driftwood Bay.

Theories of origin of thin-skinned deformation have been discussed extensively ever since the classic work of Buxtorf on the Juras. Most modern theories favour a mechanism of gravitational gliding, initiated either by compression (Bucher, 1955), or simply by detachment and sliding from topographically higher areas (Kehle, 1970). Decreased friction along a plane of shear is now considered to facilitate sliding. Mechanisms for decreasing this friction include abnormally high fluid pressures (Rubey and Hubbert, 1959), and the transformation of gypsum to anhydrite plus water (Heard and Rubey, 1963). The folds of the Parry Islands Fold Belt in the present study area appear to have formed by a gravitational mechanism that may not involve rocks beneath the décollement. Little can be added to clarify whether the initiation of gliding was by compression or by uplift to the north, because the critical source area to the north is covered either by water or by thick sediments of the Sverdrup Basin.

Deformation of the Parry Islands Fold Belt in the Bathurst Island group may be attributed to one or both of two deformations that are documented in the report area. These are the deformations bracketed there by the Upper Devonian Griper Bay Formation and the Lower Permian Belcher Channel Formation, and the post-Eureka Sound deformation. The earlier deformation is part of the Ellesmerian Orogeny of Thorsteinsson and Tozer (1970), and the younger one is part of their Eurekan Orogeny. In the two places where the earlier unconformity is exposed in the map-area, Helena Island and Cameron Island, angular discordance is slight. This situation by itself would suggest that the Ellesmerian Orogeny was mild in the report area. On Melville Island, however, it produced the severely deformed Parry Islands Fold Belt. The writers consider that the main deformation producing the Parry Islands Fold Belt in the report area took place during the Ellesmerian Orogeny, and that post-Eureka Sound deformation of the belt was of less consequence.

Interpretation of the Cornwallis Fold Belt

The Cornwallis Fold Belt reflects movements of the underlying basement as earlier described by Kerr and Christie (1965). A northerly trending, horst-shaped salient of Precambrian igneous and metamorphic rocks, the Boothia Uplift, which lies to the south of the Bathurst Island group, has risen relatively as much as 10,000 feet above the general basement level during several pulses of activity. The western boundary of the uplift is a zone of steep, north-trending normal faults which, at high levels, become reverse faults and thrust Precambrian crystalline rocks onto the Paleozoic sedimentary formations. The western edge of the Boothia Uplift aligns with the Cornwallis Fold Belt on eastern Bathurst Island (*see* Fig. 3). An Early Devonian unconformity on the Boothia Uplift and on the Cornwallis Fold Belt indicates that they rose simultaneously. The Cornwallis Fold Belt and its structures probably formed in response to vertical movements of the underlying Precambrian basement.

An important feature of the report area is the distinctive north–northwestward trend of Erskine, May, and Young Inlets. These could be erosional features that developed perpendicular to trends of the Parry Islands Fold Belt, guided by the trends of a prominent jointing. On the other hand, they may reflect the selective erosion of gentle broad structural highs that strike roughly parallel with the Cornwallis Fold Belt. The Parry Islands folds may have been superimposed on these pre-existing structures. No firm conclusion can be drawn, but the most compelling evidence suggests that the latter certainly took place in the southern part of May Inlet before the Parry Islands folding. This is shown by the fact that the Bathurst Island Formation was domed and eroded in Early Devonian time prior to Stuart Bay deposition. This dome is exposed in the core of the Half Moon Bay structure where it culminates on the east side of May Inlet (*see* Fig. 5). Clearly, a structural high with a narrow east–west extent existed there before the east–west folding occurred. Additional stratigraphic evidence will be required to show whether this was no more than a local dome, or whether it extended as an anticline along May Inlet. Two other structures, the Stuart Bay and Thornton Point anticlines have culminations along or near May Inlet. It is not known whether these culminations existed earlier, but they furnish some additional evidence that May Inlet is broadly coincident with an anticlinal trend. Glacial erosion probably was partly responsible for erosion of the inlets. Blake (1964) reports that glacial features are common in the Bathurst Island group, but that most are related to locally centred ice caps. Post-glacial uplift has affected the entire report area. The amount of uplift, measured by the height of the marine limit, is close to 300 feet along the east–central and southeast coasts, but reaches 400 feet in the long inlets that indent the north coast, suggesting that the ice may have been thicker in the central region.

Summary and Conclusions

Three orogenies occurred in the report area. The first, which resulted from differential vertical uplift of the underlying Precambrian basement, effected the northerly trending Cornwallis Fold Belt in the eastern part of the island, and probably also produced mild, broad folds of roughly parallel trend farther west. Three similar pulses of uplift are assigned to this orogeny, two in Early Devonian and one in Late Devonian time.

The second orogeny, occurring between Late Devonian and Early Permian times, produced the Parry Islands Fold Belt, a southerly moving allochthon thousands of square miles in area. The plane of décollement probably occurs within halite, and gypsum–anhydrite of the Bay Fiord Formation. Deformation within the allochthonous mass was largely by flexural slip folding, except for western facies of the Eids Formation which deformed by flexural flow folding. Displacement of the allochthonous block and shortening within it diminished from north to south. The allochthon broke away from the western margin of the Cornwallis Fold Belt by left lateral faults and includes certain western parts of that fold belt.

The third orogeny was of Cretaceous and probably Tertiary ages. On southeastern Bathurst Island it produced extensional phenomena that include grabens and basic igneous activity that presumably occurred along the older Cornwallis trends. Regional considerations suggest that it may be this orogeny that was responsible for folding the rocks of the Sverdrup Basin on Cameron Island.

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APPENDIX OF STRATIGRAPHIC SECTIONS

*1. Northwestern Cameron Island
*2. Southwestern Cameron Island
3. Southeastern Cameron Island
4. Central Massey Island
5. South of Pell Inlet
6. Erskine Inlet
*7. Head of Erskine Inlet (Norris, 1963)
8. Southern Byam Martin Island (north flank)
9. Southern Byam Martin Island (south flank)
10. Northern Helena Island
11. Southwestern Helena Island
12. Central Helena Island
13. Hosken Islands
14. Stokes Range
15. Dundee Bight, west
16. Dundee Bight, central
*17. Purcell Bay
*18. Young Inlet, west
19. Young Inlet, south
20. Young Inlet, east
21. Young Inlet, southeast
22. Green River
23. Cape Kitson
*24. Head of Stuart Bay
25. Twilight Creek
*26. Cut Through Creek
27. Half Moon Bay, west
28. Half Moon Bay, east
29. Reindeer Bay
30. Moses Robinson River
31. Driftwood Bay (composite)
32. Head of Bracebridge Inlet
33. Polar Bear Pass
34. Head of Goodsir Inlet
35. Scoresby Hills, west
36. Heart Lake
*37. Crying Fox Creek (McMillan, 1963b)
38. Bathurst Caledonian R. J–34 well
39. Misty River
40. Head of Freemans Cove
41. Truro Island
42. Dyke Ackland Bay

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*Not studied or included in appendix

Unit	Lithology	Thickness (feet)	Height above base (feet)

SECTION 3. Southeastern Cameron Island; a north-dipping section on the southeastern part of Cameron Island beginning at latitude 76°26′N, longitude 103°05′W, 1.5 miles due west of the southeastern tip of the island. Thicknesses measured by scale on aerial photograph A–16151–158.

Trold Fiord Formation

MELVILLE ISLAND GROUP

Griper Bay Formation

Unit	Lithology	Thickness (feet)	Height above base (feet)
9	Sandstone, quartzose, grey-green, argillaceous; siltstone, grey-green; shale, dark grey; at a height of 600 feet is GSC loc. 65801 that includes: *Schuchertella*? sp. *Productella* sp. very large productellid, indet. *Plicochonetes* sp. *Ptychomaletoechia*? sp. *Cyrtospirifer* sp. pectinoid pelecypod small pelecypods *Mooreoceras bradfordoides* Flower (identified by D. H. Collins) *Lobobactrites*? sp. (identified by D. H. Collins): this faunule was dated by D. J. McLaren as Famennian (*see* Kerr, McGregor and McLaren, 1965) however, he now dates it more precisely as lower Famennian (pers. com., 1971) *Aculeispores* sp. *Ancyrospora* sp. *Hystricosporites* sp. ?*Lophozonotriletes excisus* Naumova this flora was identified by D. C. McGregor and dated as Middle or Upper Devonian (pers. com., 1974)........	650	3,750
8	Sandstone, quartzose, grey-green, argillaceous; some pebble-conglomerate, yellow-orange........	450	3,100
7	Shale, coaly, black, very recessive; at the base is GSC loc. 65799 which contains: ?*Ancyrospora* sp. *Apiculatasporites* sp. *Biharisporites* sp. *Leiotriletes microdeltoidus* McGregor *Lophozonotriletes curvatus* Naumova *L. grandis* Naumova *Verruciretusispora magnifica* (McGregor) Owens *Perotrilites perinatus* Hughes and Playford *Punctatisporites* sp. *Retusotriletes* sp. *Tholisporites densus* McGregor *Triangulatisporites rootsii* Chaloner identified and dated by D. C. McGregor as mid-Frasnian to early Famennian		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	At a height of 35 feet is GSC loc. 65800 which contains: ?*Ancyrospora* sp. (same species as in GSC loc. 65799) ?*Archaeozonotriletes foveolatus* Naumova *Biharisporites* sp. *Calamospora* sp. ?*Dibolisporites* sp. *Geminospora punctata* Owens *Geminospora verrucosa* Owens *Lophozonotriletes cristifer* (Luber) Kedo *L. curvatus* Naumova *L. grandis* Naumova *L. macrogrumosus* Naumova *Lycospora magnifica* McGregor *Perotrilites perinatus* Hughes and Playford *Punctatisporites* sp. *Tholisporites densus* McGregor *Verrucosisporites* sp. identified and dated by D. C. McGregor as late Frasnian or early Famennian (pers. com., 1974)........	50	2,650
6	Sandstone, fine grained, quartzose, impure, argillaceous, medium to dark grey-green; siltstone and shale, dark grey-green, poorly exposed........	500	2,600
5	Sandstone, pebbly; fine conglomerate of well-rounded chert fragments in arkosic sandstone matrix........	100	2,100
4	Sandstone, arkosic, yellow-orange, pebbly sandstone common, some greenish sandstone........	400	2,000
3	Sandstone, fine grained, quartzose, argillaceous, medium to dark grey-green; siltstone and shale, dark grey-green, poorly exposed recessive unit; minor yellow-orange arkosic sandstone..	400	1,600
	Total preserved thickness of Griper Bay Formation........	2,550	
	Hecla Bay Formation		
	UPPER MEMBER		
	(contact conformable)		
2	Sandstone, quartzose, very pure, white to very light grey, weathering blue-grey; alternating with minor sandstone, cream, weathering rusty, medium to thick bedded, bluff forming; contact with overlying Griper Bay Formation is covered........	550	1,200
1	Sandstone, quartzose, cream to very light grey, weathering the same colour, with rusty weathering hematitic interlayers, thick bedded, fairly recessive; in upper part there is much crossbedding; muscovite flakes common........	650	650
	Exposed thickness of Hecla Bay Formation........	1,200	
	Exposed thickness of Melville Island Group........	3,750	
	Lower limit of exposure at a fault		

Unit	Lithology	Thickness (feet)	Height above base (feet)

SECTION 4. Central Massey Island; a south-dipping section on the north side of central Massey Island beginning at latitude 76°02′N, longitude 103°05′W, at the mouth of a stream and continuing southward from this point. Thicknesses measured by scale on aerial photograph A–16761–95.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	MELVILLE ISLAND GROUP		
	Griper Bay Formation		
	MEMBER C		
8	Arkosic sandstone, yellow-orange, weathering rubbly and mainly felsenmeer	200	4,250
	MEMBER B		
7	Sandstone, quartzose, impure, greenish, medium grained, commonly with coaly black shale interbeds	600	4,050
6	Sandstone, siltstone, black shale interlayers, very finely grained, thinly bedded	535	3,450
	MEMBER A		
5	Sandstone, quartzose, impure, greenish, medium grained, blocky	365	2,915
	Preserved thickness of Griper Bay Formation	1,700	
	Hecla Bay Formation		
	UPPER MEMBER		
	(contact conformable)		
4	Sandstone, quartzose, fine to medium grained, yellow-orange, weathering yellow-grey, blocky, very light grey to very light cream sandstone with occasional red hematitic interbeds; recessive, faintly reddish weathering	485	2,550
	LOWER MEMBER		
3	Sandstone, quartzose, with some hematitic interlayers	750	2,065
	Total thickness of Hecla Bay Formation	1,235	
	Preserved thickness of Melville Island Group	2,935	
	Bird Fiord Formation		
	(contact conformable)		
2	Sandstone, quartzose with calcareous cement; the interval is mainly covered with occasional sandstone outcrops, much greenish weathering shaly interlayers	1,300	1,315
1	Sandstone, quartzose, calcareous, micaceous, light greenish grey to light grey, fine grained, weathering greenish yellow; brachiopods and trilobites common	15	15
	Exposed thickness of Bird Fiord Formation	1,315	
	Lower limit of exposure		

Unit	Lithology	Thickness (feet)	Height above base (feet)

SECTION 5. South of Pell Inlet; a south-dipping section south of Pell Inlet that begins at latitude 75°39'N, longitude 102°20'W and continues southward from that point. Thicknesses measured by scale on aerial photograph A–16761.

MELVILLE ISLAND GROUP

Griper Bay Formation

MEMBER D

Unit	Lithology	Thickness (feet)	Height above base (feet)
14	Sandstone, with minor shale; at a height of 300 feet in a shale horizon is GSC plant loc. 7257 which yields spores as follows: ?*Archaeozonotriletes famenensis* Naumova cf. *A. purus* Naumova *Cyclogranisporites* sp. *Geminospora punctata* Owens cf. *Hymenozonotriletes argutus* Naumova *H. deliquescens* Naumova *Hystricosporites delectabilis* McGregor *Leiotriletes dissimilis* McGregor *Lophozonotriletes curvatus* Naumova *L. proscurrus* Kedo *Verruciretusispora magnifica* (McGregor) Owens *Perotrilites perinatus* Hughes and Playford *Punctatisporites* sp. *Stenozonotriletes* sp. *Tholisporites densus* McGregor this florule was identified by D. C. McGregor and dated as mid- to late Frasnian, with late Frasnian preferred (pers. com., 1974)	700	6,315
	MEMBER C		
13	Sandstone, impure, arkosic; pebbly sandstone, moderately resistant	450	5,615
	MEMBER B		
12	Sandstone, grey-green, fine grained; siltstone grey-green; shale, dark grey, minor; all intimately interbedded; recessive	950	5,165
	MEMBER A		
11	Sandstone, quartzose, blocky	350	4,215
	Preserved thickness of Griper Bay Formation	2,450	

Hecla Bay Formation

UPPER MEMBER

(contact conformable)

Unit	Lithology	Thickness (feet)	Height above base (feet)
10	Sandstone, quartzose, very pure, recessive, poorly consolidated, reddish hematitic shale interlayers	1,100	3,865

Unit	Lithology	Thickness (feet)	Height above base (feet)
	LOWER MEMBER		
9	Sandstone, quartzose, typical Hecla Bay Formation, rather pure, thick bedded to massive, resistant	750	2,765
8	Shale, dark grey, very soft; at a height of 40 feet contains GSC loc. 67106	150	2,015
7	Sandstone, quartzose, salt and pepper sandstone, light tan colour, occasionally greenish tinge, plant fragments are common, abundant crossbedded; at a height of 300 feet are pyrite concretions; the unit becomes more quartzose upward	675	1,865
6	Sandstone, quartzose, fairly pure, rubbly weathering, tan to yellowish	630	1,190
5	Siltstone and shale, grey-green, recessive	50	560
4	Sandstone, quartzose, tan coloured, fairly pure; interbeds of greenish shale and red hematitic sandstone	150	510
3	Shale, greenish grey, and fine-grained sandstone that is shaly; with worm trails; contains GSC loc. 67105	20	360
2	Sandstone, quartzose, fairly impure, blocky, thick bedded, very minor green shale interbeds	140	340
	Total thickness of lower member of formation	2,565	
	Total thickness of Hecla Bay Formation	3,665	
	Bird Fiord Formation		
	(contact conformable)		
1	Sandstone, quartzose, calcareous, very shaly; with equal amounts of shale interbeds that are greenish grey	200	200
	Observed thickness of Bird Fiord Formation	200	
	Lower limit of exposure		

SECTION 6. Erskine Inlet; a south-dipping section occurring southwest of the southernmost end of Erskine Inlet, beginning at latitude 75°45′N, longitude 101°30′W, and continuing southward. Thicknesses measured by scale on aerial photograph A–16151–100.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	MELVILLE ISLAND GROUP		
	Griper Bay Formation		
	MEMBER B		
7	Sandstone, grey-green, fine grained, siltstone grey-green; shale, dark grey, interbedded	1,000	8,230
	MEMBER A		
6	Sandstone, quartzose, blocky, resistant	530	7,230
	Exposed thickness of Griper Bay Formation	1,530	

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Hecla Bay Formation		
	UPPER MEMBER		
	(contact conformable)		
5	Quartz sandstone, white, weathering white, friable in part, cross-bedded (wind driven?), red staining on some surfaces, thick bedded, red shale interlayers	1,400	6,700
	LOWER MEMBER		
4	Sandstone, quartzose, rather pure, thick bedded to massive, resistant	2,200	5,300
	Total thickness of Hecla Bay Formation	3,600	
	Bird Fiord Formation		
	(contact conformable)		
3	Sandstone, quartzose, calcareous cement, grey-green, shaly, alternating with dark green shale intervals, the sandstone is sparsely micaceous; the sandstone forms resistant layers and outcrops sporadically while the alternating shale units are recessive, the shale is dark grey-green, fissile; occasional interbeds of light yellow-grey, non-calcareous quartz sandstone	2,300	3,100
	Eids Formation		
	(contact conformable)		
2	Limestone, shaly, thin bedded to fissile, moderately resistant, forming a ridge, upper contact covered	300	800
1	Shale, siltstone, very limy, thin bedded to fissile, crumbly, very recessive generally, rubbly with no outcrops, upper contact not exposed, thickness uncertain but a probable minimum of 500 feet	500	500
	Exposed thickness of Eids Formation	800	
	Lower limit of exposure		

SECTION 8. Southern Byam Martin Island (north flank); section occurs on southern Byam Martin Island on the north flank of a major east–west trending fold, beginning at latitude 75°09′N, longitude 104°10′W, and extending northward. Thicknesses measured by scale on aerial photograph A–16766–122.

	MELVILLE ISLAND GROUP		
	Griper Bay Formation		
5	Sandstone, quartzose, greenish, non-calcareous, very shaly and silty, fine to medium grained, interbedded with dark green to dark grey non-calcareous shale. The entire unit is recessive	1,000	4,010

Unit	Lithology	Thickness (feet)	Height above base (feet)
4	Sandstone, quartzose, quite pure, medium grained, very light cream; crossbedding, ripple-marks, weathering very light blue-grey; bluff-forming, massive to thick bedded	30	3,010
3	Sandstone, quartzose, light cream, occasionally crossbedded and ripple-marked, rare greenish interbeds up to 40 feet thick	780	2,980
2	Sandstone, quartzose, greenish	1,000	2,200
	Examined thickness of Griper Bay Formation	2,810	
	Hecla Bay Formation		
	UPPER MEMBER		
	(contact conformable)		
1	Sandstone, quartzose, very pure, cream to very light grey, occasionally rusty weathering, occasionally hematitic interbeds	1,200	1,200
	Exposed thickness of the Hecla Bay Formation	1,200	
	Base of section at lower limit of exposure		

SECTION 9. Southern Byam Martin Island (south flank); section occurs on southern Byam Martin Island on the south flank of a major east–west trending fold, beginning at latitude 75°09′N, longitude 104°10′W, and extending southward. Thicknesses measured by scale on aerial photographs A–16766–122 and A–16766–115.

MELVILLE ISLAND GROUP

Griper Bay Formation

8	Sandstone, quartzose, fine grained, grey-green, fairly resistant, minor siltstone and shale	150	3,730
7	Sandstone, quartzose, fine grained, grey-green, interbedded with much soft quartzose siltstone and shale	180	3,580
6	Siltstone, quartzose, grey-green, calcareous; sandstone, quartzose, poorly exposed, recessive; coquinoid interbeds, thin silty limestone interbeds. At a height of 20 feet are interbeds of coquinal brown limestone (GSC loc. 65797) that contain the following fossils: Invertebrates (according to D. J. McLaren) *Productella* sp. *Ptychomaletoechia*? sp. rhynchonellid n. gen. ? open-coil planispiral gastropod abundant fragmentary gastropods and pelecypods scattered crinoid columnals *Lobobactrites*? sp. (identified by D. H. Collins) Conodonts (identified by T. T. Uyeno) *Palmatolepis perlobata* Ulrich and Bassler *Pelekysgnathus inclinata* Thomas *Apatognathus* cf. *A. varians* Branson and Mehl *Icriodus costatus* (Thomas)		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Spores (identified by D. C. McGregor) ?*Archaeozonotriletes famenensis* Naumova *A. gracilis* Kedo ?*Geminospora* sp. ?*Hymenozonotriletes denticulatus* Naumova *Hystricosporites porcatus* (Winslow) Allen *Lophozonotriletes cristifer* (Luber) Kedo *L. curvatus* Naumova *Perotrilites* sp. *Retusotriletes simplex* Naumova the fauna has been dated by McLaren as early Famennian (pers. com., 1971), and the spores were dated by McGregor as late Frasnian or early Famennian, probably early Famennian (pers. com., 1974) At a height of 120 feet interbeds of coquinal limestone (GSC loc. 65798) yielded the following fauna: Invertebrates (identified by D. J. McLaren) *Productella*? sp *Ptychomaletoechia*? sp. rhynchonellid n.gen. ? *Cyrtospirifer* spp. (one species with apsacline interarea resembling *C. mimetes* (Crickmay)) open-coil planispiral gastropod pelecypod and gastropod fragments pectinoid pelecypod Invertebrates (identified by D. H. Collins) *Mooreoceras bradfordoides* Flower compressed, actinosiphonate oncocerid *Lobobactitrites*? sp. Conodonts (identified by T. T. Uyeno) *Palmatolepis perlobata* Ulrich and Bassler *Icriodus costatus* (Thomas) *Apatognathus* cf. *A. varians* Branson and Mehl *Herrmannia*? sp. (identified by M. J. Copeland) Spores as were identified by D. C. McGregor include: *Archaeoperisaccus opiparus* Owens *A. ovalis* Naumova cf. *Archaeozonotriletes micromanifestus* Naumova ?*A. variabilis* Naumova *Endosporites macromanifestus* Hacquebard *Geminospora verrucosa* Owens ?*Hymenozonotriletes denticulatus* Naumova *Lophotriletes atratus* Naumova *Lophozonotriletes excisus* Naumova *L. cristifer* (Luber) Kedo *Perotrilites* sp. *Retusotriletes* sp. *Stenozonotriletes* sp. ?*S. ornatus* Naumova McLaren has dated the fauna in GSC loc. 65798 as early Famennian (pers. com., 1971) and McGregor dated the associated flora as late Frasnian or early Famennian (pers. com., 1974)......................................	150	3,400

Unit	Lithology	Thickness (feet)	Height above base (feet)
5	Sandstone, quartzose, fine grained, medium grey-green, medium green; much interbedding of grey-green siltstone and dark green shales	600	3,250
4	Sandstone, quartzose, light grey to cream	250	2,650
3	Sandstone, quartzose, impure, shaly and silty, dark greyish green, weathering medium greyish green, minor hematitic bands	1,200	2,400
	Examined thickness of Griper Bay Formation	2,530	
	Hecla Bay Formation		
	UPPER MEMBER		
	(upper contact conformable)		
2	Sandstone, cream to very light grey, weathering blue grey, occasionally rusty and red-purple hematitic beds, massive to thick bedded	50	1,200
1	Sandstone, quartzose, very pure, cream to very light grey, occasional y rusty weathering, occasional hematitic interbeds	1,150	1,150
	Exposed thickness of Hecla Bay Formation	1,200	
	Lower limit of exposure		

SECTION 10. Northern Helena Island; section is an isolated erosional remnant of Belcher Channel Formation on northern Helena Island, beginning at latitude 76°44′N, longitude 100°45′W, and continuing northward. Located on aerial photograph A–16151–165. Section is upward continuation of Section 12. Section measured by tape and described by W. W. Nassichuk.

	Belcher Channel Formation		
11	Limestone, dolomitic, silty, coarsely crystalline, thin bedded with colonial coral heads up to 2 feet in diameter and rare gastropods; biostromal limestone unit with corals as at unit 8	70	510
10	Limestone, dolomitic, finely crystalline, silty, thin bedded, yellow-orange weathering	70	440
9	Limestone, dolomitic silty, greenish grey, vuggy, thin bedded, few corals as in unit 7	30	370
8	Limestone, dolomitic, biostromal, with abundant colonial corals; GSC loc. 73160 which contains *Antiquatonia* sp., stenoscismatacean brachiopod indet., "*Lithostrotion*" *kunthi* (Stuckenberg), and an indeterminate tabulate coral; these were identified by E. W. Bamber who states (pers. com., 1971) that they have been found elsewhere in the Lower Permian Belcher Channel Formation	60	340
7	Limestone, dolomitic, fine grained, vuggy, chert nodules in part, some beds are biostromal (part of GSC loc. 73159 came from this unit)	10	280
6	Shaly interbeds, white chert nodules abundant in dolomitic limestone, recessive	10	270
5	Limestone, dolomitic, brownish grey, finely crystalline, vuggy as below, beds 4 inches thick, with colonial corals, beds some-		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	times more than 1 foot thick containing white irregular chert nodules up to 10 inches in diameter, GSC loc. 73159 which was collected in this unit and unit 8 includes colonial corals identified by E. W. Bamber (pers. com., 1971) as "*Lithostrotion*" cf. *portlocki* Milne-Edwards and Haime, ?*Stylastraea* sp., *Roemeripora* sp.	45	260
4	Limestone, dolomitic, silty as below except solitary corals rare, silicified where present	90	215
3	Limestone, dolomitic, fine grained, yellow-green, weathers yellow-grey, beds 1 foot thick, vuggy, traces of silicified gastropods, solitary corals	80	125
2	Limestone, dolomitic, fine grained, light grey, weathering pale green, thin-bedded unit, recessive, forming valley, shaly interbeds, unit contains badly weathered solitary corals	25	45
1	Dolomite, finely crystalline, very porous and vuggy, partly silty with some laminae, poorly bedded, blocky	20	20
	Preserved thickness of Belcher Channel Formation	510	
	MELVILLE ISLAND GROUP		
	Griper Bay Formation		
	(contact regional angular unconformity)		
	Sandstone, quartzose, rather pure, very light grey, weathering light cream (for rocks beneath this *see* Sec. 12)		

SECTION 11. Southwestern Helena Island; a north-dipping section that begins on the south coast of Helena Island at latitude 76°36'N, longitude 101°05'W. It is in the valley of a southeast-flowing stream whose mouth is 6 miles northeast of the southernmost tip of Helena Island. Located on aerial photograph A–16203–208. Thicknesses measured in part by tape and in part by scale on the photograph.

	MELVILLE ISLAND GROUP		
	Hecla Bay Formation		
	LOWER MEMBER		
8	Sandstone, fine grained, medium light brown, tiny orange limonitic specks, tiny muscovite flakes, resistant, thick bedded, weathers slightly rusty brown, covered at the base	200	2,590
	Examined thickness of Hecla Bay Formation	200	
	Bird Fiord Formation		
	(contact conformable)		
7	Sandstone, quartzose, fine grained, slightly calcareous, micaceous, dark green, medium bedded; interbedded with non-calcareous shaly sandstone, grades up to younger formation; due to decrease in calcareous cement; woody fragments, burrows and		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	tracks; shallow water; in this unit is GSC plant loc. 7019 which contains: *Ancyrospora ancyrea* (Eisenack) Richardson *Asperispora* sp. *Calyptosporites velatus* Richardson ?*Hymenozonotriletes argutus* Naumova *Perotrilites* sp. *Samarisporites* sp. (? = *Hymenozonotriletes macrotuberculatus* Archangelskaya) *Stenozonotriletes insessus* Allen *Verrucosisporites* sp. this florule was identified by D. C. McGregor (pers. com., 1974) who stated that the assembly is Eifelian or Givetian, more likely Givetian	250	2,390
6	Sandstone, quartzose, fine grained, strongly calcareous, light brown, faintly green, tiny muscovite flecks, medium bedded, resistant alternating with recessive greenish brown siltstone and shale; at a height of 400 feet in GSC plant loc. 7018	700	2,140
5	Sandstone, very fine grained, quartzose, strongly calcareous, grey-green, resistant, medium bedded, alternating with dark greenish shales, recessive; at a height of 275 feet (GSC plant loc. 7016) is? *Archaeotriletes incompositus* Chibrikova, at a height of 500 feet (GSC plant loc. 7017) is *Ancyrospora* sp., *Calyptosporites velatus* Richardson, and *Grandispora* (2 species); these were identified by D. C. McGregor (pers. com., 1974) who considered that GSC plant loc. 7016 suggests a Givetian age and that GSC plant loc. 7017 is Givetian or Eifelian, more likely Givetian	500	1,440
	Total thickness of Bird Fiord Formation	1,450	
	Blue Fiord Formation		
	(contact covered)		
4	Covered. Probably Blue Fiord Formation	100	940
3	Limestone, shaly, fine grained, medium grey, weathering tan-grey, medium bedded	40	840
	Total thickness of Blue Fiord Formation	140	
	Eids Formation		
	(contact conformable)		
2	Interval is covered but contains rubble of the Eids Formation. It is soft shaly siltstone and silty shale, light tan	600	800
	Total thickness of Eids Formation	600	
	Stuart Bay Formation		
	(contact conformable)		
1	Shale, silty, dark grey, calcareous, weathers tan, moderately resistant	200	200
	Exposed thickness of Stuart Bay Formation	200	
	Base of section at lower limit of exposure		

Unit	Lithology	Thickness (feet)	Height above base (feet)
SECTION 12.	Central Helena Island; a north-dipping section on central Helena Island, beginning above a southerly directed thrust fault a mile inland. The south coast at latitude 76°39′N, longitude 100°47′W. Thickness measured by scale on aerial photograph A–16151–166.		
	Belcher Channel Formation		
20	Limestone, dolomitic (*see* Sec. 10)		
	MELVILLE ISLAND GROUP		
	Griper Bay Formation		
	(contact regional angular unconformity)		
	MEMBER C		
19	Sandstone, quartzose, rather pure, very light grey, weathering light cream (in places removed by pre-Belcher Channel erosion)....	300	11,395
18	Sandstone, quartzose, medium grained, various colours, mainly orange with some brownish and greenish strata..........................	900	11,095
	Total thickness of Member C..	1,200	
	MEMBER B		
17	Sandstone, greenish grey, impure, quartzose, slightly cherty, coaly bits throughout, shale interbeds, soft, thin bedded, succeeded abruptly by quartz sandstone but actual contact covered........	800	10,195
16	Small amount of section missing through normal faulting.............	100?	9,395
15	Shale, dark grey to dark grey-green and medium grained greenish grey, impure, quartzose, sandstone; at base is a coaly shale yielding GSC plant loc. 7014, which contains: *Archaeoperisaccus* sp. ?*Archaeozonotriletes gorodkensis* Kedo ?*A. variabilis* Naumova *Geminospora punctata* Owens *Geminospora verrucosa* Owens ?*Hymenozonotriletes polymorphus* Naumova of Ozolin'a 1960 (not *H. polymorphus* of Naumova 1953, Pl. 22) *Stenozonotriletes* sp. *Tholisporites densus* McGregor these were identified by D. C. McGregor (Kerr, McGregor, and McLaren, 1965; also pers. com., 1974), who dates the florule as mid- to late Frasnian and favours the late Frasnian age................................	120	9,295
	Total thickness of Member B..	1,020	
	MEMBER A		
14	Sandstone, coarse, pebbly, light greenish grey, impure, quartzose; much angular white and some black chert fragments; conglomeratic at the base, pebbles of rounded white chert and some black chert..	500	9,175
13	Sandstone, quartzose, impure, medium to coarse grained, angular, much white and some black chert fragments, some fragments of green shale, overall colour medium, light greenish grey, in places abundantly crossbedded, plant fragments in places,		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	also green, silty and shaly interbeds; upper contact sharp and may be a disconformity, GSC plant loc. 7027 *Archaeozonotriletes micromanifestus* Naumova *A. variabilis* Naumova *Biharisporites* sp., ?*B. submamillarius* McGregor *Chelinospora* sp. ?*Geminospora svalbardiae* Allen cf. *Hymenozonotriletes spinuliferus* Naumova *Hystricosporites* (2 species) *Verruciretusispora magnifica* (McGregor) Owens *Stenozonotriletes* sp. this assemblage was identified by D. C. McGregor (pers. com., 1974), who dated it as mid- to late Frasnian	375	8,675
12	Sandstone, quartzose, dark green, fine grained, medium bedded, interbedded with shaly siltstone and shale, dark green to black, plant fragments common; ripple-marks common, along strike it is partly laterally gradational into the coarser overlying unit; at height of 950 feet is GSC plant loc. 7026, which contains: *Ancyrospora* (2 species) *Apiculiretusispora* sp. *Archaeoperisaccus opiparus* Owens *Biharisporites* sp. *Grandispora* sp. *Hystricosporites porcatus* (Winslow) Allen *Hystricosporites* sp. *Retusotriletes laevigatus* Guennel this assemblage was identified by D. C. McGregor (pers. com., 1974), who considered that it is Frasnian, and probably early Frasnian	1,800	8,300
	Total thickness of Member A	2,675	
	Total preserved thickness of Griper Bay Formation	4,895	
	Hecla Bay Formation (contact probably conformable)		
	UPPER MEMBER		
11	Sandstone, quartzose, very light cream, weathers light grey to rusty; at 200 feet in the interval common subangular pebble beds of white chert and some dark grey chert to ½ inch diameter	400	6,500
10	Covered, rubble is light cream, quartz, sandstone, weathering cream	1,300	6,100
	Total thickness of upper member	1,700	
	LOWER MEMBER		
9	Sandstone, greenish, recessive, plant bearing; GSC loc. 7025 contains: ?*Archaeozonotriletes micromanifestus* Naumova *Calyptosporites velatus* Richardson *Grandispora* sp.		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Hystricosporites sp. cf. *Hymenozonotriletes spinosus* Naumova *Perotrilites* sp. cf. *Diaphanospora riciniata* Balme and Hennelly this assemblage was identified by D. C. McGregor (pers. com., 1974), who stated that it is either late Middle or early Upper Devonian, and favoured a Givetian age	30	4,800
8	Sandstone, quartzose, faintly feldspathic and micaceous, very light cream, blocky, resistant, weathering cream	1,500	4,770
7	Sandstone, quartzose, feldspathic, faintly micaceous, fine grained, reddish orange, thick bedded, minor greenish sandy interlayers at base, grades up to cream sandstone	250	3,270
6	Sandstone, quartzose, fine grained, tan-brown, non-calcareous, blocky, crossbedding; interbeds of slightly limy shaly sandstone, greenish wood fragments and fossils, top of unit grades to overlying red-orange sandstone; at the base is GSC plant loc. 7022 which contains: *Ancyrospora* sp. cf. *Archaeozonotriletes arduus* Archangelskaya ?*Hymenozonotriletes praetervisus* Naumova *Perotrilites* sp. *Samarisporites* sp. (? = *Hymenozonotriletes*) *macrotuberculatus* Archangelskaya *Verrucosisporites* sp. this florule was identified by D. C. McGregor (pers. com., 1974) who considers that the assemblage is of Eifelian or Givetian age, more likely Givetian; at a height of 200 feet is a 1–13-foot fossiliferous lensing interlayer of tan, limy sandstone, GSC plant loc. 7024 yielding *Ancyrospora* sp. *Apiculatasporites* (2 species) ?*Camarozonotriletes obtusus* Naumova *Camarozonotriletes* (2 species) ?*Hymenozonotriletes polyacanthus* Naumova *H. proteus* Naumova ?*Lophozonotriletes* (2 species) *Raistrickia aratra* Allen *Stenozonotriletes* sp. *Verrucosisporites* sp. the above florule was identified by D. C. McGregor, who dated the assemblage as Givetian or Frasnian, with late Givetian suggested as the most reasonable age (pers. com., 1974)	300	3,020
5	Sandstone, quartzose, fine grained, brownish, resistant, blocky	300	2,720
	Total thickness of lower member	2,380	
	Total thickness of Hecla Bay Formation	4,080	
	Bird Fiord Formation		
	(contact covered)		
4	Covered; rubble is blocky, non-calcareous, quartz sandstone, probably of Bird Fiord Formation; contact not exposed at top	320	2,420

Unit	Lithology	Thickness (feet)	Height above base (feet)
3	Sandstone, quartzose, strongly calcareous, fine grained, greenish grey, resistant, alternates with non-calcareous, green sandy shale and siltstone, recessive	800	2,100
	Total thickness of Bird Fiord Formation	1,120	
	Eids Formation		
	(contact conformable)		
2	Siltstone, quartzose, very slightly calcareous, tan, weathers light yellow-grey, crossbedding common; resistant	300	1,300
	Total thickness of Eids Formation	300	
	Bathurst Island Formation		
	(contact conformable)		
1	Siltstone, dark grey, quartzose, calcareous, thin bedded, weathers slightly brownish grey, in places limestone nodules	1,000	1,000
	Total exposed thickness of Bathurst Island Formation	1,000	
	Lower limit of exposure at a fault		

SECTION 13. Hosken Islands; section on the southernmost of the two Hosken Islands, north of Bathurst Island proper, that begins in the centre of the island at latitude 76°43′N, longitude 100°05′W and continues eastward. Measured in part by staff and in part by scale on aerial photograph A–16203–122.

	Bathurst Island Formation		
8	Siltstone, medium brown, thin to medium bedded, strongly calcareous; GSC loc. 67118	500	2,070
	Cape Phillips Formation		
	(contact conformable)		
7	Shale, fissile, recessive; at base are graptolites, GSC loc. 67117	90	1,570
6	Siltstone, thin to medium bedded, fairly resistant, GSC loc. 67116	600	1,480
5	Shale, fissile, silty, black, recessive, at top grades to siltier rock that is harder; thin to medium bedded; at top is GSC loc. 67115	230	880
4	Limestone, rubbly, fetid; GSC loc. 67114	70	650
3	Shale; at base with biserial graptolites, GSC loc. 67113	30	580
	Total thickness of Cape Phillips Formation	1,020	
	CORNWALLIS GROUP		
	Irene Bay Formation		
	(contact conformable)		
2	Limestone, micritic, with fossil fragments, light grey, thinly bedded, recessive, alternates with yellow-grey shaly interlayers, toward		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	top shaly interlayers weather rusty, fossiliferous, with favositid heads common in GSC loc. 67112	150	550
	Total thickness of Irene Bay Formation	150	
	Thumb Mountain Formation		
	(contact conformable)		
1	Dolomite, microcrystalline, fetid, sugary, medium dark grey	400	400
	Exposed thickness of Thumb Mountain Formation	400	
	Base of section at lower limit of exposure		

SECTION 14. Stokes Range; a north-dipping section northwest of Dampier Bay, on the west side of May Inlet, northern Bathurst Island. It begins near sea level at a thrust fault at the foot of high bluffs at latitude 76°17'30"N, longitude 101°05'W. Thicknesses measured by scale on aerial photograph A-16151-31.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Cape Phillips Formation		
	(faulted at the top)		
7	Shale, typical of the Cape Phillips Formation	700	2,567
6	Limestone, dark grey-brown, micritic, fetid, weathering light brown	12	1,867
	Exposed thickness of formation	712	
	CORNWALLIS GROUP		
	Irene Bay Formation		
	(contact conformable)		
5	Limestone, micrite, commonly with fossil fragments, thinly bedded, dark grey, much soft greenish shale interlayers weathering green, recessive, fossils lying loose are abundant	180	1,855
	Total thickness of Irene Bay Formation	180	
	Thumb Mountain Formation		
	(contact conformable)		
4	Limestone, dark grey, fetid, vuggy, resistant, slightly dolomitic	50	1,675
3	Limestone, micrite, thick bedded, light grey, resistant, slightly dolomitic	150	1,625
2	Dolomite, shades of grey, finely porous, fetid, medium bedded, occasionally laminated, resistant	475	1,475
1	Covered; felsenmeer, probably representing this formation	1,000	1,000
	Preserved thickness of Thumb Mountain Formation	1,675	
	Lower limit of exposure at a thrust fault		

Unit	Lithology	Thickness (feet)	Height above base (feet)

SECTION 15. Dundee Bight, west; a north-dipping section beginning at latitude 61°01′N, longitude 100°25′W, 3 miles west of Dundee Bight in a very short north–northwesterly flowing stream valley. Thicknesses measured by scale on aerial photograph A–16151–180.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Bird Fiord Formation		
8	Sandstone, calcareous cement; siltstone; shale	300	2,941
	Eids Formation		
	(contact conformable)		
7	Shale and siltstone, limy, dark grey, fine grained, very recessive, thin bedded to fissile	1,500	2,641
	Total thickness of Eids Formation (approximate)	1,500	
	Stuart Bay Formation		
	(contact sharp but conformable)		
6	Sandstone, quartzose, fine grained, light grey-brown, bluff-forming, grades sharply to the overlying Eids Formation	80	1,141
5	Siltstone, quartzose, shaly, calcareous, dark grey, weathers yellow-grey, gradational at top	450	1,061
4	Limestone, silty, nodular	1	611
3	Shale and siltstone	4	610
2	Limestone, crinoidal, brown	6	606
	Total thickness of Stuart Bay Formation	541	
	Bathurst Island Formation		
	(contact probably conformable)		
1	Shale and siltstone, calcareous, dark grey to dark grey-brown	600	600
	Observed thickness of Bathurst Island Formation	600	

SECTION 16. Dundee Bight, central; section on the western shore of May Inlet in coastal cliffs, beginning at latitude 76°02′N, longitude 100°15′W, and continuing southward on the south flank of a main anticline. Thicknesses measured in part by staff and in part by scale on aerial photograph A–16151–180.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Eids Formation		
8	Siltstone and shale, limy (approximate thickness)	1,500	5,285
	Stuart Bay Formation		
	(contact probably conformable)		
7	Siltstone and fine-grained sandstone, medium chocolate brown to medium grey, calcareous, laminated to thin bedded, weathers		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	yellow-grey; upper contact with the Eids Formation is covered; contains much flagstone; plant fragments common; at about 370 feet is GSC loc. 67077	840	3,785
6	Sandstone, pebbly, pebbles of chert to ¼″ diameter maximum, dark grey, black, red; limestones, sandy, variable thicknesses of pebbly beds and limestone beds in a siltstone succession	30	2,945
	Total thickness of Stuart Bay Formation	870	
	Bathurst Island Formation		
	(contact probably disconformable)		
5	Siltstone, quartzose, calcareous, dark chocolate brown, weathers yellow-grey, thin to medium bedded, in lower part alternates with minor dark green, non-calcareous fissile shale, weathering medium grey; through the unit are occasional interbeds of thick-bedded, medium brown limy, quartz siltstone, weathering orange; at a height of 1,200 feet is GSC loc. 67073; just below 1,800 feet is GSC loc. 67074; at 1,800 feet is GSC loc. 67075; at 1,810 feet is GSC loc. 67076, which contains tentaculitids	1,900	2,915
4	Siltstone and shale, dark chocolate brown, slightly calcareous, thin bedded, weathers yellow-grey; at the base are loose fossils GSC loc. 67069; at a height of 40 feet is GSC loc. 67070; at 70 feet is GSC loc. 67071; at 135 feet is GSC loc. 67072	145	1,015
	Total thickness of Bathurst Island Formation	2,045	
	Cape Phillips Formation		
	(contact conformable)		
3	Shale, dark grey, recessive, non-calcareous, fissile, weathers dark grey to medium grey, occasionally rusty, upper 100 feet becomes calcareous, weathers yellow-grey, grades up to calcareous, chocolate brown rock of the overlying formation; at height of 110 feet is GSC loc. 67063; at 195 feet is GSC loc. 67064; at 265 feet is GSC loc. 67065; at 265 to 267 feet is a 3-foot thick band of orange weathering, slightly calcareous siltstone; at 330 feet is GSC loc. 67066; at 385 feet is GSC loc. 67067	490	870
2	Shale, dark grey, much interbedded calcareous siltstone in beds and lenses, medium grey, weathering yellow-grey	55	380
1	Shale and lesser siltstone, dark grey, non-calcareous, weathers tan-grey, thinly bedded at top, becomes medium grey, calcareous, very silty rock; at the base is GSC loc. 67061 with graptolites; at a height of 125 feet is cf. *M. riccartonensis* 10 inches long; at 230 feet is GSC loc. 67062	325	325
	Exposed thickness of Cape Phillips Formation	870	

Unit	Lithology	Thickness (feet)	Height above base (feet)

SECTION 19. Young Inlet, south; a northwesterly dipping section that begins at the northwest tip of a small lake at latitude 76°20′N, longitude 99°00′W, and about 4 miles south–southeast of the head of the western arm of Young Inlet and continues northwest. Thicknesses measured by scale on aerial photograph A–16761–168.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Bird Fiord Formation		
28	Sandstone, quartzose, light grey-green to light grey, very faintly limy	150	4,005
27	Sandstone, quartzose, limy, shaly, grey-green, weathers slightly greenish grey, recessive, interbeds approximately 10 feet thick of sandy limestone which is resistant, limestone decreases upward	300	3,855
26	Shale, green, non-calcareous, calcareous veining, soft and very recessive	30	3,555
25	Covered, probably limy sandstone	85	3,525
24	Limestone, very quartz sandy, light grey, slightly greenish	5	3,440
23	Covered	30	3,435
22	Limestone, quartz sandy	5	3,405
21	Covered, probably limy sandstones	28	3,400
20	Limestone, quartz sandy, bluff forming	5	3,372
19	Sandstone, very limy, and limestone, sandy, grey-green, minor grey and cream sandstone, weathers yellow-grey, largely rubble interval, recessive	80	3,367
18	Sandstone, quartzose, slightly calcareous, with muscovite grains, medium light grey, powdery limonite specks, weathers orange	50	3,287
17	Sandstone, quartzose, calcareous, muscovite flakes; thin to medium bedded, dark grey, weathers greenish grey	95	3,237
	Observed thickness of Bird Fiord Formation	883	
	Blue Fiord Formation		
	(contact conformable)		
16	Limestone, medium bedded, brown, sandy and shaly; much shale in discrete beds up to 3 feet thick, non-calcareous	110	3,142
15	Limestone, thick bedded, brown, minor shale	55	3,032
14	Covered, rubble of limestone	90	2,977
13	Limestone	2	2,887
12	Covered, rubble of limestone	25	2,885
11	Limestone, micritic, fragmental, medium brown, weathers light yellow-brown, very shaly, shaly interlayers in part, wavy surfaces on bedding, ledge forming	70	2,860
10	Covered	60	2,790
	Total thickness of Blue Fiord Formation	412	
	Eids Formation		
	(contact conformable)		
9	Siltstone and mudstone, strongly siliceous and dolomitic, quartzose, calcareous; dark grey to dark chocolate brown, weathers tan-yellow, resistant, grades to overlying rock	200	2,730
8	Siltstone and mudstone, calcareous, quartzose, slightly siliceous generally, in places highly siliceous, thinly bedded, medium		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	dark grey, fairly resistant, weathers tan-yellow, occasional rusty weathering interlayers	850	2,530
	Total thickness of Eids Formation	1,050	
	Stuart Bay Formation		
7	Siltstone, quartzose, calcareous, chocolate brown, minor dolomite interbeds and minor chert-pebble conglomerate, weathers yellow-tan, 30 to 38 feet from the top is an 8-foot interval of coarse boulder conglomerate with boulders up to 2 feet in diameter, rounded, black fragmental crinoidal, shaly limestone; overlain by black shaly limestone which shows intraformational slumping, dying out upward and grading into shaly limestone and limy shale of the overlying formation; boulders at the top of the unit contain crinoid fragments (GSC loc. 67737)	1,000	1,680
6	Dolomite, sugary, fine-grained, light to light grey, weathering light grey, medium bedded, bluff former	150	680
5	Covered, the rubble is a thinly bedded siltstone	120	530
4	Siltstone, quartzose, very limy, minor chert-pebble conglomerate, chocolate brown, fairly resistant	45	410
3	Shale, limy, dark grey, recessive	50	365
2	Limestone, very shaly, very petroliferous, well-rounded chert pebbles up to 1 inch in diameter, thin bedded, weathers medium light grey, contains fossils (GSC loc. 67736)	15	315
	Total thickness of Stuart Bay Formation	1,380	
	Bathurst Island Formation		
	(contact disconformable)		
1	Siltstone	300	300

SECTION 20. Young Inlet, east; a northwest-dipping section beginning at latitude 76°28′N, longitude 98°37′W, about 5 miles east–northeast of the head of Young Inlet. Thicknesses measured by scale on aerial photograph A–16761–195.

	MELVILLE ISLAND GROUP		
	Hecla Bay Formation		
	LOWER MEMBER		
13	Sandstone, quartzose, medium to coarse grained, yellow-orange, weathering yellow-orange, limonitic spots; this unit contains GSC plant locs. 8409 to 8412, and GSC locs. 83331 and 83332	146	8,668
	Bird Fiord Formation		
	(contact conformable)		
12	Sandstone, quartzose, usually calcareous, medium grained, yellow-orange, weathers yellowish orange, crossbedded and ripple-		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	marked; this unit contains GSC plant locs. 8403 to 8408 and GSC locs. 83327 to 83330	506	8,522
11	Sandstone, quartzose, medium grained, calcareous, generally light grey, slightly greenish, chert fragments, weathers greenish, alternates with abundant dark greenish grey sandy shale, many trails on surfaces, largely covered, sand ledges protrude; the unit contains GSC plant locs. 8397 to 8402 and GSC locs. 83322 to 83326	560	8,016
10	Shale, greenish, non-calcareous, recessive; this unit contains GSC plant locs. 8395 and 8396	38	7,456
	From conodonts and spores McGregor and Uyeno (1972) regard this formation as Eifelian and Givetian.		
	Total thickness of Bird Fiord Formation	1,104	
	Blue Fiord Formation		
	(contact conformable)		
9	Limestone, variable, largely covered, medium light grey to dark grey, shaly, fossils occur in big blocks; uppermost 30 feet form an outcropping limestone bluff, micritic, fragmental, medium light brown, weathers yellowish brown, slightly greenish, greenish shale partings; the unit contains GSC plant locs. 8390 to 8394 and GSC locs. 83317 to 83321	558	7,418
8	Limestone, crinoidal in places, shaly, medium brown, medium bedded, weathers very light brown; this unit contains GSC plant locs. 8388 to 8390 and GSC locs. 83311 to 83316. At the base (GSC loc. 67018) Klapper identified *Icriodus* cf. *corniger*	347	6,860
	From conodonts and spores McGregor and Uyeno (1972) regard the formation as Eifelian.		
	Total thickness of Blue Fiord Formation	905	
	Eids Formation		
	(contact conformable)		
7	Mudstone, calcareous, siliceous, dark chocolate brown, dolomitic, weathers light brownish grey, thin to medium bedded, conchoidal fracture, upper 100 feet covered, becoming more limy upward	845	6,513
6	Limestone, very siliceous, dolomitic, shaly, common chert nodules, dark grey, weathers very light, brownish grey, thin bedded to fissile, weathering shows laminae, sharp clinkery sound on striking, toward top it becomes dark chocolate brown, grading into the overlying unit, *Tentaculites* and trails occur; this unit contains GSC plant locs. 8385 and 8386 and GSC loc. 83310. X-ray analysis showed the following composition: specimen 8385; height 85 feet—calcite 66%, quartz 28%, dolomite 3%, illite 2%, kaolinite 1%; specimen 8386—calcite 80%, quartz 17%, dolomite 3%	1,000	5,668
	From spores and conodonts McGregor and Uyeno (1972) regarded the formation as late Emsian and Eifelian.		
	Total thickness of Eids Formation	1,845	

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Stuart Bay Formation		
	(contact gradational)		
5	Limestone, very shaly, siliceous, dark grey to black, medium bedded, weathers light grey, partly replaced by black chert nodules; interbedded in equal amounts with faintly limy siliceous dark grey to black shale, weathering light grey; upward shale becomes more predominant grading to overlying rock, plants occur at the base in GSC loc. 67016; this unit contains GSC plant locs. 8383 and 8384, and GSC locs. 83307 to 83309	292	4,668
4	Sandstone, very fine grained, calcareous, yellow-brown to chocolate brown, weathers light yellow-tan, thin bedded; minor siltstone, chocolate brown, grades to dark grey shaly limestone at the top; this unit contains GSC plant locs. 8379 to 8382	345	4,376
3	Sandstone, very fine grained, quartzose, yellow-brown to chocolate brown, medium bedded; minor siltstones; this unit contains GSC plant locs. 8376 to 8378, and GSC locs. 83305 and 83306. GSC loc. 83306 at a height of 353 feet in this unit contains *Monograptus* cf. *M. yukonensis*, Jackson and Lenz, 1963, that was identified by R. Thorsteinsson and dated as late Siegenian to early Emsian	403	4,031
2	Sandstone, very fine grained, quartzose, calcareous, chocolate brown, weathers tan, lesser amounts of siltstone, occasional sandy crinoidal limestone; chert-pebble conglomerate at the base; at a height of 200 feet is GSC loc. 67014; at the top is GSC loc. 67015 (graptolites). This unit contains GSC plant locs. 8371 to 8375, and GSC locs. 83299 to 83304	280	3,628
	From spores and conodonts McGregor and Uyeno (1972) regarded the formation Emsian, with possibly some Siegenian at the base.		
	Total thickness of Stuart Bay Formation	1,320	
	Bathurst Island Formation		
	contact concordant (probably a regional unconformity)		
1	Sandstone, quartzose, very fine grained, calcareous, thin to medium bedded, medium dark grey to chocolate brown; abundant calcareous, quartz siltstone, which is thin bedded, chocolate brown, weathers tan; at the top are graptolites, GSC locs. 67012.		
	D. C. McGregor collected the following samples in this formation, GSC plant locs. 8343 to 8370 and T. T. Uyeno collected GSC locs. 83292 to 83298. According to McGregor and Uyeno (1972) GSC loc. 83298, 30 feet below the top of the formation, contains *Nowakia* sp. and *Styliolina* sp. (identified by A. W. Norris), plant megafossils including *Rebuchia* n. sp., *Drepanophycus spinaeformis* Goeppert, *Sawdonia ornata* (Dawson) Hueber, and a new genus of zosterophylloid line (identified by F. M. Hueber), and *Monograptus* sp. cf. *M. thomasi* Jaeger (1966) (identified by R. Thorsteinsson and dated as probably Siegenian or Emsian). On the basis of these fossils, McGregor		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	and Uyeno (1972) regard the formation as probably Siegenian	3,348	3,348
	Exposed thickness of Bathurst Island Formation	3,348	
	Base of section at lower limit of exposure		

SECTION 21. Young Inlet, southeast; section begins a latitude 76°21′N, longitude 98°35′W, about 6 miles south–southeast of the southern end of the east branch of Young Inlet. Thicknesses measured by scale on aerial photograph A–16761–193.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Bird Fiord Formation		
21	Sandstone, calcareous; limestone, arenaceous, dark greenish to light greenish	300	6,645
	Observed thickness of Bird Fiord Formation	300	
	Blue Fiord Formation		
	(contact conformable)		
20	Limestone, dark grey, medium bedded, shaly, with shaly interlayers; weathering yellow-brown; limestone, sandy, weathering yellow-brown, grades abruptly to overlying formation	870	6,345
	Total thickness of Blue Fiord Formation	870	
	Eids Formation		
	(contact conformable)		
19	Shale and mudstone, very siliceous, calcareous, dolomitic, fetid, thin bedded, dark grey to black, weathers medium light grey to light tan, interbedded with dark limy fissile shale, *Tentaculites* abundant, at the top unit becomes dark very shaly limestone and limy shale and grades to overlying formation; the formation here is the resistant so-called clinkery facies of the Eids	850	5,475
	Total thickness of Eids Formation	850	
	Stuart Bay Formation		
	(contact conformable)		
18	Limestone, fragmental, constituting patch reefs, grading laterally to sandy limestones, very petroliferous, thickness varies, the width is a minimum of 50 feet; GSC loc. 67735	15	4,625
17	Limestone, fragmental, sandy	40	4,610
16	Limestone, massive, constituting a patch reef, grading to sandy limestone and limy sandstone laterally	20	4,570
15	Limestone, fragmental, medium bedded	10	4,550

Unit	Lithology	Thickness (feet)	Height above base (feet)
14	Limestone, boulders up to 4 feet in diameter of poorly rounded to rounded, medium light grey fragmental limestone and pellet limestone with some white subrounded chert fragments; GSC loc. 67734	20	4,540
13	Limestone, fragmental, medium grey, weathers medium grey, thick bedded, ledge forming	35	4,520
12	Sandstone, quartzose, dark grey, dolomitic, fine grained, weathers tan-brown, a typical flagstone, thin bedded, interbedded with about 30% of medium brown sugary dolomite	300	4,485
11	Dolomite, sugary, medium dark grey, contains irregular black chert nodules, blocky, sharp contact at the base of this unit	40	4,185
10	Sandstone, quartzose, shaly, the base is marked by pebble-conglomerate, grading up to sandstone and some mudstone; chocolate brown; non-calcareous; at a height of 500 feet is GSC loc. 67028	650	4,145
9	Sandstone, quartzose, fine grained, shaly, shaly siltstone, mudstone; all are calcareous, dark chocolate brown, weathering tan; *Tentaculites* observed in places, grading to entirely mudstone at the top	340	3,495
8	Conglomerate, fine, pebbles with maximum diameter of 2 inches are of tan, white, grey-green, orange, dark grey, and red chert, and limestone; pebbles are angular to subrounded; also sandy limestone interbeds; in upper 20 feet is GSC loc. 67733 containing intact brachiopods that are probably indigenous and broken corals that possibly are not	105	3,155
7	Limestone, quartz sandy, fine grained; sandstone, limy, medium light grey, weathering tan; graptolites present at a height of 80 feet in GSC loc. 67732	190	3,050
6	Siltstone, limy, dark grey to chocolate brown, weathers tan, thin bedded, minor fine-grained sandstones; *Tentaculites*	125	2,860
5	Covered, sandy limestone and limy sandstone, probably as below	75	2,735
4	Limestone, quartz sandy; quartz sandstone, limy; medium light grey, weathering tan, a few conglomeratic interbeds, recessive	100	2,660
3	Conglomerate, fine grained, thick bedded to massive, pebbles of limestone and chert, forms resistant ledge	45	2,560
2	Conglomerate, coarse pebbles of medium grey limestone up to 4 inches in diameter, and of white grey, black, cream, or red chert that are up to 2 inches in diameter; thick bedded to massive; a sandy limestone constituting a resistant ledge contains GSC loc. 67731; this unit is in three cycles which upward are coarse to fine	15	2,515
	Total thickness of Bathurst Island Formation	2,125	
	Bathurst Island Formation		
	(contact unconformable)		
1	Siltstone, shaly, calcareous, dark grey-brown, sandstone, fine grained, medium grey-green, fish fragments are common	2,500	2,500
	Exposed thickness of Bathurst Island Formation	2,500	
	Base of section at lower limit of exposure		

Unit	Lithology	Thickness (feet)	Height above base (feet)

SECTION 22. Green River; a north-dipping section beginning at latitude 76°26′N, longitude 98°10′W, at the headwaters of Green River in the core of a faulted anticline. Thicknesses measured by scale on aerial photograph A–16202–26.

	Bird Fiord Formation		
13	Sandstone, quartzose, calcareous, medium to light grey-green; alternating with dark grey-green shale intervals	800	8,605
	Blue Fiord Formation		
	(contact conformable)		
12	Limestone, brown, shaly, thin to medium bedded; GSC loc. 67104	600	7,805
11	Limestone, micrite rather pure, cream, medium bedded; GSC loc. 67103	900	7,205
	Total thickness of Blue Fiord Formation	1,500	
	Disappointment Bay Formation		
	(contact conformable)		
10	Dolomite, generally porous, more finely porous upward, cream coloured, vuggy at base	1,300	6,305
	Stuart Bay Formation		
	(contact conformable)		
9	Siltstone, sandstone, minor limestone	1,300	5,005
	Bathurst Island Formation		
	(contact disconformable?)		
8	Siltstone, quartzose, brown, medium bedded, and some thin bedded, weathering light greenish grey to yellow-tan, largely covered during this interval	2,200	3,705
	Total thickness of Bathurst Island Formation	2,200	
	Cape Phillips Formation		
	(contact conformable)		
7	Siltstone, shaly, brown, slightly calcareous, weathers slightly greenish grey to yellow-tan, thinly bedded, grades to overlying formation by increase in siltiness, also becomes thicker bedded and more calcareous	200	1,505
6	Covered interval, dark grey fissile shale, grades to brownish, slightly calcareous siltstone; in talus at a height of 50 feet in unit; abundant cf. *Monograptus bohemicus* lies loose, probably is closely derived	500	1,305
5	Limestone, medium light grey, thinly bedded; GSC loc. 67102	85	805
4	Shale; at height of 65 feet is GSC loc. 67100; at 145 feet is GSC loc. 67101	365	720

Unit	Lithology	Thickness (feet)	Height above base (feet)
3	Shale, medium bedded, silty, dolomitic, light chocolate brown, weathers slightly rusty brown, resistant; GSC loc. 67099	30	355
2	Shale, fissile to thin bedded; loose at a height of 100 feet is GSC loc. 67098	200	325
	Total thickness of Cape Phillips Formation	1,380	
	CORNWALLIS GROUP		
	Irene Bay Formation		
	(contact conformable)		
1	Limestone, thin bedded, micrite, greenish shale interlayers, weathers green, slightly rusty, rusty weathering tinge	125	125
	Observed thickness of Irene Bay Formation	125	
	Lower limit of exposure at a fault		

SECTION 23. Cape Kitson; section begins at the centre of an anticline at latitude 76°29′N, longitude 97°40′W, a mile southwest of Cape Kitson on northeastern Bathurst Island and continues to the southwest. Thicknesses measured in part by staff and in part by scale on aerial photograph A–16202–127.

	Stuart Bay Formation		
	(upper contact covered)		
9	Siltstone, quartzose, very calcareous, thinly bedded; interbeds of medium bedded, brownish, shaly crinoidal limestone; this unit is mainly covered except for the limestone outcrops with a few interbedded reefs; limestone interbeds in the lower part (GSC loc. 67121) contains *Levenea* sp., *Gypidula*? sp., *Leptaena* sp., indet., rhynchonellid with colour markings, *Atrypa* "*reticularis*", and an indeterminate coral; this faunule was identified by Johnson and Boucot, who regard it as of Early or Middle Devonian age	250	
	Cape Phillips Formation		
8	(Gap in exposures, with unknown thickness covered)	?	
7	Limestone, shaly, nodular, shale interbeds, medium light brown, weathers yellow-tan, very sporadically exposed; at a height of approximately 425 feet is GSC loc. 67120	800	1,413
6	Shale, fissile, papery, biserial graptolites, grades up to slightly shaly limestone	20	613
5	Limestone, shaly, brown, coquina of straight cephalopods	3	593
4	Shale, fissile, papery, black	20	590
	CORNWALLIS GROUP		
	Irene Bay Formation (assumed)		
3	Gap in outcrop equivalent to 130 feet of rock	130	570

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Thumb Mountain Formation		
	(contact conformable?)		
2	Dolomite, light tan, crystalline with cherty nodules, fossils of the "Arctic Ordovician fauna" (GSC loc. 67119) present, upper contact covered	340	440
1	Dolomite, dark brown, markedly cherty, vuggy, fetid, shattered, rubble only is exposed in this interval	100	100
	Exposed thickness of Thumb Mountain Formation	440	
	Base of section at lower limit of exposure		

SECTION 25. Twilight Creek; section beginning at latitude 76°11'N, longitude 99°10'W, at the mouth of Twilight Creek and continuing upstream to the northwest. Lithologic descriptions are taken from McLaren (1963b) and supplemented with revised faunal identifications and datings. It is published here because it is a key section containing the type sections of the Bathurst Island and Stuart Bay Formations.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Eids Formation		
	This formation continues upward and is mainly mudstone and shale, calcareous, grey, with some beds of argillaceous limestone, soft weathering		
10	Calcareous shale, black, interbedded in nearly equal amounts of medium-bedded highly variable limestone; the basal unit yielded fragmentary fauna (GSC loc. 25837): indet. dalmanellid *Leptaena*? sp. indet. stropheodontids *Phragmostrophia* sp. large indet. rhynchonellids *Atrypa "reticularis"* smooth reticulariids (not *Ambocoelia*) Boucot, Johnson and Harper identified the fauna and state that on the basis of *Phragmostrophia* the collection is of Emsian age At the base is GSC loc. 83702 and at a height of 20 feet is GSC loc. 83703. These were collected by Uyeno, who identified the following fossils in both collections; *Polygnathus foveolatus* Philip and Jackson, *Spathognathodus* n. sp., *Ozarkodina* n. sp. Uyeno (pers. com., 1971) dated these collections as Emsian	90	6,235
	Stuart Bay Formation (type section)		
	(contact conformable)		
9	Sandstone, quartzose, argillaceous and calcareous, brownish grey, uniformly fine grained, thin bedded and laminated; interbedded near the top and bottom with black sandy mudstone		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	and siltstone; homogeneous, weathers to yellowish brown flagstone fragments, 1 to 2 inches thick	565	6,145
8	Mudstone, silty, calcareous, thin bedded, dark grey, soft weathering and shaly; single beds of fine-grained greyish brown limestone occurring at irregular intervals, commonly are less than a foot thick, they may increase a short distance along strike to small biohermal masses, several feet thick; some intervals of crinoidal and shell fragments. At a height of 135 feet in this unit is GSC loc. 25835, containing *Schizophoria* sp. A *Parachonetes* aff. *macrostriatus* (brachial valve) "*Leiorhynchus*" sp. A *Atypra* "*reticularis*" *Carinatina* ? sp. (brachial valves) *Elythyna*? sp. reticulariid (smooth) 2-hole crinoid ossicles Boucot, Johnson and Harper identified this fauna and dated it as Emsian (pers. com., 1971)	220	5,580
7	Sandstone, quartzose, thin bedded, fine grained, laminated, argillaceous with interbedded calcareous sandstone	415	5,360
6	Mudstone, calcareous, sandy, and argillaceous sandstone; contains three pebble beds, varying in thickness along strike from about 9 inches to 2 feet, of well-rounded pebbles of grey chert and brown aphanitic limestone in a calcareous sandy matrix; along strike these pebbles grade into irregular beds of pale brown, fine-grained limestone; limestone pockets in the basal pebble beds (GSC loc 25834) include the following fauna: *Parachonetes* aff. *macrostriatus* (ped. valve) *Atrypa* "*reticularis*" *Carinatina* ? sp. (brachial valve) pauciplicate spirifer (brac. valve) This fauna is regarded as Emsian by Boucot, Johnson, and Harper (pers. com., 1971)	20	4,945
	Total thickness of Stuart Bay Formation	1,220	
	Bathurst Island Formation (type section) (disconformity?)		
5	The formation consists largely of fairly fine grained quartzose sandstone, variably argillaceous and calcareous, and calcareous sandy mudstones. In fresh surface the formation is formed of monotonous well-bedded flagstones that weather yellowish brown to pale brown; there are varying amounts of mudstone or sandstone, but the formation is strikingly homogeneous; calcareous and argillaceous, quartzose sandstones alternate with calcareous, sandy, and silty, thin-bedded mudstones. The formation contains graptolites identified by Thorsteinsson at various heights above the base: At 3,310 feet (GSC loc. 25831) *Monograptus yukonensis* Jackson and Lenz 1963 At 3,230 feet (GSC loc. 25832) *Monograptus yukonensis* Jackson and Lenz 1963		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	At 3,150 feet (GSC loc. 25833) *Tentaculites* *Monograptus yukonensis* Jackson and Lenz 1963 At 3,000 feet (GSC loc. 25829) *Tentaculites* *Monograptus* n. sp. aff. *M. hercynicus* Perner At 2,490 feet (GSC loc. 25837) *Monograptus yukonensis* Jackson and Lenz 1963 *Monograptus yukonensis* Jackson and Lenz 1963 had earlier been called *Monograptus* n. sp. A by Thorsteinsson (Berdan *et al.*, 1969). Following Klapper (1969) this species is dated as Early Devonian, and more specifically as Siegenian or early Emsian (Thorsteinsson, pers. com., 1971)........	3,410	4,925
	Total thickness of Bathurst Island Formation..........	3,410	
	Cape Phillips Formation (contact transitional)		
4	Shale and mudstone, black, largely non-calcareous but dolomitic in the lower parts, some bands of dark grey argillaceous dolomite, some of which are irregular in thickness while others are nodular and discontinuous; the dolomite bands weather prominent orange-yellow; many of the black mudstones and shales are strongly petroliferous; in the upper 200 feet of the formation the shales are interbedded with equal amounts of dark grey, argillaceous and calcareous siltstone which is thin bedded and laminated and weathers into pale reddish brown fragments. Graptolites of the Cape Phillips Formation were identified and dated by R. Thorsteinsson (pers. com., 1971), and shelly faunas were identified and dated by G. W. Sinclair. Faunas and their heights above the base of this unit are as follows: At 945 feet (GSC loc. 25824) *Ceratiocaris* sp. indet. *Monograptus* n. sp. B aff. *M. angustidens* Přibyl age: uppermost Pridolian At 935 feet (GSC loc. 25824) *Monograptus* cf. *M. uniformis* Přibyl age: Gedinnian (*M. uniformis* represents the basal zone of lowermost Devonian, or Gedinnian) At 735 feet (GSC loc. 25822) Orbiculoid brachiopods *Ceratiocaris* aff. *C. acuminatus* Hall At 405 feet (GSC loc. 25820) *Monograptus transgradiens praecipuus* Přibyl age: late Pridolian At 295 to 375 feet (GSC locs. 25818 and 25821) *Monograptus* sp. indet. At 205 feet (GSC loc. 25817) *Monograptus* sp. indet. At 195 feet (GSC loc. 25815) *Plectograptus macilentus* (Tornquist) *Monograptus bohemicus* (Barrande) *Monograptus nilssoni* (Barrande)		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Monograptus cf. *M. crinitus* Wood *Monograptus* spp. indet. age: lower Ludlovian	950	1,515
3	Mudstone and shale, calcareous, black; with thin beds of argillaceous limestone in the basal 20 feet; banded and laminated mudstones with varying amounts of pyrite, especially in the lower part; weathered surfaces are pale yellowish brown to orange-brown, faunas and their heights above the base of the unit include: At 245 to 355 feet (GSC loc. 25814) *Paraplectograptus eiseli* (Manck) *Plectograptus textor* Bouček and Munch *Monograptus* cf. *M. flemingii* (Salter) *Monograptus* cf. *M. vomerinus* (Nicholson) *Cyrtograptus trilleri* (Eisel) age: uppermost Wenlockian At 120 to 245 feet (GSC loc. 25813) *Paraplectograptus eiseli* (Manck) *Plectograptus textor* Bouček and Munch *Monograptus flemingii* (Salter) *Monograptus* cf. *M. latus* M'Coy *Monograptus* cf. *M. vomerinus* (Nicholson) *Cyrtograptus lundgreni* Tullberg age: upper Wenlockian At 70 to 120 feet (GSC loc. 25812) *Monograptus* cf. *M. priodon* (Bronn) *Cyrtograptus* sp. indet. age: probably lower part of Wenlockian series At 30 to 70 feet (GSC loc. 25811) are the following: *Stomatograptus robustus* Bouček *Monograptus convolutus coppingeri* Etheridge *Monograptus priodon* (Bronn) *Monograptus* cf. *M. personatus* Tullberg *Monograptus* spp. indet. *Cyrtograptus* n. sp. aff. *C. centrifugus* Bouček age: uppermost Llandovery At 0 to 30 feet (GSC loc. 25810) *Stomatograptus grandis* (Suess) *Stomatograptus robustus* (Bouček) *Monograptus spiralis spiralis* (Geinitz) *Monograptus* cf. *M. priodon* (Bronn) *Monograptus* n. sp. aff. *M. vomerinus* (Nicholson) *Cyrtograptus lapworthi* Tullberg *Cyrtograptus* n. sp. aff. *C. centrifugus* Bouček age: late Llandovery (penultimate and ultimate zones)	360	565
2	Shale, calcareous, black, with varying amounts of interbedded argillaceous limestone, which is fine grained and laminated, weathering into thin flagstones; faunas and their heights above the base of this unit are as follows: At 65 to 115 feet (GSC loc. 25809) *Monograptus* cf. *M. priodon* (Bronn) *Monograptus* sp. aff. *M. vomerinus* (Nicholson) age: upper Llandoverian or lower Wenlockian At 40 to 60 feet (GSC loc. 25808) *Monograptus turriculatus turriculatus* (Barrande)		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Monograptus turriculatus minor Bouček *Monograptus* cf. *M. jaculum* (Lapworth) *Monograptus* cf. *M. conspectus* (Přibyl) age: upper Llandoverian At 35 feet (GSC loc. 25807) *Climacograptus* cf. *C. scalaris* Linnarsson *Petalograptus* cf. *P. palmeus* (Barrande) *Monograptus millepeda* M'Coy *Monograptus* cf. *M. regularis solidus* Přibyl *Monograptus* sp. indet. age: lower Llandoverian At a height of 15 feet (GSC loc. 25806) *Climacograptus* sp. indet. *Monograptus* sp. indet. *Rastrites* sp. indet. age: Llandoverian	130	205
1	Limestone, fine grained, variably argillaceous, black and grey, with interbeds of black calcareous mudstone and shale; some of the limestone beds are strongly petroliferous and others are nodular, mottled, and aphanitic; faunas and their heights above the lowest exposures are: At 60 feet (GSC loc. 25805) *Streptelasma* sp. *Foerstephyllum*? sp. straight cephalopod *Illaenus* sp. Sinclair considered the age to be Middle or Late Ordovician At 15 to 25 feet (GSC locs. 25802 and 25804) *Orthograptus* n. sp. which Thorsteinsson regards as Late Ordovician in age Near the base (GSC loc. 25803) *Lophospira* cf. *L. milleri* (Hall) *Straparollina* n. sp. "*Orthoceras*" spp. abundant asaphid trilobites (two genera) *Leperditella*? sp.	75	75
	Exposed thickness of Cape Phillips Formation	1,515	
	Base of section at lower limit of exposure		

SECTION 27. Half Moon Bay, west; a composite section in the Half Moon Bay structure on the east side of May Inlet at latitude 76°02′30″N, longitude 99°55′W. All strata up to the Eids Formation measured on the south flank; Eids and younger formations measured on the north flank. Thicknesses measured by scale on aerial photographs A–16203–45 and A–16203–146 (*see* Fig. 4 and Pl. XVI).

Bird Fiord Formation

(upper limit of exposure)

13 Sandstone, quartzose, very limy, micaceous; sandy limestone; sandy shale; limy shale; dark grey-green, dark green, brownish

Unit	Lithology	Thickness (feet)	Height above base (feet)
	green, resistant, limy sandstone and sandy limestone, alternating with shales which are dark green	2,300	8,031
	Exposed thickness of Bird Fiord Formation	2,300	
	Blue Fiord Formation		
	(contact conformable)		
12	Limestone, micritic, thin to medium bedded; shaly interlayers give irregular wavy surfaces to bedding planes; biostromal; contains GSC loc. 67026 and GSC loc. 67027	45	5,731
	Total thickness of Blue Fiord Formation	45	
	Eids Formation		
	(contact conformable)		
11	Siltstone and mudstone, quartzose, very limy, medium grey to tan, soft, crumbly, recessive, limestone interbeds near top but grading sharply to the overlying unit, cross-laminae occur most commonly at the base, gradational with lower unit, thickness uncertain because of a possibility of deformation	1,400	5,686
	Total thickness of Eids Formation (approx.)	1,400	
	Stuart Bay Formation		
	(contact conformable)		
10	Siltstone, thin to medium bedded, slightly calcareous; interbedded mudstone and shale, orange weathering; at base is soft sediment deformation	1,400	4,286
9	Pebble-conglomerate, siltstone matrix, pebbles of white chert and crinoidal fragments, GSC loc. 67092	60	2,886
	Total thickness of Stuart Bay Formation	1,460	
	Bathurst Island Formation		
	(contact angular unconformity)		
8	Siltstone, thin bedded to fissile, fine grained; sandstone, very fine grained; shale, rarely calcareous; dark brown to dark grey; weathers tan-brown; at the base are GSC locs. 67024 and 67091 with graptolites and fish fragments	1,150	2,826
	Total thickness of Bathurst Island Formation	1,150	
	Cape Phillips Formation		
	(contact conformable)		
7	Shaly, dark grey, slightly calcareous, thin bedded to fissile; siltstone; minor limestone, grading sharply upward to the overlying formation	650	1,676
6	Limestone, argillaceous, dark grey to dark chocolate brown, thin bedded; much dark grey calcareous shale and some dark grey calcareous siltstone; graptolites common; grades very gradually to overlying shale unit	650	1,026

Unit	Lithology	Thickness (feet)	Height above base (feet)
5	Limestone, fine grained, medium brown	34	376
4	Shale, black, calcareous, silty, some siltstone, very soft; biserial graptolites	40	342
3	Limestone and dolomite, medium bedded, mottled, the limestone is dark grey, the dolomite is grey-brown	37	302
	Total thickness of Cape Phillips Formation	1,411	
	CORNWALLIS GROUP		
	Irene Bay Formation		
	(contact conformable)		
2	Shale, calcareous, green; interbedded with thin bedded, micritic limestone, with fossil fragments, recessive; minor black shale, calcareous	65	265
	Total thickness of Irene Bay Formation	65	
	Thumb Mountain Formation		
	(contact conformable)		
1	Limestone, micritic, medium grey to grey-brown, shaly interlayers present and weathers greenish or rusty yellow, medium bedded	200	200
	Exposed thickness of Thumb Mountain Formation	200	
	Base of section at lower limit of exposure		

SECTION 28. Half Moon Bay, east; section on the east side of a dome in the Half Moon Bay structure, beginning at latitude 76°02′30″N, longitude 99°55′W, and continuing first east and then south through a major stream-cut. Thicknesses measured by scale on aerial photograph A–16203–146 (*see* Fig. 4 and Pl. XVI).

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Eids Formation		
	(upper limit of outcrop)		
9	Siltstone and mudstone, very limy, medium grey to tan, soft crumbly; lower part very recessive, upper part moderately resistant; specimen K1-63-69c taken from a height of 1,000 feet showed the following X-ray analysis: calcite 49%, quartz 34%, dolomite 6%, illite 5%, feldspar 3%, kaolinite 2%, pyrite 1%, and a trace of chlorite	1,100	6,565
	Stuart Bay Formation		
	(contact conformable)		
8	Siltstone, medium bedded, weathering orange, slightly calcareous, mudstone interbeds and fissile black calcareous shale; at a height of 20 feet is GSC loc. 67088; at 675 feet is GSC loc. 67089; at 1,175 feet is GSC loc. 67090	1,380	5,465

Unit	Lithology	Thickness (feet)	Height above base (feet)
7	Siltstone, thin to medium bedded, often flaggy, hard, yellow-orange weathering, thin crinoid beds at base; at a height of 10 feet is GSC loc. 67086; at 155 feet is GSC loc. 67087	170	4,085
	Total thickness of Stuart Bay Formation	1,550	
	Bathurst Island Formation (contact conformable)		
6	Siltstone, thin bedded, fine grained; at a height of 15 feet is GSC loc. 67082; at 30 feet is GSC loc. 67083; at 175 feet is GSC loc. 67084; at 300 feet is GSC loc. 67085	305	3,915
5	Siltstone, thin bedded to fissile, recessive, slump structures common with movement toward the south; at a height of 575 feet is a one-foot limestone interbed; between 755 and 785 feet limestone interbeds are common, and comprise 25% of the rock; at a height of 770 feet is GSC loc. 67081	785	3,610
4	Siltstone, coarse, very fine grained sandstone, thin to medium bedded, intraformational slumping to the south, very minor black shale interbeds; at a height of 200 feet is GSC loc. 67080	225	2,825
3	Siltstones, dark brown to dark grey, calcareous, flaggy, interbedded with about equal amounts of shale, fissile, calcareous, at 100 feet from the top is flagstone with tarry bituminous liquid, the top is fissile and graptolites are present (GSC loc. 67079)	1,800	2,600
2	Siltstone, medium brown, limy, yellow-tan weathering, flagstones to fissile	500	800
	Total thickness of Bathurst Island Formation	3,615	
	Cape Phillips Formation (contact conformable)		
1	Shale, limestone	300	300
	Observed thickness of Cape Phillips Formation	300	

SECTION 29. Reindeer Bay; an east-dipping section of the Melville Island Group above an angular unconformity. Section begins at latitude 76°14′30″N, longitude 97°40′W, about 1½ miles inland from the east coast of Bathurst Island in the course of a northeasterly flowing stream that enters the sea at a delta 5 miles south of Reindeer Bay. Thicknesses measured by staff. Section visible on aerial photographs A–16202–48.

MELVILLE ISLAND GROUP

Griper Bay Formation

MEMBER B

Unit	Lithology	Thickness (feet)	Height above base (feet)
11	Sandstone, quartzose, fine grained, weathers dark grey-green	40	1,305
10	Shale	35	1,265
9	Sandstone, quartzose, fine grained, medium light grey-green, non-calcareous, impure, small scale cross-laminae, at about 30 feet above base of unit a shale interbed (GSC loc. 59041) are the following spores: *Acanthotriletes hirsutus* Chibrikova		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	cf. *A. uncatus* Naumova cf. *Archaeozonotriletes famenensis* Naumova ?*A. micromanifestus* var. *famenensis* Naumova *Biharisporites* sp. *Calamospora atava* (Naumova) McGregor *Cyclogranisporites* (2 species) *Hymenozonotriletes deliquescens* Naumova var. *cinctus* Chibrikova *H. parvimammatus* (Naumova) Kedo *Hystricosporites* sp. *Lophozonotriletes cristifer* (Luber) Kedo *L. tylophorous* Naumova *Perotrilites* (2 species) *Pustulatisporites gibberosus* (Hacquebard) Playford *Retusotriletes* cf. *R. subgibberosus* Naumova ?*Stenozonotriletes definitus* Naumova *Stenozonotriletes* (2 species) The foregoing spores were identified by D. C. McGregor and dated as probably early Famennian (McGregor, pers. com., 1974)........	140	1,230
8	Shale, at 60 feet (GSC plant loc. 7256) are the following spores: cf. *Ancyrospora simplex* Guennel ?*Archaeotriletes membranus* Kedo ?*Archaeozonotriletes famenensis* Naumova *Calamospora* sp. *Contagisporites optivus* (Chibrikova) Owens cf. *Cornispora* sp. (? = *Anisozonotriletes bicornis* Nazarenko) *Cymbosporites* sp. (same as in 7254) *Hymenozonotriletes parvimammatus* Naumova *Hystricosporites* sp. *Lophozonotriletes cristifer* (Luber) Kedo *L. excisus* Naumova *L. grandis* Naumova *Perotrilites perinatus* Hughes and Playford The foregoing spores were identified by D. C. McGregor, who states that the most likely age is early Famennian....	125	1,090
7	Sandstone, fine grained, quartzose, impure, interbeds of siltstone that are similar; minor light grey-green shale interbeds; the sand is ripple-marked, crossbedded and surface marked; top marked by 3-foot limestone interbed...........	175	965
6	Shale, dark grey-green, fissile, interbedded with medium grey-green siltstone beds up to 3 inches thick, very occasional olive-grey to brown limestone beds, top is marked by a 5-foot brown limestone interbed; at a height of 5 feet (GSC plant loc. 7254) are the following spores: *Biharisporites* sp. cf. *Cornispora* (? = *Anisozonotriletes bicornis* Nazarenko) ?*Cymbosporites* (2 species) *Hymenozonotriletes parvimammatus* Naumova *Hystricosporites* (2 species) *Lagenicula devonica* Chaloner *Lophozonotriletes cristifer* (Luber) Kedo *L. excisus* Naumova		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Perotrilites perinatus Hughes and Playford		
	?*Stenozonotriletes simplex* Naumova		
	The foregoing spores were identified by D. C. McGregor who states that the age is probably early Famennian, but that the possibility of a latest Frasnian age could not be definitely eliminated		
	At 80 feet (GSC plant loc. 7255) are the following spores:		
	?*Archaeozonotriletes famenensis* Naumova		
	?*A. foveolatus* Naumova		
	cf. *A. polymorphus* Naumova		
	Calamospora sp.		
	cf. *Cornispora* (? = *Anisozonotriletes bicornis* Nazarenko)		
	Cymbosporites sp.		
	?*Dibolisporites* sp. (same as in GSC loc. 65800)		
	?*Hymenozonotriletes denticulatus* Naumova		
	H. parvimammatus Naumova		
	?*H. spinulosus* Naumova		
	Hystricosporites sp.		
	Lophozonotriletes grandis Naumova		
	L. cristifer (Luber) Kedo		
	L. curvatus Naumova		
	Perotrilites sp.		
	Phyliothecotriletes sp.		
	?*Stenozonotriletes simplex* Naumova		
	Triangulatisporites rootsii Chaloner		
	The foregoing spores were identified by D. C. McGregor, who dated them as late Frasnian or early Famennian, probably early Famennian	90	790
5	Sandstone, quartzose, fine grained, impure, medium greenish grey, weathers greenish grey, grades abruptly upward to shale and siltstone above a 3-foot brown limestone interbed	50	700
4	Covered (possibly minor faulting)	100	650
3	Sandstone, quartzose, fine grained, impure, medium greenish grey, weathers greenish grey, lowermost 50 feet are gradational with the lower member which consists of orthoquartzite	150	550
	Preserved thickness of Member B	905	
	MEMBER A		
	(contact conformable)		
2	Sandstone, quartzose, very pure, light cream on fresh surfaces with faint rusty bands, weathers faintly rusty tan, thick bedded, medium grained, subrounded	200	400
	Total thickness of Member A	200	
	Preserved thickness of Griper Bay Formation	1,105	
	Hecla Bay Formation		
	(angular unconformity)		
	LOWER MEMBER		
1	Sandstone, quartzose, light grey to white, weathering slightly rusty light grey	200	200
	Observed thickness of Hecla Bay Formation	200	

Unit	Lithology	Thickness (feet)	Height above base (feet)

In the next major stream, 4 miles south of Section 29 and about 3 miles inland from the coast, a collection (GSC loc. 59040) was made in Member B, at about 1,300 feet above the base of the formation and higher than anything in Section 29 (*see* Kerr, McGregor, and McLaren, 1965). GSC loc. 59040 contains both shelly fauna and spores. The shelly fauna includes:

Acanthatia ? sp.
Basilicorhynchus sp.
Ptychomaletoechia? sp.
rhynchonellid indet.
Cyrtospirifer cf. *C. animasensis* (Girty)
Cyrtospirifer sp.
orthocone nautiloid fragments
These were identified by D. J. McLaren and dated as early Famennian (pers. com., 1971)

The spores from GSC loc. 59040 include:

cf. *Acanthotriletes gratus* Kedo
A. famenensis Naumova
cf. *Archaeozonotriletes famenensis* Naumova
?*A. notatus* Naumova
cf. *A. semilucensis* Naumova
Cyclogranisporites (2 species)
Endoculeospora sp. (?*Archaeozonotriletes subnotatus* Chibrikova)
Hymenozonotriletes inaequus McGregor
H. parvimammatus Naumova
H. versabilis Kedo
?*Lophozonotriletes crassus* Naumova
L. cristifer (Luber) Kedo
L. dentatus Hughes and Playford
cf. *L. macrogrumosus* Kedo
cf. *L. rarituberculatus* (Luber) Kedo
Perotrilites sp.
Pustulatisporites sp. (cf. *Acanthotriletes pullus* Naumova)
Reticulatisporites sp.
Retusotriletes cf. *R. pychovii* Naumova
Stenozonotriletes cf. *S. clarus* Ishchenko
Verrucosisporites cf. *V. rufus* Butterworth and Williams
The above spores were identified by D. C. McGregor, who considered them to be of Famennian age, probably early Famennian

SECTION 30. Moses Robinson River; a west–northwest-dipping section beginning at latitude 76°04′N, longitude 97°45′W in the valley of Moses Robinson River. It begins at a fault 3 miles inland from the mouth of that river and extends upstream (*see* Fig. 13). Thicknesses measured in part by staff and in part by scale on aerial photograph A–16202–52.

Bird Fiord Formation

10 Sandstone, quartzose, limy cement, micaceous, grey-green, dark green and medium grey, in places limonitic specks, thin to medium bedded, weathers grey-brown and grey-green; sandy limestone; dark greenish sandy shale; the sandstone beds are

Unit	Lithology	Thickness (feet)	Height above base (feet)
	resistant, and the shaly beds recessive; at a height of 50 feet is GSC loc. 67008; at 175 feet is GSC loc. 67009; at 225 feet is GSC loc. 67010	450	5,965
	Preserved thickness of the Bird Fiord Formation	450	
	Blue Fiord Formation		
	(contact conformable)		
9	Limestone, micritic, very light grey to light cream, weathering very light grey; thick bedded and micritic at base becoming medium bedded and slightly fragmental to top, upper and lower contacts gradational; at about 300 feet corals were collected in GSC loc. 67007	600	5,515
	Total thickness of the Blue Fiord Formation	600	
	Disappointment Bay Formation		
	(contact conformable)		
8	Dolomite, very light grey to cream, weathering light yellowish cream, sugary, medium to thick bedded; minor vuggy dolomite, grades upward to limestone of the overlying formation (the lower part of this unit in a creek 2 miles to the southwest was designated as the upper or B member of the Sherard Osborn Formation by Thorsteinsson and Glenister (1963, p. 591). It is suggested that the term Sherard Osborn Formation be abandoned	600	4,915
7	Sandstone, quartz and chert grains grading upward to dolomite. In the stream valley 2 miles to the southwest this unit thickens to 100 feet of conglomerate consisting of chert and quartz pebbles in a sandy dolomitic matrix. There the unit was assigned by Thorsteinsson and Glenister (1963, p. 591) to the upper part of Member A of the now abandoned Sherard Osborn Formation	10	4,315
	Total thickness of Disappointment Bay Formation	610	
	Stuart Bay Formation		
	(contact angular unconformity)		
6	Limestone, shaly, bioclastic, light grey, slightly brownish to dark grey-brown, weathering tan to yellow-grey, thin to medium bedded, abundant calcareous shaly siltstone interbeds. At the base is GSC loc. 67004, which yielded *Leptaenopyxis* cf. *bouei* Barr, and an indeterminate spirifer (Johnson, pers. com., 1971), as well as *Icriodus pesavis* (Uyeno, pers. com., 1971), and has been dated by those workers as Siegenian. At a height of 240 feet two faunules were collected: GSC loc. 67005, which yielded *Dalejina* sp., indeterminate dalmanellids, *Atrypa* "*reticularis*", *Favosites*, and *Icriodus pesavis*; and GSC loc. 67006, which yielded *Schizophoria* sp., an indeterminate orthotetacean, *Mesodouvillina*? sp., *Atrypa* "*reticularis*", and an indeterminate atrypoid. Johnson and Boucot identified these faunules, dating GSC loc. 67005 as Early Devonian, and GSC loc. 67006 as Early or Middle Devonian. GSC locs.		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	67004, 67005, and 67006 also yielded graptolites that are now under study	550	4,305
	Total thickness of the Stuart Bay Formation	550	
	Bathurst Island Formation		
	(regional angular unconformity)		
5	Siltstone, quartzose, limy, chocolate brown, thin bedded; silty limestone, argillaceous limestone, quartzose limestone, graptolites collected in the unit a mile to the south along strike include GSC loc. 67002 and GSC loc. 67003; [this unit and the overlying formation are on strike with and probably equivalent to the lower or carbonate part of Member A of the type section of the Sherard Osborn Formation (Thorsteinsson and Glenister 1963, p. 591); the present writer suggests in this report that the name Sherard Osborn Formation be dropped from use]	525	3,755
	Total thickness of Bathurst Island Formation	525	
	Cape Phillips Formation		
	(contact conformable)		
4	Shale, dark grey, very limy and containing limestone interbeds at base, becoming non-calcareous upward, at top grades sharply to younger formation by appearance of calcareous component and colour changes to moderate brown	800	3,230
3	Limestone, thin bedded, very shaly, medium to dark brownish grey, weathers light tan-brown, interbedded with abundant calcareous dark brownish grey shale and siltstone, which are graptolitic, becoming shalier upwards gradationally, fairly recessive	500	2,430
	Covered	100	1,930
	Total thickness of Cape Phillips Formation	1,400	
	CORNWALLIS GROUP		
	Irene Bay Formation		
	(contact conformable)		
2	Shale, greenish, calcareous, recessive, interbeds of thin limestone, micritic with fossil fragments	30	1,830
	Total thickness of Irene Bay Formation	30	
	Thumb Mountain Formation		
	(contact conformable)		
1	Limestone, micritic, light grey, yellowish grey, thick bedded, hard, dense, weathers yellowish grey with rusty staining in places; dolomite minor; at top is greenish shaly interbed	1,800	1,800
	Exposed thickness of Thumb Mountain Formation	1,800	
	Lower limit of exposure at a normal fault		

Unit	Lithology	Thickness (feet)	Height above base (feet)

SECTION 31. Driftwood Bay (composite); section is a composite of four segments whose locations are shown on Map 1350A and which occur within a radius of 2 miles of latitude 75°57′N, longitude 97°50′W, near Ptarmigan Creek. Thicknesses measured in part by staff and in part by scale on aerial photograph A–16202–16.

MELVILLE ISLAND GROUP

Griper Bay Formation (?)

MEMBER A (LOWER)

Unit	Lithology	Thickness (feet)	Height above base (feet)
14	Quartz sandstone, cream, very light grey, yellow-orange on fresh surfaces; weathering colours range from yellow-orange to rusty orange; thick bedded to massive, medium to coarse grained, very rarely with limy cement; this is the youngest formation in the area, it occurs only in one long belt that is largely downfaulted, and rests unconformably on rocks ranging from the Thumb Mountain Formation to the Bird Fiord Formation; the type section of the Driftwood Bay Formation of Thorsteinsson and Glenister (1963, Fig. 50, loc. G) is a part of this unit but that formation has been abandoned herein	1,500	8,640
	Exposed thickness of Griper Bay Formation....................	1,500	

Hecla Bay Formation

(contact angular unconformity)

Unit	Lithology	Thickness (feet)	Height above base (feet)
13	Sandstone, quartzose, very pure yellow-orange, weathers yellow-orange, soft....................	400	7,140
12	Sandstone, quartzose, very light grey, clean, friable, weathering very light grey, abundant limonitic quartz sandstone weathering rusty red....................	300	6,740
	Exposed thickness of Hecla Bay Formation....................	700	

Bird Fiord Formation

(contact conformable)

Unit	Lithology	Thickness (feet)	Height above base (feet)
11	Sandstone, quartzose, very limy, micaceous, thin bedded, grey-green, dark green; brownish green interbeds of sandy limestone and micaceous quartzose shale; poorly exposed, the upper two thirds of this unit being nearly covered by rubble; occasional wood fragments; at 10 feet above the base occurs GSC loc. 26440, and at 200 feet occurs GSC loc. 26443, both being collected by Thorsteinsson and Glenister (1963) and identified as Middle Devonian in age....................	600	6,440
	Total thickness of the Bird Fiord Formation....................	600	

Blue Fiord Formation

(contact conformable)

Unit	Lithology	Thickness (feet)	Height above base (feet)
10	Limestone, micritic, cream coloured, very light grey, minor medium brown, coquinal at top and base; thick bedded....................	900	5,840
	Total thickness of Blue Fiord Formation....................	900	

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Disappointment Bay Formation		
	(contact conformable)		
9	Dolomite, very slightly limy, sugary, very light grey to cream, minor vugs, weathers light yellowish cream, resistant	1,000	4,940
8	Sandstone, quartzose, dolomite cement, cream to very light brown, weathers light yellow brown, resistant, thick bedded, quartz grains weather as laminae; small scale cross-laminae	300	3,940
7	Conglomerate, pebbles of angular to rounded chert that is white, dark grey, yellow or orange; (in places this lower unit is absent altogether and younger units of this formation rest on rocks that range from the Bathurst Island Formation to the Thumb Mountain Formation)	250	3,640
	Total thickness of Disappointment Bay Formation	1,550	
	Bathurst Island Formation		
	(contact angular unconformity)		
6	Covered, rubble composed of siltstone, quartzose, limy, chocolate brown	250	3,390
	Total thickness of Bathurst Island Formation	250	
	Cape Phillips Formation		
	(contact conformable)		
5	Shale, dark grey, very limy and containing limestone interbeds at base, becoming non-calcareous upward, at top grades sharply to younger formation by appearance of calcareous components and colour changes to moderate brown. At locality D, Thorsteinsson and Glenister (1963, p. 590) made collections in ascending stratigraphic order (GSC loc. 26433) that range from a suggested Wenlockian age to the middle part of the lower Ludlovian subseries	800	3,140
4	Limestone, thin bedded, very shaly, often cherty, medium to dark brownish grey, weathers light tan-brown; interbedded with abundant calcareous dark brownish grey shale and siltstone, which are graptolitic, becoming shalier upwards, fairly recessive; at the base in a thin black fissile shale (GSC loc. 67001) were collected *Pseudogygites latimarginatus* and biserial graptolites; Thorsteinsson and Glenister (1963, p. 589) refer to collections made in ascending stratigraphic order in this unit at their locality C (GSC loc. 26434) ranging in age from latest Ashgillian to latest Llandoverian	550	2,340
3	Dolomite, sugary, mottled, dark grey and grey-brown, petroliferous, basal and upper contacts sharp; this is part of Member A of the formation; it contains GSC loc. 67000	50	1,790
	Total thickness of Cape Phillips Formation	1,400	
	CORNWALLIS GROUP		
	Irene Bay Formation		
	(contact conformable)		
2	Limestone, thin bedded, medium grey, shaly, greenish shaly interlayers, microcrystalline with fossil fragments, recessive	40	1,740
	Total thickness of Irene Bay Formation	40	

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Thumb Mountain Formation		
	(contact conformable)		
1	Dolomite, light grey, sugary, vuggy, minor limestone, medium bedded, becoming more limy towards the top, resistant; Thorsteinsson and Glenister (1963, p. 588) collected Middle Ordovician faunules in this unit; GSC loc. 26432, containing *Rafinesquina* cf. *R. lenta* Troedsson, "*Orthoceras*" sp., *Plectorthis* sp., and *Brachyaspis*? sp.; and GSC loc. 26437, containing *Paleocystites* sp., *Rhinidictyia* cf. *R. minor* Ulrich, *Resserella* sp., *Rafinesquina* sp., *Rafinesquina* cf. *R. deltoidea* (Conrad), *Isotelus* sp., *Goniurus* sp., *Flexicalymene* cf. *F. whittakeri* Foerste, and *Leperditella* sp.	1,700	1,700
	Exposed thickness of Thumb Mountain Formation	1,700	
	Lower limit of exposure at a fault		

SECTION 32. Head of Bracebridge Inlet (north side); section begins at latitude 75°43′30″N, longitude 98°45′W, continues west into a main creek valley and then north. Section is the upper part of a composite section shown on Figure 5, and is illustrated in Plate XVIII. Thicknesses measured in part by staff and in part by scale on aerial photograph A–16203–19.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Bird Fiord Formation		
12	Sandstone, quartzose, calcareous, light grey, weathering greenish grey, interbedded with dark green limy shales	230	4,520
	Observed thickness of Bird Fiord Formation	230	
	Blue Fiord Formation		
	(contact conformable)		
11	Limestone, micrite, fossil fragments, brown, weathers tan, medium bedded, irregular bedding, sandy interlayers, some layers highly fossiliferous	235	4,290
	Total thickness of Blue Fiord Formation	235	
	Eids Formation		
	(contact conformable)		
10	Siltstone and mudstone, siliceous, dolomitic, slightly to medium bedded, fetid, weathers medium light grey, alternates with shaly limestones, dark grey, medium bedded, the former type increases and becomes predominant upward, it is a hard clinkery rock; at a height of 50 feet is GSC loc. 59038; at 250 feet is GSC loc. 59039	2,000	4,055
	Total thickness of Eids Formation	2,000	

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Stuart Bay Formation (contact conformable)		
9	Dolomite, silty, light tan, very fine grained to sugary, medium bedded, laminated, interbedded with dolomitic siltstone, dark grey, weathering tan; minor limestone, poor rubbly exposure; grades to limestone of younger formation at top	550	2,055
8	Covered	150	1,505
7	Dolomite, fine grained, light olive-grey to medium grey, shaly, medium bedded to thick bedded, minor coquina, alternates with dark chocolate brown silty dolomite in layers about 10 feet thick on the average, weathers light tan, minor chert pebbly interlayers; at a height of 475 feet is GSC loc. 59037, a silicified faunule containing: *Schizophoria* sp. *Dalejina* sp. *Cortezorthis* sp. (large, w/radial septa) *Gypidula* sp. *Leptaena* sp. indet. orthotetacean *Megastrophia*? sp. *Phragmostrophia* sp. *Stropheodonta*? sp. (fine ribs) *Strophonella*? sp. *Atrypa* "*reticularis*" *Atrypa*? sp. (coarse ribbed) *Elythyna*? sp. *Cyrtina* sp. indet. brach. indet. corals This fauna was identified by Johnson and Boucot who considered it to be of Emsian age (pers. com., 1971)	800	1,355
6	Conglomerate, dolomite matrix, light olive-grey, chert boulders up to 8 inches in diameter, black or dark grey-brown; dolomite boulders; minor black chert interbeds	45	555
5	Dolomite, dense, hard, fine grained, light olive-grey, weathers light orange, coquinoid with silicified brachiopods; at 25 feet below the top is GSC loc. 59036, a silicified faunule containing *Skenidium* sp. *Cortezorthis* sp. (small form) *Muriferella* sp. *Schizophoria* sp. (small form) *Dalejina* sp. *Gypidula* sp. (ribbed) *Leptaena* sp. indet. orthotetacean indet. stropheodontid *Phragmostrophia* sp. *Strophonella*? sp. indet. ribbed rhynchonellid "*Atrypa*" sp. (fine ribs, non-frilly) *Atrypa* "*reticularis*" *Spinatrypa* sp. *Carinatina*? sp.		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Nucleospira sp. rostrospiroid reticulariid ambocoeliid *Cyrtina* sp. This fauna was identified by Johnson and Boucot who considered it to be of probable early Emsian age (pers. com., 1971)	25	510
4	Limestone, silty, medium grey-brown, weathers light tan; abundant limy quartzose siltstone, medium brown, weathering tan, minor silty dolomite toward top; all are sporadic outcrops	340	485
3	Covered	45	145
2	Siltstone, quartzose, calcareous, thin bedded, dark grey to dark grey-brown, alternating with thin interlayers of calcareous fine-grained sandstone, light grey-brown; at height of 25 feet in the unit is GSC loc. 59035 containing: *Cortezorthis* sp. indet. rhynchonellid *Atrypa "reticularis"* *Favosites* sp. This collection was identified by Johnson and Boucot, and considered to be of Siegenian or Emsian age (pers. com., 1971)	30	100
1	Siltstone, dolomitic, dark grey	70	
	Exposed thickness of Stuart Bay Formation	2,055	
	Base of section at lower limit of exposure		

SECTION 33. Polar Bear Pass; a northwesterly dipping section occurring at latitude 75°44'30"N, longitude 98°25'W, north of the central part of Polar Bear Pass. It is 3 miles north of the main right angle bend and on the east side of the main stream flowing to Goodsir Inlet. Measured by scale on aerial photograph A–16203–66, and by staff. The section includes observations on the Stuart River Formation made by H. P. Trettin and fossil collections made by R. Thorsteinsson (*see* Fig. 4 and Pl. XVIII).

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Disappointment Bay Formation		
6	Dolomite	700	2,260
5	Conglomerate, boulders, cobbles and pebbles of chert and quartzite; interbedded dolomite	500	1,560
	Observed thickness of Disappointment Bay Formation ..	1,200	
	Stuart Bay Formation		
	(contact angular unconformity)		
4	Dolomite, evaporitic type, microcrystalline, medium to dark grey, sooty, thin bedded to very thin bedded, ripple-marks, mudcracks, fetid odour, interbedded with beds of limestone with fossils, and with patch reefs; at a height of 100 feet in unit 4 (GSC loc. 67141) are: *Anastrophia*? sp.		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Gypidula aff. *pseudogaleata* Hall *Gypidula* aff. *problematica* (Barr.) indet. brachiopod (pentameroid?) *Cymostrophia*? sp. "*Chonetes*" sp. indet. rhynchonellid aff. "*Plethorhynchia*" *diana* (Barr.) aff. *Astutorhynchia* sp. *Spinatrypa* sp. *Atrypa* "*reticularis*" *Toquimaella kayi* Johnson (figured in Johnson, 1967) indet. reticulariid (faintly ribbed)		
	The foregoing fauna was identified by Johnson and Boucot, who consider that it is Early Devonian, probably early Siegenian, and of about *Quadrithyris* Zone age (pers. com., 1971). In unit 4 there are at a height of 125 feet, GSC loc. 67142 containing graptolites; at 135 feet, GSC loc. 67143 containing graptolites; at 350 feet, GSC loc. 67144 containing graptolites; at 455 feet, GSC loc. 67145 containing:		
	Skenidioides sp. *Isorthis* cf. *canalicula* (Schnur) *Cortezorthis* sp. (small and large) *Schizophoria*? sp. *Muriferella* sp. *Dalejina* sp. *Gypidula* sp. *Leptaena* sp. "*Schuchertella*" sp. *Strophonella* sp. *Stropheodonta* cf. *filicosta* Johnson *Phragmostrophia* sp. *Chonetes* sp. indet. rhynchonellids, 2 spp. *Katunia*? sp. *Atrypa* "*reticularis*" *Spinatrypa* sp. *Anatrypa*? sp. *Nucleospira* sp. *Howellella*? sp. *Quadrithyris*? sp. indet. reticulariid (aseptate) *Cyrtina* sp. indet. brachiopods *Leonaspis* sp. *Receptaculites* sp. indet. corals indet. gastropods		
	The foregoing fauna was identified by Johnson and Boucot who considered that it is of probable early Emsian age (pers. com., 1971).................................	540	1,060
3	Covered (approx. thickness)..	250(?)	520
	Total thickness of Stuart Bay Formation.........................	790	

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Bathurst Island Formation		
	(contact covered)		
2	Covered (approx. thickness)	250(?)	270
1	Dolomite, microcrystalline, calcareous, dark grey, crinoidal; contains GSC loc. 67140	20	20
	Exposed thickness of Bathurst Island Formation	270	
	Base of section at lower limit of exposure		

SECTION 34. Head of Goodsir Inlet; a northwesterly dipping section that begins at latitude 75°44′N, longitude 98°17′W and continues northwest. Thicknesses measured by scale on aerial photograph A–16203–66. Section is shown on Figure 4 and Plate XVIII.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Disappointment Bay Formation		
14	Dolomite, with basal conglomerate containing boulders, cobbles and pebbles of chert and quartzite	400	5,050
	Observed thickness of Disappointment Bay Formation	400	
	Stuart Bay Formation		
	(contact angular unconformity)		
13	Siltstone and dolomite, same as unit 9, recessive	150	4,650
12	Dolomite, evaporitic, silty resistant, some limestone interbeds, thinly bedded, outcropping as isolated stacks	60	4,500
11	Siltstone and dolomite, same as unit 9, recessive	130	4,440
10	Limestone reef (*see* Pl. VI), brecciated, highly fossiliferous, light grey, micritic, massive, fractured, abundant shelly fossils in three collections. These are GSC loc. 67038, which contains: *Gypidula* aff. *kayseri* "*Brachyprion*" cf. *mirabilis* *Thliborhynchia* sp. (costellate) indet. rhynchonellid sp. *Atrypa* sp. (fine ribbed) *Spirigerina supramarginalis* *Dubaria* sp. *Ogilviella rotunda* *Cyrtina* sp. *Conocardium* sp. favositids GSC loc. 67039, which contains: *Schizophoria* sp. *Machaeraria* sp. *Atrypa* sp. *Spirigerina supramarginalis* *Dubaria* sp.		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Ogilviella rotunda favositids GSC loc. 67040, which contains: *Atrypa* sp. (fine ribbed) favositids All were identified by J. G. Johnson who stated (pers. com., 1971) that GSC locs. 67039 and 67040 are of *Quadrithiris* Zone age (early Siegenian). In places reef is absent and interval is occupied by correspondingly thicker sections of the enclosing units	60	4,310
9	Siltstone, calcareous, recessive, dolomitic, chocolate brown, weathering tan; siltstone, dolomitic. The base of this unit coincides with an angular unconformity a mile to the northeast, where the entire Bathurst Island Formation is absent due to erosion	100	4,250
	Total thickness of Stuart Bay Formation	500	
	Bathurst Island Formation		
	(contact angular unconformity)		
8	Siltstone, dolomitic, calcareous, medium chocolate brown, thin bedded, weathering tan; recessive, with occasional interbeds of very light grey, crinoidal limestone and micritic limestone that are up to 15 feet thick; at a height of 480 feet is GSC loc. 67037; a mile to the northeast the entire formation is missing due to erosion prior to Stuart Bay deposition	900	4,150
	Total thickness of Bathurst Island Formation	900	
	Cape Phillips Formation		
	(contact conformable)		
7	Siltstone, dolomitic, medium chocolate brown, thin bedded to fissile, weathering rusty brown; interbeds of medium to light brown dolomitic siltstone, medium bedded, weathering rusty; grades by increasing calcareous interbeds to calcareous siltstone of overlying unit; at a height of 230 feet are GSC locs. 67035 and 67036	900	3,250
6	Siltstone, dolomitic, slightly calcareous, medium dark brown, weathering tan, thinly bedded, slightly cherty, poor exposure in this interval; at a height of 285 feet loose fossils were collected at GSC loc. 67034	400	2,350
5	Chert, shaly, thin to medium bedded, often nodular, medium chocolate brown, cherty dolomitic siltstone interbeds, resistant, grades upwards with decreasing amounts of chert to cherty dolomitic siltstone	320	1,950
4	Shale, dolomitic, dark chocolate brown; siltstone, calcareous, dolomitic with tan silty, sugary, dolomite interbeds, occasionally fossiliferous, limestone nodules up to 1 foot in diameter; at a height of 37 feet is GSC loc. 67030	155	1,630
	Total thickness of Cape Phillips Formation	1,775	

Unit	Lithology	Thickness (feet)	Height above base (feet)
	CORNWALLIS GROUP		
	Irene Bay Formation		
	(contact conformable)		
3	Dolomite, finely crystalline, thin bedded, medium grey, fine grained, interbedded with greenish weathering shaly layers, recessive	50	1,475
	Thumb Mountain Formation		
	(contact conformable)		
2	Dolomite, sugary, finely porous to vuggy, light to medium chocolate brown, thick bedded to massive; at a height of 840 feet is GSC loc. 67029	1,000	1,425
1	Dolomite, tan to brown, sugary, finely porous to vuggy, strongly petroliferous	425	425
	Exposed thickness of Thumb Mountain Formation	1,425	
	Base of section at lower limit of exposure		

SECTION 35. Scoresby Hills, west; an easterly dipping section in the Scoresby Hills. Base occurs at latitude 75°50′N, longitude 98°40′W, and continues northeast to latitude 75°52′30″N, longitude 98°22′W. Thicknesses measured by scale on aerial photographs A–16203–64 and A–16761–178.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Disappointment Bay Formation		
12	Dolomite, blocky; contact covered, position estimated	400	8,892
	Stuart Bay Formation		
	(disconformity?)		
	UPPER MEMBER (DOLOMITE)		
11	Covered (position of contact estimated)	1,350	8,492
10	Dolomite, thin bedded, dolomitic siltstone, interbedded quartz sandstone; becoming quartz sandy upward	1,450	7,142
9	Dolomite, interbedded dolomitic siltstone and limestone; the limestone decreases in proportion upward	350	5,692
	Thickness of upper member	3,150	
	LOWER MEMBER		
	(siltstone, limestone, conglomerate)		
8	Limestone, medium dark grey, thick bedded; scattered chert pebbles; with interbeds of siltstone that are abundant in the lower part and decrease in abundance upward; upper contact drawn where limestone begins to be interbedded with dolomite	200	5,342
7	Siltstone, dolomitic, thin to medium bedded, with thin- to medium-bedded limestone interbeds increasing upward, the upper contact being drawn where limestone is predominant	665	5,142

Unit	Lithology	Thickness (feet)	Height above base (feet)
6	Siltstone, with interbeds of conglomerate in bands 2 to 5 feet thick containing chert pebbles	375	4,477
5	Siltstone, mudstone, fine-grained sandstone, dolomitic, calcareous, thin to medium bedded; poorly exposed; along strike 2 miles to the south are numerous conglomerate and pebble interbeds from 2 to 85 feet thick, with clasts of chert, limestone, and dolomite, usually in a limestone matrix; bioclastic limestone interbeds	1,050	4,102
4	Conglomerate, bioclastic, limestone boulders and pebbles, chert pebbles; in a space of 100 feet it decreases in thickness laterally westward from 12 feet to 0	12	3,052
3	Siltstone, sandstone, shale; occasional graded bedding; becomes coarser upward	1,400	3,040
2	Patch reefs, algal, stromatoporoids, corals; with rounded limestone boulders up to 4 feet in diameter; thickness ranges from 0 to 40 feet	40	1,640
	Thickness of lower member	3,742	
	Total thickness of Stuart Bay Formation	6,892	
	Bathurst Island Formation		
	(contact probably conformable)		
1	Siltstone, sandstone, shale; commonly graded beds; at the base of each graded bed is sand-sized quartz and calcareous skeletal debris, grading upward to silt-sized particles of the same material, and finally to dark brown to black calcareous silty shale; in the upper part of the unit there is more limestone; the contact is drawn below a reefal conglomerate of the overlying formation (at a height of 1,300 feet in this unit is a normal fault presumed to have very minor displacement)	1,600	1,600
	Exposed thickness of Bathurst Island Formation	1,600	
	Base of section at a fault		

SECTION 36. Heart Lake; a north-dipping section beginning at the eastern end of Heart Lake (latitude 75°31'30"N, longitude 100°00'W) and continuing to the northeast. Thicknesses measured in part by staff and in part by scale on aerial photographs A-16203-185 and A-16194-17.

Bird Fiord Formation

17	Sandstone, quartzose, partly limy, alternating recessive and resistant, greenish grey, weathering greenish grey, poorly exposed recessive; at height of 475 feet is GSC loc. 67060	600	5,510
16	Sandstone, quartzose, non-calcareous, generally light green, non-limy, resistant	30	4,910
15	Sandstone, medium grey, quartzose, recessive, thinly bedded, poorly exposed, non-limy	175	4,880
14	Sandstone, quartzose, limy, medium bedded, light to medium grey, fossiliferous at base, yielding GSC loc. 67059	20	4,705

Unit	Lithology	Thickness (feet)	Height above base (feet)
13	Sandstone, quartzose, limy, light to medium grey, recessive, thin to medium bedded	75	4,685
12	Sandstone, quartzose, grey to greenish grey, very limy, alternating with sandy limestone, ripple-marks, crossbedded, worm borings, resistant, medium bedded, near top fossils are in a limestone GSC loc. 67058	60	4,610
11	Sandstone, quartzose, shaly, grey and greenish with minor limestone and sandstone interbeds, recessive, poorly exposed, alternating with shaly interbeds, thin to medium bedded	120	4,550
10	Sandstone, quartzose, limy, resistant; limestone, sandy, some highly fossiliferous beds, worm burrows common; alternating with lesser amounts of recessive dark green shale, medium bedded; at the base is GSC loc. 67057	30	4,430
	Total thickness of formation	1,110	
	Eids Formation		
	(contact conformable)		
9	Limestone, thinly bedded, shaly and silty, shaly interbeds, occasional worm markings, lower contact gradational, upper contact abrupt	275	4,400
8	Limestone, very shaly, fissile to thin bedded, medium light grey, weathers yellow-grey; equal amounts of interbedded shale, medium grey, limy, micaceous, weathers yellow-grey, gypsiferous interbeds contorted by interbedding slip; in lower part is GSC loc. 67055	275	4,125
7	Unexposed, probably soft weathering Eids as above	750	3,850
6	Unexposed, probably Eids as below	400	3,100
5	Limestone, very shaly, thin bedded to laminated, dark grey, weathers yellow-grey, occasional *Tentaculites* observed, interbeds of thinly bedded, very shaly limestone, moderately resistant; clinking sound, at top of unit is GSC loc. 67054	200	2,700
	Total thickness of Eids Formation	1,900	
	Stuart Bay Formation		
	(contact conformable)		
4	Siltstone, dolomitic, thin to medium bedded, slightly calcareous, at the base is a 15-foot thick bed of shaly limestone with minor chert pebbles, petroliferous, dark grey to black, weathering yellow-brown, siliceous, at a height of 240 feet is a pebble bed 2 feet thick	1,550	2,500
	Bathurst Island Formation		
	(contact conformable)		
3	Shale, dark grey, fissile and recessive, fossils at base of this unit from GSC loc. 67043	350	950
2	Siltstone, dark grey-brown, weathering tan-brown, calcareous, resistant	200	600
1	Shale, dark grey to black, fissile, slightly calcareous, weathers recessive and tan-brown; some interbeds of medium brown,		

Unit	Lithology	Thickness (feet)	Height above base (feet)
	calcareous siltstone and fine-grained calcareous sandstone, weathers yellow-brown; fossils from near top of unit include GSC locs. 67041 and 67042	400	400
	Exposed thickness of Bathurst Island Formation	950	
	Base of section at lower limit of exposure		

SECTION 38. Bathurst Caledonian River J-34 well; section is from the log of a well drilled at latitude 75°33′31″N, longitude 98°43′00″W. Descriptions are of cuttings and core shown in the completion report (Dominion Explorers Group—Canso *et al.*, 1964), and have been modified by the writer.

	Bathurst Island Formation		
18	Dolomitic siltstone and shale; at a height of 1,150 to 1,160 feet is *Tentaculites* sp.	1,440	10,000
	Preserved thickness of formation	1,440	
	Cape Phillips Formation		
	MEMBER C		
17	Shale, limestone, and siltstone	325	8,560
16	Siliceous shale; at a height of 211 to 229 feet in core No. 2 are *Monograptus transgradiens* Perner, and *Linograptus* sp., which R. Thorsteinsson identified and dated as indicating the penultimate graptolite zone of the Pridolian	1,000	8,235
	Thickness of Member C	1,325	
	MEMBER B		
15	Marl, shale, and limestone	120	7,235
14	Limestone	45	7,115
13	Shale, chert, and limestone	440	7,070
	Thickness of Member B	605	
	MEMBER A		
12	First bituminous shale and limestone	140	6,630
11	Cherty dolomite	90	6,490
10	Cherty limestone	285	6,400
9	Second bituminous shale and limestone	205	6,115
8	Dolomite	44	5,910
	Thickness of Member A	764	
	Total thickness of Cape Phillips Formation	2,694	
	CORNWALLIS GROUP		
	Irene Bay Formation		
7	Shale	156	5,866

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Thumb Mountain Formation		
6	Limestone	360	5,710
5	Dolomite	615	5,350
4	Shale	35	4,735
3	Dolomite, limestone, and shale	1,010	4,700
	Total thickness of Thumb Mountain Formation	2,020	
	Bay Fiord Formation (?)		
2	Shale, anhydrite, and dolomite	417	3,690
1	Salt, dolomite, siltstone, anhydrite, and shale	3,273	3,273
	Penetrated thickness of Bay Fiord Formation	3,690	
	Penetrated thickness of Cornwallis Group	5,866	

SECTION 39. Misty River; section begins at latitude 75°19′N, longitude 98°45′W near Misty River and continues northwest to latitude 75°28′N, longitude 99°20′W. Thicknesses measured by scale on aerial photographs A–16203–94, A–16203–160, and A–16203–158.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Bird Fiord Formation		
15	Sandstone, quartzose, limy	750	4,795
	Blue Fiord Formation (contact conformable)		
14	Limestone, thin to medium bedded, similar to unit below	300	4,045
13	Limestone, brown, shaly, medium bedded to thick bedded; at a height of 100 feet above base (GSC loc. 67129) is *Icriodus nodosus*; at 200 feet is *Icriodus corniger*; at 280 feet is *Icriodus angustus*. These were identified by Klapper (Ormiston, pers. com., 1970), and all can be considered as Eifelian in age because of their positions	560	3,745
	Total thickness of Blue Fiord Formation	860	
	Eids Formation (contact conformable)		
12	Same rock type as below, thin bedded to laminated, grades sharply to overlying formation by becoming medium bedded, with more limestone	500	3,185
11	Siltstone, dolomitic, dark grey, siliceous, slightly limy, weathering very light brownish grey, rarely thin bedded or fissile, conchoidal fracture, clinkery sounding when struck; GSC loc. 67128	250	2,685
	Total thickness of Eids Formation	750	
	Disappointment Bay Formation (contact conformable)		
10	Dolomite, sandy, interbedded with dolomitic sandstone	550	2,435

Unit	Lithology	Thickness (feet)	Height above base (feet)
9	Dolomite, very light tan, fine grained, constituting 80% of the interval; remainder of the interval is primarily sandstone, fine grained, quartzose, dolomitic, light yellow-orange, slightly calcareous; both rock types are blocky; upper part is very quartz sandy	650	1,885
	Total thickness of Disappointment Bay Formation	1,200	
	Stuart Bay Formation		
	(contact unconformable?)		
8	Limestone, siliceous, dark grey to black, thinly bedded, some calcareous siltstone and calcareous, very fine grained sandstone	500	1,235
7	Dolomite, fine grained, thick bedded, hard, light grey to cream. This unit is just an interbed	50	735
6	Limestone, quartz sandy, often bioclastic, alternating with limy siltstone which is thinly bedded, usually the former is resistant and the latter is recessive; at base is a clastic limestone; GSC loc. 67125	140	685
5	Covered; the rubble constitutes brown, non-calcareous sandstone, and dark grey limestone, shaly and silty	200	545
	Total thickness of Stuart Bay Formation	890	
	Bathurst Island Formation		
	(contact angular unconformity)		
4	Limestone, dark grey, fissile to thin bedded, siliceous and shaly, weathers medium grey, the top is poorly exposed	175	345
3	Sandstone, quartzose, limy, light brown to tan, up to 20% of the interval is composed of bioclastic sandy limestone yielding GSC loc. 67124; interval also contains a hard, clinkery, dark grey, limy siltstone	50	170
2	Sandstone, calcareous, medium bedded, light brown to tan; very uniform lithology throughout	50	120
1	Limestone, thinly bedded, dark grey, very shaly and silty, weathers medium light grey, rubble only; GSC loc. 67123	70	70
	Exposed thickness of Bathurst Island Formation	345	
	Base of section at lower limit of exposure		

SECTION 40. Head of Freemans Cove; a north-dipping section at latitude 75°14′N, longitude 98°03′W, one-quarter mile northeast of the head of Freemans Cove, eastern Bathurst Island (*see* aerial photograph A–16203–7). Section incorporates observations made by P. G. Temple and by L. V. Hills. Measurements made by staff.

	Eureka Sound Formation		
8	Shale and sand	5–10 feet	32.5+
7	Coal; contains sample No. 3 of Hills (GSC loc. C-7605)	6 inches	27.5+
6	Clay, yellow	a few inches	27+

Unit	Lithology	Thickness (feet)	Height above base (feet)
5	Andesite	10–20	27+
4	Shale, micaceous, organic, dark grey to black; possibly faulted; contains channel samples No. 1 and No. 2 of Hills (GSC locs. C-7603 and C-7604)	15	17+
3	Sandstone, quartzose, slightly feldspathic, tan containing leaves and stems of fossil plants (GSC loc. C-4323) including *Metasequoia occidentalis* (Newberry) Chaney, *Taxodium dubium* (Sternberg) Heer, *Cercidiphyllum arcticum* (Heer) Brown, and *Corylus*? sp.; this florule by itself indicates a Late Cretaceous or Early Tertiary age; however, because of the datings of overlying microfloras it is regarded as Late Cretaceous (Dorf and Hickey, pers. com. 1970)	2	2+
2	Sand, quartzose, uncemented, white, medium to fine grained; with stringers of brown lignitic shale	?	
1	Coal, with tree trunks	a few feet	
	Total preserved thickness of Eureka Sound Formation	approx. 50 feet	
	Base of section at lower limit of exposure		

According to Hills (pers. com., 1965 and 1971), all three samples contain the same microfloral assemblage, and these are listed below, along with their ages and Hills' conclusions:

Spores

Aequitriradites spinulosus (Cookson and Dettman) Cookson and Dettman	Cretaceous
Appendicisporites sp. Weyland and Krieger	
Arcellites sp. (Miner) Ellis and Tschudy Indet.	
Cicatricosisporites Potonie and Gelletich	
Gleicheniidites senonicus Ross	Jurassic to Cretaceous
Laevigatosporites gracilis Wilson and Webster	Cretaceous to Tertiary
Laevigatosporites ovatus Wilson and Webster	Cretaceous to Tertiary
Laevigatosporites Ibrahim	
Lygodiumsporites ? (Pot., Thoms., & Thierg) Potonie	
Osmundacidites elongatus Rouse	U. Cretaceous
Pilosisporites verus Delcourt and Sprumont	L. Cretaceous (?)
Polypodisporites ? Potonie	
Cupressus pallens Bolkovitina	Cenomanian to Turonian
Schizosporis reticulatus Cookson and Dettman	Cretaceous
Cingutriletes clavus (Balme) Dettman	Jurassic to Cretaceous
Stereisporites cf. *antiquasporites* (Wilson and Webster) Dettman	Cretaceous
Cingulatisporites sp. Brenner pl. 14, fig. 3	Cretaceous
Verrucosisporites sp. (probably new)	
Matonisporites cf. *M. excavatus* Brenner	Cretaceous (?)
Taurocusporites ? Stover	
Rugulatisporites sp. Pflug	

Gymnospermae

Vitreisporites pallidus (Reissinger) Nilsson	Jurassic to Cretaceous
Cycadopites Wodehouse	U. Cretaceous to Tertiary
Bennetiteaepollenites minimus Singh	Cretaceous
Alisporites (Daugherty) rest. Potonie and Kremp	

Unit	Lithology	Thickness (feet)	Height above base (feet)

Parvisaccites Couper	
Phyllocladites Cookson	
Podocarpidites multesimus (Bolkovitina) Pocock	Jurassic to Cretaceous
Podocarpidites naumovai Singh	Albian to Cenomanian
Podocarpidites Cookson	
Piceapollenites Potonie	
Pityosporites (Seward) Manum 1960	
Metasequoia type papillate grain	U. Cretaceous to Tertiary

Angiospermae

Alnus (*Alnipollenites*) 6 pored	U. Cretaceous to Tertiary
Alnus (*Alnipollenites*) 5 pored	U. Cretaceous to Tertiary
Aquilapollenites trialatus Rouse	Maestrichtian
A. quadrilobus Rouse	Maestrichtian
A. amplus Stanley	Maestrichtian
Betula sp. type very similar to form described from the U. Cret. by Bolkovitina	U. Cretaceous to Recent
Corylus type	U. Cretaceous to Recent
Ericipites Wodehouse	U. Cretaceous to Recent
Proteacidites marginatus Rouse	U. Cretaceous
Wodehousea spinnata Stanley	Maestrichtian

Acritarchs, Hystrichosphere and Dinoflagellates

Deflandrea cf. *D. rectangularis* Cookson and Eisenack	U. Turonian to M. Senonian
D. tripartita Cookson and Eisenack	U. Turonian to M. Senonian
D. micracantha Cookson and Eisenack	U. Turonian to M. Senonian
D. cf. *D. echinoidea* Cookson and Eisenack	U. Turonian to M. Senonian
Paleostomocystis fragilis Cookson and Eisenack	Albian to Cenomanian
Hystrichospaeridium tubiferum (Ehrenberg) Deflandre	Cretaceous
H. stellatum Maier sensu Cookson and Eisenack	Albian to Cenomanian
cf. *H. ferox* Deflandre	Albian to Senonian
Veryhachium reductum Deunff	Ordovician to Cenomanian
Veryhachium sp. 5 spined	
Diplotesta luna Cookson and Eisenack	(?) U. Albian to Cenomanian
Hystrichosphaera furcata	Cretaceous
Baltisphaeridium multispinosum Singh	Albian
Baltisphaeridium Eisenack	
Odontochitina striatoperforata Cookson and Eisenack	Albian to Cenomanian'
Gonyaulax margaritifera Cookson and Eisenack	Senonian (Campanian to Santonian)
Diconodinium glabrum Cookson and Eisenack	Albian to Cenomanian (?)
Microdinium ornatum Cookson and Eisenack	Albian to L. Turonian
Spinidinium styloniferum Cookson and Eisenack	Albian (?)
Micrhistridium sp.	

Observations and Conclusions

1. All three samples appear to contain a similar microfloral assemblage; however, acritarchs, hystrichospheres, and dinoflagellates are more common in sample 1.

2. All acritarchs, hystrichospheres, and dinoflagellates identified in this report have been described from marine sediments in Australia (foram control), and it can therefore be inferred that the beds on Bathurst Island are marine. The decrease in number and variety in samples 2 and 3, however, suggests a change to more continental conditions.

Unit	Lithology	Thickness (feet)	Height above base (feet)

3. The strata are undoubtedly of Late Cretaceous age. The listed stratigraphic ranges of plant microfossils seem to suggest that sediments of two ages are involved, and that the small fault is significant. A late Cenomanian or early Turonian age is suggested by such fossils as *Odontochitina striatoperforata*, *Veryhachium reductum*, and *Paleostomocystis*, whereas species of *Wodehousea* and *Aquilapollenites* for example suggest a Maestrichtian age.

Two factors lead me to believe that the beds are of Maestrichtian age: first, microfossils indicative of the Cenomanian age are rare, and secondly they occur with fossils representative of the younger age.

SECTION 41. Truro Island; section on east–central Truro Island in valley of main south-east-flowing stream beginning on the east shore of the mouth of the stream at latitude 75°18′30″N, longitude 98°08′W. Thicknesses measured by staff and by scale on aerial photograph A–16202–2.

Overlying beds; Blue Fiord Formation

Disappointment Bay Formation

Unit	Lithology	Thickness (feet)	Height above base (feet)
14	Dolomite, slightly limy, tan-brown, sugary, resistant	675	1,305
	Cape Phillips Formation		
	(contact angular unconformity)		
13	Siltstone, quartzose, dolomitic, loose graptolites abundant, limy, fine grained, chocolate brown, thinly bedded, weathering yellow-grey, dolomite crystals in rosette arrangements up to 1″ in diameter; at height of 230 feet is GSC loc. 67139 yielding *Monograptus testis*	260	630
12	Siltstone, quartzose, dolomitic, slightly calcareous, thinly bedded, cherty	20	370
11	Siltstone, quartzose, dolomitic, slightly calcareous, cherty, rubbly interval of no outcrop	40	350
10	Chert (GSC loc. 67137), black, shaly, thin to medium bedded, wavy bedding comprising 75% of the interval; interbeds and nodules of fetid, brown dolomite, up to 1½ feet in diameter (GSC loc. 67138); non-calcareous black shale interbeds	65	310
9	Shale, dark grey to black fissile	25	245
8	Dolomite, fetid, limy, brown, resistant	20	220
7	Siltstone, quartzose, dolomitic, fine grained, medium chocolate brown, weathering rusty yellow, grading up to the overlying dolomite, recessive	54	200
6	Shale, black, non-calcareous, fissile to thin bedded, recessive, very minor dolomitic interbeds at base; at top is GSC loc. 67136 yielding graptolites	6	146
5	Dolomite, fetid, limy grained, occasionally vuggy, minor shale interbeds, resistant	45	140
4	Shale, black with limestone nodules and dolomite interbeds, biserial graptolites throughout; GSC locs. 67134 and 67135	23	95
3	Shale, black, becoming calcareous at the top by gradation to the overlying unit, recessive; at base is *Pseudogygites latimarginatus* and biserial graptolites in GSC loc. 67133	37	72

Unit	Lithology	Thickness (feet)	Height above base (feet)
2	Limestone, medium brown, very shaly, weathering greenish grey, grades to the shales above; GSC loc. 67132	15	35
	Total thickness of Cape Phillips Formation	610	
	CORNWALLIS GROUP		
	Irene Bay Formation		
	(contact conformable)		
1	Limestone, micritic, tiny fossil fragments common, medium brown, medium bedded, weathering light brownish grey, interbedded with greenish weathering shaly particles	20	20
	Exposed thickness of Irene Bay Formation	20	
	Base of section at lower limit of exposure		

SECTION 42. Dyke Ackland Bay; section extending northwesterly from latitude 75°04′N, longitude 98°45′W to latitude 75°09′N, longitude 99°17′W. Section begins 2 miles east of the head of Dyke Ackland Bay between two small circular lakes. Thicknesses measured by scale on aerial photographs A–16203–176, A–16194–7, and A–16203–166.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Bird Fiord Formation		
11	Shale, dark grey-green, limy, with limestone interbeds; very recessive	140	5,640
	Observed thickness of Bird Fiord Formation	140	
	Blue Fiord Formation		
	(contact conformable)		
10	Limestone, micrite composing almost the entire section of this formation; the lower half is light grey to light brown, thick bedded, resistant, blocky weathering, fossils at the base are from GSC loc. 67107; the upper half of the section is mainly light brown, with many white calcite blebs; the upper contact is covered but it appears to be gradational with the overlying unit; at a height of 400 feet in this unit is a 15-foot thick, brown, crinoidal, shaly limestone unit which contains fossils (GSC loc. 67108)	900	5,500
	Disappointment Bay Formation		
9	Dolomite, dense, very fine grained, rarely sugary, sooty grey, weathers tan; at base light cream; at top gets yellow silty interbeds before grading to limestone of overlying unit	2,000	4,600
	Total thickness of Disappointment Bay Formation	2,000	

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Stuart Bay Formation		
	(contact probably disconformity)		
8	Dolomite, sugary, finely porous, weathers darker than the overlying and underlying units, it grades in its upper few feet to light cream limestone for a few feet	700	2,600
7	Dolomite, fetid, medium brown, weathering medium dark brown, slightly rusty, friable, sugary to vuggy, crinoidal, medium to thick bedded, minor crinoidal interlayers, grades up to light cream and grey dolomite, weathering medium light grey, faintly purplish	150	1,900
6	Dolomite, very light cream, finely crystalline, often friable, sugary to vuggy, thin to medium bedded, weathering slightly rusty-cream	200	1,750
5	Dolomite, thinly bedded, light cream to tan, weathering light cream, interbedded with minor medium light grey dolomite; silty and sandy at the base	575	1,550
4	Sandstone, quartzose, thin to medium bedded, friable, generally light grey to cream, fine grained, rusty veined, grades to dolomitic siltstone in upper part	125	975
3	Sandstone, quartzose, olive-grey to medium light grey-brown, medium to thick bedded, crossbedded with source direction from the southeast, worm markings, dolomitic	100	850
	Total thickness of Stuart Bay Formation	1,850	
	Bathurst Island Formation		
	(contact angular unconformity)		
2	Dolomite, very slightly quartz sandy at base grading up to dolomite, light coloured	250	750
1	Sandstone, quartzose, dolomitic, medium to thick bedded, resistant, slightly rusty tan, weathering rusty tan, clear quartz sand grains, in places quite vuggy; grades up to dolomite, slightly sandy	500	500
	Exposed thickness of Bathurst Island Formation	750	
	Base of section at lower limit of exposure		

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