

# BETWEEN GREENLAND AND AMERICA

CROSS-CULTURAL CONTACTS AND THE ENVIRONMENT  
IN THE BAFFIN BAY AREA



ARCTIC CENTRE

University of Groningen Netherlands

B E T W E E N   G R E E N L A N D   A N D   A M E R I C A

CROSS-CULTURAL CONTACTS AND THE ENVIRONMENT  
IN THE BAFFIN BAY AREA

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## PREFACE

The papers presented at the Seventh International Symposium organized by the Arctic Centre of the University of Groningen are published here in their entirety. The symposium's title was "Cross cultural contacts and the environment in the Baffin Bay area" and it was held in Groningen, The Netherlands, on 18-19 September 1986. The centre's earlier symposia have dealt with Arctic whaling, early European exploitation of the North Atlantic, Spitsbergen, Inuit culture in Greenland, and Scandinavian Arctic cultures.

The Arctic Centre wishes to acknowledge the financial support given by the Royal Dutch Academy of Science, the Willem Barentsz Stichting, and the Faculty of Arts of the University of Groningen. The symposium which was projected by the Board of the Arctic Centre, was planned and set up by an organizing committee comprising the editors of these proceedings and Mr. Herbert Prins, to whom their special thanks are due for his wise advice and attention to practical detail. The committee wishes to place on record here its thanks to all who helped to set up the symposium and who contributed to its success. They included not only every one of the contributors, organisers and participants, but also personnel of the Groningen Faculty of Arts, especially those of the congress bureau, as well as Mrs. Gonnie Goossens, who entertained us with colour slides of icebergs set to music. Finally, the editors wish to thank Mrs. Tineke Datema-Ruben, secretary of the Arctic Centre, and her colleagues and helpers in the secretariat, for their patience and skill in converting much corrected and often partly illegible typescripts in varying styles into a finished print-out.

Although we have standardized the spelling of place names as between the different papers printed here, and adopted a uniform editorial style for all of them, we have attempted neither to impose a uniform spelling in general nor a uniform use of terms. For instance, the words 'Inuit' and 'Eskimos' are treated as equally acceptable alternatives. References in one contribution to another have only exceptionally been inserted, it being thought desirable to print the papers as near as possible in their original form. There were two substantial changes from the programme as originally planned: Mr. Gerti Nooter had perforce to withdraw his contribution, and Dr. F.O.Kapel very kindly agreed to present Dr. E.W.Born's paper in his absence.

The Arctic Centre  
University of Groningen  
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Louwrens Hacquebord  
Richard Vaughan

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## INTRODUCTION

The different contributors to this symposium are in different disciplines and in different countries; they can be thought of as working along parallel lines. The function of the symposium was to bring their work together, to juxtapose their hypotheses, to reveal discrepancies between their conclusions, above all to show where problems exist and point to their nature. Thus the reader must not be surprised to find one author calling the native inhabitants of northwest Greenland 'Polar Eskimos' and another calling them 'Thule Inuit'; one stating they were isolated in the years before 1818, another demonstrating that they were not. Such disparities only serve to underline the value of holding symposia like this one. Out of such a concourse and confrontation of individual studies systematic and certain knowledge may hopefully emerge.

Is there any foreseeable outcome or end-product of the different studies gathered together here? The first and most brilliant attempt to write the complete history of a sea was Fernand Braudel's La Mediterranee. In his wake, historians began to look at the North Sea in a new light, a light coloured by the connections between peoples around its shores. Is it too far-fetched to think of Baffin Bay, and its associated seas Davis Strait and the Labrador Sea, as a single entity, and to trace the history of the peoples on these shores against the background of their environment? The Norsemen or Vikings, it now appears, created a kind of sea-empire or maritime territory for themselves out of these waters just as they already had done in the North Sea and the North Atlantic. Perhaps some day it will be possible to reconstruct not only the Viking history of Baffin Bay but also the total history of human activities round the seas which divide Greenland from America. This symposium could be construed as a first small step towards such a goal.

In recent times the brute forces of politics and warfare, symptoms of nationalism, have in many places obliterated the past, obscuring or replacing the lasting and meaningful processes of history. Thus the geographical unity of Baffin Bay was divided by the imperialisms of Britain and Denmark. Now we have Canada (with sporadic intrusions by the United States into her Arctic domains there) on one side of Baffin Bay, and an emerging, dare one suggest nationalistic, Greenland on the other. This new Greenland is rapidly replacing the old Danish Greenland, though the Thule district was only formally taken over by Denmark as recently as 1937. The real human unity of the area has been obscured by these developments. That unity was provided by the Inuit inhabitants and their predecessors the so-called Palaeoeskimos who, at one time or another, have settled on almost every shore between the Labrador Sea and Smith Sound. Here they lived and survived, in tiny, scattered,

nomadic hunting communities, for thousands of years, until the modern world disrupted and transformed their way of life and engulfed and all but obliterated them. Historians write in this respect about the 'contact period', but the word contact is perhaps none too appropriate except in the sense that a road roller makes contact with a hazel nut when it runs over it.

The material presented at this symposium brings together, be it noted, the two sides of Baffin Bay, for more than half the papers come from Canada and Denmark. Most of them are concerned, directly or indirectly, with the impact on the native inhabitants of successive white incursions into Baffin Bay. Beginning with the Vikings, we continue with a consideration of the effects of Basque activities in Labrador on both Indians and Eskimos, with the eighteenth-century Dutch whalers' impact on the Eskimos of Greenland's west coast, with the arrival of English and Scottish explorers and whalers in the Thule district in the nineteenth century and, finally, the delicately balanced subsistence hunting economy of the Polar Eskimos is considered in relation, among other things, to the impact on it of ideological activities like the campaign against the sale of seal skins. This then is the principal theme of our symposium: contacts and connections between different cultures and their results in the one geographical area. Nor have we entirely forgotten the impact of the Eskimos on the European mind, for Dr. s'Jacob examines images of the Eskimo, as well as of the Arctic, in accounts written by Europeans.

Contacts between different peoples do not, of course, happen in a vacuum. We included the word 'environment' in our title advisedly, and three contributions are devoted to it. Professor van Straaten explains why Baffin Bay exists at all and his exposition of the geological history of the area serves as an introduction to what follows. Dr. Weidick, though being at pains to explain why glaciers are not always accurate climatoscopes, nevertheless holds out the exciting prospect of eventually providing a full climatic record to elucidate Greenland's history. Finally Dr. Born, in describing the sea mammals and the hunting routines and methods of the present-day Thule Inuit, is directly concerned with their relationship to the environment.

Every symposium has lessons to teach. Ours makes very clear the provisional nature of much of our knowledge. But then our speakers are in the midst of their work, giving us in some cases the very latest information available. Almost all of them referred to matters still not universally agreed and settled. Moreover at every turn, even in the usually well-documented nineteenth century, they were confronted with lack of evidence. Notable too is the frequent discrepancy between the archaeological and the historical evidence. Dr. McGhee struggles bravely in the face of a hopelessly inadequate historical record but points to the

probable accumulation of more archaeological materials in due course, and Professor Tuck is in the midst of doing just this, reporting on a major archaeological find made only a few weeks before the symposium.

These problems will doubtless be surmounted. The long-term and solidly-based research programmes that lie behind the contributions to this symposium will see to this. Professor van Straaten shows us how active a research field plate tectonics now is, especially in relation to the Baffin Bay area. The great national ethnographic museums of Canada and Denmark, represented by Drs. McGhee and Gulløv, will continue the good work they have already carried out over the years. Professor Tuck leads a major long-term project on sixteenth-century whaling in southern Labrador. Behind the contributions of Drs. Weidick and Born lie the energies, the resources, and the skills of those great institutions, so active in research, the Geological Survey of Greenland and the Greenland Fisheries and Environment Research Institute. Lastly our own Arctic Centre in Groningen has been able, at the symposium, to present the first results of the research programme known as the Disko Project, in the shape of the papers by Dr. s'Jacob and the writer of these lines. The relevance of this programme, and the need to develop it effectively to include an archive-based study in detail of Dutch whaling in west Greenland, was one of the lessons of this symposium.

Richard Vaughan



## THE ORIGIN OF THE SEAS BETWEEN GREENLAND AND CANADA

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*At the end of the Paleozoic, 235 million years ago, Canada, Greenland and Europe were parts of one great continent: 'Pangaea'. Low areas of this continent were covered by shallow, 'epicontinental' seas. After the Triassic period, 235-200 million years ago, this continent broke up gradually. First, 'grabens' were formed, for example, on both sides of Greenland, which were from time to time partly filled with sea water. Deep ocean basins, at first very narrow, began to form in the Labrador Sea area roughly 80 million years ago, in the Late Cretaceous, and, since 55 million years ago, the end of the Paleocene, also in Davis Strait, Baffin Bay and east of Greenland. The spreading of the sea floor west of Greenland terminated approximately 36 million years ago. Many details of the process are still problematical, among them the crustal movements in Nares Strait and in Davis Strait.*

*In the Middle Miocene, about 13 million years ago, the climate in the northern regions deteriorated, and during the last 3.5 million years ice rafting of stones and other rock debris was active. In this same period glacial erosion profoundly changed the coastal morphology, producing, among other landforms, fjords and skerries. The chronology of events is summarized in Fig.10.*

### Introduction; Pangaea

In the years since the Second World War much progress has been made in geology through the development of what is known as 'plate tectonics'. This branch of the earth sciences deals with the movement and arrangement of 'plates', which together form the outer shell of the earth: the 'lithosphere'. The plates consist of an upper layer of 'crustal' rocks (above the so-called Moho-discontinuity) and a lower layer of 'upper mantle' rocks, extending downward to depths of 50 to 150 km. Most of the present plates comprise a continental and an oceanic part; four are entirely oceanic. Whereas formerly many geologists were firmly convinced of the fixed position of continents and oceans, their mobility has now become one of the most fundamental notions in geology, the evidence for it still piling up every day. These spectacular developments have been due to the application of various new techniques of investigation, such as the study of the magnetization of rocks, yielding information about their original position, the making of borings in the floor of the deep oceans, and improvements in the seismic exploration of structures below the earth's surface. The new data throw light on countless, formerly unexplained geological phenomena, revealing their

interconnections and bringing them together in a single theory.

Yet, many details of the processes of plate tectonics still await investigation, while the number of unsolved problems presenting themselves increases rather than diminishes as research proceeds. Certainly the most intriguing question in plate tectonics is that of the primary cause, or causes, of the plate movements, and the related processes taking place at greater depths within the earth. Some of the minor problems that are as yet unsolved are connected with the origin of the seas between Greenland and Canada.

As is generally known, it was the German astronomer and meteorologist, Alfred Wegener, who was the first to provide a synthesis about continental drift, its possible causes, and its many consequences, such as the distribution of fauna and flora, now and in the geological past, and the displacement of indicators of ancient climates (1910). With regard to the latter, the (present) distribution of traces of Late-Paleozoic(1) ice-caps is utterly incomprehensible without accepting the idea of continental drift, these traces having been found in South America, South and Central Africa, Madagascar, Antarctica, Australia, India, Pakistan and Oman. Wegener was not the first, though, who presented the idea of continental drift. That had been done before him by, among others, G.H. Darwin (1898), W.H. Pickering (1907) and, in particular, F.B. Taylor (1908).

Wegener's conclusions concerning the movements of continental masses(2) were received with enthusiasm by many geologists. However, a majority rejected them, not on the basis of his arguments for drifting, which were sound, but because of his explanation of the physics of the process, which was unacceptable. The 'fixists', on the other hand, had to recur to the most unlikely hypotheses to account for the facts that so clearly point to continental drift.

In Wegener's reconstruction of the geography at the end of the Paleozoic all continents that are now separated from one another were joined together in one big 'supercontinent': 'Pangaea'. This concentration of continental crust in one great complex has been confirmed by the new data. What Wegener did not know is that the Pangaea situation was only a passing stage in the long history of plate motions. It appears that continental masses have been shifting to and fro over the earth's surface most of the time, some of them breaking up or drifting apart, while others moved towards each other or became welded together. Thus, before Pangaea times, the North American continent, together with Greenland, had been separated from Europe and Northwest Africa by a deep ocean which, through the drift of these continents, was closed around 400 million years ago. On the other side, about 250 million years ago Asia drifted against Europe.

The 'unity' did not last long, geologically. Already during the Triassic, 235 to 200 million years B.P.(3), the

first signs of rupturing appeared between North America and North Africa, and during the Jurassic, 200 to 135 million years B.P., a deep ocean formed in this area. From there a widening tear developed that subsequently propagated in a northerly direction.

The original juxtaposition of Labrador and Baffin Island on the one side and of southwestern Greenland on the other is shown in the reconstruction in Fig.1. It is seen that not only the age provinces on both sides match with each other, but also the patterns of the geological structures. Of course, reconstructions of this kind cannot be made by fitting the (most seaward parts of the) coastlines against each other, because coasts in general do not correspond to the outer edges of the continental masses, the marginal parts of which lie mostly below sea level: the 'continental shelf' or 'platform' (4).

Although, as mentioned above, the first rupturing between North America and the 'Old World' had already started in the Triassic, it took a long time before the continents were completely separated from each other by deep ocean waters. One of the consequences has been that many North American dinosaurs of the Upper Jurassic were very similar to European and African ones. An example is the giant Brachiosaurus, one of the biggest land animals that ever existed, 12 m high and 24 m long. Its remains, though belonging to different species, are found in Colorado, Portugal, Algeria and Tanzania (Fig.2). This proves that north of the newly formed ocean basin there must have been, at least temporarily, a land connection. Representatives of this dinosaur have probably even walked on what is now Greenland and Baffin Island. It should be mentioned, in this connection, that the climates in these areas, during the Jurassic period, were much warmer than they are nowadays: in the first place, Greenland and northwest Canada had in that period a more southerly position, and secondly, and more significantly, the temperatures were, all over the world, considerably higher than they are now.

#### The Graben stage

During the Jurassic period extensional forces were active in the southwestern part of Greenland. They resulted in the formation of vertical fissures, parallel to the present coast, which were filled with basalt (Watt 1969). At the end of the following period, the Cretaceous (135 to 66 million years B.P.), gaps of oceanic depth were formed between Canada, Greenland and north-western Europe. These gaps were preceded by so-called grabens. A graben (Fig.3) is a structure produced by the slow sinking (5), between more or less parallel fractures ('faults'), of a long and relatively narrow part of the earth's crust. The boundary fault planes converge downwards, and the subsidence is typically the result of extensional forces in the crust (arrows in

Fig.3). A present-day example of a graben that has been studied in great detail is that of the Upper Rhine Valley between Basel and Mainz (see e.g. Illies and Fuchs 1974). The total amount of subsidence which has occurred in that graben varies: west of the Odenwald it exceeds 4 km. The horizontal extension corresponding to the subsidence is of the same order of magnitude.

A graben depression acts as a trap for sedimentary matter, brought to it from the sides and from up-valley by rivers. In this way thick complexes of gravelly, sandy and clayey layers are accumulated. Where the fluvial sediment supply is small, swamps may develop, in which peat is formed, which later, after burial under new sediments, may be transformed into coal. Where grabens are situated in the proximity of the sea and fluvial sedimentation is insufficient to keep the surface above sea level, the area may become inundated by marine waters. Then long, shallow ('epicontinental') embayments of the sea are produced. Sometimes even long straits originate, leading from one sea to another. In such marine environments sand and mud is deposited, by washing in of material from the land and by accumulation of shells and tests of (mostly microscopic) marine organisms.

All the above-named types of deposits are found in the coastal areas of central western and central eastern Greenland. On the east side sediment accumulation had already started in the Permian, about 250 million years ago. The oldest deposits in the west date from the Lower Cretaceous, about 120 million years B.P. Comparison of the marine fossil faunae leads to the conclusion that in the Jurassic and in the Cretaceous long sea straits existed along the eastern margin of Greenland, connecting the Arctic seas with the Atlantic Ocean basin in the south (Birkelund *et al.* 1976). A similar strait has probably been present in the Cretaceous on the west side of Greenland (Henderson *et al.* 1976). No graben deposits are known from the coast of the Labrador Sea, but they have been encountered, dating from the Cretaceous, in offshore borings in that area.

A striking feature of the Upper Rhine Valley graben, and of other grabens (e.g. those in East Africa), is that it is located in the middle of an uparched part of the earth's crust. The western half of this uplifted area is formed by the Vosges and the Pfälzer Wald, the eastern half by the Black Forest and the Odenwald. The uplift is most likely due, directly or indirectly, to the upwelling of hot material in the earth's 'mantle', i.e. the circa 2900 m thick shell of the earth enveloping its (metallic) core. Although the mantle material is (mainly) solid, it can - slowly - flow (by plastic deformation), as in general all solids can do. The ability to flow is enhanced by heating, and has its maximum at temperatures near the melting point. In spite of the increase of the temperatures with depth,

the rocks deep within the mantle are unmolten, owing to the simultaneous downward increase of the pressure.

Where mantle material moves upward, it causes, below the earth's crust, a local rise of the temperature. This brings about a more dilated condition, and hence uparching of the surface. It is not known whether the bulging of the crust in graben areas is entirely due to such thermal expansion. To some extent it might be caused by accumulation of mantle rocks, or their derivatives, under the crust.

Since, during the ascent, the upwelling material is decompressed, a certain fraction of it becomes molten, the melt having in general a basaltic composition. Owing to its mobility part of the melt normally finds its way through the crust to the surface, causing volcanism (e.g. that in and along the East African graben system, and the - now extinct - Kaiserstuhl volcano in the Rhine Valley near Freiburg).

Where it arrives at the underside of the crust, the ascended material, in so far as it does not accumulate, has to flow sideways. By doing so in opposite directions it exerts a drag on the overlying crust, thus creating extensional forces in it, and accounting for graben formation. It could be supposed that this drag also leads to removal of some of the material of the underside of the crust, and hence to crustal thinning. From seismic investigations it appears that in the southern part of the above-mentioned area, namely the Vosges, the Black Forest and the Rhine Valley in between, the crust is in fact considerably attenuated (in the manner indicated in Fig.3). An alternative, perhaps less likely explanation of the thinning phenomenon might be that the rocks of the lower part of the crust are transformed into denser material, thereby giving it the seismic properties of mantle substance.

The graben situation may last a long time. The oldest sediments deposited in the Upper Rhine Valley graben date from the Eocene, which means that the structure has been there for some 50 million years. In the Baffin Bay and Davis Strait areas the graben persisted until the beginning of the Tertiary, that is, for at least 65 million years. Then a new stage set in: that of the active drifting apart of Greenland and Baffin Island, and the formation of oceanic crust in the newly produced gap. In the Labrador Sea the transition from graben to oceanic chasm had already occurred in the Cretaceous.

#### The process of ocean floor accretion

Geophysical and geological investigations have made it clear that oceans are gradually formed by accretion in 'rift zones'. The crust on both sides of such rifts is moving slowly away in opposite directions, with velocities of less than 1 to more than 10 cm per year. From time to time fissures are thereby formed in the rift zone. These

are filled up immediately with rock melt coming from below, out of the mantle. Part of the melt extrudes from the fissures, forming submarine lava flows. The molten material of fissures and flows soon solidifies to basalt, whereafter new fissures are produced (and filled), in, along and between the fissure fillings that had been formed shortly before, the process repeating itself continually. In this way a gradually widening strip of new crust originates: 'sea floor spreading' (Fig.4).

The oceanic rift zones lie on the highest, central part, the 'crest' of submarine ridges. In this respect there is a distinct analogy with the continental grabens and their uparched surroundings. Whereas in their case it is not yet certain how far the crustal uplift is caused by the locally expanded state of the upper mantle, it is clear that the oceanic ridges, where the upwelling in the mantle is mostly much stronger, owe their existence mainly or entirely to thermal effects. Above the zone of upwelling the material is hottest and most dilated; as it flows sideways from the rift zone, it cools and contracts, leading to lowering of the surface. In the Atlantic Ocean the accretion ridge follows rather closely its median line, except north of Iceland, and is rightly called the Mid-Atlantic Ridge. The difference in level between the crest and the oldest parts of the (basaltic) ocean crust may amount to some 2.5 km. The difference in water depths between the ridge crest and the lateral parts are generally smaller, owing to burial of the crust under gradually accumulating sediment. The older the crust, the longer this accumulation has been going on.

The accretion of the ocean floor is clearly visible in the patterns obtained by magnetometric research on and above the oceans. They consist mostly of 'lineations': series of narrow stripes, elongate patches etc., parallel to the rift in the accretion ridges, the patterns on both sides being one another's mirror image. Each pair of stripes or aligned patches corresponds to a certain stage in the process of sea floor spreading, the oldest lying at the greatest distance from the median rifts. The lineations are due to differences in magnetization of the basaltic crust, which result from reversals of the magnetic polarity of the earth. The ages of the successive stripes have been established by means of bore samples. In the last decennia hundreds of borings have been made in the deep ocean floor, all over the world. Where possible, the entire sediment cover was penetrated, the drilling being terminated in the basaltic rocks underneath. The ages of the latter, and those of the oldest sediments, resting directly upon them, were determined in the laboratory in different ways. In this manner the history of formation of ocean basins can be studied in much detail(6).

The thickness of the oceanic crust, without the sediment cover, depends on the rate of supply of basaltic melt from the earth's interior, and on the rate of spreading of the

ocean floor. Normally the two are more or less in equilibrium with one another, so that the crust under the oceans has an approximately constant thickness over its whole width, regardless of differences in the rate of accretion. This typically oceanic crust is mostly between 4 and 6 km thick. Only locally has the basalt production been much greater, for example at the Iceland-Faroes ridge, where the crust is up to 20 km thick. Iceland itself is the only place on earth where a large portion of the oceanic accretion ridge, owing to excessive outpouring of basalt, protrudes above the water.

In its generally small depth to the Moho, the (normal) oceanic crust differs fundamentally from that of the continental masses, where the crust is mostly between 25 and 35 km thick. It is primarily because of this difference that the surface of the continents lies so much higher (on average almost 5 km) than that of the ocean floor. The continental crust also differs from that under the ocean in its chemical and mineralogical properties, being characterized by a much greater variation of rock types, and by the abundance of rocks of granitic composition, notably granites, 'gneisses' and 'granulites'.

The first stage of the separation of Greenland from Canada.  
The opening of the Labrador Sea and its extension in the  
Baffin Bay area

Magnetometric research in the Labrador Sea has yielded, in its deep parts, a typical oceanic accretion pattern. The oldest lineations were formed between about 80 and 55 million years ago, that is during the Late Cretaceous and the Paleocene (see Fig.9). They can be traced southeastward into the Atlantic Ocean, where they curve towards the south in the area off Newfoundland (Fig.5). The direction of accretion in the Labrador Sea during this first stage was such that Greenland, with respect to Labrador, moved approximately towards the northeast(7) (Fig.5). At that time the rift of the young Mid-Atlantic ridge did not yet continue northward along its present course between Greenland and Norway, but passed directly into the Labrador Sea.

Then, approximately 55 million years ago, at the end of the Paleocene (see Fig.5 and Fig.9), the accretion direction in the Labrador Sea suddenly shifted over more than 30 km to northnortheast (Srivastava 1978, Tucholke and Fry 1985). At the same time sea floor spreading began in the northernmost parts of the Atlantic Ocean area, east of Greenland, the rift zones being connected in a 'triple junction' south of Cape Farvel. However, whereas the accretion in the Atlantic Ocean since then has been continuous up to the present time, and is still going on today, the formation of new ocean floor in the Labrador Sea stopped at the end of the Eocene, about 36 million years B.P.. Cooling

of the lithosphere under the Labrador Sea has led to lowering of the abandoned accretion ridge. Moreover, the crust has been buried under a thick cover of sediments. The result is that at the surface of the sea floor the central ridge is no longer visible.

Geophysical investigations in the Baffin Bay area have shown that its deepest part is likewise underlain by typically oceanic crust (Fig.6) (Keen *et al.* 1974). Magnetic lineations are less clear than in the Labrador Sea, probably mainly because of the abnormally thick sediment cover in this basin. Yet, it can hardly be doubted that the crust has originated through the same type of spreading process as that which gave rise to the other oceanic basins of the earth. Regarding the time of formation, it is generally assumed that this coincided with the second stage of accretion in the Labrador Sea. This age appears to be in agreement with the results of a deep ocean boring carried out recently in Baffin Bay (Fig.7) (Arthur *et al.* 1986). Just as in the Labrador Sea, the accretion in Baffin Bay stopped at the end of the Eocene(8).

It seems contradictory that during the first stage oceanic crust was generated in the Labrador Sea, while more to the north, in Baffin Bay, the crust retained its continental character. It has been suggested that during this first stage only the southern part of Greenland moved northeastward, by slip along one or several fault planes, running southwest-northeast through Greenland, from the Disko Bay area to Dronning Louise Land or Lambert Land. However, no clear indications for such faults are (yet) known from the coastal areas; nor is geophysical information available which points to the presence of such structures below the icecap.

Another possibility is that a certain amount of crustal extension did occur in the Baffin Bay area during the first Labrador Sea stage. This would agree with a reconstruction(9), whereby Greenland as a whole has rotated around a rotation pole north of Baffin Island, approximately in Lancaster Sound. In this case the stretching of the crust in Baffin Bay would have been only a fraction of what it was in the Labrador Sea. Nevertheless, it must have been sufficient to cause either a very considerable thinning of the continental crust, or the first formation of a narrow strip of oceanic crust. Depending on the sediment supply this beginning gap could have been deep or shallow.

If such a rotation of Greenland has indeed taken place, the northern part of it must have moved towards the northwest, causing compression. This could account for the Late-Cretaceous and Early Tertiary folding in northern Greenland and in Ellesmere Island.

### Davis Strait

Up to this point only the opening of the Labrador Sea and of Baffin Bay has been dealt with. The question arises: what happened during these times in Davis Strait? This strait is not only relatively narrow, it is also much shallower than the seas on both sides. Geophysical data show that the shallowness coincides with a considerable thickness of the crust: up to 20 km, see Fig.6 (Menzies 1982). In this connection it must be pointed out that along the northeastern part of the Strait, in central West Greenland, large areas are covered by basaltic rocks(10). Basalt is also present on the opposite side, at Cape Dyer on Baffin Land. Moreover, it has been found in borings in the bottom of the strait (Fig.7).

On the Greenland coast the volcanic series attains thicknesses of up to 1.5 km (Clarke and Pedersen 1976). Here, age determinations have been made, showing that the whole series was produced in the time between 63 and 56 million years B.P., that is, just before the beginning of the second accretion stage in the Labrador Sea and the (main) opening of Baffin Bay. Such massive outpouring of basalt has occurred at many other places on earth as a prelude to the breaking up of continental crust. Obviously it signifies an increase in the rate of upwelling in the mantle, which also accounts for an increased rate of spreading of the crust. The extrusion of basalt under such circumstances tends to be concentrated in certain areas ('hot spots'). It is no wonder, therefore, that in and along the seas of West Greenland the basalt formations and the thick submarine accumulations should be limited to one, central area.

From the above it may not be deduced that under the whole area of Davis Strait the entire crust is made up of basaltic rocks. Borings off the West Greenland coast (see Fig.8), one of them not far from the middle of Davis Strait, showed the presence of Precambrian continental rocks. In addition, the sub-bottom structures in the Strait have a marked southsouthwest-northnortheast trend, the same direction in which Greenland has moved during the second stage of ocean floor accretion (Tucholke and Fry 1985). These data suggest a situation embodying a so-called transform fault system, as indicated in Fig.8 (cf. Menzies 1982). A transform fault is a vertical fracture, along part of which horizontal displacements of crust take place owing to ocean floor accretion, while along the other parts the blocks on both sides remain stationary with regard to each other (see Fig.5). It originates, together with the beginning of sea floor spreading, at places where an accretion ridge ends, to be relieved, on the other side of the fracture, by a ridge with a shifted position. Probably, Davis Strait is partly underlain by continental crust that has been attenuated by stretching during the first Labrador Sea accretion stage, and which has been covered with basalt during the Paleocene stage of violent volcanism.

### Baffin Bay and the 'Nares Strait dilemma'

From the bathymetric sketch in Fig.7 it is seen that most of Baffin Bay, in contrast to the Labrador Sea, is shallower than 2000 m. Also the maximum depths in Baffin Bay are not much greater than half of those in the Labrador Sea. The shallowness of Baffin Bay is partly due to the broad margins of submerged continental crust, partly to its very thick (up to 5 km) infill of marine deposits. The attenuation of the continental margins, leading to their submergence, is bound up with the sagging of fault blocks along seaward dipping fractures. In at least one area a submarine graben structure is present, namely in Melville Bugt. Notwithstanding its sediment fill the graben is still marked as a depression in the sea floor.

With regard to the deep part of Baffin Bay, underlain by oceanic crust, there is little evidence for the direction of its accretion, but it is hardly possible that it differed from that of the second stage of the Labrador Sea. This means that during this period, roughly corresponding to the Eocene, the whole of Greenland has drifted towards the northnortheast (with regard to Labrador and Baffin Island) (cf. Fig.8). Many geophysicists assume that its northwestern part has thereby moved along a fault running through Nares Strait. The relative displacement would have amounted to at least 200 km. On the other hand, the geologists who have investigated these areas have come to the conclusion that, if lateral movement occurred at all along Nares Strait, it cannot have been over more than some 50 km. According to them several geological structures and other markers, found on one side of the strait, continue on the opposite side with only little offset. Perhaps the strongest indication is the boundary between Lower Silurian(11) shallow and deep water deposits, which appears to cross the strait at the northern end of Kane Basin (Hurst and Kerr 1982). It must be remarked, though, that not all geological arguments are equally convincing, that at least some of them can be interpreted in other ways, and that there are even geological data that can be used as indications of a large lateral displacement (Newman 1982a). Also, it cannot be doubted that Greenland has drifted over a considerable distance to the northnortheast. A possible solution is perhaps that the relative displacements in the Nares Strait area were not confined to the strait itself, but were divided over a number of more or less parallel fault planes, most of which are on Ellesmere Island (cf. Newman 1982a, Miall 1983) (12).

### The late Tertiary and Quaternary history of the seas west of Greenland

Much information about the oceanographic development of the seas west of Greenland will shortly become available when

the data from three new borings, two in the Labrador Sea and one, mentioned above, in Baffin Bay, are published. From a preliminary paper (Arthur et al. 1986) it appears, among other things, that in the Middle Miocene (around 13 million years B.P.) the climates in the northern regions began to deteriorate and Arctic waters commenced to flow southwards in Baffin Bay. Since about 3.5 million years B.P., in the Pliocene, sand and pebbles were deposited on the floor of Baffin Bay, by melting of icebergs and ice-floes. Ice-floes carrying rock material are normally derived from coasts, by freezing of sea water. Icebergs originate by calving of glaciers where these flow out into the sea. They may transport large quantities of rock fragments, sand and clay, carried along from far inland.

The onset of cold climatic conditions in the Middle Miocene in the Baffin Bay area coincided approximately with the beginning of large scale ice rafting of sand and pebbles in the seas around Antarctica. Apparently, at that time, many of the Antarctic glaciers enlarged in such a way as to reach the coasts. Probably this was the result of the formation of a large icecap. In that case the sea level must have dropped markedly, owing to the large amounts of water that were 'stored' as ice on land. In fact, a considerable, abrupt, world wide fall of sea level at this time is indicated by the isotopic composition of fossil plankton remains in oceanic sediments(13) (see e.g. Miller and Fairbanks 1985).

It follows from the above that, around Baffin Bay, extensive glaciation of the land, with glaciers reaching down to the coasts, began much later than in Antarctica. Even so, in the 3.5 million years during which in the northern countries glaciers have flowed out into the sea, they have profoundly influenced the morphology of the coasts, namely by glacial erosion. Although glacier ice flows much more slowly than river water, its erosive power is many times greater. This is due to several circumstances, for example the intensity of subglacial weathering, the force with which rock fragments, frozen in the base of the glacier ice, scratch over the rocky substrate, and the large areal extent of the erosive action, which is not limited to a narrow stream bed, as in rivers, but takes place over the whole ice-covered surface. Where former river valleys, with their generally more or less V-shaped cross sections, are occupied by glaciers, they are scoured out both to great depth and great width, the cross sections becoming typically U-shaped. Naturally, the effects of glacial erosion are visible only after the ice has melted away. Since its maximum extension during the last cold stage of the Quaternary ice age (about 15 000 years ago) the ice in northeast Canada has disappeared almost completely, whereas in Greenland most of the land remains glaciated, apart from the coasts. After the retreat of the glaciers the sea entered the deepened and widened valleys, thus changing them into 'fjords': comparatively deep embayments with

steep walls, many of them penetrating far inland. The strong erosive effect of glaciers is immediately seen when comparing the coastlines of areas that were glaciated during the ice age to those that were not. Thus the formerly ice-covered Pacific coasts of Canada and southern Chili are heavily indented, in contrast to the relatively smooth, but otherwise comparable coasts of the western United States and northern Chili, which remained free of ice.

Another peculiarity of glacier erosion is its tendency to produce an uneven bottom relief, full of hills and depressions. This ensues from the ability of glacier ice to flow uphill over protuberances so long as the ice surface slopes down in the flow direction. Owing to this property primary depressions or places of less coherent rocks can be scalloped out and deepened considerably. After deglaciation the hollows become filled with water, so that lakes are formed. A glance at a geographic map is sufficient to see the difference between the areas which in the ice age have been covered by glaciers, and those which remained free of ice, the former being strewn with lakes. Where such formerly glaciated landscapes have subsequently become covered by shallow seas, it is not the depressions, but the elevated parts that are conspicuous. In such areas, especially along coasts, the waters may abound with small islands: so-called skerries.

It is clear that the intensity of glacial erosion also implies a large production of sedimentary material: coarse and fine rock fragments, sand, silt and clay-sized particles. They are deposited, not only in fjords and other coastal waters, and on beaches, but also in the forelying deeper seas. It is partly owing to this strong 'glacial' supply that the sediments on the floor of Baffin Bay have reached their (above mentioned) great thickness. Another factor has probably been intensive frost weathering in the high parts of the northern land areas during the millions of years between the Middle Miocene and the ice age when the climates, though not typically glacial, were nevertheless relatively cold.

#### Notes

1. Approximately 300 to 235 million years ago.
2. The distinction between continents and islands on account of their surface area is geologically meaningless. Geographers lay down an arbitrary boundary somewhere between the sizes of Greenland (an 'island') and Australia (a 'continent'), leaving the submerged 'continental platforms' out of consideration. Geologically, a continent is characterized by crustal thickness and rock composition. Some continental masses are small, e.g. Madagascar, or very small, e.g. Corsica.
3. B.P.: before present.

4. Where continental masses have been torn apart, this submergence of the outer parts is obviously a secondary phenomenon. It is the result of thinning of the crust at the margins, probably due to stretching.
5. Actually, the lowering of the surface mostly takes place in sudden, small movements, over not more than a few metres, occurring at long intervals.
6. The times of the polarity reversals during the last few million years are corroborated by the study of volcanic rock series on land, for example on Iceland.
7. It should be noted that in relation to northwestern Europe Greenland has moved in the same period to the northwest.
8. The depth at the drilling site was 2020 m. The time of termination of ocean crust accretion is found by correlating structures in the sedimentary complex in the whole deep basin with deposits penetrated by the boring.
9. This reconstruction is discussed by among others Peirce (1982) and Menzies (1982; see also Bullard *et al.* (1965).
10. A peculiarity of the basalts on Disko Island is their content of metallic iron. It is formed through reduction of iron oxides in the basaltic melt by incorporation of peat, coal and carbon-rich shales of Cretaceous and Paleocene age. The iron is segregated as (liquid) spherules, which by their high density sink down in the melt. By coalescence of such spherules, and solidification, blocks of up to a few metres diameter have been formed (see e.g. Klöck *et al.* 1986).
11. About 430 million years old.
12. In addition, the formation of the grabens of Lancaster Sound and Jones Sound must have been accompanied by a small displacement of Ellesmere Island towards the northnortheast, i.e. in the same direction as that of the drift of Greenland.
13. The evaporation of great volumes of sea water, required for the accumulation of inland ice, leads to a relative concentration of the heavy oxygen isotope  $^{18}\text{O}$  in the sea water. This is reflected in the  $^{16}\text{O}/^{18}\text{O}$  proportion in the carbonate ( $\text{CaCO}_3$ ) tests of marine organisms. Obviously, such an important climatic change in the polar regions must have had its consequences on the climates at lower latitudes. Since a world-wide cooling of climates must have led to a lowered rate of evaporation, and hence of precipitation, it may be expected that in certain areas deserts could arise. This seems indeed to have been the case: it was in about this same period that in North Africa and in Australia deserts started to develop.

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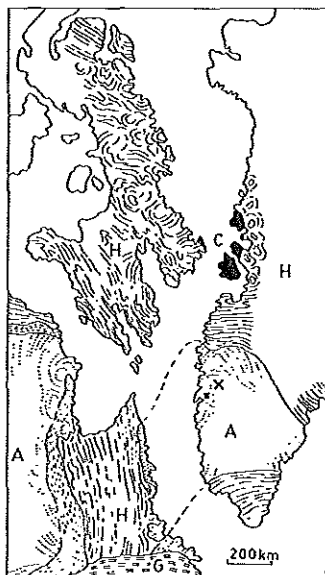


Fig. 1. Sketch map showing supposed original position of Baffin Island, Labrador and Southern Greenland, with age provinces and main trends of geological structures.

A: older than 2500 million years (m.y.)  
 x area where oldest rocks known on earth are found: 3750 m.y.

H: age between 2000 and 1200 m.y.

G: age between 1200 and 900 m.y.

C: Cretaceous and early Tertiary rocks.

Mainly after Bridgwater, D. et al. 1973, Mem. 19 Amer. Assoc. Petrol. Geol. 99-116.

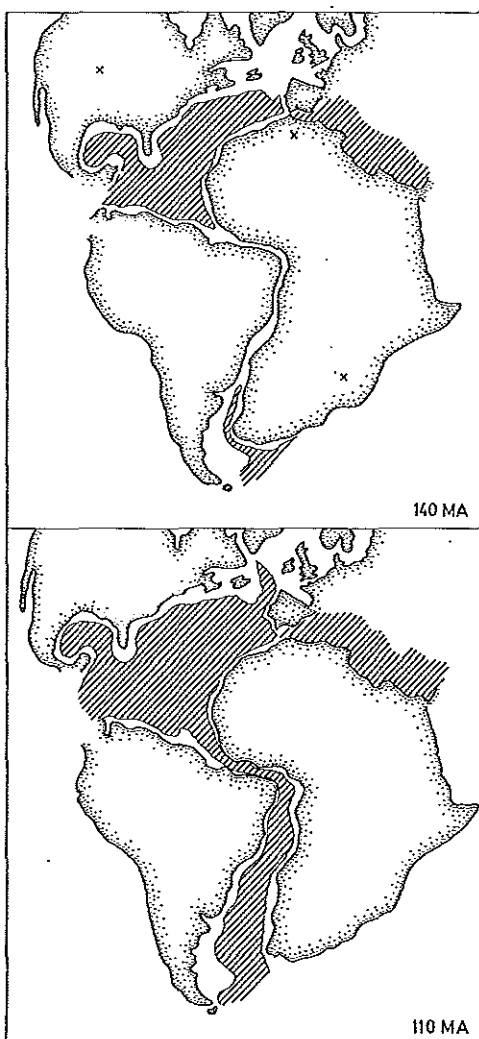


Fig. 2. Stages in the development of the Atlantic Ocean.

Above: probable situation 140 million years ago (Late Jurassic). Crosses mark places where remains of *Brachiosaurus* have been found. Below: probable situation 110 million years ago (Middle Cretaceous).

Shaded: deep ocean. For the sake of clarity the continents are indicated by the present coastlines, which do not correspond to those at the time of the reconstructions. After Salater et al. 1977, Journ. Geol. 85: 509-52.

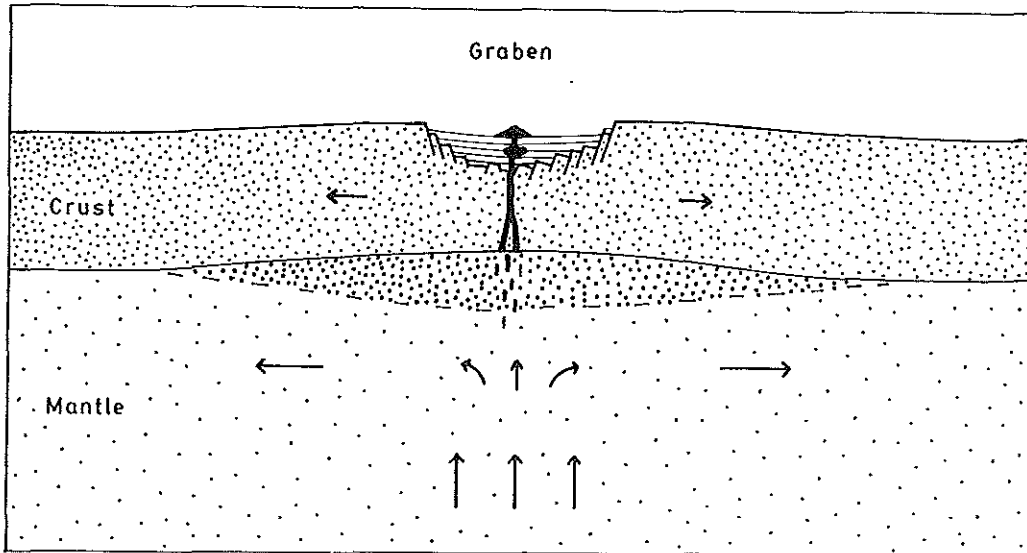


Fig.3. Diagram of graben formation above zone of upwelling in mantle. Heavy dots: partly hypothetical 'cushion' of material with properties differing slightly from those of the adjoining mantle. The sedimentary fill of the graben is indicated by more or less horizontal 'strata'. Black: volcanic rocks. No data are yet available concerning the downward extension of the fractures. N.B. The continental crust is normally between 25 and 35 km thick.

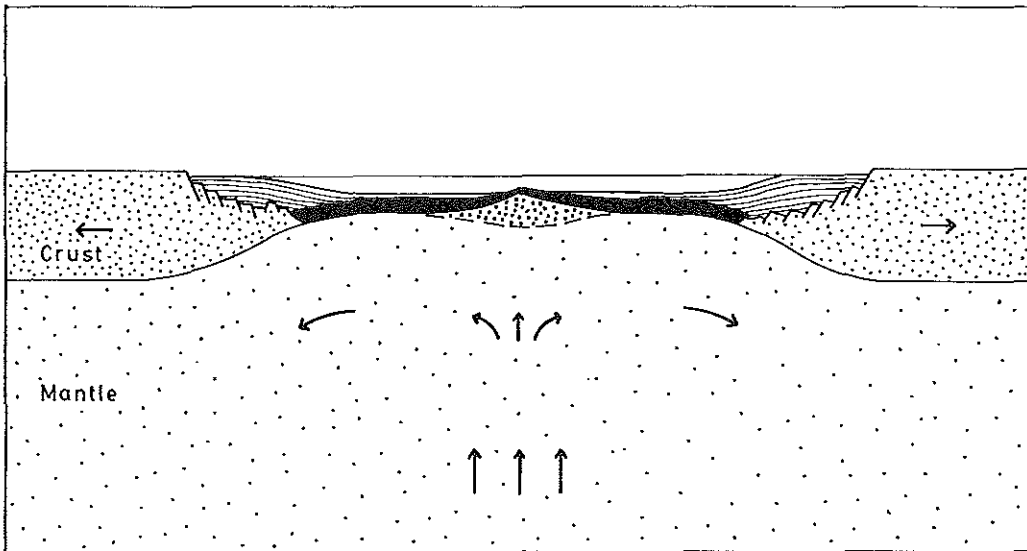


Fig.4. Diagram of ocean floor accretion and concomitant continental drift. The accretion occurs above a zone of upwelling mantle material. The oceanic crust, composed of basalts and related rocks, moves away from the rift in opposite directions. Owing to contraction by cooling of the upper layers of the mantle the crust subsides gradually. At the same time it is buried under a sediment cover of increasing thickness. The outer parts of the continents are thinned, submerged and covered by continental shelf deposits.

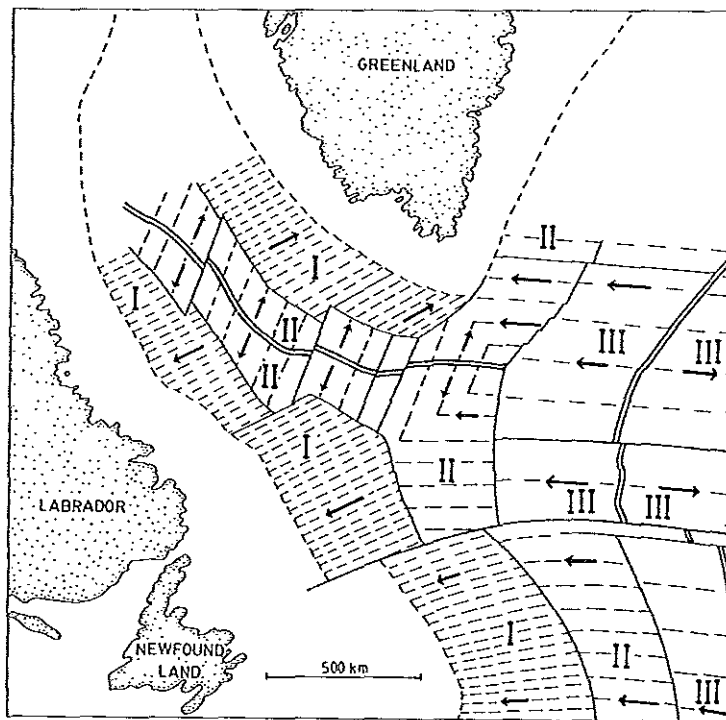


Fig.5. Simplified map of accretion pattern in Labrador Sea and adjoining part of Atlantic Ocean.

I. First Labrador Sea stage (Late Cretaceous and Paleocene).

II. Second Labrador Sea stage (mostly Eocene).

III. Accretion since Eocene, in Atlantic Ocean only.

The accretion directions are marked by arrows. Heavy double lines: rift zones. Thick lines crossing rift zones: transform faults. The triple junction was active only during stage II. Based on Tucholke and Fry 1985.

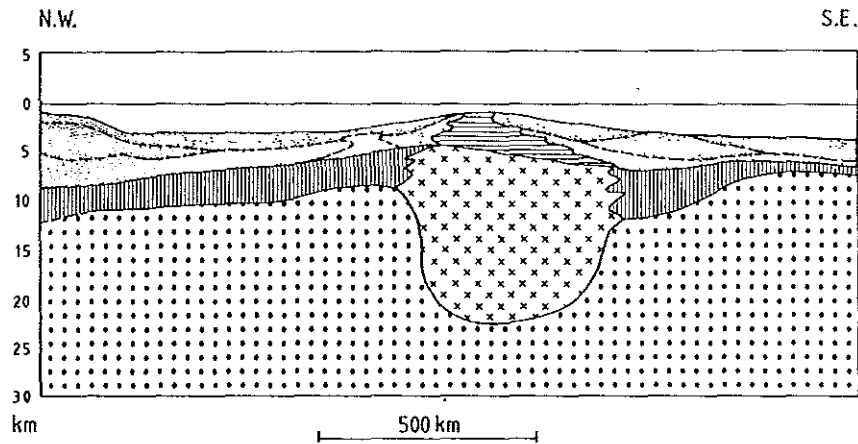


Fig.6. Schematic cross section along line A-A' on Fig.7.

Circles: mantle.

Crosses: continental crust. Vertical shading: oceanic crust. Horizontal shading: epicontinental basalt.

Dots: sediments.

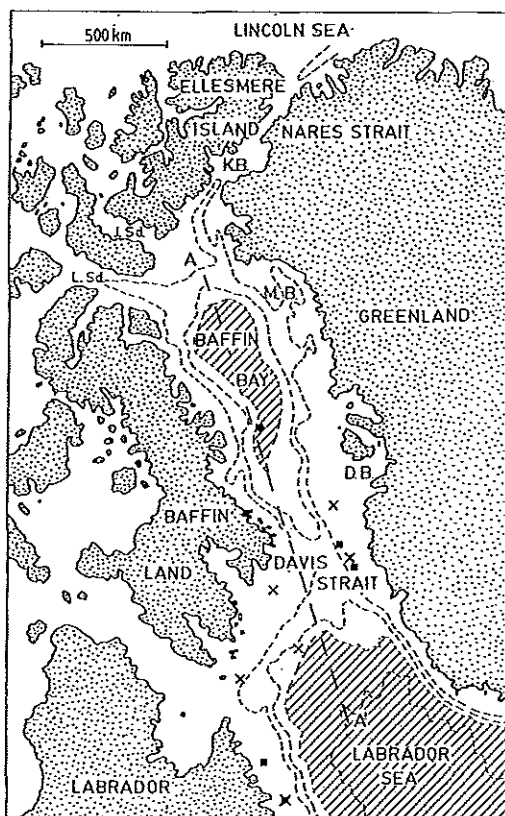
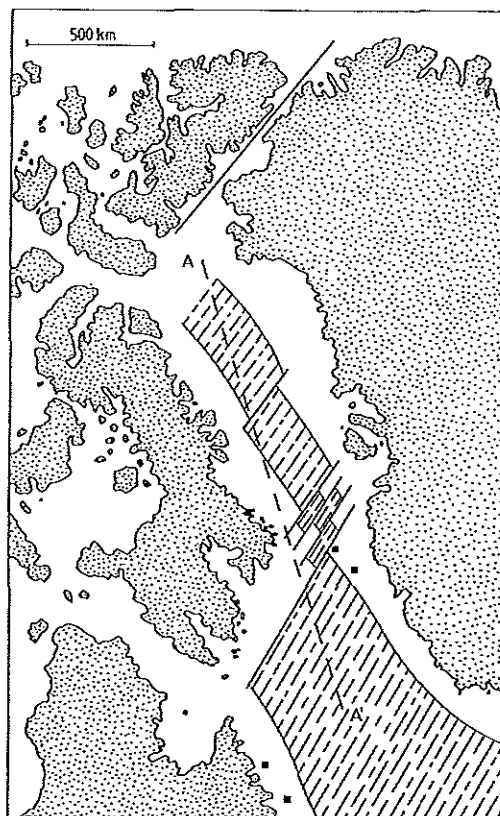


Fig.7. Bathymetry of seas west of Greenland. Filled circle: site of deep sea drilling (Arthur et al. 1986). Squares: offshore drillings terminated in Precambrian rocks. Crosses: drillings penetrating into volcanic rocks. K.B.: Kane Basin. M.B.: Melville Bugt. D.B.: Disko Bugt. J.Sd.: Jones Sound. L.Sd.: Lancaster Sound.

Fig.8. Hypothetical distribution of oceanic crust (shaded) and (main) transform faults in seas west of Greenland. The oceanic crust is covered by sediment with thicknesses of up to several kilometres. A-A': line of section of Fig.6. Black squares: borings penetrating into Precambrian rocks.



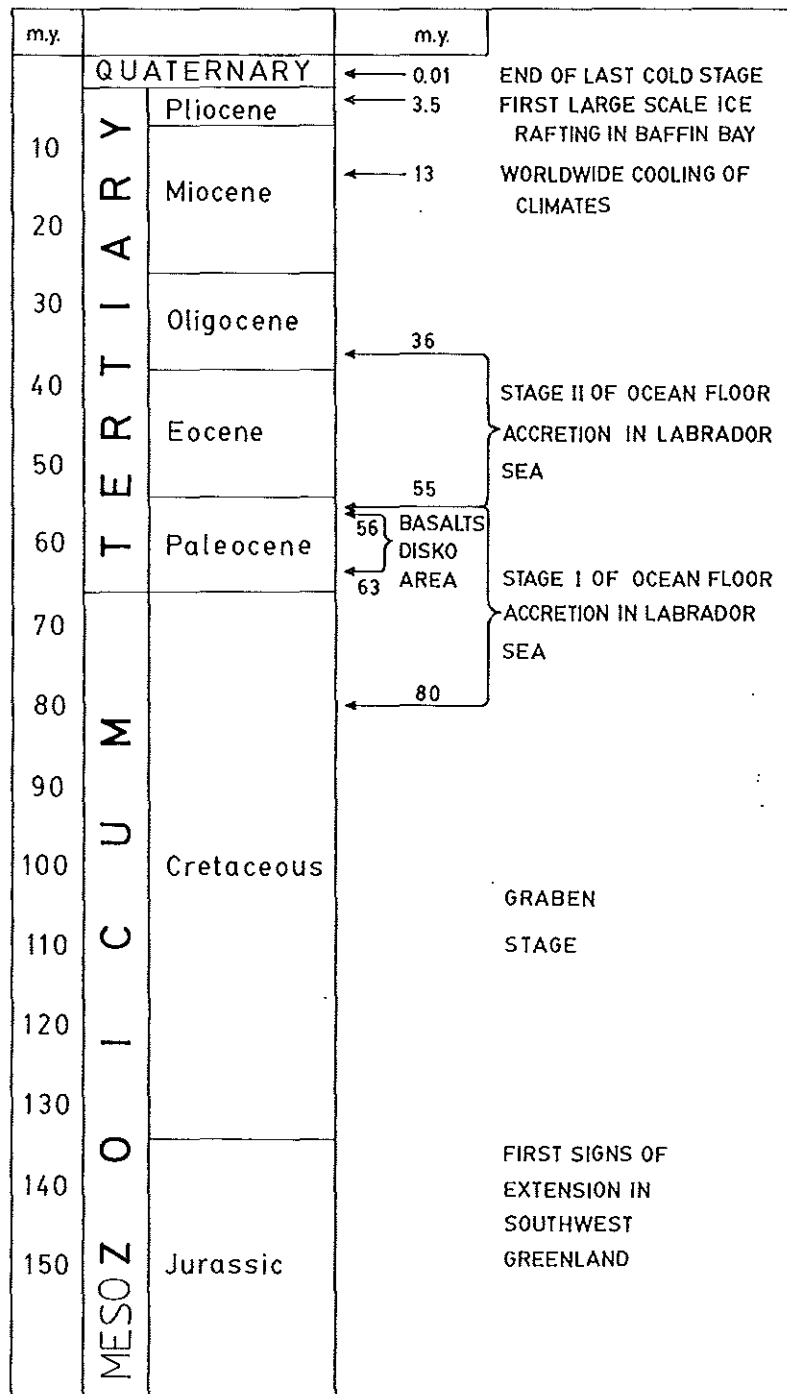


Fig.9. Chronology of events in areas west and south of Greenland. All ages in millions of years.

## CHANGES IN THE GLACIERS AND CLIMATE OF GREENLAND IN THE LAST TWO MILLENNIA: THE PRESENT STATE OF KNOWLEDGE

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*The old concept of glaciers as simple climatoscopes has been modified considerably in the last three or four decades. This goes especially for the Inland Ice which is the main object of the present contribution. Detailed climatic records have now been revealed from the ice cores drilled in the interior of the Inland Ice and at the same time the marginal changes of this ice cover have been determined.*

*The last 4000 years is mainly a period of cooling spells following the Holocene climatic optimum. This implies that the ice margin generally became activated in readvances, which in most places culminated as late as 100 years ago. These readvances have destroyed the geological evidence of earlier changes, but organic material brought by the glacier ice from the bottom to the ice margin indicates that the ice margin has been in places at least 10 km behind its present position.*

*Attempts at reconstruction of these successive advance phases in the last millennia have been made on the basis of calculations of the glacier's response to climate change. This procedure requires knowledge of many factors (climate, subsurface and surface of the ice, mass balance) and its application is therefore restricted to minor areas of the ice margin. The procedure seems a promising method of bridging the information gap between the well-documented early postglacial recession of the Inland Ice margin and the known neoglacial fluctuations of the most recent centuries. The outlines of the Inland Ice marginal changes presented here are only a simplified version of a rich variety of glacier behaviour, with sectors oscillating with different amplitudes or even in opposite phases. The goal of present glacier documentation and monitoring is to locate these differences, even if they cannot be explained on the basis of present knowledge of the mass balance and physics of the ice sheet. Changes in minor glaciers in Greenland are little known. In general, during the last few centuries they seem to follow the patterns of behaviour elsewhere, namely growth until the middle or last part of the last century, and a recession culminating in the last few decades.*

### Glaciers as climatoscopes

The classical concept of glacier changes is that of a valley glacier with the snout moving down the valley when it becomes colder and retreating up the valley when it becomes warmer. The whole question then was to determine and date the changes of the frontal positions in order to obtain a

curve showing the climatic fluctuations. Since the introduction of modern mass balance concepts and glacier physics (Paterson 1981) in the last three or four decades, it has been generally accepted that this simple concept of glaciers as 'climatoscopes' can only be used with considerable reservation. Thus, an increased summer melt of the glacier could be compensated by increased snow accumulation in the same period, so that the glacier could maintain its size - a size which then expresses two different climatic situations. If climatic change induces changes in the extension of the glacier, the adaptation of the glacier to the new climatic situation takes a certain time, dependent on glacier size. In small glaciers this adjustment is a matter of some years, whereas in larger glaciers it can be a matter of centuries.

The modern approach to the investigation of glacier changes and their causes is to determine the annual gain (snow accumulation) and loss (by melting or calving ice production) of the glacier and in this way the total annual mass change. This is then compared with climatic records (mainly summer temperature and snowfall) over the same period, and from this the changes in the glacier back in time can be reconstructed. Records from coastal meteorological stations, where observations reach back into the end of the last century (Upernavik, Jacobshavn, Godthaab, Qornoq, Ivigtut, Nanortalik and Angmagssalik), can be used. Older climatic series can be obtained from ice cores, containing information extending 100,000 years back in time. In connection with such 'modelling' of the glacier's response to climatic fluctuations, the classical geological and historical documentation of changes in glacier extent act as a control on these calculations.

#### Ice core climatic records

Ice coring and the interpretation of ice cores have been developed into a highly sophisticated physical discipline within glaciology. Work in Denmark was done by W. Dansgaard and his colleagues. The ice core records not only contain information about the changing climate, but also for example about variations in the deposition of chemical constituents or volcanic ashes on the surface of the Inland Ice. In dating the core and extracting the climatic record the basic idea is that the proportion of the oxygen isotopes  $O_{16}$  and  $O_{18}$  vary in accordance with temperature (and therefore also according to height of deposition). Based on a certain height (i.e. at a specific drilling site), it is possible to determine summer and winter layers because of the difference in temperature of the deposition of the snow on the surface of the glacier. With time a snow particle deposited on the surface will be buried and finally transported by the glacier movement to the margin of the glacier.

For minor glaciers this transport of the ice from the interior (or upper parts) to the margin is a matter of centuries, whereas in larger ice sheets it takes more than 100.000 years (see Fig.1). The consequence is that ice cores obtained in the central parts of the Inland Ice contain a climatic record for this long period. Individual annual layers can be directly counted 8000-10.000 years back, but other methods are used to determine the age of deeper (and older) strata. Both variations in oxygen isotope composition and the thickness of the individual annual layers of snow and ice can be measured. This implies that such a record contains information on changes in both 'isotopic temperature' and in accumulation of snow.

The main emphasis has been on the deep drillings at Camp Century and Dye 3 (Fig. 2) because of the record range here of over 100.000 years, which covers both the last Ice Age (Wisconsinian) and postglacial (Holocene) time. For the Camp Century record, the variations in temperature are shown in Fig. 4. However, in the present description of the climate of the last two millenia, the intermediate drillings of Milcent (depth 398 m, covering the last 800 years) and Crête (depth 405 m, covering the last 1400 years) have also to be taken into consideration. All the ice cores indicate relatively stable climatic conditions throughout the Holocene period, but with an increasing tendency to cold spells (see Fig.4) in the last 4000 years of which the latest one (about 600 to 100 years ago) was the most intensive ('the Little Ice Age').

Climatic trends in the Little Ice Age and the centuries before this period can be demonstrated from the above-mentioned four ice coring sites, and the paleotemperature trends of all the records indicate the same variations. They are also in agreement with the historical records from Iceland and England covering the last millenium (Langway *et al.* 1985). With regard to fluctuations of snow accumulation, the curves of ice cores from the Inland Ice differ widely, but there is some tendency towards coincidence between warmer spells and high precipitation. More shallow drillings on the Inland Ice with sufficient geographical spread will be required to detect changes through time in the maximum and minimum accumulation zones of the Inland Ice surface. The bottom of the Inland Ice contains deposits from the Ice Age. A consequence of the ice movement (Fig.1) is that 'Ice Age ice' is being brought to the margin of the Inland Ice. A sampling of the oxygen variation from the margin of the Inland Ice to the 'snow line' will therefore show a kind of 'horizontal Camp Century core' (Fig.1. bottom), where the outermost about 1 km of the ice margin is 'Ice Age ice'.

### The dating of the Holocene retreat

To furnish some background for discussion of the changes of glaciers (i.e. in Greenland essentially the Inland Ice) in the last 2000 years, it is necessary to give a short review of the preceding millenia.

Since the end of the last Ice Age the ice margin has retreated, and several stages in this recession have been dated. The map Fig. 3 shows the main development in examples from West Greenland. In all parts of Greenland the ice margin gradually receded from the outer coast to the present positions, which at different points were reached between 8000 and 6000 years ago. This recession occurred at the fastest rate where large parts of the ice margin were in contact with the sea (e.g. Disko Bugt). Slower recession took place where the ice margin was entirely on land. So far, this development of 10.000-6000 years ago is well documented, since radiocarbon dating of ice margin deposits is possible by means of organic material in lakes or marine deposits laid down in connection with changes in the ice. However, the recession of the ice margin continued beyond the position of the present ice margin (see Fig.4) and only with the onset of a colder climate in the last 4000 years did it gradually move forward to the present position.

### Neoglacial fluctuation of the Inland Ice margin

Since most tracks of the ice margin deposits of the last millenia are buried by the present ice margin, direct mapping of changes in the ice is not possible. One approach to determine marginal changes in the last millenia is to collect organic material brought by ice movement to the ice margin surface or to the ice margin from the glacier bed. Occurrences of such material are frequent and a great variety of ages can be noticed. However, the position of some of these localities at least demonstrates that the ice margin in places receded more than 10 km behind the present position.

One of the localities Pâkitsup ilordlia in Disko Bugt. Wood (twigs of willow) was found at the ice margin and that the age of this was 285 years. This shows that the ice margin then was at least 1/2 km further to the east than now. At this locality reindeer bones were also found in 1986, and these were dated to 3040 +/-60 years B.P. (before the present) (N.Reeh and H.H.Thomsen pers. comm.). Pâkitsup ilordlia is situated in a part of the Inland Ice investigated by numerous expeditions: de Quervain; P.-E.Victor, Expeditions Internationales au Groenland; Greenland Ice Sheet Project; Cold Regions Research and Engineering Laboratory; and Geological Survey of Greenland. The investigations of these expeditions have resulted in a good coverage of information based on the climatic records of Crête and Milcent, see Fig. 2, the measured annual gain and

loss of snow and ice at different altitudes on the ice sheet (mass balance), the meteorological observations in Jakobshavn since 1873 and a knowledge of the altitudes of the surface and of the landscape beneath the ice cover. All the glaciological data from the region were then used to calculate a mass balance history of the last 1600 years. Finally, from these results the consequences of these changes on the flow of the ice and of the changes of the margin were calculated.

The calculations of the ice margin response in the Pâkitsu ilordlia area (Reeh 1983) concerned several parts of the ice margin. The entire ice margin had a brief advance around A.D. 800 and in the period 1600-1900 (the Little Ice Age) a more sustained period of advances. Between these occurrences a relatively mild climatic period in the early middle ages can be discerned, when the ice margin position was like the present one or even 1 km behind the present one. The calculated curves all show a tendency to two main advances during the Little Ice Age: one around 1700 and one between 1850 and 1900. According to the calculations, the 1700 advance should have been the greater, but historical documentation of one sector (1GE08001) demonstrates that the 1880 advance was in fact the greater. This discrepancy indicates that sufficient data for such calculations are still lacking.

The theoretical method of calculating marginal changes in the ice is promising, but as shown by the example of Pâkitsu ilordlia, it requires a large quantity of data. In this case, the calculations could only be made back to A.D. 600, because the nearby Crête ice core record only reaches that far back in time. The requirement of a large amount of data for the calculations will restrict them to specific areas, and it might be questioned whether or not these parts of the ice margin represent a general trend of advance or retreat, of the entire ice sheet margin. In order to consider some geographical trends, we must now review some examples of documented changes of the Inland Ice in the last 200 years.

#### The Jakobshavn Isbrae

Pâkitsu ilordlia was an example of a land-based part of the ice margin with relatively simple conditions. However, a great deal of the response of the Inland Ice margin to changing climate seems to be regulated through ice streams, which move with great speed (up to 7 km/year) and are situated in deep subglacial valleys. They produce calf ice in large quantities in the form of icebergs which break off from their snouts and float out to sea. The paramount example of such an ice stream is Jakobshavn Isbrae 25 km southeast of the Pâkitsu ilordlia area. It is one of several ice streams in the margin of the Inland Ice which

are very important for the regime of the ice sheet: The total annual output of icebergs from the Inland Ice is about 300 km<sup>3</sup> water equivalent.

The entire annual gain of the ice sheet through snow accumulation in the interior is estimated to 500-600 km<sup>3</sup> water equivalent, and since the ice margin is nearly stable this must imply that this gain is compensated by a loss by melting of the marginal parts of the ice sheet (200-300 km<sup>3</sup> annually) and the loss by calf ice production mentioned above. Since ice streams are fast moving, they must be considered as 'safety valves' for the ice sheet which facilitate a relatively fast adjustment of this great ice body to a changing climate. The Jakobshavn Isbrae is the largest of these ice streams, producing about 30 km<sup>3</sup> calf ice per year, i.e. a tenth of Greenland's total calf ice production. It can therefore be considered as a main drain of the interior of Greenland and the geological background might be that the pre-glacial Tertiary river systems already had the same main pattern, leading to the Disko Bugt area (Weidick 1976).

The changes in the Jakobshavn Isbrae are well known from the middle of last century onwards, and a great deal of older information relating to it has been collected by J. Meldgaard (Larsen and Meldgaard 1958). An advancing phase of the glacier can be deduced from this early information and a continuous advance throughout the eighteenth century seems confirmed by A. Dalager's observation of vegetation and turf pushed by the glacier, and by the covering of old winter houses by the advancing ice (Giesecke 1807). Since the archeological site of Qaja is undisturbed and situated only a few kilometres west of the maximum extension of the glacier, Meldgaard concluded that the Jakobshavn Isbrae reached its maximum extent during the last 2500 years around 1850-1870 (the archeological deposits at Qaja reach that far back in time). Some minor fluctuations during the recession since 1850 may have been overestimated by not allowing for the difference of up to 2 km between the winter and summer positions of the glacier front. These seasonal fluctuations can now be documented by satellite information (Landsat scenes, H. Højmark Thomsen pers. communication).

The curve of the Jakobshavn Isbrae frontal positions seems to be an enlarged version of that of Pâkitsup ilordlia, but with the 1850-1880 peak greatly enlarged. So is the amplitude in general, being here 26 km against the 1-2 km of the Paakitsup ilordlia area, and with a thinning (lowering) of the ice surface in this century of 180-200 m against the 40 m reported at the margin of Pakitsup ilordlia. Other larger ice streams also seem to be magnifying glasses of the glacier changes in most of the surrounding ice margin. They must be considered as the most dramatic foci for the marginal changes, possibly steering the changes in large parts of the neighbouring sectors. In what follows, the changes in the Jakobshavn Isbrae will be compared with those of other ice streams, or calf ice

producing outlets, based on information from the last few centuries.

#### Marginal changes of some ice streams and of their surroundings

The key outlets to be dealt with in what follows are:

The Upernavik Isstrøm at 72°55'N, West Greenland.

Kangiata nunata sermia in Godthaabsfjord at 64°15'N, West Greenland.

Egalorutsit kitdlit sermiat in Nordre Sermilik fjord at 61°15'N, West Greenland.

Sermeq in Søndre Sermilik fjord at 60°45'N, West Greenland.

The Midgaardsgletscher in Sermilik fjord at 66°10'N, East Greenland.

The changes in frontal positions of these glaciers are shown in Fig. 5 together with the climatic record of an ice core from Dye 3 and a curve for the summer temperature in Godthaab. It will be noticed that all the glaciers in Fig. 10 are remarkable for their great frontal changes (10-26 km), and that their major advances (fat arrows) occurred 100-200 years after the major cold spells between A.D. 1500 and 1700.

The following remarks on details in the fluctuations of these glaciers and their surroundings are relevant:

#### Upernavik Isstrøm

There are reports of early advances of the glacier, but the position of the glacier front was first mapped in 1850, when it was at its maximum extent in historical times. After that, Upernavik Isstrøm almost maintained this advanced position for the rest of the century. A subsequent recession culminated in the 1940s, and the front is still receding, but now at a slower rate. The total retreat of Upernavik Isstrøm amounts to about 20 km. Wide areas north of Upernavik Isstrøm have been subject to a similar dramatic retreat of the ice margin in the last 100-150 years, although not reaching the 20 km of Upernavik Isstrøm. The receding ice margin is revealing an archipelago of hilly islands formerly covered by the ice (Kollmeier 1980).

#### Kangiata nunata sermia

This glacier is situated in the interior of the Godthaabsfjord-Kangersuneq ice fjord complex, and it is the main calf ice producer in this system. A thinning of the frontal parts of the glacier of about 300 m and a recession of about 20 km can be deduced from the trimline zone surrounding the present glacier. The major advances of this glacier seem to have taken place in the 1700s (Weidick

1982) with a maximum at the middle or end of that century. There are reports from the last half of the 1700s that this advance covered a large lake and buried Norse ruins. Around 1808, the glacier seems to have been in recession, and this has continued up to the present time, although interrupted by minor readvances or halts around 1880-1890 and around 1920. The thinning and recession dominates wide areas around the ice stream and it is possible that this area in Viking times was fertile land with farms. It was then overwhelmed by the Inland Ice margin, but is now once again being released from this ice cover, but as barren moraine terrain. The ice margin behaves differently further to the north and further to the south from Kangiata nunata sermia. Around Narssap sermia (to the north) and Isortuarssuup sermia (to the south) it seems to have been relatively stable or slightly advancing in the last century. The region just north of the glacier Qamanârssuup sermia represents a transition between the two types of behaviour. The ice margin here has participated in the general recession of the region around the main glacier of Kangiata nunata sermia. At this locality, however, the recession has turned to an advance during the last two decades (Knudsen and Møller 1982).

#### Egalorutsit kitdlît sermiat

This glacier is one of the outlets from the southern slope of the Inland Ice proper. It too reached its maximum extension in historical times in the 1700s, when the position of the front was around 10 km further down the fjord than now (see Fig. 6). Already by about 1840, its frontal position was close to the present one, but there are indications of several minor pulsations of the glacier front since then. Only one of these, from around 1942, is documented by aerial photographs. In South Greenland, as in the Godthaab area (referred to under Kangiata nunata sermia), there are reports of Norse ruins buried under the advancing ice margin, and from the map in Fig. 6 it can be seen that variations also occur here in the behaviour of the ice margin. A region with a strong recession can be noticed around Egalorutsit kitdlît sermia. It extends from the Aputaiuitsoq nunataq over Egalorutsit kidlît sermiat and 100 km further to the west. The beginnings of the advances in these sectors are little known, but they seem to have occurred in the 1600s and 1700s. They culminated at different times at different sites, varying from the end of the 1700s (example: Egalorutsit kitdlît sermiat) to the last half of the 1800s (most other localities), and they were everywhere followed by a recession, which was initiated in the last century but took place mainly in this century. The region east of Aputaiuitsoq nunataq, around another great ice stream, Egalorutsit kangigdlît sermiat, shows a quite different behaviour. There is good evidence that the ice margin in this area has advanced continuously

in the last 100-200 years, and at some points the rate of advance since 1942 has been measured at 15-20 m per year. Clearly, the effects of the Little Ice Age in this sector have not yet run to an end, but a full explanation of this phenomenon has still to be given. For example, climatic change could also imply a shift in the rate of snow accumulation on the southern slope of the Inland Ice, but such a possibility has still to be substantiated.

#### Sermeq

This glacier can also be located in Fig. 6 (indicated with "S"), at the head of Søndre Sermilik fjord. The glacier front is now split in two branches by a semi-nunatak, but the trimline zone surrounding the present glacier 12 km down the fjord is witness of an earlier greater extent. In contrast to the other glaciers described above, this glacier does not originate from the Inland Ice, but is an outlet of a large local ice cap. It can be deduced from legends that the front of Sermeq before the middle of the last century was close to the same retreated position as now, and that a well developed vegetation covered the nunatak in the front of the glacier. This indicates that the subsequent advance was the largest one in historical times. After the middle of the last century the glacier advanced 12 km down the fjord in a relatively short time. At the first mapping of the glacier in 1881, it was at its maximum extension in historical times. After then up to 1952, there was only a thinning and a retreat of the glacier front of 1-2 km. Since 1952 the glacier tongue has split up rapidly into calf ice, and by 1983 it was 12 km behind the position of 1881 and back where the advance started in the middle of last century. The size and speed of Sermeq's advance is remarkable, considering the relatively small area of snow accumulation of this glacier. It seems that the glacier has a special response behaviour where the snow accumulation is built up over a long time (centuries?) and is then released in a sudden 'catastrophic' advance, i.e. a temporary surge (see below). All the neighbouring glaciers in this region (see Fig. 6) show a recession of 1-2 km, and prior to this they all seem to have advanced, culminating at the end of the 1800s.

#### The Midgaardsgletscher

Turning to East Greenland, records of glacier changes are sparse and only cover this century. Best known is Midgaardsgletscher at the head of Sermilik fjord near Angmagssalik. It is part of a rather complex system of valley glaciers and minor ice caps connecting with the Inland Ice. The glacier fills a depression reaching from the Sermilik fjord in the west to the fjord of Kangerdlugssuatsiaq in the east where the outlet is called

the Glacier de France. There are tales in the neighbourhood of former sounds, now buried by the advancing ice, but the date of the advance of the glaciers cannot be established. In the beginning of this century the front of the Midgaardsgletscher still seems to have been close to the maximum for historical times. Like Sermeq in Søndre Sermilik, it was then thinning but retreating little until the outer part broke up between the 1960s and 1978 and the front position receded about 10 km. Information about the neighbouring glaciers to the Midgaardsbrae is erratic and there seems little common trend. Thus the Knud Rasmussen Gletscher seems rather stable whereas the Helheim Gletscher has advanced since the 1930s.

#### Comments on the behaviour of the outlets of the Inland Ice and the large ice caps in the last centuries

The examples given above illustrate the great variety of glacier response, and it is clear that, although the cold spells of the Little Ice Age are primary causes of the changes in the extent of the ice cover, the more detailed behaviour of the individual lobes or sectors depends very much on other local topographic or climatological factors.

#### Local glaciers

So far discussion has focused on large glaciers and glacier systems, mainly the Inland Ice; a closer relationship between glaciers and climate must be expected in the case of minor local glaciers. Unfortunately not much is known, either geologically or historically, about the thousands of small glaciers scattered over the coastal rims of Greenland. The formation of the great majority of these local glaciers took place after the snow line reached its present altitude; before this, the coastal landscape was largely covered by the Inland Ice.

The question of the existence of early Holocene glacier advances has been investigated on the west coast, and it is characteristic that the few traces found (age of advances presumably 8000-10.000 years B.P.) refer to localities close to the outermost coast (Kelly 1980). In most local glaciers, the advances in A.D. 1600-1900 have overridden older Holocene traces of glacier stages. What can be seen today is, therefore, mainly a rim of very recent moraines around the glacier and, distal to this, the landforms of a much older continental glaciation. In historic times there are differences in the behaviour of individual glaciers. Maximum advances are mainly achieved around 1750 or around 1850-80. Studies of the behaviour of several local glaciers were made in the Sukkertoppen area (Beschel 1961) and the results were placed in a global context (Fig. 7). The main conclusion was that coastal glaciers in Greenland had early

major advances, i.e. around 1600-1700, whereas the colder inland glaciers reacted more slowly and their advances often culminated in the middle of the nineteenth century. From the same area more recent investigations lead to the conclusion that the glaciers responded rapidly to the temperature change but had a lagged response to precipitation changes of about 10 years for minor glaciers and 20-30 years for the larger ones (Gordon 1981). At the moment, many local glaciers are still receding in South Greenland and the island of Disko, whereas reactivation is noticeable in other areas, e.g. around Sukkertoppen and in the Umanak area.

### Glacier surges

In contrast to the gradual changes in the margins of most glaciers, surging glaciers are characterised by sudden and rapid advances over a period of a few years or months following a build-up in the upper parts of the glacier which may have taken many decades or even a century or more. This behaviour only occurs in a few glaciers among many in a region, and the surging glaciers can be of any type or size. The mechanism of glacier surges is not well known. They were first described from Alaska in the 1930s. Sermeq in South Greenland, described above, is a possible surging glacier. The first documented glacier surge in Greenland was in East Greenland, where the valley glacier Løberen (Danish: "the runner") behaved in this way (Olesen and Reeh 1969). Løberen was 7.5 km from the shore around 1950 and its lower parts were thinning. Between 1950 and 1961 it started an initial advance of 3 km, but with increasing speed. Somewhat before 1967 its advance must have come to an end, and this implies that the final speed of the front may have been over 1 km per year. In 1967 it was thinning again. More surging glaciers have been located in the same area of East Greenland (Rutishauser 1971). In West Greenland this behaviour was documented first from a minor corrie glacier on Disko island (Weidick 1984), and it is possible that several glaciers on this island, as well as on the peninsula Nûgssuaq just north of Disko, exhibit the same behaviour. Even parts of the Inland Ice may have reacted at places in this way with temporary surges, but this has still to be proved.

### Conclusions

The climatic developments of the last two millenia are known through the ice core records and especially the temperature conditions, which indicate a period with several relative warm spells for the first millenia, and a period with an increasing frequency of cold spells, the Little Ice Age, for the second.

The glacier changes over the centuries have followed those of temperature, although with various times of delay in the response. The individual response of a specific glacier lobe exhibits strong modifications of the main trend because of local climatic and topographic factors. It must also be realised that a detailed knowledge of the variations of Greenland's thousands of glacier lobes is restricted to 100-200 relatively well documented examples, and that none of these records goes back beyond the 1700s.

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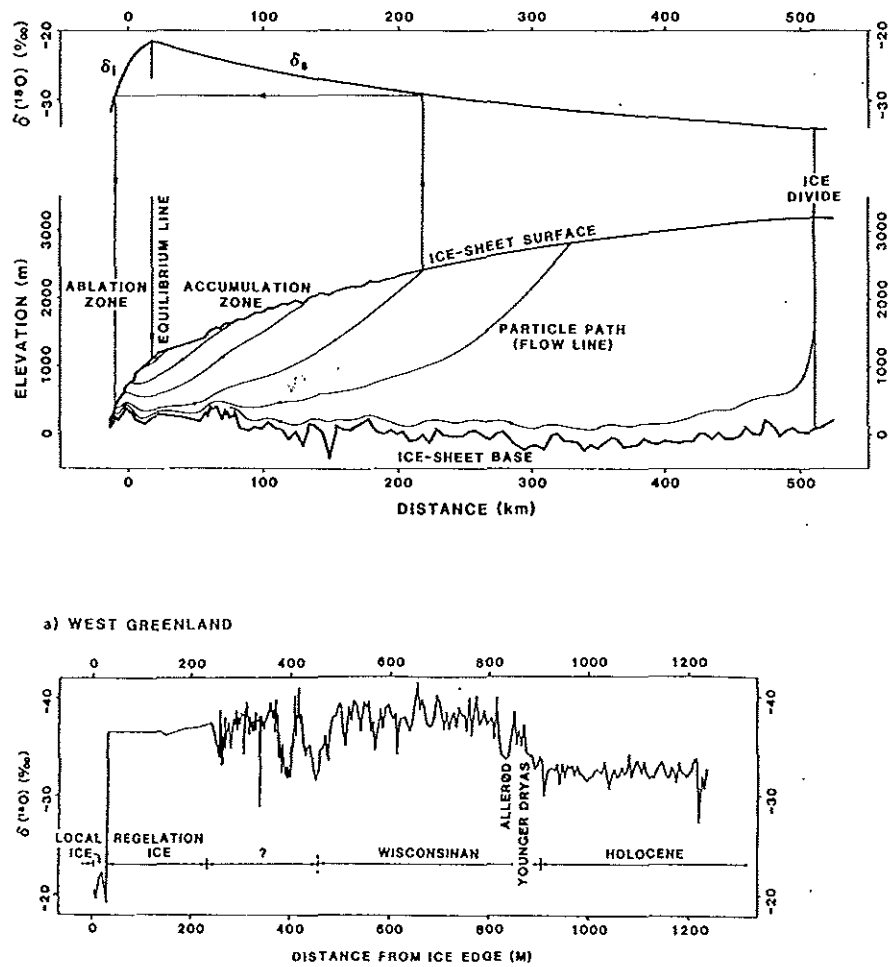
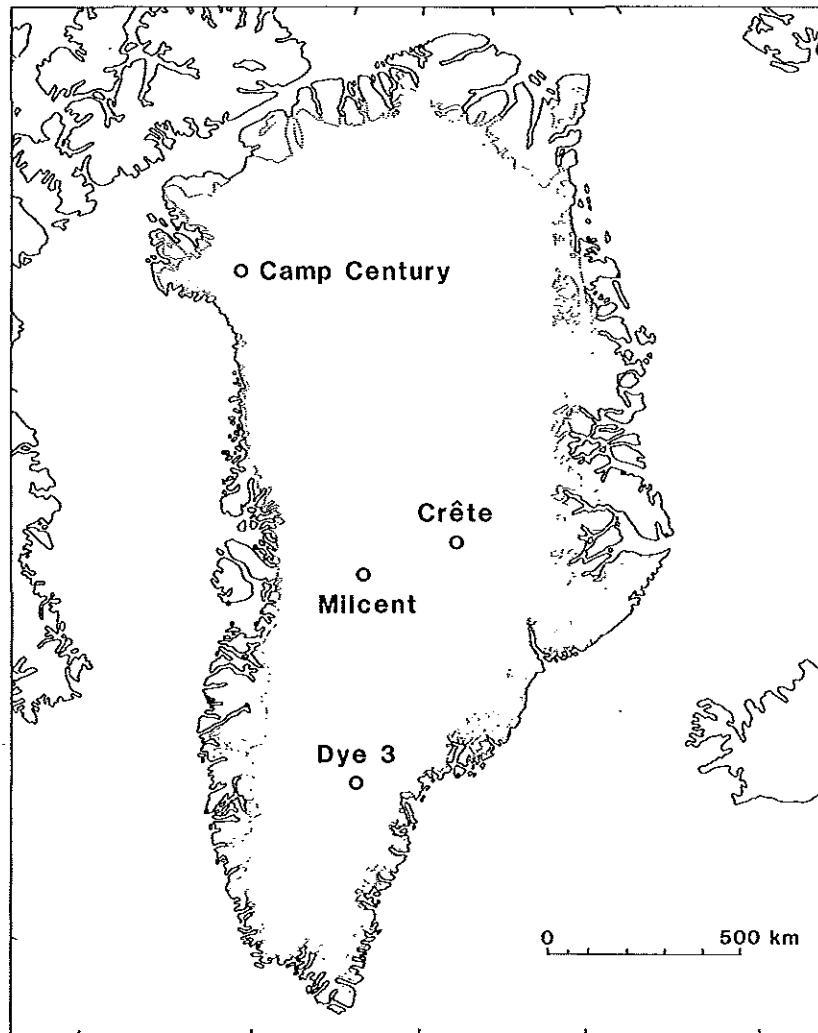
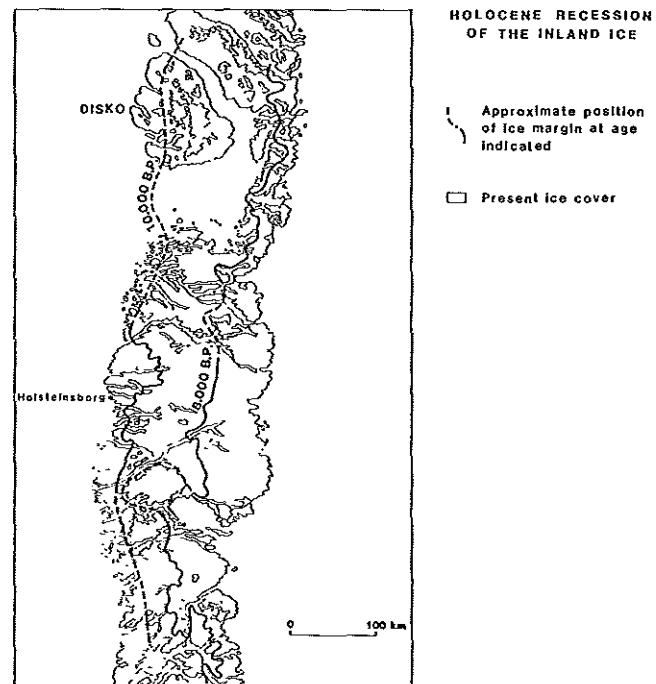


Fig.1. Top: Average isotopic variation of the surface of the Inland Ice between Disko Bugt and the central parts of the Inland Ice (expressed in  $\delta^{18}\text{O}/\text{‰}$ ). The particle path of the deposited snow during its transition to glacier ice is also shown. The  $\delta^{18}\text{O}$  distribution in the surface snow of the accumulation zone ( $\delta_s$ ) indicates the altitude effect (same age of the deposited snow). The  $\delta^{18}\text{O}$  ( $\delta_i$ ) in the surface of the glacier ice in the ablation zone indicates the age of the ice, where the outermost 1 km of the ice margin reflects the isotopic composition of the ice deposited in the interior as snow during the Wisconsinian (last Ice Age). From Reeh and Thomsen 1986. Bottom: Isotopic composition of the outermost 1200 m ice margin in detail. The difference in the isotopic composition of Ice Age and Holocene ice can be seen and compared with the Camp Century record of Fig. 4. From Reeh *et al.* in press.



*Fig.2. Drill sites for deepest ice cores on the Greenland Inland Ice (more detailed information can be found in Langway et al. 1985).*



*Fig.3. Extent of the Inland Ice over central West Greenland at 10,000 and 8000 years B.P. From Weidick 1985.*

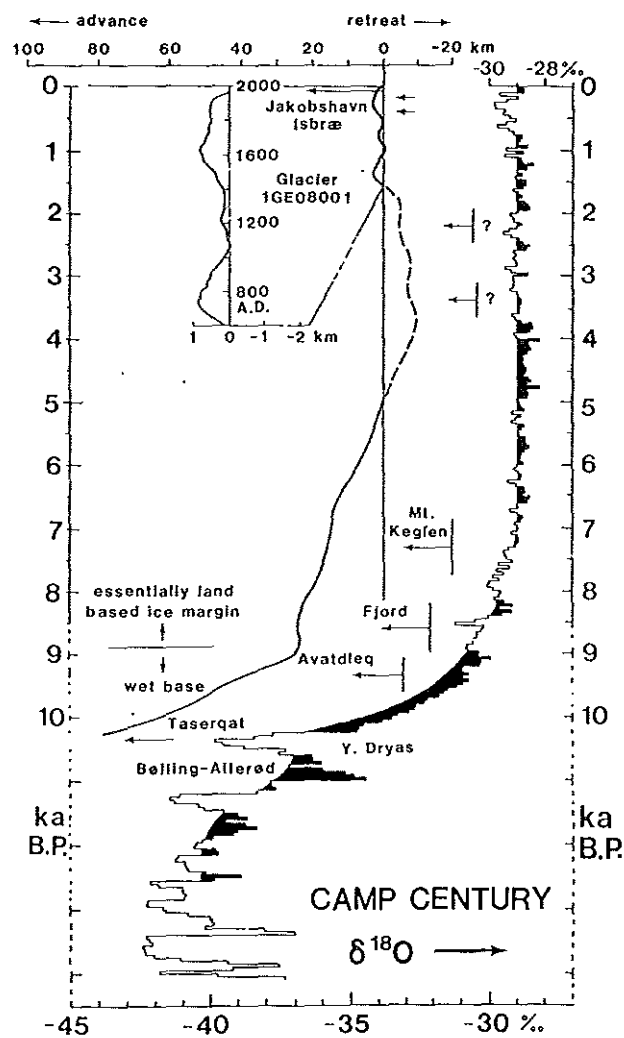


Fig.4. Recession of the ice margin between Disko and Jakobshavn, compared to the Camp Century climatic record according to Dansgaard *et al.* (1984). Halts and readvances are marked by arrows. Inset: details of the fluctuation at Pakitsup ilordlia ice margin near Jakobshavn. From Weidick 1985.

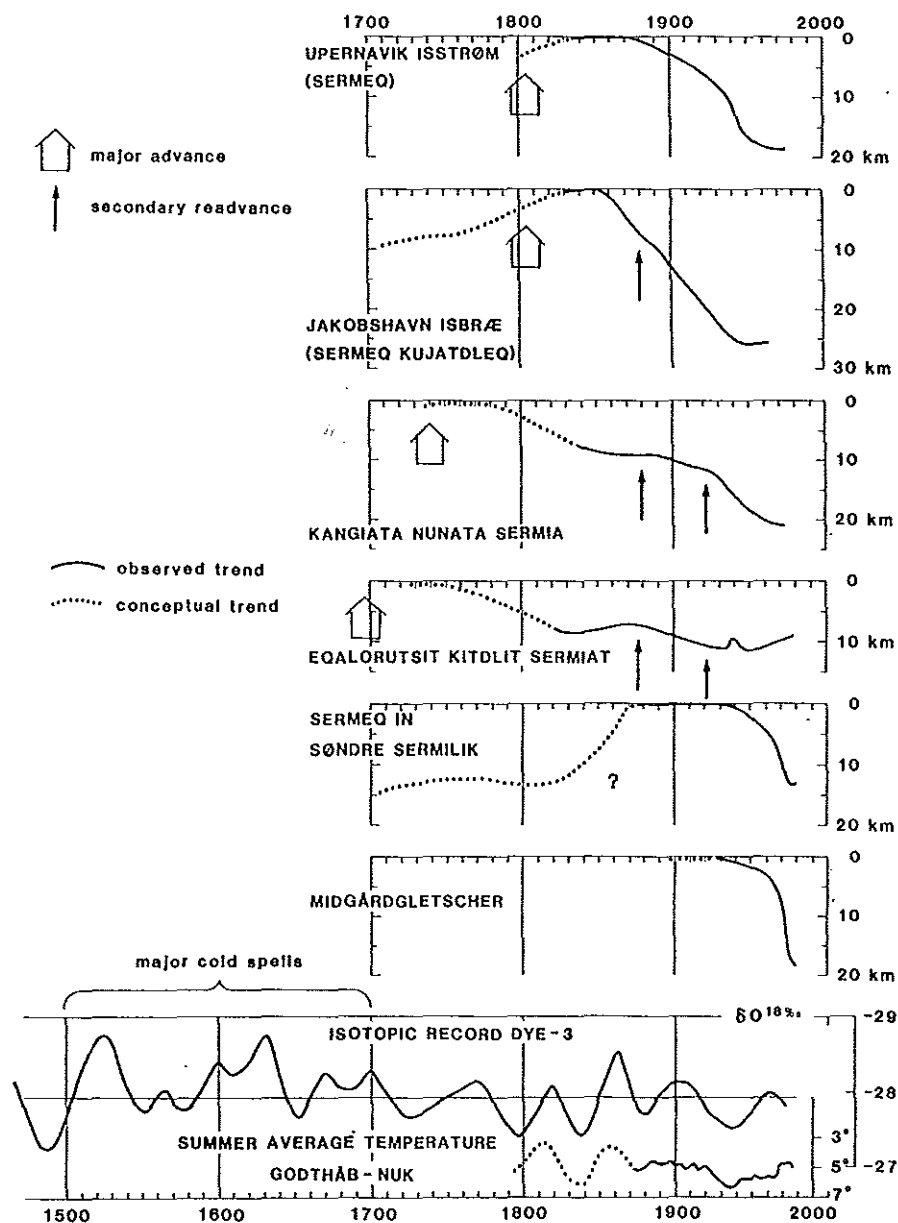
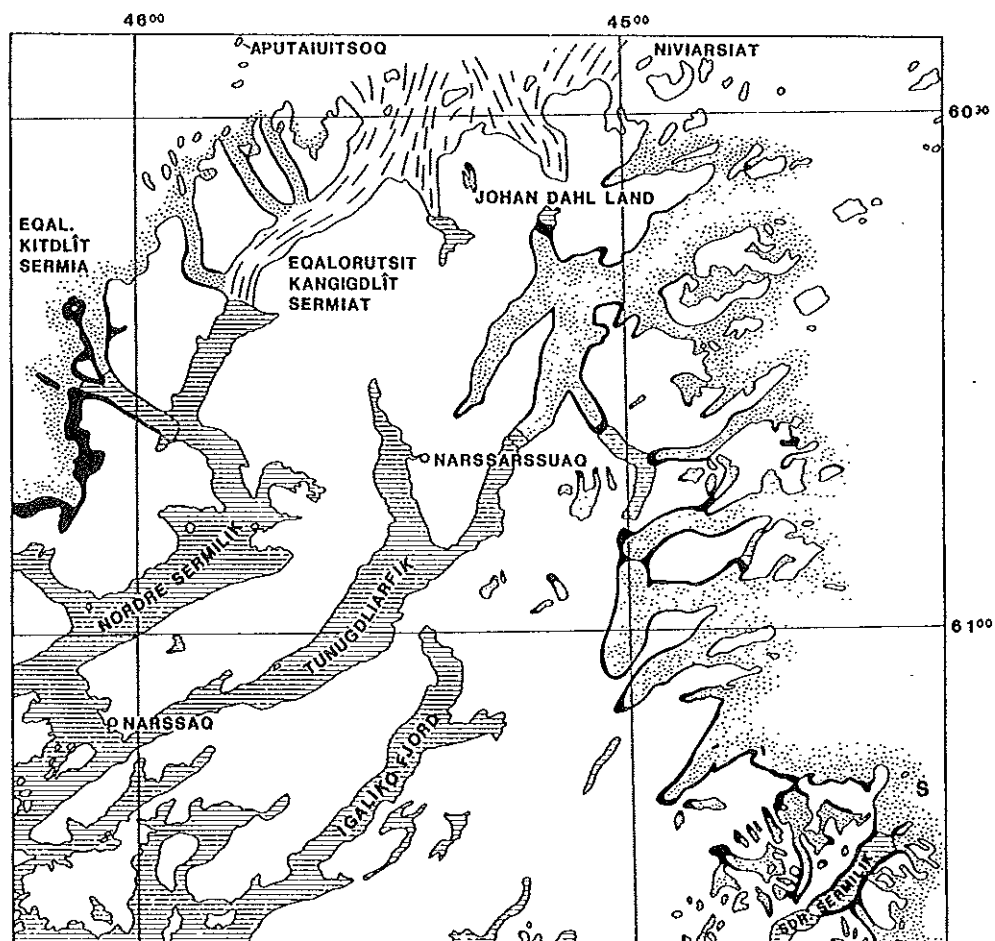


Fig.5. Response curves of some major calving ice producing outlets from the Inland Ice (Upernavik Isstrøm, Jakobshavn Isbræ, Kangiata nunata sermia, Eqalorutsit kitdlit sermiat) and from other extensive ice covers (Sermeq in Søndre Sermilik and the Midgaardsgletscher near Angmagssalik). Bottom: Isotopic temperature record from Dye 3 ice core for the period A.D. 1500-1970. From Dansgaard *et al.* 1973 and the variations of the summer temperature in the town of Godthaab/Nuuk. From Weidick 1982.



General advance of ice margin during the 20th century.



General recession of the ice margin during the 20th century.

Extent of trim line zone and indicated maximum extent of outlets in the fjords.

10 0 10 20 km

Fig.6. South Greenland. Areas covered by glacier ice in the 1700s and 1800s are shown in black. *Fremrykning af isrand* = present advance of ice margin. *Tilbagetraekning af isrand* = present ice margin, receding. From Weidick 1982.

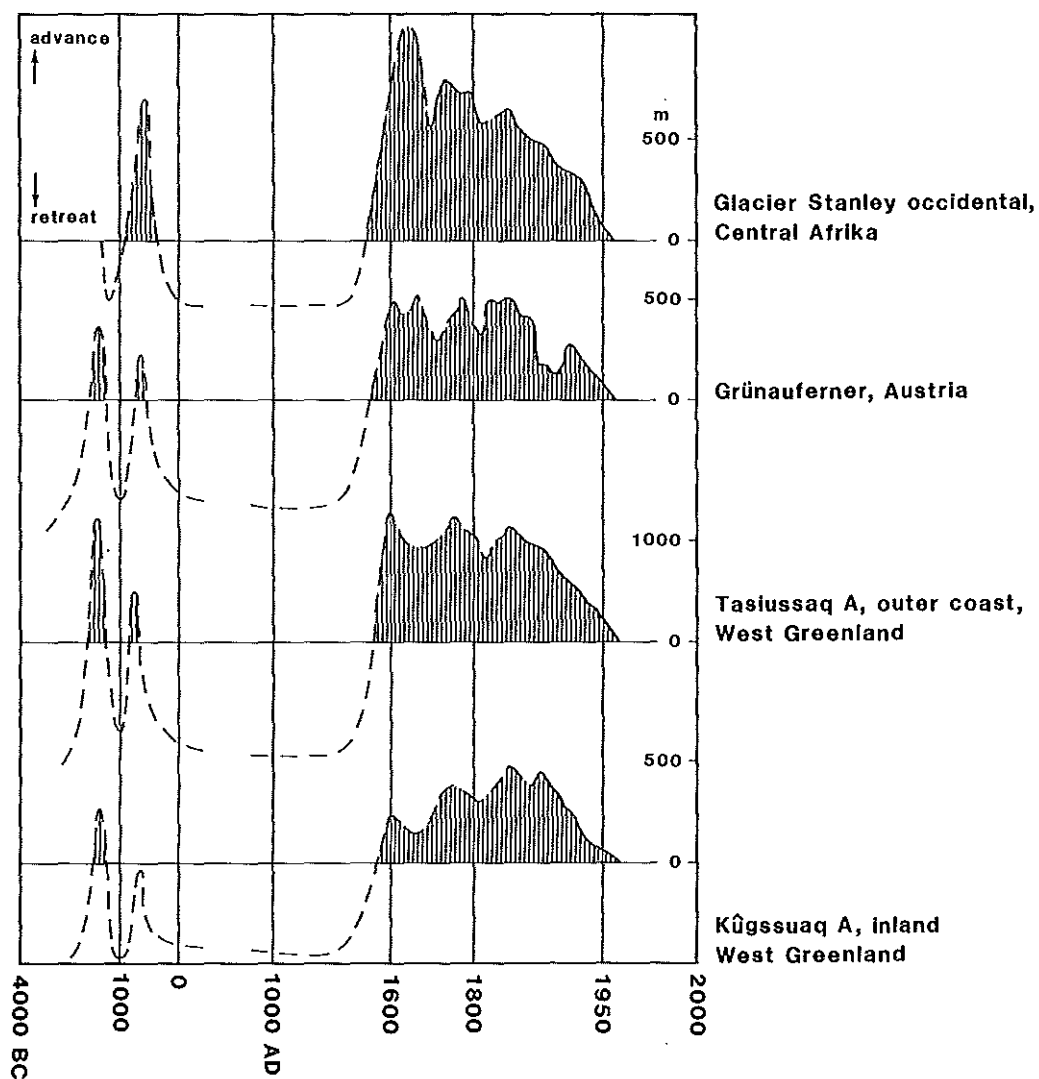


Fig.7. Glacier advance (upwards) and retreat (downwards) in the last 2000 years, from lichenometrical, geomorphological, historical and dendrochronological evidence. From Beschel 1961.

## THE RELATIONSHIP BETWEEN THE MEDIAEVAL NORSE AND ESKIMOS

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*The ancestors of the Eskimos arrived in the eastern North American Arctic shortly after the establishment of Norse colonies in southwestern Greenland. There are few references to Eskimos in the Icelandic sagas and other historical accounts, and it has generally been thought that contacts between the two groups were few and hostile. Recent archaeological finds suggest that the relationships between the Norse and Eskimos may have been more complex, and existed over a greater period of time than had been previously thought. Contact may have begun with plundering and/or trading in the eastern Canadian Arctic during the twelfth and thirteenth centuries, and intensified with Eskimo immigration to Greenland during the following centuries.*

During the 'settlement period' of Iceland, between about 870 and 930 A.D., immigrants flocked to the island, which had an estimated population of 30,000 people by the end of the period. All of the useful land had been taken, and adventurers or fighters who could no longer get along with their neighbors began to look elsewhere. Eirik the Red's exploration of Greenland about A.D. 980 arose from such circumstances, and the immigrants who followed him to establish colonies on the southwestern coast of the island soon swelled the population to 3000 or more people. For the next four centuries ships from Greenland, Iceland and northern Europe crossed and recrossed the North Atlantic, bringing immigrants to Greenland, taking people on visits to the Old Country, and most importantly carrying the trade on which the Greenlandic colonies depended for a livelihood. The Greenlandic settlements were only 800 kilometers from the Labrador coast of North America, and less than 500 kilometers, a little over two day's sailing, across Baffin Bay, from Baffin Island. The Norse were excellent seamen with ships capable of extended ocean voyaging, yet they had only the most primitive methods of navigation, and ships could often survive storms only by running before them for days. The accounts of the period tell many stories of ships being storm-driven far from their intended course, and in such a situation it was inevitable that North America would be discovered by ships travelling between Greenland and Europe.

This is exactly what seems to have happened, probably within a year or so of the founding of the Greenland settlements. According to the Icelandic sagas, the first sighting was by a skipper named Bjarni Herjulfsson, on his first voyage from Iceland to visit his family in Greenland.

Bjarni's discoveries were followed up a few years later, probably around A.D. 1000, by Leif Eirikson, who visited and named three countries: Helluland, a rocky and barren land which is probably Baffin Island; Markland, a low forested coast which can almost certainly be identified with Labrador; and finally Vinland, where there was good grazing and timber, and where they even claim to have found the grapes for which Leif named the country. After wintering and doing some exploring, Leif and his crew loaded a cargo of grapes and timber, and sailed for Greenland. Leif's reports led to four voyages to Vinland over the next decade, after which there are no further mentions of Vinland voyages in the saga accounts (Jones 1986).

There has been much argument over the location of Vinland, with scholars and local enthusiasts placing it anywhere between Labrador and Florida, and even in the Great Lakes and the Mississippi Valley. The geographical descriptions in the sagas are simply too vague to allow certain placement on a modern map, but there is a growing consensus that they best fit the area of Newfoundland. The main problem with a Newfoundland location is the absence of wild grapes, but there is a strong suspicion that what Leif found were only berries, and that he followed the practice of his father, the namer of Greenland, in "giving a land a good name so that men would want to go there". A Newfoundland location is supported by the Sigurdur Stefansson map, a late sixteenth-century Icelandic chart which seems to have been copied from an earlier document, and which shows Greenland, Helluland, Markland and the Promontorium Winlandiae. The latter feature unmistakably resembles the Great Northern Peninsula of Newfoundland, in its shape as well as in its latitude relative to the British Isles and its distance and direction from Greenland.

It was on the northern tip of the Great Northern Peninsula that Helge Ingstad, in 1960, found the remains of what appeared to be an ancient European settlement (Ingstad 1977). The archaeological evidence suggests that L'Anse aux Meadows was briefly occupied by Europeans several centuries before Columbus' discovery of the New World, and it seems most likely that this occupation was by the Greenlandic Norse. Archaeology cannot prove that this was the Vinland of the Norse sagas -- the houses may have been built and occupied by an unrecorded Norse expedition -- but it is in the most likely geographical area, and we would expect that the remains left by the brief visits of Leif and Thorvald Eiriksson, Thorfinn Karlsefni, and the murderous Freydis, would look very much like what has been found at L'Anse aux Meadows.

During two of the Vinland voyages described in the sagas, the explorers are said to have met a race of humans whom they called Skraelings, and over the past century or so there has been considerable debate as to who these people were. If we assume that the Vinland of the sagas was in the general Newfoundland area, that Markland was the forested coast of southern and central Labrador, and that Helluland

was Baffin Island and perhaps the adjacent mountainous tundra coast of northern Labrador, we now know who was living in these areas around A.D. 1000, the time of the Vinland voyages. Archaeological work over the past decades indicates that three distinct groups of aboriginal peoples occupied northeastern Canada during the period that the Norse occupied southwestern Greenland.

The forested regions of Labrador and Newfoundland were inhabited by Indians (Tuck 1976; Fitzhugh 1978). These people were probably the ancestors of the Beothuck Indians of Newfoundland and, somewhat less certainly, of the Algonkian-speaking Montagnais and Naskapi Indians who occupied Labrador during the past few centuries. During the summer season, when they would have been encountered by Norse explorers, they probably occupied small coastal settlements of birch-bark wigwams, using birch-bark canoes for hunting and fishing.

During most or all of the period of Norse occupation of Greenland, the mountainous tundra region of northern Labrador was occupied by Dorset culture Palaeoeskimos (Tuck 1976; Cox 1978). These were the descendants of people who had crossed from Siberia to North America about 2000 B.C., and were the first people to widely occupy the Arctic regions of the New World. During the second millennium B.C. they spread southwards along the Labrador coast, and occupied the Island of Newfoundland between approximately 500 B.C. and 500 A.D. We know very little about the Palaeoeskimos, since they became culturally and perhaps biologically extinct prior to close contact with Europeans. They appear to have had relatively small populations, leading lives of economic insecurity, and lacking such items of technology as the bow and arrow, float harpoons, dogsleds and perhaps even boats. The Palaeoeskimos disappeared from most regions of Arctic Canada and Greenland shortly after 1000 A.D.; only in Ungava and northern Labrador do they seem to have survived for a further 500 years.

The third group whom the Norse could have encountered were the Thule culture Eskimos, the ancestors of the present Eskimos of Arctic Canada and Greenland. These people expanded rapidly eastward from Alaska during the eleventh century A.D (McGhee 1984a). By the early twelfth century they had reached northwestern Greenland, and by the thirteenth century had arrived in Ungava and northern Labrador, where they appear to have coexisted with the Dorset Palaeoeskimos for the following two centuries (Plumet 1979; Fitzhugh 1980). By the thirteenth century they had also expanded southward down the west coast of Greenland to at least the Disko Bugt area, and during the following century colonized the outer coast of the Norse settlement area in southwestern Greenland (Gulløv 1982). The Thule people brought with them from Alaska a rich maritime hunting way of life, and technology such as sinew-backed bows, float harpoons, skin boats including single-man kayaks and umiaks capable of transporting an entire camp or hunting large whales. This technology was considerably more sophisticated than that of their

Palaeoeskimo predecessors, whom they appear to have displaced from most Arctic regions.

At various times and at various places in their exploration of the New World, the Norse were therefore likely to have come into contact with three distinct aboriginal populations: Indians in the forested regions of Labrador and Newfoundland; Dorset culture Palaeoeskimos in the tundra regions of Ungava and northern Labrador; and Thule culture Eskimos in the eastern Arctic Islands and later in Greenland.

Although the Vinland voyages mentioned in the sagas all seem to have occurred during the first two or three decades of the eleventh century, there is archaeological evidence, and one historical record, indicating that at least sporadic trips across Baffin Bay to eastern Canada continued for at least three centuries after that time. The historical record is a note in the Icelandic annals reporting that in 1347 a ship was driven to Iceland while on a voyage from Markland to Greenland (Jones 1986: 136). If Markland is the forested coast of Labrador, it seems likely that the Greenlanders, whose only source of timber was driftwood, would have made continued use of this resource. They may also have had occasional contacts with the native peoples of the area, as is suggested by a few small fragments of smelted sheet copper found in the occupation sites of the Dorset culture Palaeoeskimos who occupied the Labrador-Ungava Peninsula at the time (Harp 1975; Plumet 1982). A more interesting find is a coin which was excavated from an Indian village site on the coast of Maine, and which has recently been recognized as a Norse penny minted between 1065 and 1080 A.D. during the reign of King Olaf Kyrre. Some of the stone tools used by the Indians who occupied the site were made from a distinctive type of chert which comes from the Ramah Bay region of northern Labrador, and one of the Indian artifacts has been reworked from a very distinctive ground-stone tool of the type used by the Palaeoeskimos of northern Labrador (Bourque and Cox 1981). It seems quite possible that the Norse penny was obtained by the Palaeoeskimos, who then traded it southward with a consignment of Ramah chert. Wherever the penny first reached native hands, its minting date appears to be proof that voyages to the New World did not cease with the explorations of the Eiriksons and Karlsefnis during the early eleventh century.

A number of other artifacts of Norse origin have been found in the New World, but all of those which can be proven not to be recent fakes or misidentifications have come from the remains of villages occupied by ancestral Eskimos in Arctic Canada. At the same time that Eirik the Red's followers were colonizing southwestern Greenland, Thule culture Eskimos were pushing eastward from Alaska and displacing the previous Palaeoeskimo occupants of the Canadian Arctic, eventually crossing from Ellesmere Island to occupy northwestern Greenland (McGhee 1984a). It was inevitable that the two immigrant groups would meet, but it was not until A.D. 1266 that there is a historical

reference to contact; this report states that a Norse hunting party to the north of the settlement area, probably in the Disko Bugt area of western Greenland, had found traces of natives. Another source, probably dating from about the same period, states that in the north the hunters had discovered small people whom they called Skraelings, and who had no iron but used stone knives and weapons of walrus ivory (Gad 1971: 88, 138). As the Eskimos expanded southward down the Greenland coast, they must have come into increasingly frequent contact with the Norse settlers, but there are surprisingly few and vague accounts of the Eskimos in the Norse historical literature. One account, dating from A.D. 1350, states that the Western Settlement, the more northerly of the two Norse colonies, had been abandoned and was in the hands of the Skraelings (Gad 1971: 145). A second indicates that about A.D. 1418 the Eastern Settlement had been attacked "from the nearby shores of the heathen", and that most of the churches had been burned (Gad 1971: 157). The general impression given by the Norse accounts is one of infrequent and hostile contact between the two groups, eventually leading to the destruction of the Norse colonies.

Archaeological evidence accumulated over the past decade suggests a distinctly different picture, and one which suggests that we should perhaps not place too much faith in the historical records. Many of the early Eskimo winter villages which have been excavated in the Eastern Arctic have produced fragments of smelted metal, and those excavated by Peter Schledermann (1980) in eastern Ellesmere Island contained pieces of woolen cloth, chain mail, and fragments of coopered barrels or tubs of oak. A portion of a bronze bowl came from a site on Devon Island. Many of these sites appear to date to the twelfth or early thirteenth centuries, suggesting that contact between the groups occurred considerably earlier than reported by the Norse (McGhee 1984b: 15-17). In support of this interpretation is a description of a people who can only be Eskimos, in a geographical work written by the respected Arabic scholar al-Idrisi who was writing in Sicily about A.D. 1150. Writing of the North Atlantic and its excellent fish resources, al-Idrisi stated that "There are also sea animals of such enormous size that the inhabitants of the inner islands use their bones and vertebrae in place of wood for constructing houses. They also use them for making clubs, darts, lances, knives, seats, ladders and, in general, all things which elsewhere are made from wood." If we interpret the large animals as whales, and the "inner isles" as those most remote from Europe, the description might refer to Thule culture Eskimos whose winter houses were framed and roofed with whale bones, and most of whose technology was based on bone, antler and ivory (McGhee 1984b: 11).

What would have been the nature of these early and unrecorded contacts? The widespread distribution of smelted iron, copper and bronze in Canadian Arctic Eskimo sites

suggests that metal, even in small fragments, was a valuable trade commodity to the early Eskimos, and was widely distributed through Eskimo trade routes. The Vinland sagas indicate that the Norse were willing to trade with the Skraelings, and it seems likely that trade with Eskimos would have been very beneficial to the Norse. The Greenland colonies depended on trade with Europe for many of their requirements -- grain, metal, timber and luxury goods such as bishops' vestments. In addition, after 1261, they were required to pay fines and annual tribute to the Norwegian king, as well as tithes and crusade taxes to the Roman church. This tribute was paid in the materials of the country -- primarily walrus and narwhal ivory but also in the hides of walrus, polar bear skins, and on at least one occasion a live polar bear (Gad 1971).

Walrus do not occur today in the subarctic region of the Norse colonies in southwestern Greenland, and they almost certainly did not occur there in the relatively warm period when the colonies were occupied. In order to obtain ivory, Norse hunters had to travel at least 400 kilometers north of the settlements to the area known as the Nordrsetur, the northern hunting grounds. As McGovern (1981) has pointed out, such hunts must have put great pressure on the Norse economy, depriving the colonies of manpower needed for farming, fishing and hunting for food. Yet the importance of European trade was such that the Nordrsetur hunt was an integral part of the Greenlandic Norse way of life. The early Eskimos who had occupied Arctic Canada and northwestern Greenland by about 1100 A.D. possessed quantities of ivory, as can be seen from the archaeological remains of their settlements. If they were willing to trade ivory for small scraps of metal and worn-out tools, as were their descendants of the seventeenth and eighteenth centuries, it would seem to have been profitable for the Norse to exploit this trade. Is there any evidence that such trade did actually occur?

It is impossible to answer this question on the basis of the sparse archaeological evidence. We might, however, mention two finds from early Eskimo villages in the eastern Arctic. The first comes from northwestern Ellesmere Island, and is a hinged bar of bronze found by Patricia Sutherland (1977). This is the beam of a folding balance, similar to those used by Norse traders for weighing coins and other small objects. This characteristic traders' artifact, the only one known west of Iceland and found in an Eskimo village 2000 kilometers from the Greenlandic Norse colonies, hints at the presence of traders somewhere in the relationship between Norse and Eskimos. The second object, found in a thirteenth-century village on the south coast of Baffin Island (Sabo and Sabo 1978), hints at the actual presence of Norsemen in Arctic Canada at the time. This is a small wooden figurine carved in typically Thule Eskimo style with flat featureless face and stumpy arms; it differs from these, however, in apparently showing an individual dressed in a long gown or robe, with what appears to be a cross on

the chest. The clothing is consistent with European clothing of the time. Baffin Island Eskimos could not have crossed Davis Strait to see Norse Greenlanders dressed in this fashion, and it is very unlikely that the figurine was traded from Greenlandic Eskimos, who had a much different tradition in carving figurines representing Europeans. The Baffin Island carving is not made in this Greenlandic style, and it seems most likely to have been made locally by someone who had seen a Norse Greenlander, perhaps on Baffin Island or in Labrador.

Baffin Island, the Helluland of the sagas, was known to the Norse, and the Norse may have coasted it for some 300 years on their voyages to the forests of Markland. It seems likely that at least occasional landings may have been made, and that contact occurred with the Eskimo occupants of the region. Out of such contacts a sporadic, occasional and opportunistic trading relationship may have been established, one which may have served as a basis for relationships between the Norse Greenlanders and the Eskimos who eventually began to move into southwestern Greenland.

The relationship between Norse and Eskimos in Greenland must have been considerably more intensive than that with the peoples encountered in voyages along the fringes of Arctic Canada, and also much more intensive and complex than that suggested by Norse historical records. Recent archaeological work has shown that the Eskimo advance down the West Greenland coast occurred considerably earlier than had been generally thought. Radio-carbon dates now suggest that Eskimos had settled the Disko Bugt area by at least the thirteenth century, before the Norse accounts first make mention of encounters with Skraelings in the north. By the following century, Eskimos had occupied the outer coastal regions of southwestern Greenland, in the same areas where Norse farms were occupied in the inner fiords. For the following one or two centuries, substantial populations of Norse and Eskimos lived in this region, and it seems inevitable that they must have worked out some means of sharing the country and its resources, other than the simple animosity of which the historical records speak.

Archaeology has so far been incapable of suggesting the nature of this set of relationships. One recent find does, however, provide an intriguing hint. Recent excavations by Claus Andreason (1982), at a Norse farm called Nipaitsoq in the Western Settlement, recovered a number of iron knife and projectile blades made in characteristic Norse form. Among these are blades which are not made from smelted iron, but from meteoritic iron. This material almost certainly came from the iron meteorites of the Cape York district of far northwestern Greenland, a source which was in the heart of Eskimo territory and which had been used by the Eskimos for centuries. Is it possible that this not only suggests trade between Norse and Eskimos, but that it was not a simple trade of European manufactured goods for native ivory and furs? The Norse Greenlanders must have been chronically short of iron, the Eskimos had access to

meteoritic iron, and in fact a trade in metal may have passed both ways between the two groups.

Traditional Greenlandic Eskimo accounts also suggest more than a simply hostile relationship with the Norse. In 1769 Niels Egede was told that when the Eskimos reached the area of the Norse colonies they wished to settle near the Norse farms. The Norse would not allow this, but were willing to trade and gradually the two groups came to be on good terms with one another. When the Norse were attacked from the sea and their settlements plundered, the Eskimos took Norse women and children to the inner fiords for their protection (Gad 1971: 158). Legends collected by Rink (1875) in the mid-nineteenth century are more complete but more difficult to interpret; by this time the Eskimos had been in contact with Europeans for over a century, and some aspects of European knowledge of the Norse colonies had undoubtedly passed to the Eskimos. Although all of these Eskimo stories tell of violence between the two groups, there are indications that relationships were seen as sufficiently good that it was at least conceivable to tell of an Eskimo girl working on a Norse farm, and of an Eskimo and Norseman who were best friends and engaged in friendly archery contests. One of the most widely known nineteenth-century Eskimo legends was the story of Ungortok, a Norse chief who was killed by the Eskimos after a complex series of events. Rather interestingly, what appears to be a version of the same legend was collected in Iceland during the early nineteenth century. This tells the story from the Norse point of view, and contains the Eskimo words innuk (man) and kayak (skin boat) as well as what appears to be an Eskimo place name. If this is actually a parallel version of the same legend, rather than the result of a more recent transfer from Greenland to Iceland, it suggests the possibility of at least a limited form of shared historical tradition between the Greenlandic Eskimos and Norse (McGhee and Einarsson 1983).

When the Norse Greenlandic colonies died out, probably during the late fifteenth century, it was almost certainly not at the hands of the Eskimos among whom they had lived for several generations. Their decline and eventual disappearance probably had more to do with a deteriorating climate, combined with a rapid decline in the value of their commercial products as furs and ivory began to reach Europe with the growth of trade in the east and Portuguese exploration in Africa. Greenlandic life must have stayed relatively constant, while Europe underwent the immense social changes from feudalism to mercantile capitalism. Abandoned by their Norse king and their Roman church, neither of whom any longer bothered to send ships to Greenland, and possibly harassed by European pirates, the Norse colonies were more likely the victims of economic forces than of native attacks.

It was a sad end to a heroic venture, one which resulted in the European discovery of North America. Here, for the first time in their westward expansion, the Norse discovered regions which were already populated by peoples of

whom they had never heard, and who outnumbered the exploring and colonizing parties which could be carried by the small Norse ships. The contacts between the Norse and the Indians of eastern North America were probably few and hostile. In Greenland however, and perhaps in the adjacent regions of the eastern Canadian Arctic, the Norse appear to have had at least sporadic contacts with Eskimos for a period of at least 300 or 400 years. As the archaeological evidence accumulates, it appears increasingly likely that the relationships between Norse and Eskimos were more complex than had been previously thought. The Eskimos, rather than being merely a threat to the Norse way of life in Greenland, may indeed have been at least economically, and perhaps to some extent socially, involved in that way of life.

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EUROPEAN-NATIVE CONTACTS IN THE STRAIT OF BELLE ISLE,  
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*Largely from an archaeological perspective, contacts between Europeans and native people in southern Labrador between the first visit of Jacques Cartier and the establishment of the first Moravian post on the northern Labrador coast are described. An attempt is made to identify the people(s) encountered by Cartier, contacts between natives and Spanish and French whalers during the second half of the sixteenth century are described, and eighteenth-century contacts with Quebec merchants are discussed. Although contacts with Indian peoples are known, the evidence for contacts with Inuit people is much greater. It is proposed that an initial period of native pilfering of European goods from abandoned whaling and fishing premises resulted in the establishment of an exchange system among Inuit groups along the Labrador coast. The eighteenth-century, during which year-round posts were established along the Strait of Belle Isle, was initiated by hostilities between Inuit and Europeans but eventually resulted in a more or less peaceful economic relationship which continued the exchange of goods among natives of the Labrador coast. The establishment of Moravian missions appears to have broken the monopoly of southern Inuit groups resulting, eventually, in dependence of Inuit upon the Moravians for European goods.*

This paper looks at the evidence for native-European contact along the southern Labrador coast, particularly along the north shore of the Strait of Belle Isle which separates the northern tip of the island of Newfoundland from mainland Labrador and Quebec. For nearly a decade a large multidisciplinary project involving Memorial University of Newfoundland, Parks Canada, the National Museums of Canada, and other institutions and scholars has been investigating sixteenth-century shore whaling along the north coast of the Strait of Belle Isle in what is now southern Labrador with particular emphasis on the Red Bay area, known to sixteenth-century Basques as the port of Butus or Buteres. Parks Canada divers have discovered the remains of more than a half dozen vessels and completely excavated a whaleship of about 300 tons, a pinnacle about 40 feet (12 m) in length, and several whaleboats averaging about 25 feet (8 m) long (Grenier 1985). Memorial University field crews have exposed portions of a number of shore stations where right and bowhead whales were flensed, blubber rendered

into oil, casks assembled and repaired, and other activities carried out (Tuck 1985; Tuck and Grenier 1981). Small living sites scattered about the island where many of the shore stations were located have given us a glimpse at the day-to-day life of the whalers and a cemetery containing about 140 individuals provided a look at the whalers themselves.

In addition to investigating the activities of European visitors to the north shore of the Strait of Belle Isle, one of the objectives of the excavations carried out on land has been to learn more about Inuit and Indian occupations of southern Labrador before and during the contact period. Up until the 1984 field season this aspect of the excavations, particularly that involving the contact period, was singularly unrewarding. Native material was recovered, mostly as a 'by-product' of the excavations, and mostly attributable to Palaeo-Eskimo occupations dating at least a millenium earlier than the sixteenth-century. Archaeological evidence of native peoples contemporaneous with the sixteenth-century whaling operation was entirely lacking. Since 1984, and particularly during the 1986 field season just concluded, a relatively large amount of native material which appears to be contemporaneous with the Basque whaling period has been recovered. Although the evidence for actual native-European interaction is still far from overwhelming, it is possible to present a brief summary of the evidence for such contacts presently at hand and offer a few premature suggestions as to where this research appears to be leading us -- both in terms of answers and more questions.

The earliest recorded contacts between Europeans and native North Americans, as McGhee (1984; this volume) has pointed out, occurred on the Labrador coast. The Greenlanders' saga records a single encounter between Norse and Labrador natives, usually thought to have been on the central coast near Cape Porcupine or the Strand, during which Thorvald Eiriksson was killed. Other references suggest intermittent Norse presence along the Labrador coast until the fourteenth-century (Gad 1971: 140). Excavations at the Norse settlement at L'Anse au Meadows in northern Newfoundland (Ingstad 1985) produced a soapstone lamp of a type in use by contemporaneous Dorset Eskimos in northern Labrador and a stone projectile point similar to those in use by Indians along the Labrador coast about A.D. 1000. On the Labrador coast itself, however, Smithsonian Institution researchers and others have sought Thorvald's grave or other evidence of Norse presence or contact with native peoples without success. The excavation of numerous Recent Indian sites in Newfoundland and Labrador dating to the centuries immediately after the Norse discovery of America has failed to reveal any trace of European material. It seems, therefore, as if the influence of the earliest Europeans to reach this part of the New World was negligible.

After the rediscovery of North America by Europeans in the late fifteenth-century, early visitors to the Strait of Bells Isle recorded a few instances of contact with native people. When Jacques Cartier visited the Strait of Belle Isle in 1534 he met there a people whose bodies were "fairly well formed" but were "wild and savage folk". They dressed in furs and wore their hair "tied up on the top of their heads like a handful of twisted hay, with a nail or something of the sort passed through the middle, and into it they weave a few bird's feathers". They are reported as having birch-bark canoes from which they caught many seals. Cartier later learned, although he does not say by what means, that : "their home is not in this place but they come from warmer countries to catch these seals and to get other food for their sustenance" (Biggar 1924: 22-3). It is impossible from Cartier's description to identify the people whom he met, except that the use of birch-bark, rather than skin, boats indicates Indians rather than Inuit. A second record, in a deposition given by Martin de Artalecu regarding the activities of Cartier and Roberval in Canada, implies that sixteenth-century explorers and fishermen were familiar with at least two groups of native people in the lower St. Lawrence valley and along the north shore of the Strait of Belle Isle. He mentioned that the Indians of the "Grand Bay" (i.e. the Strait of Belle Isle) were "better people" than the Indians from Canada who had killed some of Cartier's men (Barkham 1980: 53). It seems from this reference that there may well have been at least a small native population resident along the north shore of the Straits during the sixteenth-century. Another reference to native people on the Strait of Belle Isle makes it clear that people from further up the St. Lawrence also visited the Strait of Belle Isle. In the deposition of Clemente de Odelica of Fuenterrabia in the Basque provinces of northern Spain regarding the same topic, he testified that while eating and drinking with Indians aboard his codfishing vessel in the Grand Bay he was informed by his guests that they had "killed more than thirty-five of Jacques' (i.e. Cartier's) men" (Biggar 1930: 463), who were at the time engaged in the ill-fated attempt to establish a colony in Iroquois country farther up the St. Lawrence.

The limited documentary evidence from the first half of the sixteenth-century provides little information as to the ethnic identification of the native people there and is only slightly more enlightening in the matter of trade or other relations between Europeans and native people. Neither Cartier nor Martin de Artalecu make any mention of attempts to trade with the people they met in the Strait of Belle Isle. De Odelica, on the other hand, apparently exchanged more than food and pleasantries with the people who visited him, in this case almost certainly St. Lawrence Iroquoians. He mentions "deer and wolf skins" given to his crew members in exchange for "axes knives and other trifles" (Biggar 1930: 462). Still another witness in the

same matter, Robert Lefant, also reported a trade in furs for iron goods (Biggar 1930: 453). It seems therefore that there is evidence for two groups of native people along the Strait of Belle Isle during the first half of the sixteenth-century and that they carried on at least some form of exchange with the Europeans who visited the area each summer. Most of this exchange, however, appears to have taken place before Basque whaling in the Strait of Belle Isle reached its industrial proportions of the second half of the sixteenth-century.

Following about A.D. 1550 records of exchange between natives and Europeans appear to be even less common than those from the first half of the century. Two sources, however, both written in the early seventeenth-century mention a different sort of relationship between Europeans and natives. According to Richard Whitbourne's oft-quoted statement, first published in 1622, the Basques employed natives to assist in whaling in return for "even small reward" (from Prowse 1895: 63). This sounds remarkably like the report of Lope de Isasti, written three years later but not published until 1850, that people he refers to as "montaneses" had learned some Basque and "talk and associate with our men and help to prepare the fish on shore in exchange for a little bread, biscuit and cider that they do not have over there" (from Barkham 1980: 54). These two statements are so close in content that it seems likely that one might have been borrowed from the other, although it is unclear who might have borrowed from whom. Neither Whitbourne nor de Isasti appears to have visited the Strait of Belle Isle hence both may have obtained the information from a third source. Although Whitbourne's statement might be suspect since, in his attempt to encourage settlement in the New World, he was clearly telling Englishmen what they wanted to hear -- that there were tractable natives in the New Found Land whose labours could easily be made to benefit the settlers -- Isasti does not appear to have been similarly motivated. It seems, therefore, that there existed an economic relationship between Basques and Indian people during the latter half of the sixteenth-century which involved the exchange of labour, rather than furs, for European goods. Presently, however, there is no archaeological evidence for such relationship.

Other than these two accounts, both written in the early 1600's, although they apparently refer to events which happened in the previous century, there are remarkably few references to natives in the records from the second half of the sixteenth-century. Except for references reported by Selma Barkham (1980:54) to a Basque whaler or fisherman killed by natives in Terra Nova, probably along the Strait of Belle Isle, to what may be caribou hides in a will from 1557, and to reports by de Isasti of hostile "esquimaos", mentions of native peoples along the Strait of Belle Isle are virtually non-existent during the remainder of the sixteenth and the seventeenth centuries. As will be shown

below, however, there may be good reasons for the absence of references to native people in the documents deposited in archives in the Basque provinces during the late sixteenth and seventeenth centuries.

During the initial years of our investigations at Red Bay evidence of native presence contemporaneous with the Basque whalers and codfishermen eluded us completely. We recovered an abundance of evidence for native utilization of the Red Bay area by Archaic Indians and Palaeo-Eskimo peoples but even the most recent of these dates more than a millenium before the sixteenth-century.

Beginning in 1984, however, a few scraps of archaeological evidence have emerged which suggest Inuit presence at the Basque whaling station at Red Bay, and at a time very close to that of the whaling operations. On Saddle Island, where the majority of our excavations have been carried out, several soapstone lamp and bowl fragments (see Fig.1), clearly of Thule or Labrador Inuit origin, have been found in the same levels as sixteenth-century Basque material. This could, of course, be the result of admixture, and in one case a soapstone fragment was contained in sods used by the Basques in roof construction, suggesting that the Inuit presence may have been earlier than that of the Basques. In a pond on nearby Twin Island, which contained a great deal of refuse from a nearby sixteenth-century Basque dwelling, were found a slate harpoon end blade and a polished stone drill bit, both of which are of unmistakable Inuit origin, and several small softwood carvings, a broken bow and several arrowshafts which also may have been made by Inuit. Owing to their greater density, the stone objects had sunk to the bottom of the pond. The wooden objects, on the other hand, remained suspended in the silt at the same level as obviously Basque material suggesting, at least, contemporaneity between the two groups.

None of the identifiable Inuit material was made from oak, beech, or other European materials although the arrowshafts were tipped with iron points, now only a stain in the remaining wood. Since these points could have been made from meteoritic iron, we have no real evidence of exchange of any sort between the two peoples. Nonetheless the context, as well as some of the Inuit tools and weapons themselves, suggest contemporaneity and we must try to explain by what means the material from two different peoples came to be associated in the same deposits. Several alternatives present themselves, none of which, unfortunately, can be 'proved' by the archaeological evidence at hand. These alternatives include, among others: 1) all the material was left there by Basques who collected and discarded a few Inuit souvenirs; 2) both Basques and Inuit occupied the site during the sixteenth-century either at the same time or during different seasons of the year; 3) all of the material was left there by Inuit who obtained the European material from the Basque whaling stations.

Which of these alternatives, if any, is correct is impossible to say with any degree of certainty, based upon the archaeological evidence alone. The first seems unlikely since broken arrowshafts, broken soapstone lamps and bowls, and the other material would seem to have been of little value as souvenirs. The third alternative also seems unlikely given the amount of Basque material and the proximity of the site to a small Basque dwelling, perhaps of a boat crew. The second alternative, however, seems most likely: Basque whalers and codfishermen as well as Inuit camped in the Red Bay area during the latter half of the sixteenth-century. Even if this general assumption is correct, however, it is still impossible to say whether the Inuit and Europeans ever met in face to face contact. It is conceivable and indeed likely, that the two groups were at Red Bay during different seasons of the year. A preliminary analysis of refuse bone from Twin Island Pond, for example, suggests spring and summer kills of the species represented (Stephen Cumbaa, personal communication). In other words the species could have been taken by Basques during the summer when they were at Red Bay or by Inuit during the spring when they could have occupied the area without ever sighting a Basque sailor. It may be that the final analysis of the food remains from Twin Island will provide a more definite answer to the question of contemporaneity between the two groups, but I do not hold much hope. In total, the archaeological evidence does seem to indicate contemporaneity between the Basques and Inuit; just how the two groups might have reacted to each other's presence will be summarized below.

Recently acquired evidence regarding an Indian presence at the Red Bay sites appears somewhat more clear than that involving Inuit and may point the way to interpretations of native-European relations of a more general nature.

Until the past summer Indian material was even less common than that of Inuit origin and consisted of but a single potsherd. The collared rim sherd, still displaying a castellated rim decorated with opposed incised lines and annular punctates looks, at first glance, to be Iroquoian but the coarse and flakey fabric of the sherd is more reminiscent of Algonkian ceramics from the Lower North Shore (J.V. Wright, personal communication). However, no trace of the ceramics produced by the Iroquoians met by Cartier near the present-day city of Quebec has been found and it is not impossible that this scrap of pottery was left by relatives of the Iroquoians whom Clemente de Odelica entertained aboard his codfishing vessel in the 1540's. Regardless of the precise origin of this sherd its position between the floor and roof fall of a collapsed Basque structure clearly indicates that it was deposited sometime before the structure collapsed. It also suggests, at least, that some Indian people camped briefly within one of the Basque structures, a situation unlikely to have occurred during the months when the whaling stations were in

operation. Other evidence of native utilization of the area was found within a few metres of this structure. A small 'workshop' where somebody had cut up fragments of one of the copper cauldrons used by the Basques to render whale oil produced a number of asymmetric copper triangles which may represent the end product or discarded offcuts from the modification of European materials. Although it cannot be demonstrated beyond doubt, these are thought to have been modified by native people, possibly the same people who left the potsherd nearby.

During the month of August 1986 our information regarding native presence at the Red Bay whaling site changed dramatically. Immediately adjacent to a large, and apparently well-preserved structure measuring about 32 by 30 feet (9.7 x 9 m) which appears to have housed a tryworks, a number of small Indian hearths were found in stratigraphic context which makes it impossible to separate them in time from the Basque occupation. Moreover, Basque ceramics, roof tiles, textile, nails, and bits of cut baleen are undoubtedly associated with the native hearths and occupation levels which also contain flakes of Ramah chert and other cherts, small notched projectile points, triangular bifaces, random flake scrapers (see Fig.2), and a single potsherd of Indian manufacture, all of which (except the potsherd) are remarkably similar to specimens from the island of Newfoundland attributed to the prehistoric and early historic Beothuk people. Other objects of virtually identical form, except that they are made from Ramah chert, and the relatively high proportion of this distinctive raw material, seem more closely related to the Point Revenge Recent Indian complex of the Labrador coast. There seems little doubt, therefore, that at least two, and possibly three, groups of Indian people -- Iroquoians and perhaps two related groups of Recent Indians from the north shore and the Labrador coast -- were along the Strait of Belle Isle during the sixteenth-century.

Looking at both the documentary sources and the archaeological record it is possible to reconstruct, at least in a general fashion, a history of contacts between Europeans and native people along the north shore of the Strait of Belle Isle during the sixteenth-century, and to extend that reconstruction more than a century toward the present. It may be possible to divide the history of native-European contact into four major periods, which involve both Inuit and Indian people, although to different extents.

The earliest period, which encompasses basically the first half of the sixteenth-century, seems to be marked by more or less peaceful relations between native and Europeans along the north shore of the Strait of Belle Isle. During this time documentary sources indicate that at least a limited amount of trade involving the exchange of furs for iron goods occurred. There is, however, virtually

no archaeological evidence for this exchange. Records suggest that the only natives present in southern Labrador at this time were those we would recognize as Indians. No evidence for an Inuit presence seems to exist.

The second period begins about the middle of the sixteenth-century when documentary evidence for trade becomes virtually nonexistent. This is a curious situation for in most, if not all, other cases in eastern North America native people who once acquired a taste for European goods were reluctant to give them up. It seems likely that whatever native people existed along the Strait of Belle Isle would have a continued, and probably increased, desire for metal and other European items which they had acquired through trade in the first half of the century. This curious lack of references to trade may not, however, mean that the native people along the Straits gave up the use of metal and other European commodities but that they acquired them by means other than trade. It may be no coincidence that references to trade disappear very shortly after whaling shore stations were established at upwards of a dozen harbours in southern Labrador and adjacent Quebec. The process of rendering whales, assembling and repairing casks, and other activities associated with whaling required shore facilities much more elaborate than did the cod fishery, particularly if the cod fishery was a 'green' or 'wet' fishery which involved very little use of shore facilities (Innes 1940). Moreover, the whaling stations, although abandoned each winter and spring, were permanent structures heavily framed with timbers held together with iron nails, covered by tile roofs, and judging by our excavations at Red Bay, surrounded by wood, metal, and other objects which would have had considerable utility to native people. The need for trade may simply have been obviated by these abandoned structures at which native peoples could obtain a variety of European materials simply for the taking; furs or other products need not have been exchanged. Therefore, the absence of references to trade, and for that matter to native peoples themselves, might not mean that the native people had disappeared but that they had chosen a response to European presence which differed from that of the first half of the century; they simply visited European whaling stations when they were abandoned and took whatever was of use to them. This suggestion finds a certain amount of support in the archaeological record, although the evidence is meagre and preliminary. The Indian hearths at Red Bay are small, appear to have been used but once or twice, and suggest repeated occupations of the area, perhaps for as little as a few days at a time. The few scraps of identifiable food bone contained in the hearths, all badly fragmented and calcined, pertain exclusively to harp seals which are available in the Strait of Belle Isle only during winter and late spring (Cumbaa, personal communication), the seasons when the Basque whalers normally were not on the Labrador coast. This

proposed pattern of scavenging or pilfering mentioned above is an extension of Pastore's (1985) hypothesis regarding the Beothuk Indians' relations with Europeans on the island of Newfoundland. Until the eighteenth-century the Notre Dame Bay area of Newfoundland's northeast coast, where Pastore's research has been conducted, was visited only seasonally by European fishermen who abandoned their premises during the winter months, and there is little evidence of trade, yet the Beothuks possessed large numbers of nails, fishhooks, and other metal objects which could have been obtained by scavenging rather than trade.

While it appears that Indian people were already either residents or seasonal visitors to the southern Labrador coast during the first half of the sixteenth-century it is not certain whether Inuit were there prior to the arrival of Europeans. There is presently no archaeological evidence to suggest an Inuit presence in pre-contact times, nor do the few documentary references describe what appear to be Inuit. Rather, it seems more likely that the Inuit were attracted to the area by the availability of iron and other materials and began their forays into southern Labrador specifically to obtain the European materials available there. The scraps of Inuit material scattered on Basque sites in Red Bay Harbour are at least suggestive of brief visits to the area rather than any pattern of long term residence.

Much of the material obtained through this pattern of pilfering by both Indians and Inuit was probably consumed by the people who obtained it. Through time, however, an increasing amount appears to have been exchanged with adjacent groups. In the case of the Indian people it is not certain how much of the material found its way westward up the St. Lawrence, and at the present time it does not appear as if any of the Indian peoples who obtained European items from the abandoned premises became important middlemen in any long distance trade. The Inuit on the central Labrador coast, on the other hand, were quick to establish a trade in European objects with their more isolated relatives along the northern coast. They appear to have expanded their range southward dramatically during the seventeenth-century, and probably earlier, and may have done so for the express purpose of obtaining European material for their own use and eventually for trade to the north. Richard Jordan suggests that the large 'communal' houses which characterize the Labrador Inuit during the late seventeenth and eighteenth centuries grew up around successful traders who assumed high status as a result of their activities. These houses often contain large quantities of European material and high status burials of adult males accompanied by a wealth of European goods are interpreted as the graves of these successful traders. During the second half of the sixteenth and perhaps for most of the seventeenth centuries this pattern of pilfering abandoned European establishments to obtain desirable

materials along the Strait of Belle Isle appears to have proceeded unhindered.

The third period which characterizes the history of native-European contacts along the southern Labrador coast began in the late seventeenth-century. Beginning at that time, and extending northward during the early eighteenth-century, a series of fortified trading posts owned by Quebec merchants marked the beginning of year-round European occupation of the coast. No longer could the Inuit simply help themselves to European goods; there were now merchants at most locations frequented by summer fishermen, and these merchants demanded payment for the goods which the Inuit desired. The first response of the Inuit to this changed situation was a series of raids on European settlements to obtain the goods for trade with the north. One such raid took place at the 'fort' established by Pierre Constantin at Red Bay in 1715. The post was burned by Inuit in 1718, but rebuilt and operated until the late 1720's. We have not been able to find a trace of this post. This period of raiding seems to me a natural response of native people with a tradition of obtaining European items at no cost who were suddenly confronted by resident traders who demanded payment for the formerly cost-free materials.

Eventually, however, the Inuit became active, if not entirely trustworthy, trading partners of the various merchants along the coast, which marks the beginning of the fourth period in the history of native-European contacts. This 'pacification' of the Inuit is often attributed to factors such as the supremacy of arms of the Europeans, but I think there may have been other, more subtle, factors at work as well. For example, if the trade with people to the north involved the exchange of European items for furs, blubber or oil, and baleen, which seems to have been the case, then it seems likely that the central coast middlemen would soon have accumulated some considerable stocks of those local products. There are only so many furs and so much blubber and baleen that a family or community could use. It also seems doubtful whether these products themselves would confer high status upon an individual. Furs, perhaps, but it seems hardly likely that the possession of a mountain of rotting blubber or several tonnes of unpleasant smelling baleen would make an individual a community leader. It seems to me, then, that an unavoidable outgrowth of the exchange with the northern people was the development of exchange with the Europeans to the south where a market for the northern products existed.

Without doubt such a pattern developed along the Labrador coast and lasted until the arrival of the Moravians in the second half of the eighteenth-century. That the first Moravians were met with hostility may also, at least partly, have an economic motive. They were there not only to Christianize the Inuit but also to establish trading posts along the north coast where the trading partners of

the more southerly people lived (Taylor 1974). It is probably stretching a point to attribute the slaying of the first Moravians to purely economic factors, but this appears to be a possible contributing factor.

The last few paragraphs, and the last two periods in the history of native-European contact, have concentrated entirely upon relations with the Inuit for the very good reason that there is virtually no evidence for Indians along the Labrador coast following the end of the sixteenth-century. Despite ample evidence of prehistoric Indian populations, whose remains extend into northern Labrador, the site at Red Bay and another just west of the Labrador-Quebec border at Blanc Sablon are the only two contact period Indian sites known from the Strait of Belle Isle or, for that matter, from the entire Labrador coast. Whether these people simply became extinct, or were forced to the interior from where they re-emerge later as the historically known Naskapi remains a mystery. The comments of Whitbourne and de Isasti cited above suggest that a different sort of relationship between Europeans and Indians existed as long ago as the late sixteenth-century. It also seems as if a similar relationship existed between the 'Montagnais' and the earliest traders to establish year-round posts in southern Labrador. It is by no means certain, however, that these more recent references are to the descendants of the same people who appear in the early sixteenth-century references and whose campsites we have excavated at Red Bay. For the present these questions must go unanswered.

This then is the state of our researches into native-European contact along the southern Labrador coast from the early sixteenth-century until the establishment of permanent European settlements. It seems to be one characterized in its earliest stages by relatively peaceful exchange of furs for European goods with European cod fishermen who visited the Strait of Belle Isle each summer. With the establishment of the substantial shore stations necessary for the prosecution of the whale fishery, which were seasonally abandoned, native people appear to have found it easier and economically advantageous simply to remove desirable items from the European premises. The evidence from Red Bay suggests that Indians practiced this pattern of pilfering and that Inuit may have been first attracted to the area by the availability of European goods. In the late seventeenth-century the year-round presence of European traders on the Labrador coast resulted in conflict between them and the Inuit, who until that time had been accustomed to obtaining European items without charge. Goods obtained both by pilfering and raiding were exchanged with people to the north and the end result of this exchange was the development of trade with Europeans both to obtain European goods but also to dispose of the local products offered by their trading partners to the north.

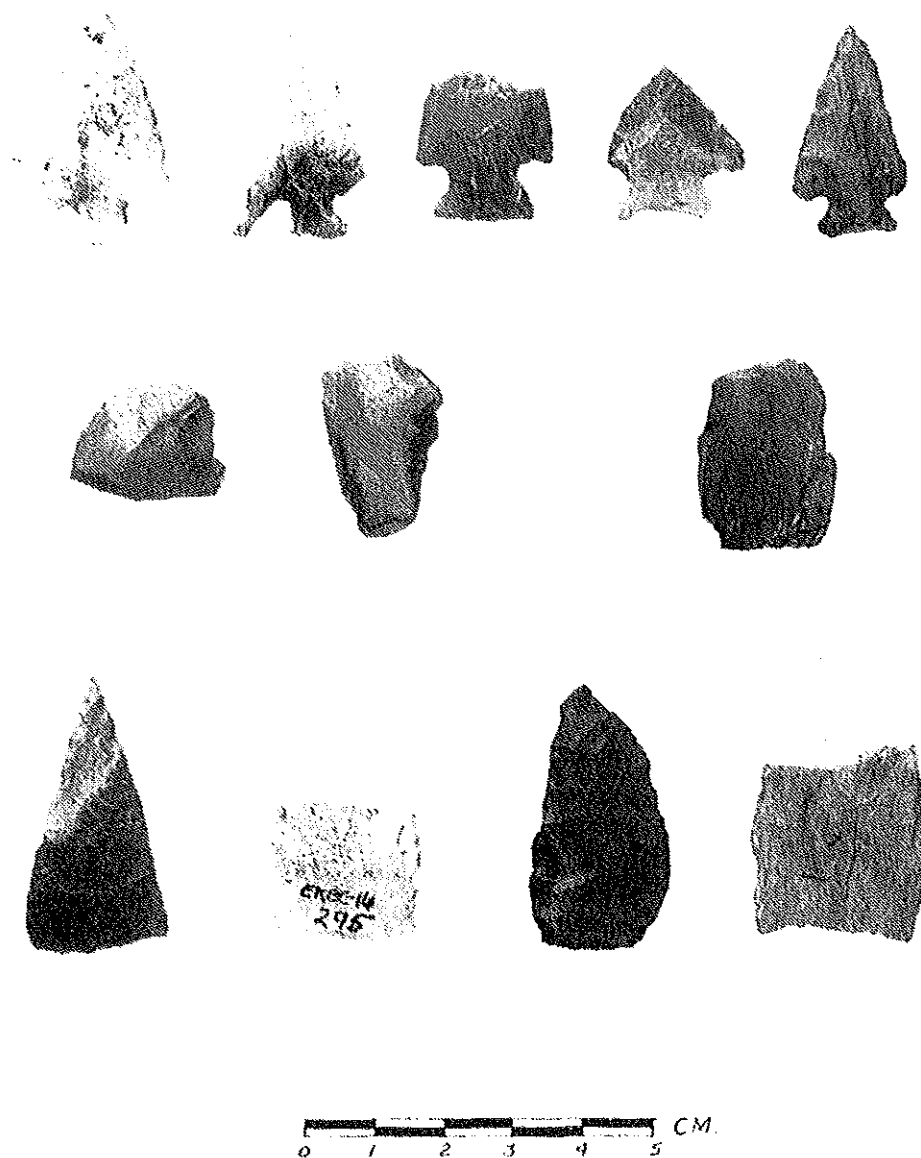
This coastal trade, in which the Inuit to the south maintained a monopoly as middlemen was broken in the late eighteenth-century by the coming of the Moravian missionaries, who provided direct access by northern people to European goods, including traps, nets, and firearms, thus accentuating the Inuit dependence upon Europeans.

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*Fig.1. Inuit artifacts from Red Bay, Labrador. Upper left - pendant from reworked soapstone bowl or lamp, nephrite drill bit, slate end blade, all from Twin Island; lower left - soapstone bowl fragment from Saddle Island; right - seal vertebrae strung on ribs, as found in Twin Island Pond.*



*Fig. 2. Recent Indian artifacts from Red Bay, Labrador. Upper row - projectile points, at the far left is an example made from Ramah chert; center row - two flake scrapers and bipolar core; bottom - bifaces, probably knives.*

## DUTCH WHALING AND ITS INFLUENCE ON ESKIMO CULTURE IN GREENLAND

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*The Dutch sailed regularly to the west coast of Greenland for more than 150 years. It is accepted that their activities there were at first mainly of an exploring and bartering character, and that after 1719 whaling became the primary reason for their presence. Dutch place names on the west coast are identified and discussed and objects of Dutch origin recovered by archaeologists are considered. A combination of historical sources, archaeological excavation, and oral tradition is used to throw light on the relationship of Eskimo bartering among themselves and with the Dutch, on the migrations of the Eskimos, on the origins of the Long House in Greenland in around 1700, and on related problems.*

During the period of over 150 years between about 1650 and 1800 when the Dutch sailed to west Greenland waters thousands of whales were caught, thousands of sailors met the women of the country, and Inuit and kayaks were captured and brought to Europe; but the influence of these activities on Greenlandic society itself is hard to visualize. The woman's knife, the ulu, is a sailmaker's knife introduced in the seventeenth century but not especially of Dutch origin; the red-haired children playing in the small villages along the coast may be of Scottish origin; and the cairns built on the tops of the islands to mark the anchorages may perhaps be of Inuit or Norse origin. Apparently, there is not much left of the 150-year-long Dutch presence on the west coast of Greenland.

But the cairns, or some of them, may well have been set up when Dutch ships were using certain harbours to barter with the Inuit. And some of these harbours can be found today, identified from the old maps. Ten years ago Gert Nooter told me about a day-dream he once had, which was to sail along the coast of Greenland with such an old Dutch map in his hands. The purpose, as I understood it, was to visit these places. This was a fascinating idea, we could baptize it a topographical study, but it never came true. It is in fact very difficult to sail along this coast without a pilot, and to find the cairns you are searching for. In 1986 I had the opportunity to follow one of the bartering routes in the district of Frederikshaab or Paamiut, but covered only 50 kilometers (Gulløv 1986b). In the Godthaab or Nuuk area, 300 kilometers north of Frederikshaab, I visited a so-called Dutch harbour named

Harbour of Hope, but nothing was to be seen there. It was very stormy weather that day, and on my way home to Nuuk I shipped a heavy sea and injured two ribs. I began to think it might be better to abandon the study of whaling on location in Greenland. In any event I propose now to discuss the Dutch influence there on the basis of documents and literary sources and not from my own experience, which was a fiasco. I felt like the Dutch whaling captain, who in 1732, together with his crew in the shallop, stood ready to throw the harpoon into the whale. One of his men missed his stroke and fell into the back of the captain, pushing him into the water. The whale was scared and dived, but the captain was saved. Apparently he was not at all angry with the man who caused this unfortunate occurrence (from Jochimsøn 1733).

Fortunately, besides the written sources, items used in barter have come down to us. Beads, knife handles, sail-maker's knives and coins are among the best known archaeological artifacts to demonstrate Dutch presence in the past. But they never had a real material function in Inuit society; their function can only be described as economic, that is, they were merely a means of payment. The economy is what is important here, for I hope to demonstrate that Dutch whaling had primarily an economic influence on Inuit culture.

To elucidate this purpose I have chosen a single geographical point of view, namely to look at whaling during the above-mentioned period from a Greenlandic angle only. I know that biases are legion when the starting point is Greenland itself, but it is not Dutch whaling as an element in the mercantilistic dominated world trade that I want to discuss, but the Greenlandic branch of Dutch whaling and trading seen, as it were, from an Eskimo point of view.

### The source material

From 1614, the year when Joris Carolus from Enkhuizen in Holland went to 'Old Greenland' on his first expedition (Bobé 1917: 259; 1936: 15), until 1720, when Lourenz Feykes Haan published his description of west Greenland (Haan 1719, 1720), the sources are desultory. After 1721, the year of the colonization of Greenland by the double monarchy of Denmark-Norway (Gulløv and Kapel 1979), reports were sent yearly to Copenhagen, and these reports are still our main source of historical information.

'Old Greenland' meant Greenland proper, especially the west coast bordered by Davis Strait, named after the English explorer who discovered these waters on his first expedition in 1585 (Hakluyt 1589), or on Dutch maps Straat Davis. 'New Greenland' was Spitsbergen. The name was first used on an English map of Spitsbergen in 1625 in the form "Greneland" (de Jong 1972: plate III). This distinction was

abandoned in the eighteenth century, when West Greenland, as the whaleships' destination, was invariably referred to as Davis Strait.

Joris Carolus entered the history of Denmark when for five years - from 1619 to 1624 - he became the head of the Danish Navigation School in Copenhagen under King Christian IV. In Amsterdam in 1634 he published Het nieuw vermeerde Licht des Zeevaerts in which one can find two West Greenland harbours indicated, Delftshaven near Atammik in the southern part of the present Sukkertoppen municipality, and Brielsche Haven near Fiskenaesset in the southern part of the present Godthaab municipality (see Fig.1). These harbours originated from an expedition sent out in 1624 to find the way north around America to China. The expedition was equipped in competition with the Dutch whaling organisation called the Noordsche Compagnie by the merchant Adriaen Dircxz Leversteyn of Delft (Bobé 1917: 260). Together with the name Statenhoek, later known as Kap Farvel, the two harbours can still be on maps a hundred years later (see Zorgdrager 1720).

In 1636 a company was founded in Copenhagen to obtain information about the inhabitants of Greenland and its resources (Bobé 1936a: 16; Gad 1961: 281). Joris Carolis was captain of one of the two ships sent out on the expedition. After this we have only one more seventeenth-century source relating to the Dutch in West Greenland. It is the famous account of the Dutch captain David Danell's three voyages to west Greenland in 1652-54 as leader of a Danish expedition (Bobé 1916). On his last trip he brought four Eskimos back to Norway, who became a major source of information about the Eskimo world in the seventeenth century. They starved from hunger and disease during the siege of Copenhagen in 1659 when Denmark was at war with Sweden.

From the time of Danell's three expeditions until the colonization of 1721 we have two main sources, the above-mentioned Feykes Haan's booklets, and Zorgdrager's whaling monograph. It is noteworthy that, when the missionary and colonizer Hans Egede in 1721 planned his colonization, the Greenland company in Bergen wrote to Copenhagen to ask them to send Haan's description together with his map (Bobé 1936b: 68).

After 1721 the sources relating to Dutch activities and their contacts with the Eskimo population come from the Danish colonists and missionaries and have the character of eyewitness accounts. Conflicts broke out between the Dutch and the colonists because the Danish king claimed sovereignty over Greenland. Twice the Dutch burned down a new colony set up near an old Dutch harbour (Gulløv and Kapel 1979: 20), and nearly 20 years after the colonization there were still problems between the two nations. The conflict was partly solved in 1739 when a Dutch ship bound for the Moravian mission in Greenland was captured in Disko Bugt after a naval battle (Gad 1969: 263-65). After that year

the Dutch still sailed in Davis Strait but seldom came to the coast.

In the first years of the Danish-Norwegian colonization the whalers and colonists helped each other. When Hans Egede arrived on the coast he was piloted into a harbour by a Dutch whaling captain who gave him his boatswain as a pilot. The next year a whaler was wrecked near Kap Farvel and when the crew arrived in boats at the tiny colony they were supplied from the limited provisions there. But the situation changed from an 'idyll' to a conflict which increased in 1728 when the Danish navy took over supplies and logistics for the colony.

Even though the colonists and whalers were in touch, they did not know much about one other. The Dutch had heard that the colony was badly equipped and thought that the colonists would soon leave the country (Egede 1925: 20). But they stayed year after year and in 1732 welcomed a person sent to them by the ship of the year, Mathis Jochimsøn, who had secret orders to spy on the whalers in their harbours along the coast (Jochimsøn 1733; Ostermann 1940: 443). Ten days after his arrival he met a whaler and invited him to the colony, where the captain together with some of his crew got something, and more than that, to drink. From that visit we have information from Danish sources about Dutch whaling ships, their equipment, the crew and their wages, the cargo for barter, the catch, about the so-called Cumberland Eiland (namely Baffin Island), also about the date of their return to Europe and where they sail in the winter, about east Greenland and about the Norse Eastern Settlement which was still supposed to exist, about how many whalers there were in Davis Strait, how much they caught, as well as the name of the captain and where he lived. This curious and informative report, which is the only source of information about Dutch whaling seen from Greenland in the first half of the eighteenth century, was used by the Danish historian Louis Bobé as one of his main sources in a paper of 1917 entitled "The Dutch in Greenland" without quoting his source. Subsequently, the late Finn Gad used Louis Bobé and his work in his History of Greenland. I will return later to Mathis Jochimsøn and his observations during his one year stay in Greenland, where he also made a map including Dutch harbours.

#### Dutch names and geography today and in the past

If we take a look at the modern map of Greenland we still find several names of Dutch origin (Fig.1), most of which date from the eighteenth century. One can find these names in Spitsbergen too. In the south of West Greenland we have Isblinken, called Frederikshaab Isblink, which was the first landfall the whalers had on their starboard side when they sailed up the west coast. 'Witteblink' was the name

they gave to this 30 kilometers long coast line where the Inland Ice reaches the sea. Today we have only the suffix - 'blink' left. Their next stop was Sydbay (Southbay) or Zuydbay in Holsteinsborg municipality, a harbour where the whalers assembled before they returned to Europe. And then to the north where the names that can be found now like beads on a thread. Rifkol in Kangâtsiaq municipality; Vester Ejland and Hunde Ejland (West and Dog Island) in Egedesminde municipality; Sydostbugten (Southeastbay) or Zuydostbay in Christianshaab municipality; Rodebay or Roobay, Klokkerhuk or Kloekehoek, and Vaigat in Jakobshavn municipality; Flakkerhuk or Vlakkehoek, and Fortune Bay or Fortuynbay on Disko in Godhavn municipality. Disko can be found too in Spitsbergen as Dusko, a name which originates from the English captain Marmeduke who voyaged in northern waters at the beginning of the seventeenth century. Dukes Bay was changed to Disko Bay, and became in Greenland the name of the famous whaling grounds. The big island, now named Disko, was called Het Eyland Disko (Rosendahl 1974). In the Uummannaq municipality we still find names such as Ubekendt Ejland or Onbekende Eyland and Svartenhuk or Zwartenhoek.

By Feykes Haan we are informed about 35 more names; of harbours, points of fresh water supply, places to barter, among many others. When Haan wrote his description and published the booklet, he had been whaling during the previous 10 years, but we find no references in his text to places south of Zuydbay and 67 degrees north latitude, though some are marked on his map. Apparently in his account of the whaling, Haan chose as his starting point geographically the place where the baleen whales (Balaena mysticetus) were. In the 1720's the missionary Hans Egede confirmed this when he was told by a Greenlander that no baleen whales were to be found at 64 degrees north where the colony was situated, but only at the so-called Sydbay, where the whales winter and migrate northwards in April when the ice breaks up. Here, at 67 degrees north, the Greenlander told Egede, he would find many people waiting for the whalers to arrive in April (Fig.2).

This Greenlander knew about two sorts of ships, real whalers or Hukkerts (Hookers), and smaller ships, Galiots, used for bartering. Mathis Jochimsøn got similar information in 1732 when he looked at the Dutch captain Ewert Donker through the brandy bottle: some of the whalers were equipped for bartering and anchored where the Eskimos lived, from Frederikshaab in the south, Fiskenaesset just north of Witteblink, and Kangâmiut or Suikerbrood in the north, before they reached Zuydbay.

When Mathis Jochimsøn made his trips north and south of the colony in 1733 he found at least 12 places where the Dutch were bartering with the Inuit. Twenty years later the merchant Anders Olsen, who spoke Greenlandic fluently and was the founder of farming in southern Greenland, visited the same places only to be informed that in former times

the Dutch would have been there (Olsen 1764). Numerous Danish colonies were by then established along the coast from Frederikshaab in the south to Disko Bugt in the north and foreign activity had become difficult (Fig.2).

We can therefore infer that the purpose of Dutch activities had changed from barter to whaling, and that the change took place in the years before 1700. The bartering took place in the southern part of the west coast, and the Dutch used the good harbours at Statenhoeck as they called Kap Farvel to get fresh water before they sailed into Davis Strait. When whaling began, a great deal of ice was encountered in south Greenlandic waters, and the whalers concentrated their activities in the northern part of the west coast around Disko Bugt and Uummannaq. Shortly after this change in Dutch activity, Hans Egede arrived and the Danish-Norwegian colonization began. Mathis Jochimsøn gave the last eyewitness account of barter south of the colony.

### Bartering goods

The goods comprised mainly striped and flowered shirts of poor woollen fabrics, stockings, gloves, brass kettles, knives, awls, bodkins, fishing hooks, glass beads, wooden trays, laths, boards and wooden chests, together with gun flints and powder. For these goods the Dutch got blubber, baleen, narwhal tusks, caribou skin, fox and seal skin (Bobé 1917: 267).

Except for the iron, the Eskimos could not use many of these things in their subsistence economy. We read in Egede's diary for 1729, that his assistant arrived at the colony from a trade trip in the south where he had found in one Eskimo house more than twelve new brass kettles of different sorts, several painted chests, trays, pewter bowls, coloured shirts, blouses, vests, hats, different kinds of carpenter's tool, tea-cups, and other small wares, all of which were hanging round inside the house, making it look like a miniature shop (Egede 1925: 230; Gad 1969: 190).

We have little information about prices, which may have changed between 1700 and 1732, when Mathis Jochimsøn wrote that two fox skins were paid for one shirt, and that one fox skin gave the captain 1-2 guilders at home. A Dutch trader on one occasion had 70 big cordels of blubber (1 cordel contains 405 litres), some baleen, a few seal skins and more than 500 fox skins.

It seems that these goods were used as prestige objects or for exchange inside Eskimo society. If that is the case, we have a parallel in the archaeological material from Eskimo Island in Hamilton Inlet on the Labrador coast, where quantities of European objects found in Eskimo winter houses have been interpreted as the product of a kind of 'purchase society' (Jordan 1978; Jorden and Kaplan 1980: 44). But purchase society or not, it looks as though some families traded more eagerly with the Dutch than others.

Most of the 15 Dutch coins or duits found from Kap Farvel to Uummannaq have perforations so that they can be used as ear-rings, and were minted between 1719 and 1748. Some of them may have been exchanged within Eskimo society, because they are found far to the south and can be dated to the period when the Dutch had left this area (Fig.3).

Why did the west Greenlandic Eskimos exchange blubber and skins for useless commodities? They could not survive for long on prestige objects alone. Was it only certain individuals or families among the Eskimos who bartered with the Dutch? Which party was the prime mover in this supply and demand? To answer these questions we have to go to the sources. Since Dutch sources still lack, one has to turn to the Danish sources, the archaeological material and Eskimo oral traditions to solve a problem which must be related to the anthropological concept of subsistence economy.

#### Eskimo activity as seen from the Danish colony

When Hans Egede arrived at the west coast of Greenland at 64 degrees north latitude, on 3 July 1721, he was welcomed by the Eskimos, who helped the crew to carry boards from the ship to the place where the new colony was to be established (Egede 1925: 8-9). Twenty years later, when he was back in Europe, he published a description of Greenland and its population (Egede 1925: 305ff.), which deals with the local population around Hope Colony and Godthaab, supplemented from 1734 with observations from Disko Bugt, where his son was a missionary at the newly-founded colony Christianshaab (P.Egede 1939). But Egede did not include the observations recorded in his diary during his 15 years in Greenland about Eskimo migration. He was not aware of this phenomenon as a necessary part of Eskimo life, for he regarded native society as static and the roaming proclivities of the Eskimos as a hindrance to his missionary work.

Every year, in the spring, he saw hundreds of Greenlanders in kayaks and umiaqs pass the colony northwards. Most of the travellers camped just north of the colony in a sound to fish for lumpsuckers together with the local Greenlanders (Gulløv and Kapel 1979: 27). When he visited the place, he noticed that they danced, and exchanged local commodities, for example soapstone, for fox skins. Later he saw the same people on their way home to the south after one or two years overwintering in the north. When he asked them why they travelled, they told him that they needed baleen for fishing lines and wood for their vessels (Egede 1925: 127). Driftwood was brought to the central southern part of the west coast with the east Greenlandic current round Kap Farvel, and the baleen whales were only found north of Zuydbay, especially in Disko Bugt (Cranz 1770a: 227; Glahn 1771: 261-71).

Egede did not reflect on the information given to him, but he was very careful in writing his diary. Today we can deduce the following patterns from his observations: Eskimos from south Greenland migrated northwards to the whaling areas for one year, not to catch whales but to get baleen. After wintering they returned to the south. On their way north they met together with Eskimos from the Godthaab area and perhaps from other places, for instance the Sukkertoppen area, and on their return they stopped to exchange some of their commodities with the Godthaab population. This pattern continued until 1733 when a ship from Europe arrived with a Greenlander on board who had been in Denmark and there caught smallpox. One year later no Eskimos were left in the Godthaab area, except for a few who had fled outside the district. Shortly after the epidemic Egede described how the south Greenlanders now went into the Godthaab fjord to get soapstone for lamps and pots (Egede 1925: 292). The local inhabitants had disappeared and there was no one left to maintain their former rights to the soapstone deposits.

Thanks to these extracts from Egede's diary, we are now in possession of an essential contribution to a description of Eskimo society at that time. The Moravians who arrived in 1733 with the smallpox ship continued the mission activity, and after Egede's departure three years later they dominated the mission field of the Godthaab district. From the parish registers of the Moravians we can follow the fortunes of the migrating south Greenlanders because many of them settled at Neu Herrnhut, two kilometers south of Godthaab (Gulløv 1983).

#### Archaeology and settlement patterns

There is another subject which is elucidated by the written source material. Both Egede and Feykes Haan mention that some of the natives lived in big winter houses (Egede 1925: 365; Haan 1720: chapter 5). When Egede arrived he mentioned houses with 30 to 40 people. These houses are rather large: ruins 10 to 15 meters long can be found on sites in the archipelago around Hope Colony. When David Danell 60 years earlier visited the West Greenland coast on his three expeditions, he found only small, circular houses shaped like a bakers oven, as he described them (Bobé 1916). What had happened? Archaeological excavations confirm that the circular winter house had been in use in the Godthaab area at least until the colonization began, to judge from the clay pipes found. In the Disko Bugt area some of the round houses contained artefacts dating from after the foundation of Christianshaab in 1734; and in the Julianehaab district to the south, glass beads and coins dated the circular houses to after 1700 (Gulløv 1982).

Our written sources are certainly correct when they state that some of the houses were big. But which ones?

Settlement patterns show a concentration of large or so-called communal houses along the coast. Under them we find the circular structures, which are also found in the fjords. Only in the middle of the eighteenth century are we first informed of communal houses in the Godthaab fjord, in places - and this is remarkable - where former south Greenlanders, now belonging to the Moravian mission, live (Gulløv 1985b).

The archaeological material demonstrates that the communal house arose around 1700, in the Godthaab area perhaps a little earlier. The earliest houses were situated on the coast at the same time as the circular houses were still in use on sites far from the coast. The oldest among the communal houses are to be found in southwest Greenland, while the newer ones are situated in northwest and southeast Greenland. Today we find the ruins of these communal houses in Greenland only south of a line from Melville Bugt to Angmagssalik (Gulløv 1986a: 186).

Historical data in connexion with kayaks brought to the Netherlands, including the expedition of Nicolaas Tunes from Vlissingen in 1656, does not add anything to these considerations of the settlement patterns (Nooter 1971: 5). We still lack sources to elucidate the origin of the communal house between 1654, when we have Danell's report, and 1709 when Feykes Haan began whaling.

The biggest concentrations of population were in Disko Bugt and in the far south, according to Egede's 1741 description (Egede 1925: 362). His sources were his son in Christianshaab and his own observations on a boat-journey to Nanortalik in 1723. Half-way between these two places is Godthaab, where he first observed the South Greenlanders at the meetingplace, today known as one of the many localities called aasiviit (aasivik, sing.) where Greenlanders from different regions camped together, exchanged the latest news, solved conflicts and found mates. Another aasivik was Taseralik some few kilometers north of Zuydbay, and on the east coast some kilometers north of Kap Farvel we have the famous Aluk, or Alik in East Greenlandic, where West and East Greenlanders camped together (Gulløv 1985b: 88).

A large number of people lived at Paamiut or Frederikshaab. It was the first place where, after 1700, the whalers found open water (Fig.2). Here we have a Dutch harbour named Schoutzens harbour, and here occur quantities of driftwood together with the migrating harp seal (Phoca groenlandica) and the bladdernose or hooded seal (Cystophora cristata). The communal house seems to have had its origin at some point between Frederikshaab and Zuydbay (Fig. 4). But there is still one more source, and that is the Eskimo oral tradition.

### The oral tradition

We have already mentioned from Egede that the Greenlanders travelled north to obtain baleen and driftwood. Anders Olsen, the merchant referred to above, reported from a visit to Paamiut in the 1750's that fishing lines were made of a sort of very strong grass braided together into long lines (Olsen 1764). But baleen lines are better, though the Eskimos had to travel 500 kilometers to get this raw material. They needed to fish in the late winter period when other resources were scarce, especially in South Greenland. That was one reason for their travels. Another is referred to in many southwest Greenlandic narratives, which describe the rich waters around Godthaab, where many sea birds gathered even in the winter period, and people also travelled there. Most of them returned after one year, and from one source we know that this travelling was organized in such a way that in one year one family left the south and, on its return, the next family made ready for departure (Walløe 1927). But whether they settled in the north or returned they would still have had problems to find a place in which to build their winter house, because no one in the old Eskimo society could settle wherever he liked. These rules of settling and rights of use to hunting areas caused conflicts, and the tales and traditions mention the aasivik as a place for song-contests carried out to resolve these conflicts.

If the occupants of one or two umiaqs and the following kayaks were allowed to build a winter house on their way north, they used driftwood to construct one big house. The shape would then be rectangular. As a native source from Kangamiut has it: We came from the south to teach people here in the north to build big houses (Mathiassen 1931: 50). One of Egede's two sons stated that the South Greenlanders settled mainly near the great ice-fjord in Disko Bugt (N.Egede 1939: 148), and the other son observed that the place, called Sermermiut, consisted of several big houses like a rural village in Denmark (P.Egede 1788: 93). There is no doubt about the connexion between communal houses and migration along the coast after 1700. The large, rectangular house, which originated around 1700, was a migrating house used in place of a village. The idea must have come from the South Greenlanders, who speak a different dialect from the Greenlanders of the west coast, as first mentioned by Egede on his journey to the south in 1723. Egede found the communal houses in use when he arrived at 64 degrees north latitude. After that the idea of a new house type was first spread by the south Greenlanders on their way to the north where they settled among foreign people, the West Greenlanders. After this stage of migration activity, the communal houses were commonly built and used in the area north of Zuydbay and Disko Bugt where the Eskimos used to wait for the arrival of the whalers (Fig. 5).

In North Greenland, the Thule district, and along the northeast Greenlandic coast, we have no documentation of European contacts in this period and no communal houses. But the ammassalimiut travelled south to Kap Farvel and continued north up the west coast, and in Angmagssalik we find communal houses in use as late as the 1940s. Who initiated the spread of the idea here one cannot say, because we lack recent archaeological excavations in the Kap Farvel area. Perhaps it came from the east coast, because the dominating dialect here is the same as that in the southernmost part of West Greenland, as it already was in 1723. The oral tradition, collected and published by Inspector H.J.Rink in the last century (Rink 1866, 1871), and by Knud Rasmussen in the 1920s (Rasmussen 1924), refers to a northward migration and not a southward one, if we select the historically based narratives among the myths and other tales. Only occasionally do we read about meetings with the whalers, and then the Eskimos act as heroes in conflict situations where they are captured and get free.

### Conclusions

From a historical point of view our knowledge is very limited. All the sources mentioned are of a terminus-post-quem kind, and describe events and situations which took place after 1700; except for one, the account of Dannell's voyage, which describes quite another situation. But we can fill out this gap in the historiography and contribute to the ethnohistory of West Greenland. Ice conditions in South Greenland deteriorated after 1700, but the Eskimos reported that in former times Dutch whalers used the harbours at Kap Farvel island to obtain supplies of fresh water (Walløe 1927). In the Godthaab area the Eskimos said that in former times families used to mine soapstone in the quarries there and made the best and finest lamps and pots to be exchanged with the Eskimos in the north (Dalager 1915). Missionaries claimed that in former times blood feuds flourished between the South Greenlanders and West Greenlanders, but had been settled by marriage ties so that the South Greenlanders now had relatives and in-laws all over the coast (Glahn 1771).

It seems probable that the whalers anchored at an aasivik-place where baleen and soapstone were exchanged among the Eskimos, together with furs, skins and driftwood. The first such place on the coast was Zuydbay or Umiiviit, meaning 'the winter settlements'. Here the whalers found a large Eskimo population which caught whales in the winter and spring; seals, halibuts and birds in the summer; and caribou in the fall. This was where most of the whalers gathered before returning to Europe. It was a bartering paradise. Other aasivik-places were known - as mentioned earlier - but they were situated on the way to the native whaling grounds north of Zuydbay. It is not difficult to

imagine what happened to the Eskimo exchange economy when foreign whalers arrived with a large supply of strange commodities. Trade expeditions were organized to the Dutch harbours to exchange knives, needles and small iron wares for blubber, skins and soapstone lamps and pots, not to mention guns and powder. A disorganization in the original Eskimos exchange economy took place: they sold their winter provisions for trifles (Gulløv 1985b).

At the beginning of the colonization in 1721 we find a situation where the South Greenlanders took advantage of this disorder in West Greenland, and after the smallpox epidemic of 1733-4 they were the only well organized group of travelling Eskimos. When the Moravians began their very effective missionary work, it was among the roaming South Greenlanders, while the West Greenlanders belonged to the Danish Mission. It was at this point that the travels stopped.

The Dutch whalers left Disko Bugt but continued whaling in East Greenlandic waters. In 1777 some survivors from the catastrophe in East Greenland - when several whalers were crushed by the ice (Kat 1818) - arrived at Pisugfik, a tiny settlement north of Godthaab, on an icefloe (Gulløv 1986c). By that time the heyday of Dutch whaling on the west coast of Greenland had long gone by.

The little settlement Kangeq, the cape, situated 20 kilometers west of Godthaab, belonged until 1900 to the Moravian mission. Here lived 150 years ago a little more than 100 Greenlanders, among them Aron, who became the national painter of Greenland. We have more than 200 water-colours and drawings from his hand, together with handwritten tales and stories. Aron and his father and among others their relatives in the settlement sent their manuscripts to Inspector Rink in Godthaab who had them published (Meldgaard 1982). More than 500 tales and stories were included in two volumes, and one third of them came from Kangeq. The Kangeq Greenlanders were all from South Greenland. They arrived around 1700, and one of their stories, illustrated by Aron, tells about the forefather, who settled in the area. Ten years ago this ruin - a big communal house - was pointed out to the archaeologists by one of his descendants, the catechist in Kangeq. Excavation made it clear that it really was the first house in the area built by a South Greenlander (Gulløv and Kapel 1979-80). From the Moravian parish registers we could follow his family through ten generations (Gulløv 1985a). Indeed, we have to do with an Eskimo tribe in the Morton Fried concept of the word (Fried 1975). They had been culturally isolated, with the assistance of the Moravian mission, for hundreds of years, and even preserved their local South Greenlandic dialect. Even between Godthaab and New Herrnhut - a distance of only two kilometers - one could distinguish the South Greenlandic i-vowels from the West Greenlandic u-vowels as late as in the 1930s, only 50 years ago. That was the last result of the magnetic influence

Dutch whaling had exercised since its beginning at the end of the seventeenth century in West Greenland.

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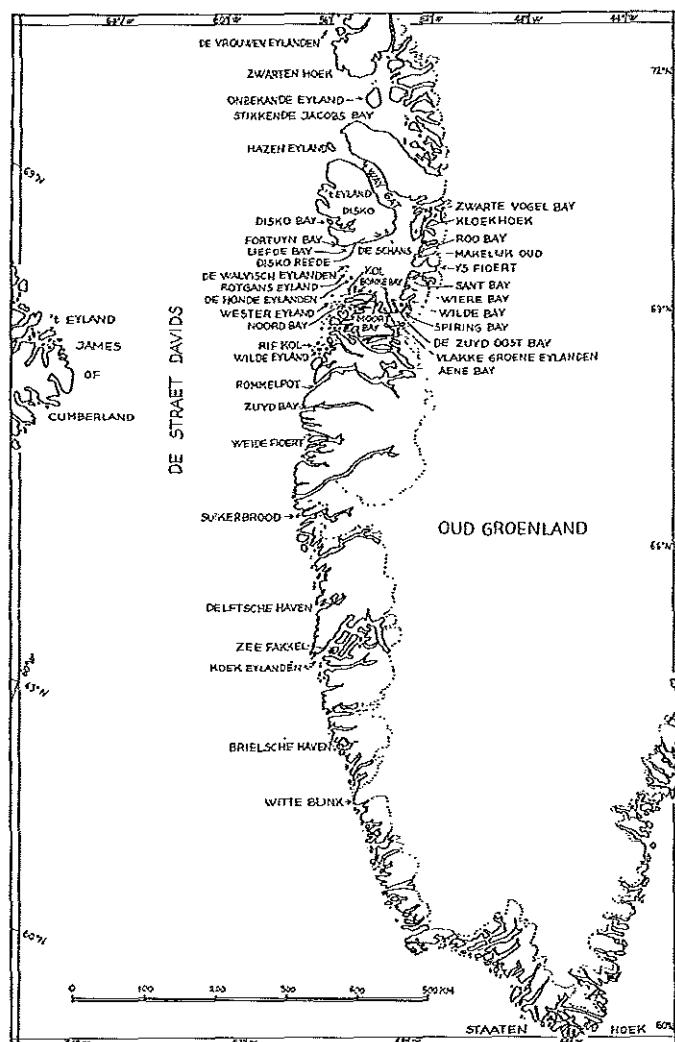


Fig.1. Dutch names on the west coast of Greenland. (Sources: Haan 1719; Bobe 1917; Jochimsøn 1733).

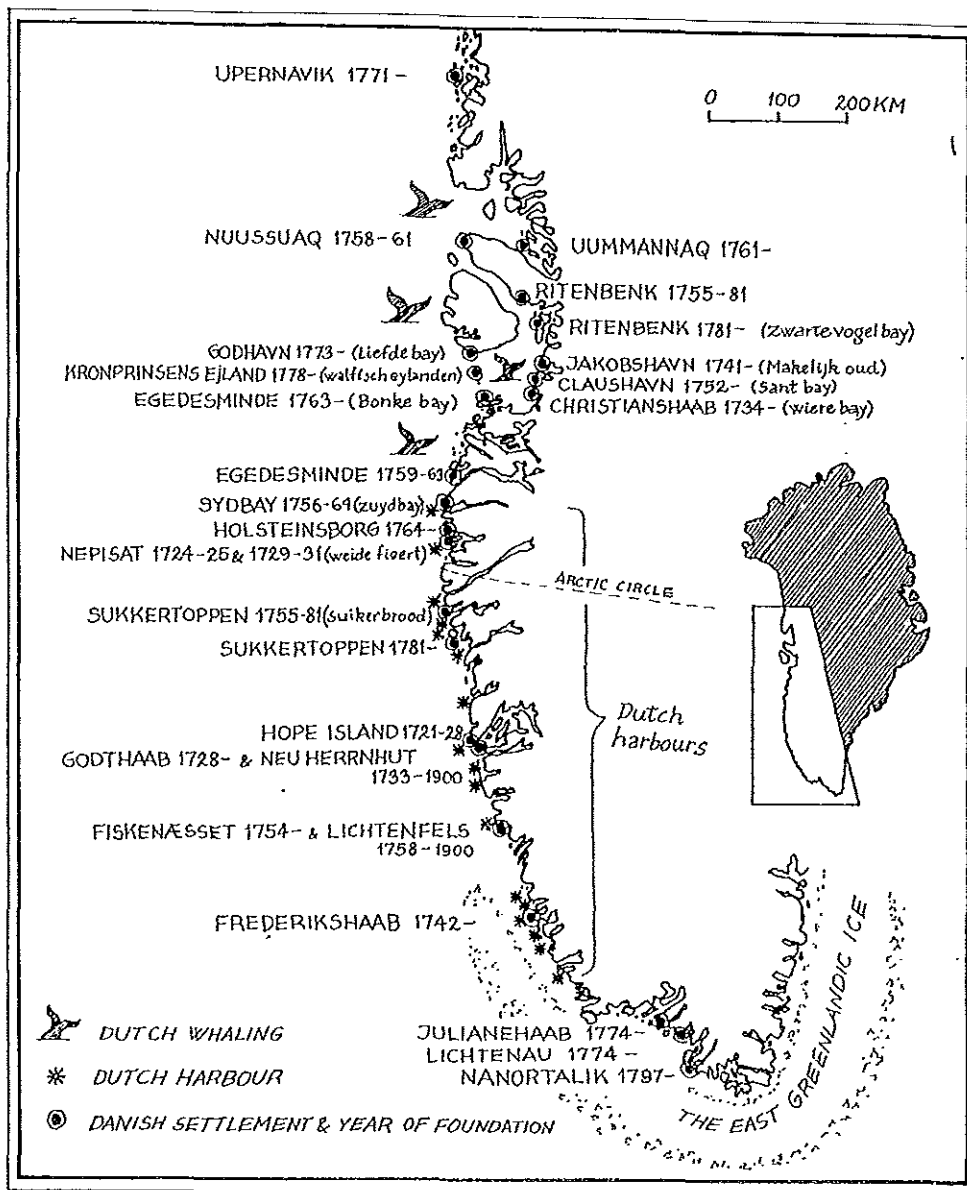


Fig.2. Danish trade and mission stations, with years of foundation. The policy behind Danish colonization can be seen as a closing of the coast to prevent Dutch initiative (Sources: Gad 1969; Jochimsøn 1733; Olsen 1764).

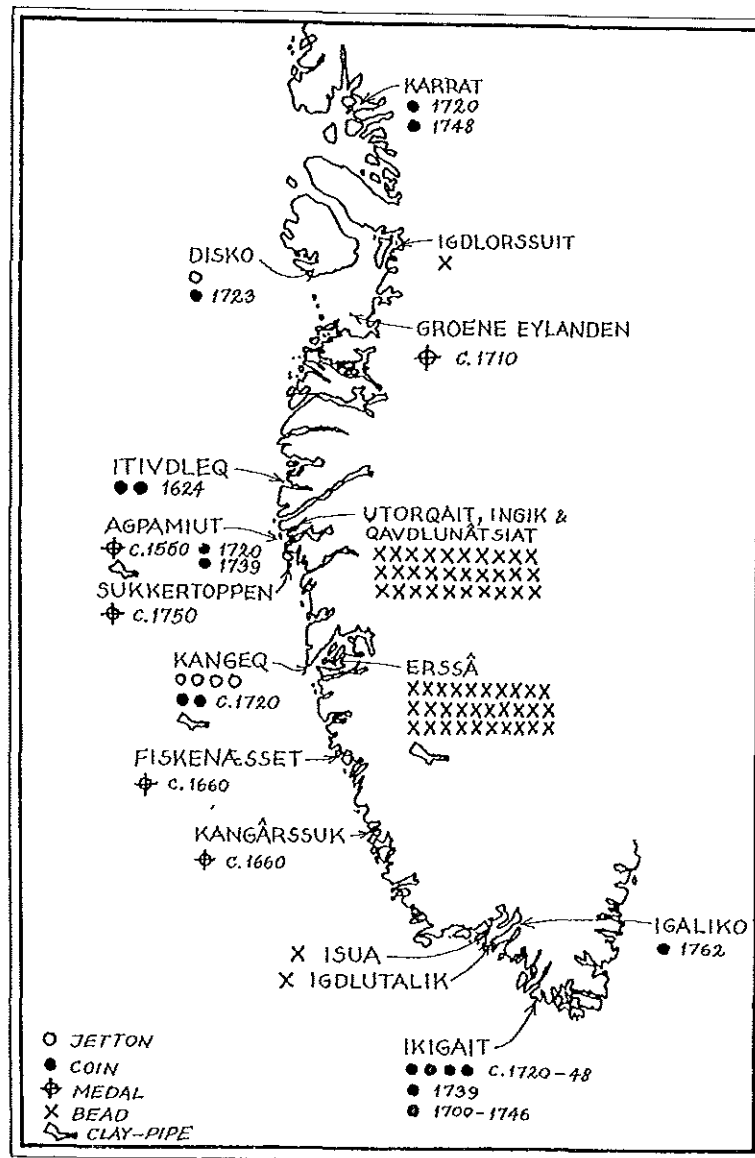


Fig. 3. European artefacts found in a pre-communal house context. The years indicate information from coins (the Agpamiut and Kangeq coins come from midden deposits, and can be connected to an early communal house context). (Sources: Thomsen 1958; Mathiassen 1931, 1934, 1936; Archives in the National Museum of Denmark and Smithsonian Institution, Washington D.C.).

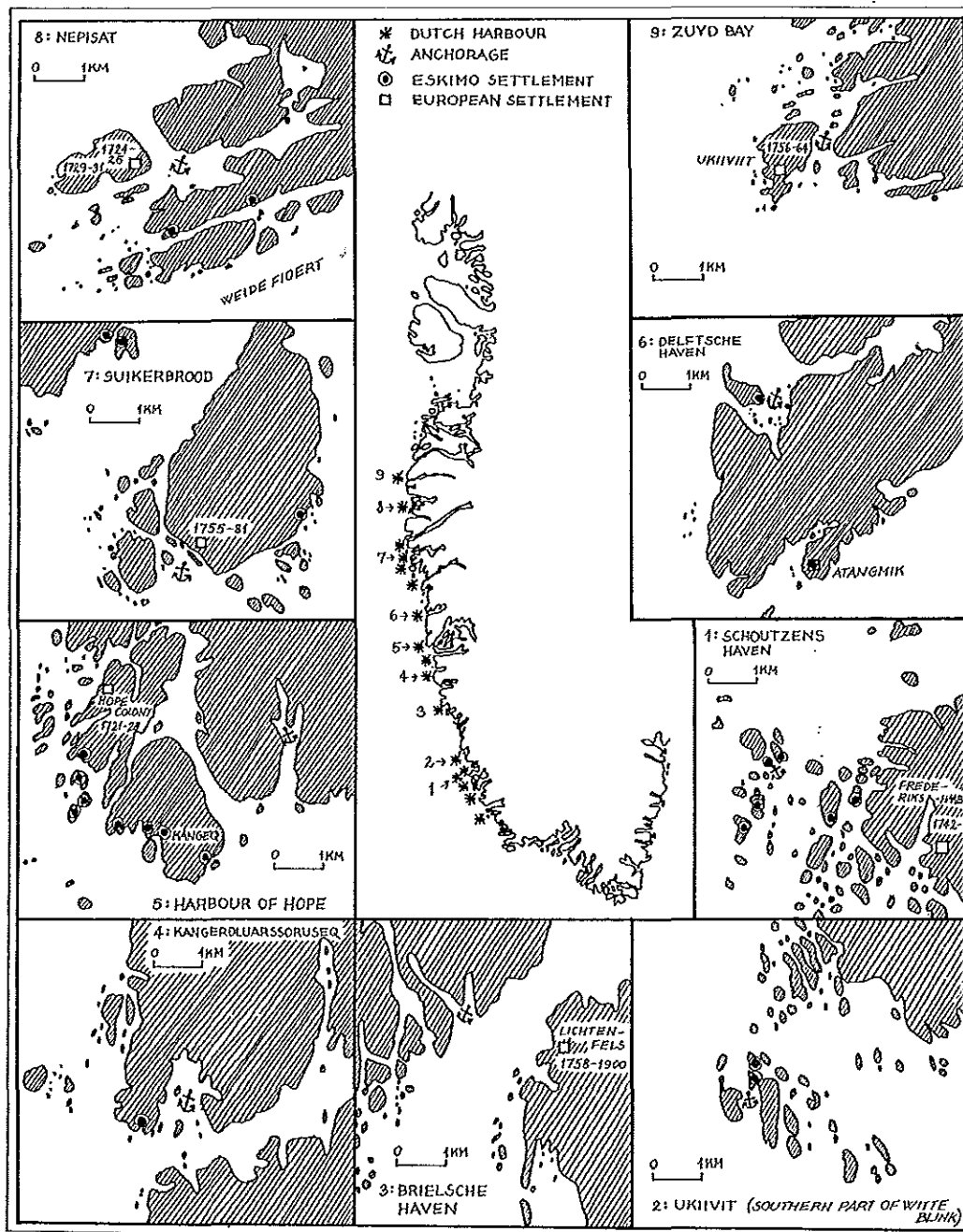


Fig.4. Nine examples of Dutch harbours. Most of the harbours shown are situated near an Eskimo settlement. Number 8, Nepisat, was burned down twice, which illustrates the conflict between the Dutch whalers and the Danish colonists. (Sources: Bobe 1917, 1925 (ed.), 1936b (ed.); Egede 1925; Gulløv 1982, 1986b; Haan 1719; Jochimsøn 1733; Olsen 1764).

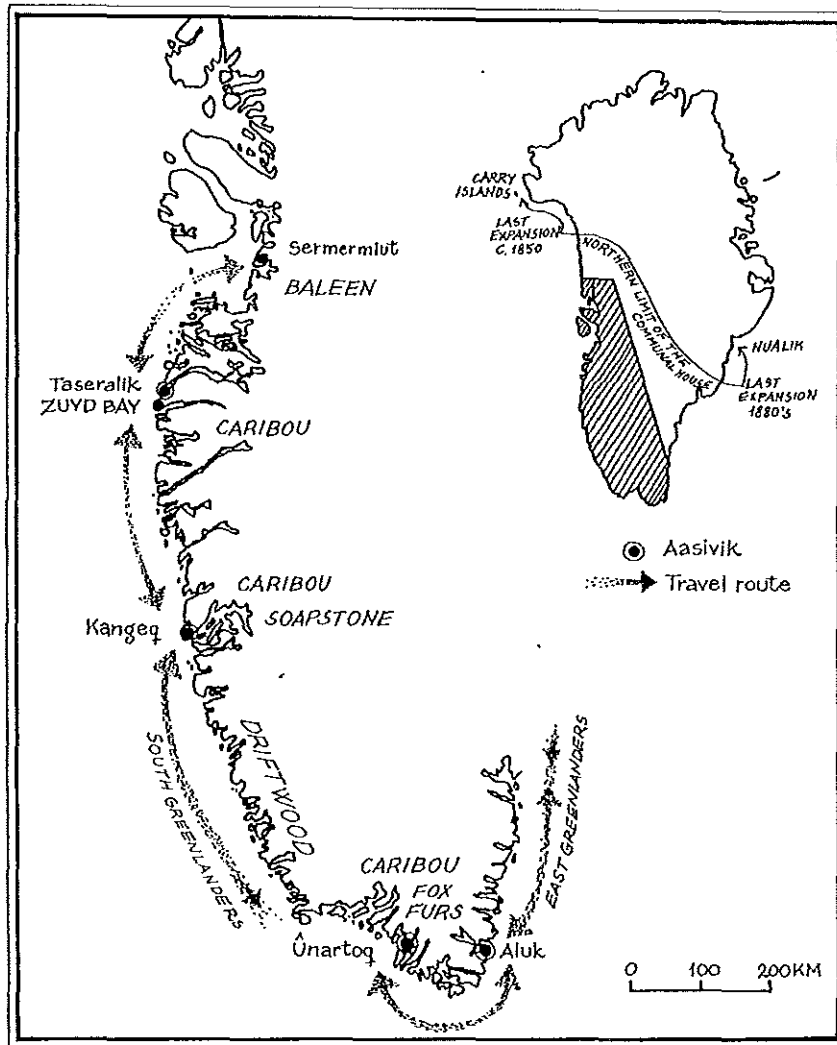


Fig. 5. Sources of southwest Greenland trade commodities. Travel routes are indicated by arrows and the summer camps (aasiviit), which became regional meeting places for Eskimos participating in the exchange system between South Greenland and the west coast, are marked. Insert, the northern limit of the distribution of the communal house in Greenland. (Sources: Cranz 1770; Egede 1925; Glahn 1971; Dalager 1915; Gulløv 1985b, 1986a; Walløe 1927).

## HOW ISOLATED WERE THE POLAR ESKIMOS IN THE NINETEENTH CENTURY?

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*Two well-established beliefs about the Polar Eskimos are examined and it is shown that they are little better than myths. The first of these beliefs is that, in 1818, when John Ross discovered them, the Polar Eskimos were completely isolated and had been for some time: they were said to have thought that they were the only people in the world. The second relates to the years after 1891, and is that the American explorer Robert Peary was responsible for bringing the Polar Eskimos out of the 'Stone' or 'Iron' Age into a modern technology. Among subjects discussed are the connection between the Polar Eskimos and the Eskimos living in West Greenland south of Melville Bugt especially before 1818; the Polar Eskimos' knowledge of the west, now Canadian, side of Smith Sound and Baffin Bay, both before and after the immigration of 1862; and the availability of wood, industrial iron or steel and manufactured products to the Polar Eskimos before 1891.*

### Introduction

The theme of this symposium is the pre-history and history of contacts between different peoples around the shores of Baffin Bay and the relationship between those contacts and the environment. The question I propose to address is exactly this, but relates to the nineteenth century and only to one small group of Eskimos, the so-called Polar Eskimos or Inughuit, who then inhabited and still inhabit the Thule district, namely that part of northwest Greenland lying between latitudes 76 and 79 degrees north, or between Melville Bugt and the Humboldt Gletscher.

### Sir John Ross, 1818

If we except the Greenland Vikings, the first Europeans to see the Polar Eskimos were officers and men of the British Navy who on 9 August 1818 arrived off Kap York in the 'discovery ships' H.M.S. Isabella and Alexander. Their commander John Ross, with the help of his Greenlandic interpreter John Sacheuse or Sackhouse, collected all the information he could about these Eskimos and included it in a special chapter of his book (Ross 1819), much to the annoyance of the secretary of the admiralty Sir John Barrow

(1846), who claimed that Ross "could not, by any possibility, have known anything of the stuff he has set down, which is of that kind of manufacture not worth the paper on which it is printed". This criticism was wide of the mark, for Ross's account of the people his Scottish nationality led him to dub the 'Arctic Highlanders', was in the main accurate.

On one important point, however, not only John Ross, but two of his officers, namely Edward Sabine (1819) and Alexander Fisher (1819), were certainly mistaken. All three of them formed the opinion that these Arctic Highlanders were and had been for some time completely isolated and cut off from the rest of the world. As Allen Young (1867) put it later, "These poor Esquimaux are entirely shut off by enormous glaciers from the rest of mankind". Ross and his two above-mentioned officers came to their conclusion partly on the basis of their interpreter's report that the Arctic Highlanders knew of no other people in the world but themselves and "no other places than the spot they occupied". Their own observations confirmed this. They noted that the cut of the Arctic Highlanders' breeches and jackets differed from that of the Eskimos further south in West Greenland, that their language was by no means identical with West Greenlandic, and, above all, that they knew nothing of the kayak and had never seen a boat of any kind before.

How can we be sure that Ross, Sabine and Fisher were mistaken in supposing the Polar Eskimos to have been isolated for some time before 1818? Simply because we know from Hans Lynge (1955) that, shortly before 1800, a certain angakkoq or shaman, by name Tuluvaq, fleeing from an epidemic, left Kidarsaq in the Upernavik district not far south of the Devil's Thumb or Kuvdlorssuaq and moved house northwards with his family to Avanerssuaq, in other words, to the Thule district. He travelled there in an umiaq or woman's boat. Meqqu, the Polar Eskimo wife of the well-known Greenlandic guide and interpreter Hans Hendrik, was descended from this Tuluvaq. Tuluvaq's presence in the Thule district is confirmed by John Ross, who has a picturesque and fanciful description of 'King' Tuluvaq, who ruled the Arctic Highlanders from a large stone house at Pitoraarfik in the north of the Thule district. Ross's companion Sabine mentions Tuluvaq or the Raven, but says nothing of his alleged royal status, and Fisher is sceptical too. In any event, in 1818, the Polar Eskimos certainly had not been isolated for a long time, and some of them must have seen a boat - Tuluvaq's umiaq.

Another piece of evidence points to the possible presence of West Greenlandic Eskimos in the Thule district during the period when its inhabitants were supposed to have been isolated. In 1921 Lauge Koch found a number of pieces of wood belonging to a kayak 40m above sea level in Morris Bugt, Washington Land, in 80 degrees 10 minutes north latitude. Mathiassen (1928) subsequently confirmed that

this kayak was West Greenlandic and that it dated from the sixteenth or seventeenth century, thus ruling out the possibility that it was abandoned in Morris Bugt in June 1854 by Hans Hendrik, who was then accompanying E.K. Kane's expedition as guide and interpreter. One cannot easily imagine the owner of this kayak paddling along the entire coast of the Thule district without some kind of contact with its inhabitants, if there were any at that time.

#### Contacts with Canada

It has long been common knowledge that, in 1862 or thereabouts, a group of 12 or 15 Eskimos, led by a certain Qillaq, originally from south Baffin Island, made the hazardous trip over the sea ice of Smith Sound from Canada to Greenland (Mary-Rousselière 1980). The arrival of this tiny group, about equally divided between the sexes, was a portentous event for the Polar Eskimos. It has even been claimed that this injection of new blood and new technology saved them from extinction. As to new blood, a hundred years later Rolf Gilberg (1976a and b, 1984) reckoned that 217 out of a total population of 603 Polar Eskimos were direct descendents of the invaders of 1862. As to new technology, the same authority reports that the newcomers certainly brought with them the kayak, the bow and arrow and the fish lure and spear. This added two new items to the Polar Eskimos' diet: caribou meat and fish. The immigrants seem also to have introduced a much improved version of the snow house. Only their tattooing fashion, or technology, was rejected.

Was the 1862 immigration the only nineteenth-century contact between the Inuit peoples living on either side of Smith Sound? Here one must understand the phrase "on either side of" somewhat broadly: there were no Inuit living on the Canadian or west shores of Smith Sound in the nineteenth century. Ellesmere Island was then uninhabited, though the Polar Eskimos had a tradition of Eskimos living to the north or northwest of themselves which is abundantly confirmed by house ruins on Ellesmere Island. It does indeed seem probable that Qillaq's adventures inaugurated the only nineteenth-century contact between Canadian and Greenlandic Inuit.

It is curious, in view of the subsequently frequent hunting excursions of Polar Eskimos to Ellesmere Island, which brought them into difficulties with the Canadian government for the allegedly illegal killing of musk oxen, that they seem very seldom to have gone there in the nineteenth century. In 1819 Edward Sabine went so far as to state that the Polar Eskimos "had never seen land over the sea, and were unacquainted with the word akilinuk by which the people of South Greenland call the opposite coast of Davis Strait". The first part of this statement cannot possibly have been true, because the coast of Ellesmere Island is

clearly visible across the entrance of Smith Sound from many places in the Thule district north of Hvalsund. But the only evidence I can find for Polar Eskimo visits to Ellesmere Island before Robert Peary took some with him there in 1898, apart from Qillaq's return journey in about 1868, is the assertion of Robert Stein (1902) that Utuniaq and Arrutaq, with their families, travelled extensively there in about 1875.

#### Contacts with West Greenland

The development of contacts between the Polar Eskimos and the Greenlanders living south of Melville Bugt began early but remained for a long time intermittent and without apparent result. John Sacheuse communicated briefly with the Polar Eskimos in 1818. Hans Hendrik deserted from Kane's expedition and lived among them from 1855 to 1860. He and his Polar Eskimo wife Meqqu had a child, but in 1858 Carl Petersen learned from some Polar Eskimo friends he met at Kap York on 27 June on board the Fox that Hans was homesick (M'Clintock 1859: 135-6). He was then living in Hvalsund and at one time had suffered so much from hunger that he had had to eat the sealskin covering of his kayak. He was waiting hopefully at Kap York in August 1860 when Hayes in the schooner United States was on his way north on the look-out for Eskimo recruits for his expedition. Hayes signed him on and took his wife and child with him as well (1860: 65-7), dropping then off at Upernavik a year later (Lidegaard 1985, Hendrik 1878). Hans does not seem to have exercised any significant influence on the Polar Eskimos; one of his daughters returned to the Thule district in 1910 (Freuchen 1959: 30-1, Gilberg 1976b: 39). It was not his west Greenland kayak that served as inspiration and model for the Polar Eskimos, but that in use in Baffin Island.

Six of the members of the Danish Literary Expedition of 1903 prided themselves on being the first to open up a sledge route across Melville Bugt and to establish regular contacts between the Polar Eskimos and their Greenlandic neighbours to the south. They comprised three Greenlanders and three Danes, and their return sledge journey southwards in February 1904 accompanied by five Polar Eskimos was followed by further trips to the Upernavik district undertaken by the Polar Eskimos to trade for ammunition and other goods against fox and bear skins (Mylius-Erichsen and Moltke 1906: 591n. and Soby 1985). In 1905 Uisaakassak moved south with three Polar Eskimo families and took up his abode at a caribou-haunt called Tuttulissuaq on the Melville Bugt coast about half-way between Savissivik and the most northerly settlements in the Upernavik district (Gilberg 1970). From there he could conveniently make occasional forays to the shop at Tasiussaq, where, shortly before 1961, the seventy-year-old Hans Nielsen could still remember the arrival in his youth of the Polar Eskimo

hunter Silluk, his sledge loaded with 75 narwhal horns (Lund-Drosvad 1961). Presumably this was between 1905 and the establishment of the Thule Trading Station at Uummannaq in 1910.

### The Peary myth

The American explorer Robert E. Peary, who first visited the Thule district in 1891, claimed for himself a decisive role in raising the Polar Eskimo standard of living to hitherto undreamed of heights. In his book The North Pole, published in 1910, he wrote as follows (48-9):

My various expeditions into that region have had the effect of raising the Eskimo from the most abject destitution, lacking every appliance and accessory of civilized life, to a position of relative affluence, with the best material for their weapons, harpoons and lances, the best of wood for their sledges, the best of cutlery, knives, hatchets, and saws for their work, and the cooking utensils of civilization. Formerly they were dependent upon the most primitive hunting weapons; now they have repeating rifles, breechloading shotguns, and an abundance of ammunition. There was not a rifle in the tribe when I first went there. As they have no vegetables, and live solely on meat, blood, and blubber, the possession of guns and ammunition has increased the food producing capacity of every hunter, and relieved the whole tribe from the formerly ever-present danger of starvation for a family, or even an entire village.

All this was accepted by Rasmussen. "For twenty years", he wrote in 1919 (1921: 6-7), "Peary had seen among the Polar Eskimos the base of his expedition, and during this short period these people had jumped from the stone age to the present time in their technical civilization". At the time of Peary's first expedition in 1891, Rasmussen goes on to imply, guns were nearly unknown, knives were made of small chips or flakes of meteoric iron mounted in bone or ivory, and sledges were made of bone fragments or bones "cunningly tied together to form runners". On this hypothesis, though "lively bartering with the Scottish whalers" had certainly taken place, guns remained rare and it was Peary, and not the whalers, who, especially through the provision of rifles and whaleboats, transformed Polar Eskimo society.

### Whalers and explorers

Did Peary play such a decisive role in the transformation of the Polar Eskimo way of life in the years after 1891? Bartering with whalers is difficult to document. The first whaleships to penetrate through the ice-filled waters of Melville Bugt to the latitude of the Thule district were the Larkins of Leith and the Elizabeth of Aberdeen. The year was 1817; one year before Ross's meeting with the Polar Eskimos. Surviving unprinted logbooks show that, from 1817-20 onwards, until at least the mid nineteenth century, quite large fleets of ships passed by annually within sight of Kap York and Kap Dudley Digges and elsewhere in the south of the Thule district. Near Kap York in particular they were often beset in the ice for days at a time. The logbooks of Hull whalers illustrate this. In 1821 the Royal George was beset for a week at the beginning of August less than two kilometres off Kap York with six sail in sight. On 26 July 1828 the Dordon was less than thirty-two km off the coast between Kap York and Kap Dudley Digges with 43 sail in sight when she turned southwest to head for the 'West Land'. In 1834, on 23 June, the Volunteer had 60 sail in company as she passed 24 km off Conical Rock. One of the longest enforced visits by whalers to the Thule district was in 1830, when the Eagle was beset "close by" Kap York on 29 July with 13 sail in sight. On 8 August she was still trapped, and 29 sail were in sight. On 23 August she was still in the ice amongst islands, and men were being sent up the hills to look for leads in the ice. On 25 August she was between Bushnan Ø and the mainland; on 26 August she was about a kilometre east of that island. At last, on 28 August, after a month had elapsed since her arrival at Kap York, she was able to make good her escape southwards: on that day she still had 29 sail in sight "making the best of their way for a south passage".

Records of contacts with natives seldom occur in the logbooks for reasons which may easily be imagined. The only mention I have come across relating to the Polar Eskimos in the first half of the century is an entry in the log of the Volunteer of Hull for 26 June 1833 when she had "more sail in company and a great number in sight". The entry continues: "I had almost forgot to state that yesterday a many Eskimaux came off from the Land to the ships in their sledges drawn by dogs they are quite uncivilised in this part of the country..." (Arthur G. Credland, personal communication). The latitude on 26 June was 76 degrees 25 minutes north, that is off Kap Atholl or Wolstenholme Ø, so the Eskimos had probably come aboard somewhere along the coast between Kap York and Kap Atholl. Other mentions in this period of contacts with Polar Eskimos by whalers occur in unofficial journals: for example that kept on the Advice of Dundee, William Penny master, by the surgeon Robert A. Goodsir (1850: 57-8). He had taken passage on the Advice with the express purpose of searching for his missing

brother Henry, assistant surgeon and naturalist on Franklin's ship H.M.S. Erebus. The Advice stopped briefly on 1 July 1849 at Kap York, but Goodsir was too busy attending to an injured man in another whaler to pay much attention to the two Polar Eskimos who came on board the ship, one of them a stout comely fellow of twenty, the other aged about forty, "very lame from the effects of a fall from a cliff". Also in reference to 1849, William Barron the Hull whaling captain who was then serving as an apprentice on the Truelove, recalled in his reminiscences how "The Esquimaux came off to us in their sledges. They were dressed in bear skins, and were very wild" (Barron 1890: 10).

After about 1850 the number of whalers declined, but from about 1875 onwards a few Scottish steam whalers began to make regular annual voyages to or through the North Water off the coast of the Thule district. Captain Milne's logbooks of his voyages in the Dundee whaler Esquimaux in the 1880s (Cambridge, Scott Polar Research Institute, Wordie Collection of whaling logs MS. 1159. reel 1) show that he made a regular habit of travelling via the Thule district coast and often stopped there. In 1883 he passed close to Kap York in "loose floes" on 29 June. In 1885 he stopped at Conical Rock on 13 June, steamed past the Pituffik Gletscher on 14 June and stopped for two hours at Dalrymple Rock, no doubt to lay in a supply of fresh eider duck eggs. In 1886 he "hooked into the ice" at the Pituffik Gletscher on 16 June and "hooked onto a floe" off Wolstenholme Ø on 18 June. On 19-20 June in company with the Polynia, another Dundee whaler, he stopped again near Dalrymple Rock and then sailed past Kap Parry and the mouth of Hvalsund before turning southwest for Lancaster Sound. In 1887 he was off the Thule district coast from 19 June to 11 July in company with two other Dundee whalers, the Terra Nova and the Nova Zembla. Contact was made with Polar Eskimos at Saunders Ø and in Hvalsund and hunting was indulged in both on shore and at sea, though not for whales.

To judge solely from the whalers' logbooks and ships' journals one would conclude that there was very little bartering with Eskimos in the Thule district, during most of the nineteenth century. Indeed I have found only one account written on board a whaleship before the very last year of the nineteenth century which mentions such barter. This was written in 1866 by the surgeon on the Hull whaler Diana, Charles Edward Smith (1923 and unpublished MS. in Hull, Town Docks Museum). In the vicinity of Kap York, on 14 June, three Eskimo men who came "aboard the ship seemed lost in a world of wonders. Evidently they had never seen a gun before, and they laughed with surprise at the noise of its report.... They were ignorant of the use of tobacco, and would not taste rum, signifying by signs and repetitions of namee (no, no) that it made their heads ache". In exchange for "a couple of large sealing knives" Captain Gravill of the Diana "obtained two walrus horns from the

ends of their spears" and some crew-members acquired "smaller spear-points in exchange for a couple of needles apiece". On another whaler, the Intrepid of Peterhead, the Eskimos bartered away one of their dogs, and the oldest of them, Tatalata, "exchanged his bearskin breeches for a pair of old trousers". Although the surgeon's account makes it clear that the Eskimos sledged over the sea ice on purpose to visit the ships, one cannot suppose that they had trade in mind - they had brought no single article of trade with them and had perforce to use for this purpose clothes they were wearing and weapons actually in use. One is tempted to conclude that in 1866, in spite of the almost annual presence of quite large numbers of whaleships offshore over a period of almost half a century, the Polar Eskimos had no regular trade with the whalers.

For further evidence on this point we have to wait nearly twenty years, but the evidence then is even more firmly negative. In 1884 the surgeon on the Dundee whaleship Nova Zembla, Matthew Campbell, records in his diary that on 23 June, at Dalrymple Rock "A great many natives came on board but they do not trok (truck) here". The same was evidently true ten years later in 1894. Otherwise why would the seaman who kept a journal on board the Eclipse of Dundee have described barter with the Eskimos in the Disko area but said nothing of barter with the Polar Eskimos who boarded his ship at Kap York (Savours 1960)? And again in 1895, on the Dundee whaler Esquimaux on 1 June, probably at Kap York, we learn that "Natives came aboard but they had nothing to barter" (Dundee, Broughty Castle Museum, per John Vaughan).

Thus far the evidence from the whaleships themselves. But if we turn to look at the evidence of manufactured or imported products in Eskimo possession, then the picture changes, even though we do not know how much iron and wood came into their hands through barter, and how much came by way of gifts, payments for services, plunder, or shipwrecks.

From three different sources we know that, already in 1852-3, objects of wood and iron were commonplace among the Polar Eskimos. Edward Belcher in 1852 recorded a sledge with wooden runners, probably made from pieces of barrel. When Edward Inglefield (1853) called at various Eskimo settlements in the Thule district in that same year he was purposely searching for objects of European manufacture in case some relic of the Franklin expedition might be unearthed. Parties of sailors went to work with picks and shovels in the winter houses, meat caches, and even graves, and soon unearthed an old, dilapidated tin canister, a piece of rope with an eye spliced in it at one end, a knife blade, set in an ivory handle, on which was stamped "B. Wilson, cast steel", and some "small pieces of steel, curiously fixed in one piece of bone, so as to form a continuous blade". It was surmised that these things came, directly or indirectly, by barter from whalers; and Kane

thought the same about the metal objects he found in the Eskimos' possession in 1853-5.

Twenty years later a passenger on board the Dundee whaler Erik noticed that the Eskimos who boarded the ship at Dalrymple Rock in 1873 had in their possession "a couple of American government rifles, with the date 1864 stamped upon them, and which, from their clean and bright state, did not appear to have been long in their hands". Albert Markham (1875: 140-1) could not believe that this government property could have been bartered to the Eskimos. Perhaps it had been plundered by them from the U.S. exploring vessel Polaris, the return of which from the north was then long overdue? Likewise of uncertain mode of acquisition but not of origin was the iron arrowhead obtained from Eskimos at Kap York in August 1891. Robert Keely, surgeon on board the Kite, was astonished to find that it was stamped with the words "Dr Hayes Ex. 1860" (Keely and Davis 1893: 170-1).

In a few cases concerning guns, we know that they came by barter from whalers. In March 1894 the Norwegian Eivind Astrup (1895: 95) mentions that a youthful Polar Eskimo companion of his was much respected by his fellows because he owned a gun which he had bartered from an "English" whaler for a quantity of ivory. For "English" one should probably read "Scottish", because the last English whaleship to visit the Thule district was very probably the already-mentioned Diana of Hull in 1866. In 1903 Torngi told members of the Danish Literary Expedition that his father had twice in his lifetime acquired a gun from the whalers (Mylius-Erichsen and Moltke 1906: 542-3).

There is some evidence from the first Peary expedition of 1891 about manufactured products in the possession of the Polar Eskimos before the 'Peary epoch' began in that year. The ethnographical collection made in August 1891 and brought back that autumn on the Kite was recently re-examined by James VanStone (1972a and b). He found much use of wood in sledges, kayaks, harpoon shafts and the like. Analysis in an electron microprobe showed that chips from nine metal bladed instruments were all of low grade manufactured steel with no nickel content. Two steel knives mounted on ivory handles bore the inscriptions "Lockwood Brothers Pampa" and "Warranted cast steel. Sheffield".

If this material, as well as some or all of the previously mentioned guns, came by barter from whalers, then there clearly was a good deal more bartering in the nineteenth century than appears from the journals and log-books written on board the whaleships. This is borne out by the probability that the Eskimos had some goods stockpiled for purposes of barter when the first Peary expedition arrived in the Thule district in 1891. In any event, from the very last year of the nineteenth century onwards we do have direct evidence of barter with Polar Eskimos on board the whaleships. In 1899, a passenger on the Dundee whaler Esquimaux, A. Barclay Walker (1909), described how off Kap

York on 2 June "The natives, men, women and children were there to meet us with their dog sleighs". "They were very dirty, but very jolly and fat. I gave tobacco and pipes to the men, tobacco and knives to the women, also some biscuits and coffee. In return we received walrus tusks, dog skins etc.". On 3 June "three natives came off in kayaks from Saunders Ø, received usual presents. In return they presented me with a new walrus skin harpoon line and sealskin fishing line".

Barter between whalers and Polar Eskimos is recorded again in 1903, and this time, when the Dundee whaleships Diana and Eclipse were off Saunders Ø on 26-7 June, the Danish Literary Expedition was in the same area at the same time, and we have reports from both sides. Thus Alexander Lamb, on the Diana, recorded in his journal on 22 June at Kap York that "The natives are visiting us from the settlement with *trok*" (per John Vaughan), but he mentioned no barter at Saunders Ø. On the other hand, after the whalers had left Saunders Ø, Uutaq complained to the Danes that two Scottish whalers had taken three fox's tails from his tent there without payment and that, on the ship, he had received nothing from the cook in exchange for the three walrus tusks he had given him (Mylius-Erichsen and Moltke 1906: 398-9).

Although Mylius-Erichsen vouchsafes no further firsthand information about barter between Scots sailors and Eskimos in 1903, he had in that same summer, some time before the arrival of the Scottish ships, collected and recorded information from the Polar Eskimos about their bartering activities with whalers in previous years. They told him that one or more whaleships arrived nearly every year in the summer at the ice edge some distance off Kap York, and remained there a day or two. Although the sea ice at that time of year has much surface water on it and is intersected with cracks, nonetheless the Eskimos go out with their sledges and board the ships. There they eat biscuits and (Mylius-Erichsen and Moltke 1906: 213):

... they exchange bear skins and fox skins for knives, saw blades, files, enamelled iron saucepans, snow spectacles, pipes, tobacco, matches, tin boxes, bottles of pickles, and in recent years breech-loading rifles, gunpowder, lead, cartridge cases, gun caps and rifle-loading appliances, as well as wood for kayaks and sledges and old boat hooks and oars for tent poles.

Significant in terms of the development of a regular trade is the implication here that the Polar Eskimos were retaining a supply of pelts especially for bartering purposes. This was substantiated later by Ulloriaq, who showed the Danes a good breech-loading rifle he had obtained for ten fox skins. He thought this a bargain, and he

offered the Danes twenty-five fox skins for their Winchester carbine - he had the skins stored in his house at Kap York. He complained that, though the Scots reckoned to provide 200 cartridges with a breechloader together with some lead, powder and accessories, by the following spring the ammunition would be used up and the rifle useless. On their way home in December 1903 the Danes stopped at Qulutannguaq's house at Kap York. The gourmet Mylius-Erichsen was there treated to a drink made "from a brown powder, which our host had obtained from the Scots, which should have been coffee, but it tasted so bitter and nasty that I could not imagine what the substance was the unsuspecting Eskimo had been fobbed off with" (558). Qulutannguaq had an amazing supply of rifles, gunpowder, lead, cartridges and especially knives - from small penknives to large butcher's knives - all obtained from the whalers, no doubt as a result of his residing at Kap York (560).

It is abundantly clear from this circumstantial report of Mylius-Erichsen, relating to the summers before 1903, that regular barter between Scottisch whalers and Polar Eskimos must have begun some time before 1899. Most probably, it began early in the 1890s, precisely at the same time as Peary's first expedition to the Thule district of 1891-2. It should be borne in mind that Peary's main impact on the Polar Eskimos, in terms of the distribution of guns and other manufactured articles and in terms of trading for ivory and furs was probably made later, from 1898 onwards to 1910, in the period when he was intent on reaching the North Pole.

### Conclusion

We may safely conclude that, by one means or another, the Polar Eskimos were obtaining wood, iron and other manufactured products during the course of the nineteenth century. If these things were not originating directly or indirectly from the whalers or their ships, then they must have come from the explorers, whom we know made a habit of distributing free gifts to the Polar Eskimos; at any rate this seems to have been done by Ross in 1818 (1819), by Belcher in 1852 (1855a), and by M'Clintock in 1858 (1859: 137). Peary was probably right in his claim that his removal of the famous Kap York meteorites in the closing years of the nineteenth century had not deprived the Polar Eskimos of their traditional source of iron because they had not been using it for generations. But he was wrong to regard himself alone as mainly responsible for bringing them from "the stone age to the present time", to use Rasmussen's words; and Rasmussen was wrong too.

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## ASPECTS OF PRESENT-DAY MARITIME SUBSISTENCE HUNTING IN THE THULE AREA, NORTHWEST GREENLAND

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*Because of the vast recurring polynya called the North Water, the northern Baffin Bay - Smith Sound area is a region of great biological significance. In the Thule area, at the northeastern margin of the North Water, a maritime hunting culture has benefited since prehistoric time from a relatively easy access to a variety of marine mammals and seabirds occurring abundantly in the area.*

*Inhabited by about 735 Inuit, often called the Polar Eskimos, of whom approximately 100 are occupational hunters, the community of Thule is exclusively dependent on harvesting of marine wildlife for subsistence. Using dogsleds as a means of transport in the winter and motorized vessels and kayaks during the open water season, the hunter and his family to a large extent adapt their hunting and travelling activity to the seasonal variations in ice conditions and availability of wild life. In winter, hunting of ringed seals (*Phoca hispida*), walruses (*Odobenus rosmarus*) and polar bears (*Ursus maritimus*) is the mainstay in the household. During spring, when there is an increased availability of marine mammals and seabirds, various hunting methods are employed for taking walruses, narwhals (*Monodon monoceros*), ringed seals and various other seals and seabirds. However, the majority of the catch is secured during the brief open water period, partially reflecting the fact that the Thule district is an important summering area for marine mammals and seabirds. During this period, when about 50% of the total annual yield of hunting products is secured, meat is cached for use during the lean winter period. Harvesting of marine resources provides each hunter with about 5000 kg of edible products per year of which about 30% is used for human consumption. The remainder is used as dogfood, emphasizing the importance of sledge dogs in a traditional Inuit hunting culture.*

*The dependence of the Thule Inuit on the catch taken during the open water season, because the use of motorized vessels has been of growing importance within the last decades, has made the hunting community increasingly vulnerable to rising fuel prices and drops in sealskin prices.*

### Introduction

The hunting communities found furthest north along the western and eastern coast of Greenland, namely in the Thule and the Scoresby Sound areas, respectively, are ecologically unique. Situated in a High Arctic environment with long and dark winters these hunting communities can harvest abundant marine resources because of their close proximity

to recurrent polynyas where ecological conditions are more favourable than in the surrounding areas. In a historical and ecological perspective the hunting community of the Thule area in northwest Greenland differs from other Greenlandic hunting communities and here a rich maritime hunting culture still thrives at the margin of the large polynya in northern Baffin Bay called the North Water. Various aspects of the hunting patterns of the Thule Inuit have been described by others (e.g. Steensby 1910; Rasmussen 1921; Vibe 1950; Bruemmer 1971; Durham 1979). The aim of this paper is to describe the dependence of the Thule Inuit upon their environment and the adaptation of their present maritime hunting patterns to the seasonally determined availability of marine resources.

### Materials and methods

The description presented here of the annual hunting pattern is based on information obtained through interviews with hunters in the Thule area where the author spent the periods May-August 1977 and 1978, July-September 1984 and July-August 1985 studying marine mammals. During these periods first hand information about maritime hunting was also obtained during several hunting trips on which the author accompanied the hunters.

A primary source of information on the size of the catch in Greenland are the Hunters' Lists of Game published annually by the Ministry for Greenland in Copenhagen (Anon. 1954-1984). In these lists the annual catch per hunter of all major game species is reported by a local representative in each settlement. Unfortunately, this system of reporting is very incomplete in Thule. An exception was 1984, when the catch taken by 105 hunters was recorded. In that year reports were received from all settlements in Thule except for Moriussaq, where 11 hunters lived in 1984. Dietz and Heide-Jørgensen (1984) list 97 occupational hunters for the entire Thule area in 1984, representing the number of hunters who in my experience are actively engaged in hunting and who have hunting as their primary source of income. For simplicity, a figure of 100 full-time hunters in the Thule area is adopted for the calculations of annual yield.

In the calculations of the annual yield of edible products derived from the maritime hunt, the average body weights and percentages of edible products per animal listed in Table 1 were used. Because of the general lack of such data from Thule most of the information was extracted from Born 1983. An exception to this procedure of calculating yields was made in the case of the ringed seal (Phoca hispida), which in terms of yield of edible products is the most important game in Thule. Average yield of edible products per ringed seal was derived in the following manner: The average total body weight of ringed seals taken

in Thule between May and June 1984 was 43 kg (Total body weight of males: 42.7 kg; SD = 13.0; range: 24 to 60 kg; N = 13, and females: 42.5 kg; SD = 15.9; range: 10.5 to 73.0; N = 13). Standard body lengths of 60 ringed seals taken in Thule in the above mentioned period indicate that about 50% of the catch consist of immatures of which one third is 0-1 year old (Dietz and Heide-Jørgensen 1984). About 70% of total body weight in ringed seals is edible products, i.e. blubber, meat, kidneys, liver, intestines etc. (Riewe 1977; Born 1983) giving an average yield of about 30 kg per ringed seal in Thule.

The estimate of 250 000 little auks (Alle alle) taken per year (Table 2) is based on information obtained by Dietz and Heide-Jørgensen (pers.comm.). The amount of edible products per little auk is estimated at 0.100 kg. Estimates of yields of other birds and fish, both playing a relatively minor role in the Thule area, were made more or less arbitrarily.

Estimates of the average annual catch of various species are shown in Table 2. The estimates were derived in the following manner: Estimates of the catch of white whales (Delphinapterus leucas), narwhals (Monodon monoceros), walruses (Odobenus rosmarus), bearded seals (Erignathus barbatus), polar bears (Ursus maritimus), various birds and fish are based on information obtained from the hunters. The catch estimates for harp seals (Pagophilus groenlandicus) and hooded seals (Cystophora cristata) are based on the skin trade figures. Estimates of the catch of ringed seals are based on skin trade data to which a quantity of seals not traded has been added. Between 1974 and 1984 an average of 6100 ringed seal skins were traded in Thule (range: 3940 in 1981 to 8850 in 1977). In most years except 1984 the catch reported in the Hunters' Lists of Game was surpassed by the number of skins traded, making the trade figures the best estimates of the actual catch. To the estimate of about 6000 ringed seals I have added another 1000 animals to account for seals not traded. These are mainly taken in the moulting period May-July when many skins are unsuitable for trading. Hence, I arrive at an estimate of 7000 animals for the average number of ringed seals taken annually in the Thule area during the last decade.

To be able to estimate the seasonal variation in the catch I used the following procedure: In the years 1975, 1976 and 1982 the Hunters' Lists of Game from Thule present the catch taken over the entire year reported on a two-week basis. However, in 1975 and 1976 only the settlements of Siorapaluk and Savissivik reported, and in 1982 reports were only received from Savissivik and the administrative centre of Qaanaaq. Nevertheless, these years are believed to reflect, in a general manner, the seasonal variation in the catch in the entire area. Weighted averages of catch per month based on the three years data were calculated and expressed as percentages. These percentages were used to

calculate seasonal catches from the estimates of total annual catches.

### The oceanographic environment

Situated at the eastern coasts of Smith Sound the hunting community of the Thule area (Fig.1) benefits from the diversity and abundance of marine mammals and seabirds occurring in the North Water (Fig.2). This large open water body is technically defined as a 'recurring polynya' - a more or less permanent area of open water in an otherwise ice-covered region (Dunbar and Dunbar 1972). It is probably created by the combined effects of ocean currents, upwelling and winds (Dunbar 1981). A current of relatively dense and cold water from the Polar Basin constantly flowing south along the eastern coasts of Ellesmere Island creates movements in the sea ice in the Smith Sound - northern Baffin area. Winds, blowing mainly from north and east in the Thule area during winter also mechanically remove young ice by breaking it up and carrying it down wind, thereby preventing it from freezing solid. The Polar water masses meet with relatively warm and dense waters of Atlantic origin flowing along the eastern side of Smith Sound (Tooma 1978). The contact between the two currents running in opposite directions probably creates upwelling and mixing of nutrients, thereby enriching the area biologically. Hence, the polynya is an important feeding area for marine mammals and seabirds, particularly during their spring migration to the summering areas (Stirling et al. 1981).

Owing to the presence of areas of open water, walruses, white whales, ringed and bearded seals and some few narwhals winter in the Smith Sound - northern Baffin Bay area (Finley and Renaud 1980). The polar bears take a large proportion of their food in the shape of immature ringed seals occurring in the shear zone between the landfast ice and the moving pack ice (Stirling and McEwan 1975). Hence polar bears occur in winter and spring at the margins of the North Water (Finley and Renaud 1980; Stirling et al. 1981).

The absence of a dense ice cover in the polynya permits solar radiation to penetrate into the water column and trigger photosynthesis. Hence, the spring bloom of phytoplankton and subsequent bloom of zooplankton commences earlier in the polynya than in the surrounding ice-covered areas. Therefore polynyas are important feeding areas when the seabirds return to breed, early in the spring. The availability of food at that time is especially crucial for females as the energetic costs of breeding are high. Hence, in the High Arctic the large colonies of seabirds such as little auk (Alle alle), Brunnich's guillemot (Uria lomvia) and various gulls are all situated in close proximity to polynyas (Brown and Nettleship 1981). Huge colonies of

little auks are found along the coasts of the Thule area (Roby et al. 1981), where there are also colonies of Brünnich's guillemots, fulmars (*Fulmarus glacialis*) and kittiwakes (*Rissa tridactyla*) (Brown and Nettleship 1981). Apart from providing the Inuit with an easy access to an abundant food source, the bird colonies also sustain large populations of Arctic foxes (*Alopex lagopus*) (Freuchen and Salomonsen 1958).

On a more local scale the ecological conditions in the Thule area favour a rich marine life. Walruses occur year-round at the extensive shallow-water mollusk banks found particularly at the entrance to Wolstenholme Fjord and Murchison Sund (Vibe 1950). From late July until September thousands of narwhals are found in Inglefield Bredning (Born 1986) where also harp seals occur abundantly during the open water season (Vibe 1950). This fjord and the adjacent inshore areas constitute an ideal habitat for the ringed seal. Abrading the ice with the claws of the foreflippers this seal is able to maintain breathing holes in the fast ice. The ringed seals wintering in the fjords of the Thule area therefore constitute a mainstay of the subsistence hunt during this period of the year (Vibe 1950).

### The people

Historically, the Inuit have gained advantage from the favourable ecological conditions in polynyas. A close relationship exists between the presence of several recurring polynyas and the location of extensive prehistoric Inuit settlements. Archaeological evidence found in the Bache Peninsula region (eastern Ellesmere Island) shows prehistoric settlements to extend back 2500-3000 years before present, indicating that this region has been utilized by Inuit living in the vicinity of a small polynya found in this area (Schledermann 1980). Numerous winter-dwelling sites found along the coast of the Thule area show that in this area too a maritime hunting culture has existed since prehistoric time (e.g. Holtved 1944).

Apparently, communication between the Thule district and West Greenland Inuit ceased in about 1600 (Holtved 1944), and the Thule Inuit were probably isolated thereafter until 1818 when John Ross came into contact with a small group near Kap York (Steensby 1910; Vaughan in this volume). After then, contacts between whalers or foreign expeditions and the Thule Inuit became almost annual. Around the mid-1860s a small group of Canadian Inuit immigrated to the Thule area via the narrow Smith Sound, re-introducing the kayak, the bow and arrow and the fish spear to the Thule area (Steensby 1910).

When the Thule Air Base was built the Inuit were moved from the Wolstenholme Fjord area to the administrative centre of Qaanaaq, established in 1953 (Gilberg 1976). From this time there has been an increased aggregation of people in permanent settlements (Malaurie 1974), a process occurring concomitantly with a population increase (Fig.3). In 1984, 735 Inuit were living in 7 permanent settlements in the Thule area (Fig.1). About 100 people were occupational hunters while a variable number had hunting as a source of additional income. Although the Polar Inuit have concentrated in permanent settlements they still to a large degree exhibit a semi-nomadic way of life, spending the summers in hunting camps along the coasts. The winters are often spent in hunting huts or with kinsmen living in other settlements.

### The annual hunting cycle

Based on differences in light and ice conditions, temperature and availability of game species the annual hunting cycle can be divided into three parts:

1) During winter 24 hours of darkness prevails from 1 November until 11 February, whereafter there is twilight until 29 April. After the formation of new ice, which usually occurs in October, travel by dogsleds commences. But, because of darkness and inclement weather hunting activity in December and January is often reduced.

2) In the spring, lasting from early May until about mid-July, there is 24 hours of daylight. Owing to this phenomenon and because the weather generally improves during this period, hunting activity increases. New ice is no longer forming along the edge of the fast ice and there is an increased occurrence of seabirds and marine mammals along the ice edge.

3) The open water season or 'summer' lasts from about mid-July, until mid-October. During the second half of July the fast ice breaks up and this permits increased boating activity. In the last period of the open water season, when twilight prevails from 15 August, hunting activity is generally confined to the daylight hours.

### Winter hunting activity

After the formation of new ice, ringed seals and a few bearded seals are hunted at their breathing holes. This hunting activity is terminated as soon as snow has covered the ice, making it impossible to find the breathing holes, and the netting season begins. The nets are set underneath the stable fjord ice, usually in the vicinity of the settlement. Often they are set close to small icebergs locked in the fjord ice. These areas are preferred by the seals because tidal movements of the icebergs create cracks

in the ice where there is easy access to air. Netting of seals provides the Inuit with fresh meat in the heart of the winter, when other animals (except for the walrus) are unavailable. The netting season continues to April, when other hunting activities begin.

With the reappearance of light in February hunting activities increase. From this time until April, walrus are hunted on the thin ice covering their feeding banks near Saunders Ø, off Neqi-Pitoraarfik and in the Foulke Fjord area. In these areas new ice forming over the mollusc banks is regularly broken and carried away by winds. Hence the ice seldom becomes too thick to prevent the walrus from breaking through it to breathe. When a walrus surfaces in a breathing hole it is harpooned and then killed by rifle shots. Often the ice is too thin to support the weight of the walrus and the animal has to be dragged underneath the new ice to a place where the ice is thick enough for it to be hauled up and flensed. This hunting is mainly carried out in the Neqi-Pitoraarfik area in February-March.

In February the hunters travel by dogsled south into Melville Bugt or north along the coast to Kane Basin to hunt polar bears. This hunting reaches a peak during March-April. Most bears are hunted southwest of Kap York along the shore lead between the moving pack ice and the land fast ice. However, sometimes the bears are pursued into the moving pack ice. During these hunting trips the hunters may be away from home for several weeks. The polar bear skins are almost exclusively used for making trousers.

In late winter some hunters and their wives catch Greenland halibut (Reinhardtius hippoglossoides) on lines lowered through holes in the fjord ice. This is particularly the case near Qaanaaq and at Qeqertat. Fishing supplies the hunters with fresh meat and dog food. During this period a limited number of Greenland sharks (Somniosus microcephalus) are also caught for dog food. During winter an average of about 400 Arctic foxes are trapped in the vicinity of the bird cliffs and the pelts are sold to the trade company (Den Kongelige Grønlandske Handel or Royal Greenland Trade Department, since 1985 named Greenland Trade).

### Spring hunting

In early May seabirds, having immigrated from the south, occur at the edge of the fast ice, where they wait for the bird cliffs to become snow free. An increasing number of narwhals also occur at the ice edge, particularly at the entrance to Hvalsund, where they await ice break-up before penetrating through leads and cracks into the summering areas at the head of Inglefield Bredning. In May-June there is a general northward migration of walrus in the Thule area. In this period small groups of walrus basking on ice floes can be met with in the vicinity of Saunders Ø,

Northumberland Ø and along the coast from Neqi north to Kap Inglefield (Anoritoq).

During spring the hunters are engaged in a variety of hunting activity. From late April an increasing number of moulting ringed seals haul out on the fjord ice beside their enlarged breathing holes. Hidden behind a canvas screen with a rifle, the hunter stalks the basking seal until within shooting range, usually about 100 m. This hunting is relatively successful in May-June. During this period ringed seals are also taken from small dinghies operating at the ice edge.

The hunters and their families camp at the ice edge in May-June. In 16-foot dinghies equipped with an outboard motor the hunters search for walruses and bearded seals among the drift ice. Walruses that are hauling out on small ice floes are shot in the head at close range with heavy caliber rifles and then retrieved by harpooning. In this period quite a few bearded seals are also taken. Narwhals swimming close to the ice edge are harpooned from kayaks and then killed by rifle shots or spears. Various seabirds such as the Brünnich's guillemot, fulmar and common eider (*Somateria mollissima*) are shot at the ice edge.

After their arrival around mid-May at their breeding colonies the little auks are netted on the scree slopes. Hunters and their families coming from all over the district camp near the bird cliffs at Savissivik and Siorapaluk. All family members are engaged in the netting and throughout the summer until late August when the birds desert the colonies little auks are an important part of the diet. A single person may catch as many as 800 within a few hours and during the entire netting season an estimated 250 000 little auks are caught. Quite a few birds are fed to the dogs, but the majority are consumed by humans or stored in whole seal skins which have the blubber attached. These seal skin bags (kivialq), each stuffed with 200-400 whole little auks, are cached under piles of rocks and the contents is later consumed in a fermented state. The little auks still constitute a very important element in the subsistence hunt of the Thule area. Earlier, the Inuit subsisted during the open water season by living near the bird cliffs. This was particularly the case prior to the re-introduction of the kayak in the Thule area around the mid-1860's (Steensby 1910).

On 23-25 June five to ten families from different settlements are engaged in collecting eggs and down of the common eider breeding on small islands (Littleton Ø, Mc Gary Ø, Knorr Øer) near the entrance to Foulke Fjord. Local legislation permits eggs to be collected only at these dates thereby allowing the birds to initiate and complete another breeding cycle. Around 2000-2500 (Born, unpubl.data) to 3500-4000 (Thing 1976) eider eggs are collected during this trip. Some of the eggs are cached for later consumption and the sale of down contributes to the cash income. During

this trip a variable number of walruses, bearded seals, ringed seals and white whales are also taken.

#### The open water season or 'summer'

After the break-up of the fast ice in the second half of July the hunters engage in two major activities, namely the walrus and the narwhal hunt. From late July until September thousands of narwhals summer in the head of Inglefield Bredning (Born 1986). The hunters camp along the shores of this fjord and watch continuously for passing herds of narwhals. Some hunters, however, prefer to watch from boats lying motionless in the fjord. When the narwhals get close, the kayaks are launched and after a short pursuit the animal is harpooned and then killed either by rifle shots or by spearing. A notable new feature in this basically traditional hunting method is an increased use of motorized vessels to transport the hunters rapidly between the head of Inglefield Bredning and the administrative centre of Qaanaaq. While the use of motors is forbidden in the narwhal hunting areas of Inglefield Bredning, motorized vessels are important for the rapid transport of raw narwhal skin - mattaq - to the freezing plant in Qaanaaq. The motorized vessels have allowed the hunters to devote more time to actual hunting by reducing the time spent on transport. The narwhal skin is sold to the Greenland trade company and shipped south for sale in southern Greenland. The extreme skill needed for hunting narwhals from a kayak still puts an upper limit to the total catch. The most experienced hunters take at total of 10 to 15 narwhals per year. Usually, only 2-3 are taken per hunter. The mattaq - rich in Vitamin C - is consumed locally in a raw state, but most of it is sold to the trade company. A single narwhal may represent the result of a week's hard work for a hunting team usually consisting of three hunters that work together. The meat and intestines are dried for human consumption or cached raw to be used later as dog food.

In June-July the walruses congregate at the southern margin of the heavy pack ice in Kane Basin between Kap Inglefield and Pim Island. In this period three to five 22-foot wooden cutters each makes one or two hunting trips to this region. This hunting activity ceases about mid-July when the walruses have retreated to the Bache Peninsula region in Canada and further north along the coast of Inglefield Land. The Thule Inuit are not allowed to hunt walruses in Canadian territory and they do not follow the walruses further north in Kane Basin because of the risk of the boats being trapped in the heavy pack ice. A cutter may bring back the meat, skin, blubber and head of about 5 walruses from such a hunting trip. Some meat is cached in the Foulke Fjord region as dog food to be used during the spring hunt for polar bears. The walrus skin and meat is very important dog food, and some of the meat, and in particular hearts, are eaten by humans. To cover the costs of

fuel etc. the tusks are sold either to the trade company or to local Danish residents.

A limited number of white whales are taken during these walrus hunting trips or when they occasionally occur in the Murchison Sund - Inglefield Bredning area during July-August. However, most of the white whales are taken in September-October during their southward migration. During summer white whales feed in shallow water and therefore they usually occur in MacCormick and Olrik Fjords. The occurrence in the Thule area of the white whale is less predictable than that of the narwhal. Hence the annual take of white whales fluctuates greatly. The products of the white whale are used in the same way as those of the narwhal.

During the second half of July and in August, harp and hooded seals and some ringed seals are taken, but, in September there is generally a move towards more hunting of these species. This shift is explained in part by an immigration of ringed seals from offshore areas to the fjords, and in part by a reduction in narwhal hunting activity. Furthermore, by this time of year, hunting efficiency increases because by now most killed seals float, since they have built up their blubber layer. Hence, a greater proportion of shot seals are retrieved before they sink. These factors explain the general increase in numbers of seals landed at the end of the open water season.

In October the walruses reappear in the Thule area immigrating from north and west. They are now hunted from cutters in the Foulke Fjord area, at the entrance to Murchison Sund, in the vicinity of Northumberland Ø, in Wolstenholme Fjord and at Savissivik. This hunting is terminated when the new ice is about 5-10 cm thick and no longer navigable for the cutters.

The increased catch of seals, walruses and white whales at the end of the open water season is advantageous because by this time of year the sub-zero temperatures are favourable for caching and storing the hunting products for winter provision. Through the formation of stable new ice, the thin-ice hunting of seals now commences and the annual hunting cycle is completed.

The annual hunting cycle described here represents a very generalized picture of hunting patterns in the entire Thule area. The seven settlements of the area are each situated in relatively different ecological and geographical environments with different accessibility to different game species. Hence the hunting patterns of the settlements vary to some extent. For example, the main bulk of ringed seals are taken in Savissivik - the southernmost settlement. In this area other marine mammals are mainly taken during the spring and fall migrations. The inhabitants of Qeqertat, living at the head of Inglefield Bredning, are dependent on the summer catch of narwhals, while ringed seals and Greenland halibut are important during the remainder of the year. In Dundas, Moriussaq, Qeqertarssuaq and Qaanaaq, all

more or less situated in the middle sections of large fjords, the hunting areas are relatively large. The inhabitants engage in the hunting of a variety of different game species and they often settle for a variable period of time at the different hunting grounds, depending on the season. In Siorapaluk, the northernmost settlement, the walrus is the mainstay in the subsistence hunt. However, generally speaking the differences between settlements in hunting patterns relate more to the relative proportion of various game species in the catch than to the range of species harvested.

#### Annual and seasonal yield of hunting products

Table 2 and Figure 4 show the estimated average yield per hunter of edible products derived from maritime hunting. About 40% of the total annual yield is derived from the catch of ringed seals. The relatively uniform proportions of ringed seals taken throughout the year are unique to the Thule area (Fig.4). By comparison, the majority of ringed seals taken in Innarsuit in the Upernavik district are caught during the period of fast ice and few are taken during the open water season (cf. Hertz and Kapel 1986). The situation in Innarsuit is typical for most Greenlandic hunting communities, while the pattern in Thule reflects the particular importance in this area of the open water season. The importance of the walrus and narwhal hunt in the Thule area is also apparent from Fig.4. About 25% and 10% of the annual yield of edible products are derived from the catch of walrus and narwhal, respectively.

During the relatively short open water season about 50% of the total annual yield is taken. The importance of the open water hunting season in the Thule area reflects the fact that this region is a major summering ground particularly for walruses and narwhals as well as for other marine mammals and seabirds. A surplus taken during the open water season is cached for the relatively lean winter period. However the dependence of the Thule Inuit on the open water catch makes the community vulnerable to increases in the price of imported goods, particularly gasoline and oil.

The average annual yield of edible hunting products available per hunter is about 5000 kg of meat, blubber, intestines and other organs (i.e. liver, kidney and heart). About 200 kg of mattaq is sold, leaving about 4800 kg available per hunter per year. The majority is made up of tissues from marine mammals and seabirds; fish and terrestrial mammals playing an insignificant role in the subsistence hunt. For example, a total of about 20-30 caribou are taken annually in the Thule area. Thus, a hunter and his family have about 13 kg of edible products available per day. Each hunter has a team consisting on average of 13 dogs. As the dog team consists mainly of

males the average body weight of a dog team member is about 30 kg (Born 1983). The sledging season lasts about 242 days from October until mid-July, but because of inclement weather and darkness sledging activity is usually somewhat reduced during December and January. During these months when a sled dog is fed about 1 kg every second day, a dog team consumes a total of about 400 kg. During the remainder of the sledging season a dog is fed about 2 kg every second day and hence in this period the total consumption per dog team is about 2350 kg. In summer, when there is no sledging, a period usually lasting about 4 months, a dog is fed about 1 kg every 3rd or 4th day. So in this period a dog team consumes a total of about 450 kg. Hence, a single dog consumes about 250 kg annually and the hunter uses about 3200 kg per year to feed his dogs. According to Jenkov (1945), who gained his experience in northeast Greenland, the annual consumption per dog was 275 kg meat and 94 kg porridge. Information presented in Born (1983) indicates that in Scoresby Sound in east Greenland the annual consumption per dog is 214 kg of tissues from marine mammals. These differences probably reflect variations between hunters in the amount of food given to the dogs and are perhaps partly related to individual variations in driving and hunting activities.

From the annual yield of 5000 kg of edible products available per hunter about 200 kg mattaq traded and about 3200 kg used as dog food should be subtracted. Hence, there is about 1600 kg (ca. 30%) left for human consumption. The average number of members per household in the Thule area is 5 (5.3, Gilberg 1976) and, therefore, each member of the 100 hunters' households has about 0.9 kg of edible products available per day. According to Schaefer and Steckle (1980), studies of the dietary habits of Canadian Inuit living in hunting communities showed a daily intake of between 0.6 and 0.7 kg which is mainly derived from hunting products (Table 1 and 2, *ibid.*). The total population of 735 Inuit of the entire Thule area theoretically each has 0.6 kg of hunting products available per day. In 1984, 28% of the population was younger than 15 years, hence relatively more food is available per grown-up person.

#### Cash income

The introduction of rifles to the Thule Inuit during Peary's expedition initiated a basic change in the hunting patterns of the Thule Inuit. After the establishment of the Danish trade station in 1910 the Inuit gradually became more dependent on foreign artefacts, most notably rifles, ammunition, various tools, and wood and iron for making sleds. These items were obtained in exchange particularly for fox skins, while other hunting products too, such as narwhal and walrus tusks, were traded. The general increase in welfare occurring in Greenland during the 1960's also

affected the Thule area. In our context the increased use of motorized vessels was a dominant factor in this process. As has been shown above, the incentives to increase hunting efficiency during the open water season were already there. However, the procurement of vessels and the expenditure connected with using them necessitate a certain cash income. During the 1960's three major changes occurred which made the open water catch increasingly important: 1) the population increased rapidly (Fig. 3), 2) there was a concentration of people in permanent settlements (see Malaurie 1974), and 3) the number of dogs per dog team increased.

An increased population in itself demanded a larger catch for subsistence, while the concentration in permanent settlements, and most notably in the administrative centre of Qaanaaq established in 1953, forced the hunters to travel longer distances to the different hunting grounds, for example to the ice edge. In the nineteenth century a hunter usually had only 3-5 dogs and much blubber was used for heating. Around 1910 the average dogteam had 6-8 members while only a few hunters had a team of 12 dogs (Steensby 1910). Nowadays the usual dog team consists of 13 animals. The increased demand for hunting products has been satisfied during the open water season. A similar efficiency in open water hunting was shown by Riewe and Amsden (1978) to be valid for Grise Fjord in Jones Sound, where approximately 60% of all species of seals taken on a yearly basis are harvested by boat hunting. However, this hunting was also demonstrated to be the most expensive method, costing most in ammunition and gasoline for each seal retrieved. Similarly, the open water hunt in the Thule area relies on a certain amount of cash income.

In the Thule area most hunting products not used for local consumption are sold to the Greenland trade company. A minor fraction is sold to private enterprises, while some meat and other hunting products are also traded locally between the Inuit. A variety of products are sold to the trade company such as seal skins, narwhal and white whale mattaq, meat of different species of seals and whales, bearded seal thongs, eider down, fox skins, narwhal and walrus tusks and various handicrafts, such as for example mittens and carved ivory. The total value of the trade to the trade company of hunting products in the Thule area is shown in Fig. 5. The values given are expressed Danish crowns and have not been adjusted to allow for inflation. After an increase at the beginning of the 1970's, there has been a levelling off in the total sum earned by the hunters from the sale of hunting products to the trade company. Furthermore, because of an increase in prices for imported goods, as shown by the graph showing developments in the Greenlandic consumer price index (Fig. 5), the real value of the traded hunting products has greatly decreased.

A mainstay in the cash income of the hunting community has been the trade in ringed seal skins. However, a drop in

prices in 1977 on the international market, probably caused by the campaigns against the sale of sealskin products, has been followed by a marked decrease in ringed sealskins traded in the Thule area (Fig. 6). This development, generally seen in all Greenland's hunting areas, has caused great problems for the Greenlandic hunting communities (see also Hertz and Kapel 1986). To ease the situation for the Greenlandic hunters the Greenland Home Rule authorities have subsidized the sealskin trade since 1979 by covering from 40 to 80% of the price paid to the hunter per skin. Nevertheless, prices ranging from 90 to 290 Danish crowns per skin at present, depending on the quality, are at the same level as in 1975 - resulting in a severe drop in real value. As a result many skins are now discarded or fed to the dogs because prices no longer cover the labor involved in preparing them. However, as shown earlier, a certain number of seals still need to be taken to meet the demand for dog food and human consumption.

It is interesting to note that the amount of mattaq traded in Thule has apparently increased in the 1980's (Fig. 6) indicating a shift in trade from the relatively unprofitable seal skins towards the more valuable mattaq, for which there is a good market in the large towns of southern Greenland. The hunters were being paid 35 Danish crowns per kilo for mattaq in 1985, and the mattaq price has to some extent increased concurrently with the rate of inflation. Furthermore, narwhal meat is traded locally for about 25 Danish crowns per kilo. Hence the narwhal is a relatively valuable game species.

Prices paid for other hunting products have also decreased recently. For example in 1985 prices paid by the trade company to the hunters per kilo narwhal tusk declined about 30% from 715 to 500 Danish crowns. This reduction was caused by a reduced market outside Greenland probably related to import restrictions enforced in 1984 by the EEC (Fischer, manager, the Trade Company, Qaanaaq, pers.comm.). Hence, the hunting community at Thule has become dependent on a certain cash income. Although this economic development began decades ago, the hunting communities are now facing overwhelming problems because of the drops in international market prices of seal skins caused by the campaigns against the sale of sealskin products, which are often misdirected and based on faulty premises.

## Discussion

Necessarily, a very generalized description of the hunting patterns in the Thule area has been presented here. As already indicated, somewhat different hunting schemes apply in the different settlements of the area. Due to lack of reliable catch data, it has not been possible to describe the annual fluctuations in catches of the different marine mammals. For example, the late winter and spring catch of

walruses may show great fluctuations from year to year. In the spring of 1979, the catch of walruses in the Negi-Pitoraarfik area was insignificant because of strong winds and adverse ice conditions, while in the spring of 1984 more than 200 animals were taken here. Similarly, catches of other marine mammals, such as for example white whales and polar bears, may show great annual fluctuations. On the other hand an unsuccessful catch of one species may to some extent be compensated for by an increased effort directed towards the catch of other species.

I have tried to show, on a very rough scale, how the Thule Inuit are still very dependent on the catch of marine mammals for satisfying their subsistence needs. The mainstay of their diet is derived from marine mammals and the use of sled dogs in a traditional hunting pattern in itself demands a substantial bulk of food derived from the harvesting of marine mammals. On the other hand, through the use of modern hunting technology, by dwelling in houses heated by imported oil and kerosene, and to a significant degree by supplementing their diet with imported food, the Thule hunters have to a large extent become dependent on a cash income. A detailed analysis of the subsistence economy of the Thule hunting community is hampered by the fact that a substantial part of the cash income of a hunting family may be supplied by one member, often the wife, who may have a salaried job as midwife, nurse, teacher etc. Furthermore, prosperous hunters may sell meat etc. to the trade company or kinsmen, thereby being able to afford to live on imported food to a higher degree than one would expect.

Although still being very traditional in many respects in comparison with most other Inuit hunting communities, the hunting patterns in the Thule area to a large extent are influenced by intrinsic and extrinsic economic forces. In order to present a valid analysis of the Thule Inuit's dependence on the living resources of their environment it would be necessary to take into account a number of sociological and economic considerations, but the necessary data, especially the economic data, are not readily available. However, beyond doubt, the basic reason for the evident success of the hunting community of the Thule area is the fact that it is situated in close proximity to the North Water polynya where various marine mammals winter, and which makes this area an important summering ground for marine mammals and seabirds.

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Table 1

Average total body weights and edible products of marine mammals harvested in the Thule area (NW Greenland).

Species or grouping	Average Total body weight(kg)	Edible products (kg)	Edible products (%)
	x		
Ringed seal	43	30	70
Harp seal	135	100	74
Hooded seal	200	150	75
Bearded seal	200	150	75
Walrus	600	500	83
Narwhal	540	350	65
White whale	540	350	65
Polar bear	200	160	80

Source: Born (1983) where estimates of weights and yields based on various sources are presented.

x, ringed seals: Derived from Dietz and Heide-Jørgensen (1984), see Materials and methods, above.

Table 2

Edible hunting products available per hunter per month in Thule (kg/hunter x month)

	Ringed s.	Harp s.	Hooded s.	Bearded s.	Walrus	Narwhal	White wh.	Polar bear	Birds	Fish	Total	% of Total
January	157	0	0	2	0	0	0	0	0	0	159	3
February	119	0	0	3	90	0	0	3	0	10	225	5
March	108	0	0	6	160	7	0	13	0	10	304	6
April	104	0	0	8	110	0	0	8	0	10	240	5
May	161	4	8	24	150	18	0	2	46	10	423	8
June	312	8	24	21	135	102	11	0	88	0	701	14
July	219	29	8	30	335	109	42	0	88	0	860	17
August	175	67	30	15	0	169	102	0	46	0	604	12
September	261	159	81	23	0	98	49	0	0	0	671	13
October	196	33	0	18	250	25	7	3	0	0	532	11
November	174	0	0	2	0	0	0	3	0	0	179	4
December	115	0	0	0	0	0	0	0	0	0	115	2
Total:	2.101	300	151	152	1.230	528	211	32	268	40	5.013	
% of total	42	6	3	3	25	10	4	1	5	1		
Total no. of animals taken												
/year	7.000	300	100	100	250	150	60	20	(-) <sup>x</sup>	-		

X 250 000 little auks plus a small number of other species.

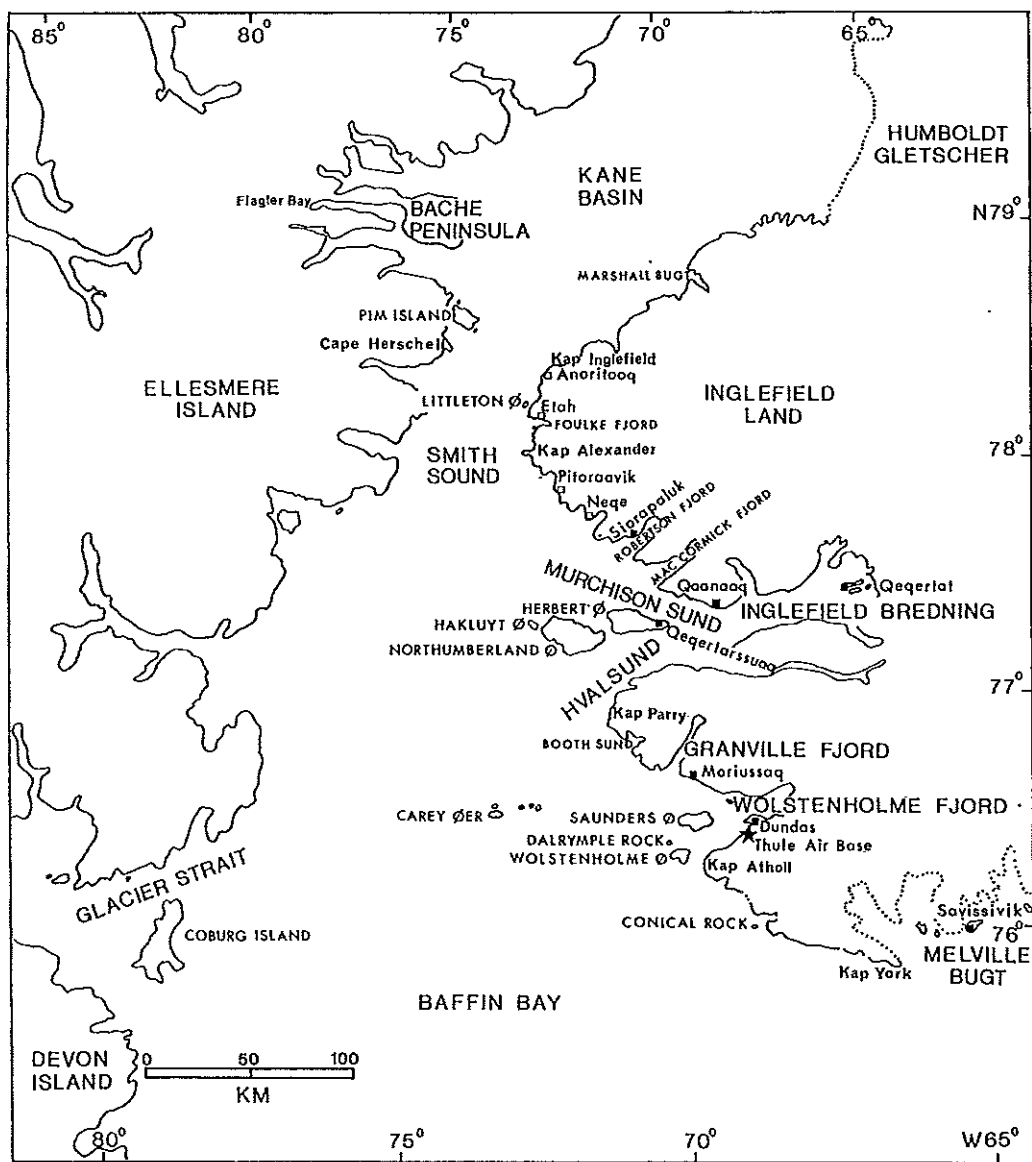


Fig.1. Map of the Thule area.



*Fig. 2. LANDSAT satellite imagery (18 April 1976) showing the northern extension of the North Water and a part of the Thule area.*

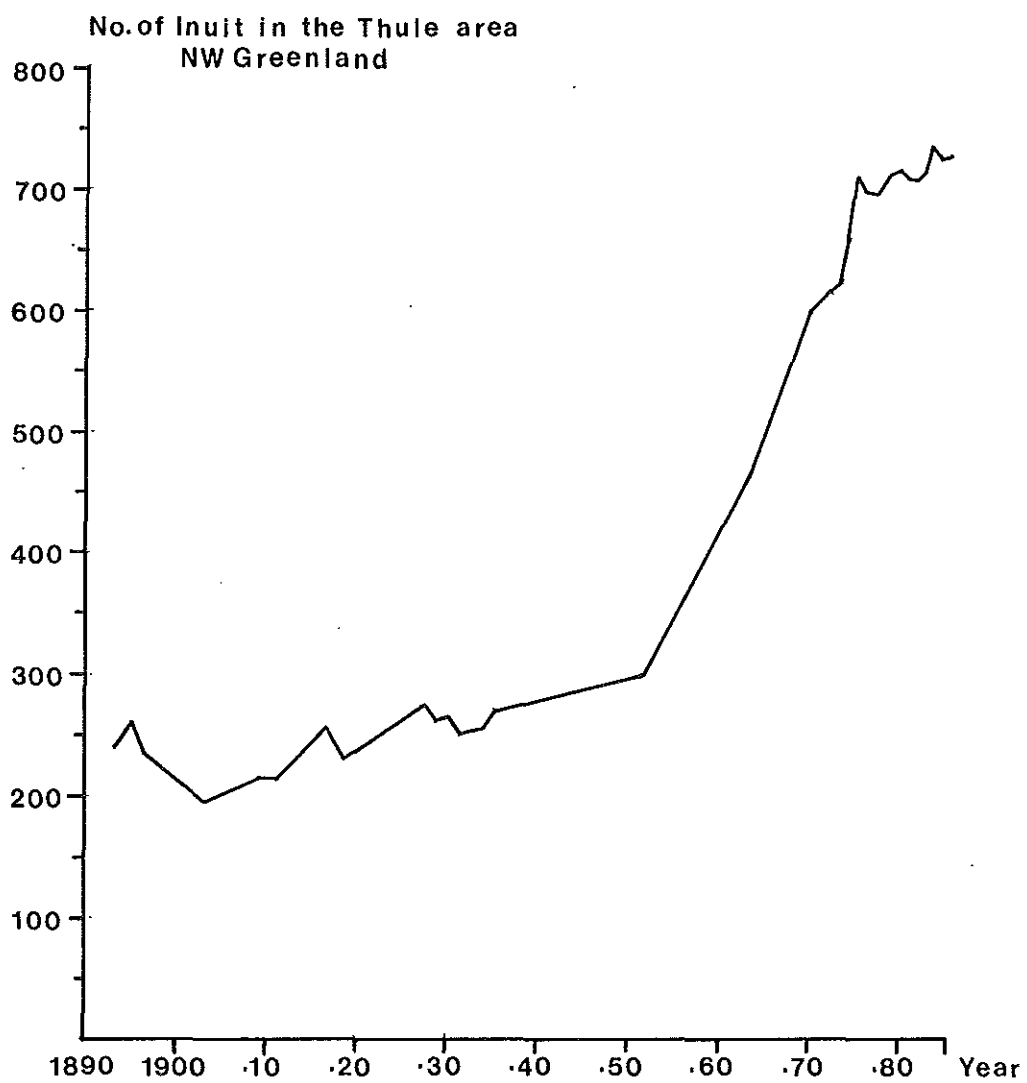


Fig.3. Growth of the Inuit population in the Thule area. Sources: 1892-1972 (Gilberg 1976); 1973-1984 (Ministry for Greenland).

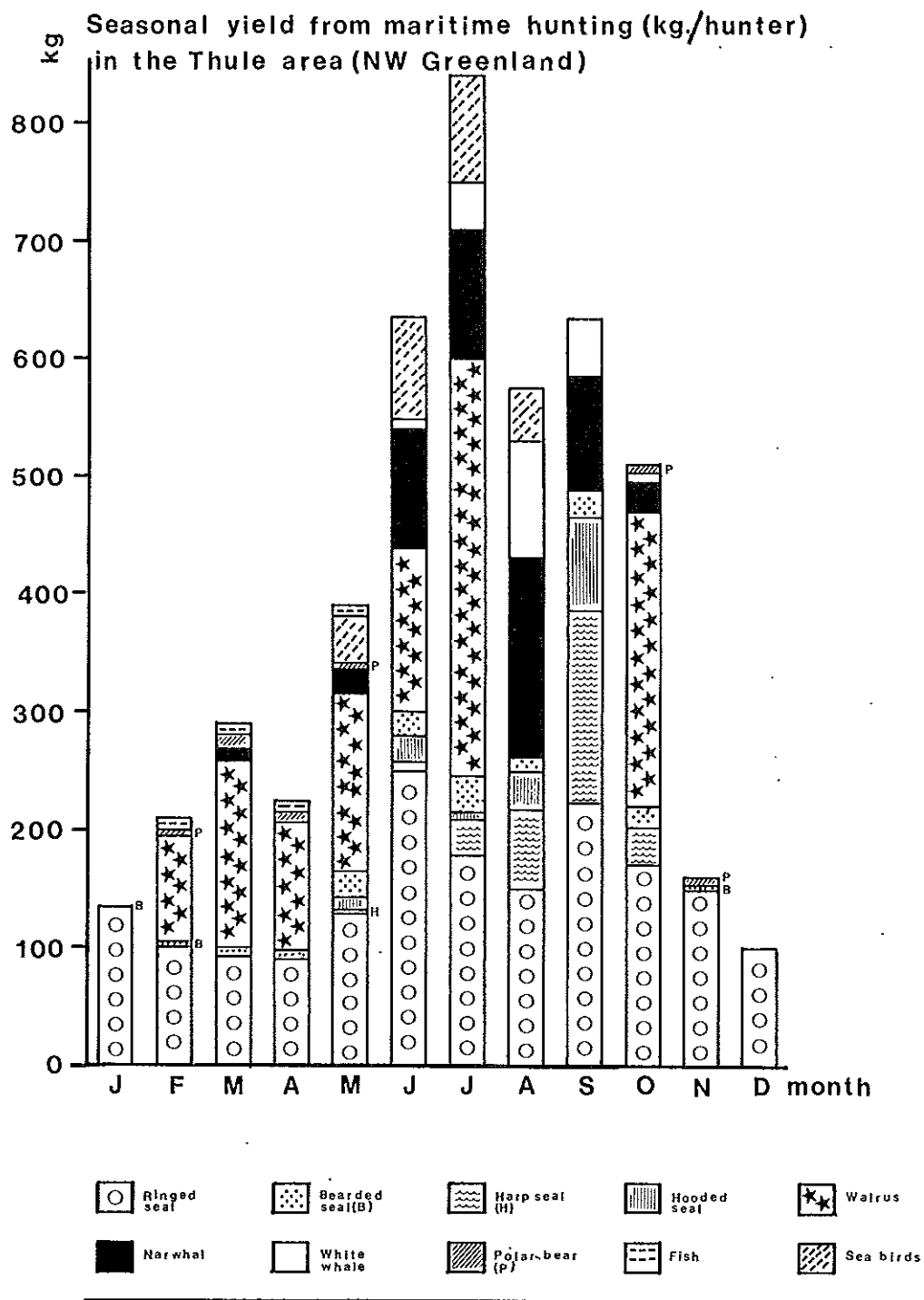


Fig.4. Seasonal yield of edibles obtained from maritime hunting in the Thule area expressed as kg per hunter.

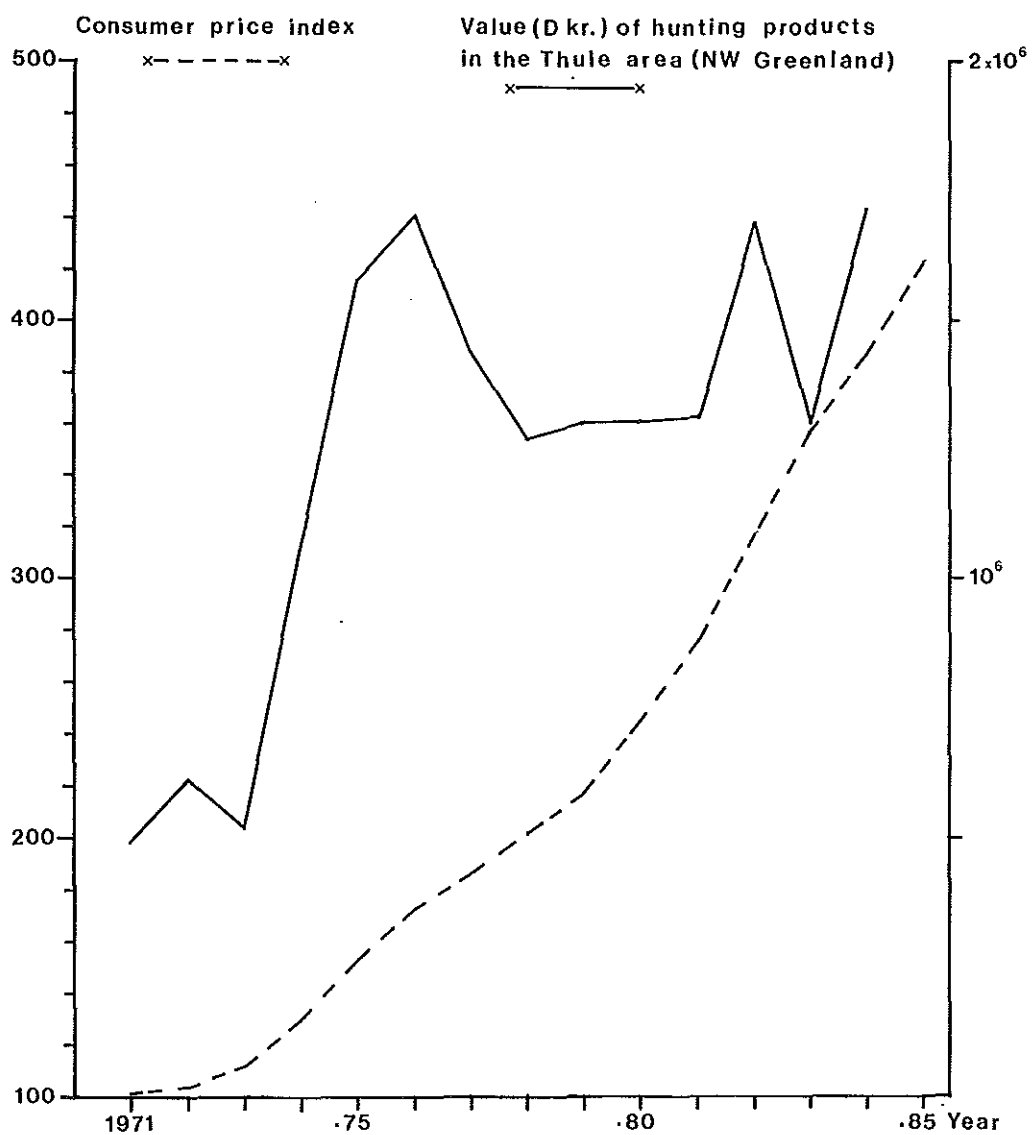


Fig. 5. Value of hunting products traded to the Greenland trade company in the Thule area (—) with a graph showing the development in the Consumer Price Index in Greenland (-----).  
Source: Ministry for Greenland.

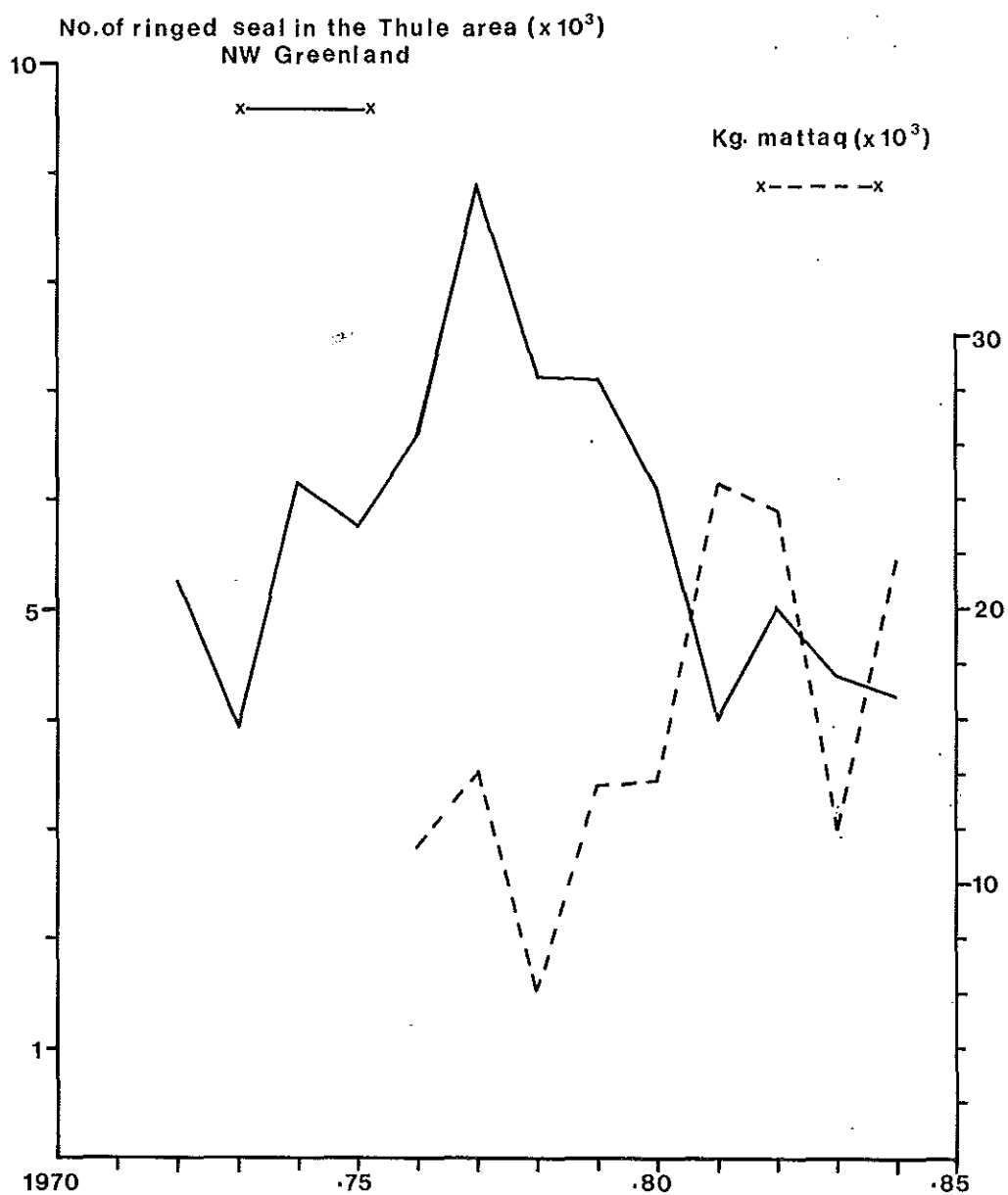


Fig.6. Number of ringed seal pelts and kg mattaq (narwhal skin) traded annually to the Greenland trade company in the Thule area.  
Source: Ministry for Greenland.

## A MODE OF THOUGHT. DUTCH PERCEPTIONS OF THE ARCTIC IN EARLY MODERN TIMES

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*In early modern times the maritime nations of Western Europe intruded into the Arctic in search of wealth. Cartographers recorded geographical knowledge on maps; whaling commanders wrote on the art of finding and killing whales; books and pamphlets on the Arctic were published to entertain, to instruct, to amaze the educated public. On the basis of some of these written sources, the attitudes of travellers in the Arctic in early modern times are discussed within a framework adapted from a model used in behavioural geography. This discovery of the Arctic, and the new knowledge acquired in the process, had to be fitted into the current cosmology and into the Christian faith. The relation of man to nature was closely connected with that of man to God. The Dutch perception of the Arctic had to underpin the Protestant mode of thought.*

### Introduction

European activity and behaviour outside Europe are determined to a great extent by European economic motives and ideologies. As for the Arctic, conservation, exploitation and national security as conceived by the major powers, are considered of primary importance nowadays. However, this paper does not go into current Arctic concerns; it explores the ideologies that prompted the Dutch to turn to the Arctic in early modern times. It forms part of the history of Dutch expansion overseas, but it may also add to a better understanding of the current debate on the management of the Arctic. It is concerned with history, especially with past images and modes of thought. However, images and modes of thought are of all times: their development is of importance for the past as well as for the present.

### The sources

Dutch perceptions of the Arctic in the different sources cannot be made to fit a single general Dutch concept of the Arctic in early modern times. Such a concept would be hopelessly vague. I thought it best to confine myself to four sources which will be analysed separately. Surprisingly perhaps, the first source is German. However, Friederich Martens' journal of a whaling voyage and description of the scenery around Spitsbergen and the catching of whales (A travel account of Spitsbergen and Greenland written in

1671) was translated into Dutch in 1685 and was one of the formative influences in Dutch perceptions of the Arctic (Martens 1675; Martinière and Martens 1685). The author of the second source relied heavily upon Martens' account, and copied out parts of it carefully. It is the famous Rise and prosperity of the ancient and contemporary Greenland fishing industry, by Abraham Moubach, published in Amsterdam in 1720. This book is a compilation of Zorgdrager's whaling-manual with historical and geographical information taken from other sources including Martens. The other two sources, namely the accounts of overwinterings in Greenland in 1777-8 by Hidde Dirks Kat and in 1826-7 by Klaas Hoekstra (Kat 1818, Hoekstra 1828), both describe shipwrecks.

These sources are a haphazard choice: they happen to be available at Groningen University Library. Advantageously, they exemplify three different kinds of Arctic account: Martens describes an ordinary whaling voyage, Moubach is a compilation of natural and geographical information on the Arctic, whereas Kat's and Hoekstra's accounts satisfied the contemporary taste for drama.

### The paradigm

These four sources will be analysed along the lines set out by a paradigm. Usually, a historian uses the narrative as an explanatory tool. Working in this tradition I could have described images of the Arctic as contained in the four sources I selected. Probably a specific image would have emerged from each source which would have made comparing them difficult and cumbersome. By using a paradigm the images can be analysed systematically: similarities and dissimilarities on crucial points will become clear and the peculiarities of the image can be traced. The paradigm used was developed in the field of behavioural geography by John R. Gold (1980: 42). It is a paradigm of individual spatial cognition and behaviour (Fig.1). This does not mean that this is a conventional study of behaviour. In terms of the paradigm, I am mainly interested in cognitive representations of the Arctic as contained in the sources. Before making the paradigm operational, it is necessary to explain some of its basic concepts and to connect these with the sources. The personality variables refer to the writers of the sources, whose personalities, motivations and emotions obviously had an impact on their writings. The issue of personality at once raises the following questions: who is the author of the source in question and what were his intentions in writing it? Motivation is defined by Gold (1980: 21) as: "the force that leads men to seek certain goals in relation to their needs", which raises questions like: why did the author go to the Arctic and why did he write about his journey? Emotion is defined by Gold (22) as: "a state of excitement or perturbation

marked by strong feeling and usually by an impulse towards a definite behaviour". In the present context we may try to answer the following questions: Did a state of excitement or perturbation lead the author to the writing of his account and, if so, to what extent was this reflected in his writing?

Group and cultural factors must clearly also be considered. We have to determine to which culture and to which cultural group the writer belonged. The authors of our sources were not confined to visual exploration of the Arctic. They also employed their senses of taste, touch, smell and hearing, and experienced purely physical sensations such as pressure, pain, cold and heat (Gold 1980: 50-56). It is worthwhile to trace this broad spectrum of sensory stimulators in our sources, because sensory stimulation is converted into an organized and coherent experience called perception (Gold 1980: 20). Learning is the process by which we draw cognitive conclusions from experience and information passed on by others in whatever form (Gold 1980: 20).

These writers about the Arctic can be said to have filtered their information on the Arctic environment. The factors mentioned thus far influenced their cognitive representations of this environment, but certainly did not affect the process of writing at the same time and to the same degree. In this process images and spatial schemata of the Arctic environment accompanied them. Gold defines an image as the mental picture called to mind when an object, person, place or area is not part of current sensory information. Spatial schemata are the frameworks within which people organize their knowledge of the spatial environment (Gold 1980: 41). Since we are primarily interested in images of the Arctic or how these authors communicated their images to us in writing, we shall ignore the spatial schemata which were primarily used to find one's way, namely the maps accompanying their accounts.

Before an author started writing he undoubtedly 'censored' his material by omitting or adding information whenever he thought fit. In terms of the Gold paradigm the process of writing was influenced by the author's personality, group and cultural factors, and cognitive processes. In short the author's attitude towards his source material influenced not only his cognitive representations, but also the process of writing. His attitude determined both the selection of issues that he offered to his reader - the content - and his presentation of these. This can be thought of as a kind of 'decision filter', but, since it is impossible to differentiate between the first process in which the author shaped his cognitive representations and the second process in which he wrote them down, in terms of the Gold paradigm, we cannot assess the influence of this 'decision filter'.

### Personality, group and cultural factors

Unfortunately, our information about these authors is scanty, and we can say little about their personalities. As a barber-surgeon Friederich Martens set out on a whaling voyage to Spitsbergen in 1671. Usually, a barber-surgeon had more education than an average seaman. Besides shaving and hair-cutting, he knew how to attend to injuries and he had some botanical knowledge in view of the curative properties of herbs. In his journal of a voyage to Spain, made in 1671-2 shortly after his voyage to Spitsbergen, Martens described the flora and fauna of the area around Cadiz (Martens 1925). This testifies to his botanical curiosity. But this journal is less remarkable than his Spitsbergen account, the quality of which is attributable to two learned men, the German professors Kirstenius and Fogel, who induced Martens to publish his journal. Dr. Fogel in particular put several questions to Martens, which induced him to add some chapters to his journal, and helped with editing, identifying herbs and attributing German names to plants and animals (Martens 1675: Dedication).

Martens' journal can be regarded as a scientific publication intended for the learned world and the educated of his days, written by a keen observer with surgical and botanical knowledge. The interest of Kirstenius and Fogel encouraged Martens to expand his journal and to compose it systematically. His account suggests that he had not been seized - and thus influenced - by any violent emotion. His voyage was an ordinary one with no shipwreck or any serious accidents. He revised his account in peace and quiet and under learned guidance, and it was published four years after the journey.

Zorgdrager's Rise and prosperity of the .... Greenland fishing industry, has a slightly different origin from Martens' journal (Fig.2). Whereas two learned men initiated the publication of Martens, it was the Amsterdam publisher and bookseller J.Oosterwyk who asked Abraham Moubach to revise a manual for whalers written by the whaling commander Zorgdrager. Moubach argues that it is necessary to instruct young as well as experienced whaling commanders with a view to the continuation of the whaling trade in which, directly and indirectly, so many people are employed. Together with the manual he incorporated a history of the discovery of the Arctic (Moubach 1720: 5-6). Oosterwyk clearly hoped to make money with the book, and this is no doubt why he inserted Zorgdrager's name in the title and asked Moubach to add further information of interest to the general public. The publication of Martens' journal was intended to preserve scientific information from oblivion, Zorgdrager's manual was meant to sell.

As far as we can judge, these two writers collected their information in very different ways. Martens had been face to face with the things he wrote about. Moubach took information freely from other books which he thought of interest

to the general public. So in a sense his work tells us more about the image of the Arctic prevalent in those days, than about the Arctic environment itself. If we were studying the Arctic itself, this would be a disadvantage, and this explains why in general Martens' book is held in higher esteem than Moubach's. But since the present enquiry concerns images of the Arctic, Moubach's book is of no less value than Martens'. Neither book is coloured by emotion.

The journals of Kat and Hoekstra are totally different in character from the books by Martens and Moubach. They are stories of shipwreck and starvation and were written with neither a scientific, nor a commercial aim in mind. Hidde Dirks Kat, a whaling commander from Ameland, sailing in a ship owned by Hamburg merchants, lost his vessel on 30 September 1777 in the ice pack east of Greenland (Fig.3). After having spent some days on an ice floe, he sailed with his crew in three sloops to the south and, after they had left these at the edge of the ice pack, they reached the mainland at Statenhoek (Kap Farvel) on foot on 11 October. They were rescued by some Inuit. Kat stayed most of the winter of 1777-8 with the Danish merchant Andreas Oelzen at Julianehaab, and returned safely to Ameland on 27 September 1778.

It must be pointed out that Kat's journal was not published until 1818, forty years after the event. A Frisian school-inspector took the initiative in the publication of this book with a view to its educational value. He thought a young reader could learn a lot from this true story of "... an old-time spirit of masculine bravery, unflinching steadfastness, untainted piety and wholly truthful and simple trust in God and His almighty support". The inspector cherished the hope that Kat's story would revive the Dutch whaling trade and induce youngsters to sign on (Kat 1818: VI).

In the introduction to Klaas Hoekstra's journal, published in 1828, the editor limits his justification for publication to the content of the story. It shows, he argues, how human valour and endurance can help overcome great dangers. This booklet also contains a description of daily life among the Inuit which proves Hoekstra to be a keen observer (1828: V-VI). He was a whaling commander from Texel, sailed with the ship Harlingen, owned by the Dutch Greenland and Davis Strait Fisheries Society at Harlingen, for the west coast of Greenland on 14 March 1826 (Fig.4). From 25 June to 25 August the Harlingen worked north from Hare Island (Hareøen) near Disko, until the ship was crushed in the ice pack. Hoekstra and his crew luckily found refuge on the London whaleship Dundee, but lack of victuals forced them to leave her on 6 October. Partly by dragging the sloops across the ice, partly by rowing or sailing, they reached Suikertop on 13 October.(1) After a Dane and some Inuit had given them first aid at Upernavik, the Dutch proceeded to the south until they reached Nuugssuaq, where they overwintered in groups divided among

the Inuit settlements of the area. In June 1827 Hoekstra and his men embarked at Claushavn on a ship bound for Copenhagen and all save two returned to Harlingen on 10 October.

Neither Kat nor Hoekstra wrote his account in the grip of powerful emotions. Both authors fought hard for their lives; they must have often felt they were going to die. When they set themselves to recording their adventures and miraculous rescues, it was relief that set the tone of their journals. At the same time they were not professional writers trying to dramatize or embellish a story; they were keen observers and their reports were factual.

#### Cognitive processes: images of the Arctic

How did these four authors assimilate their Arctic experiences: their sensations, perceptions and learning, and how did this process of assimilation affect the ensuing image of the Arctic that remained in the author's mind and found its way into his work? Friederich Martens regarded the coast of Spitsbergen with a painter's eye. He actually illustrated his booklet with seventeen engravings, but these have an explanatory function only and are of no artistic value (Fig.5). Certainly, Martens was moved by the scenery of Prince Charles Foreland (Prins Karls Forland). He described fluctuations of colours on the slopes of the mountains (White 1855: 17).

When, on the 18th of June, on a Sunday, in the forenoon, we first came to the Foreland of Spitzbergen, the foot of these mountains looked like fire, and the tops of them were covered with foggs; the snow was marbel'd, and looked as if it were boughs and branches of trees, and gave as bright and glorious a gloss or shining to the air or skies as if the sun had shin'd.

He was impressed, too, by the changes in snow and ice formations in the mountains which occur whenever it snows or thaws (White 1855: 18):

Below, at the feet of the mountains, stand the hills of ice very high, and reach to the tops of the mountains; the cliffs are filled up with snow, wherefore the snow mountains show very strange to those that never saw them before; they appear like dry trees with branches and twigs, and when the snow falleth upon them they get leaves, as it were, which soon after melt, and others come in the room of them.

Apart from his eye for detail and descriptive powers, Martens is very sensitive to the impact that the scenery

has on him. In the following passage, he captures marvelously the atmosphere of the Arctic, when he climbs some cliffs to look for a whale (White 1855: 21):

We went in the night, when it was very clear sunshine, upon one of the rocks near the English haven, about a mile long, to look after a whale that had got away from us: in the middle of this harbour others were a rowing in their longboats, which we could hardly discern; a great part fell down from one of these mountains, which sounded very loud. The mountains look'd black, strip'd with veins of snow. It was so calm that we could hardly perceive any breeze of wind, and not very cold; the shoar was very full of sea-horses, which roared so that we could hear them a great way off, as if some bulls had bellowed.

These quotations aptly illustrate the scope of Martens' sensations, which in these passages are mainly of an auditory and visual kind. It is clear that Martens took great pains to conjure up the Arctic scene in his reader's mind.

Moubach's description of the whaling trade is somewhat flat, lacking the personal component that makes the other sources so attractive. Because he never went to the Arctic, he could not write from his own experience. His book totally lacks the sub-stratum of sensation that shaped Martens' account of the Arctic scene. He took his information from the whaling commander Zorgdrager and many other authors, so that his writing emanates from a process of learning governed by questions like: how and by whom were Greenland, Iceland and Spitsbergen discovered, what peoples live there, what is their history and, in particular, along which routes do the whales migrate through the Arctic waters, what is the history of the whaling trade and which techniques are to be used in the catching and processing of whales? (Moubach 1720: Content). The image of the Arctic that prevails in Moubach's account is that of an obscure region about which there is much to tell and which is of primary importance for the whaling trade.

Kat, Hoekstra and their crews were exposed to the Arctic climate for a considerable period of time. After Kat's ship had been crushed in the ice pack on 30 September 1777, he and his crew found themselves without shelter of any kind, for other ships nearby, that might have offered them board and lodging, had been crushed too (Kat 1818: 8) (Fig.6). They had to survive in the open for nineteen days: five days on an ice floe, two days in sloops, and in the remaining twelve days they stumbled across the ice to Statenhoek (2) and along the coast northwards. Surprisingly, the cold and the suffering from frozen fingers, lips and toes, are hardly mentioned. This is a striking feature of this account, which stands out when we compare it to Hoekstra's

report of similar experiences. Kat sticks to the facts when he tells us about the deaths of some of his men, when water appeared among the ice floes and swallowed up some of them, whereupon the ice floes come together again. Another example of Kat's matter-of-fact attitude towards his Arctic experience is his reaction to the deaths of four of his men who, huddling close to him at night, are found frozen to death in the morning (1818: 16-17). His description of this sad event is non-dramatic and factual, he does not allow himself to be carried away by his emotions. This does not mean that Kat does not wish his reader to appreciate the dangers that threatened him. When his ship has been crushed and he and his crew are on the ice, he writes (1818:9):

One sadly looked at another, lost in profound thought as to how and where we were to end our lives, finding ourselves in this sorry state in which we beheld death.

He expressed his joy at his friendly reception among the Inuit as follows (30-31):

We felt as if we had risen from the grave. This wild people's generous love, that surpasses that of many Christians indeed, made us wistful in our hearts and grateful to God. To be able to hear children wailing reconciled us to our fate. It seemed to us that we were back home. They comforted us with a kind of soup made of seal meat boiled in water. Anyone who has not undergone a similar experience could not believe how heartily we ate.

It must be emphasized that Kat does not regard the unbaptized Inuit with less esteem than the Christian ones. The quotation reveals their charity towards strangers that surpasses that of many Christians. He praises the treatment he received among the Moravian missionaries, and equally values the care of the heathen Inuit (Kat 1818: 46).

Hoekstra mentions the ordeals of frozen lips, fingers and toes, and of thirst several times. Unlike Kat, he did not have to exchange the shelter of his ship for the Arctic cold suddenly. When his ship was crushed by the ice pack on 25 August, he and his crew stayed with Captain Duncan of the Dundee till 6 October. After leaving, they were without any shelter for ten days, toiling along towards the mainland coast of Greenland. After spending eight days first with a Danish and then with an Inuit family, Hoekstra and his men made their way southwards in sloops, because there was not enough food to spare for them in these places. After four days in sloops they reached Nuugssuaq on 27 October (1828: 35-61).

Hoekstra's perception of his predicament is often coloured by despair. The night before they left Captain Duncan's ship, they could get no sleep because of the fear of death on the journey to the mainland the next day (p.34). When they finally arrived on shore, they lit a fire of some planks ripped off the sloops in order to melt some of the snow to quench their thirst; but a fight broke out among the crewmen over the water (p.45). In the sloops on their way from Prøven to Nuugssuaq they had such a frightful sleepless night because of pain and cramp that Hoekstra feared that even the strongest of them would succumb (p.58). But these moments of despair are in sharp contrast with those of relief and joy. When they reached Nuugssuaq, they lodged with the Inuit and were given a meal (p.62):

Our food was ready at night. We had such a good meal that nobody among us had ever had such a good meal in his life, though it was only pea soup and groats, without any meat or fat. We felt keenly that its heat warmed us and did us good.

Hoekstra added a description of Inuit life to his journal. In 24 pages (90-114) he gives much information about their means of subsistence, their houses, their boats, but also about topics much more difficult to observe, namely marriage, birth and death.

In a way Kat and Hoekstra are what we would call nowadays social anthropologists engaged in participating research. They came through an Arctic winter among the Inuit. They not only lived among them, but they lived like them as well. Hoekstra's view of the Inuit is not an unfavourable one, but, unlike Kat, he holds the Christian Inuit in higher esteem than their unbaptized kinsmen (Hoekstra 1828: 64). With disgust he notes their filthy habits, the heat, smoke and vermin in their dwellings, but he praises their hospitality, vigour and endurance in turn and attaches far more importance to the technique used in the construction of their kayaks and their capacity to make fine clothes out of skins (Hoekstra 1828: 38-40, 50, 53, 63, 65, 69, 91-94, 102).

Neither Kat nor Hoekstra say anything about the Arctic scenery. They note the atmospheric and sailing conditions, and they describe the trek across the ice pack and the voyage by sloop. This is hardly surprising in an account of shipwreck and survival. It is this very theme that shapes the image of the Arctic prevailing in both booklets. Owing to the hazards of the ice pack and the weather it is an exceedingly dangerous region. Safety lies in the protection of a ship and plentiful food; without a ship death is at hand. The only recourse is to try to reach an Inuit settlement, preferably inhabited by some Danish colonists as well. The Inuit, Christian as well as heathen, are a friendly people who will extend shelter and food to those desperately in need of them. But the most important lesson

the reader can learn from these accounts does not concern the Arctic, but mankind. Man can indeed survive in harsh and desperate circumstances so long as he is prepared to fight, but what is more important, he must first and foremost rely on God.

#### A mode of thought

Religion is an integral part of all four booklets. Martens, Moubach, Kat and Hoekstra were all devout Christians. In the dedication of his book to the Hamburg burgomaster and aldermen, Martens vindicates the Hamburg voyages to the north with a biblical command: Man shall not leave to go to waste what God created in His wisdom. So it is that obedience to the word of God makes the Hamburg merchants launch their ships to the north in order to exploit God's Creation.

Moubach (1720: 137-39) fears that his reader may conclude on the basis of textual evidence that he minimizes God's power, and regards Nature as a divine power in its own right. There may be people, he writes, who have such an unsteady faith that natural philosophy undermines it altogether. The true Christian, however, studies the Great Dictionary of Nature in order to worship the skill and wisdom of his Creator even more. God created man as the highest form of life; all other forms of life are subjected to him. Therefore man, placed at the pinnacle of creation, must proceed to the study of nature. But man is not at all perfect; he is ignorant in many respects and his enterprises often fail to work out well. God, however, is perfect and thus His Creation is perfect too. Nature is in the hand of God as a brush in a painter's hand. God governs the brush. Both Martens and Moubach vindicate human enterprise in Christian terms. For them voyaging to the cold and inhospitable Arctic and studying nature there, are in accordance with God's decrees and a fulfilment of man's duty to Him.

In their journals Kat and Hoekstra often refer to God. In moments of distress or joy they express their feelings in the language of the Holy Bible. When on 11 October 1777 Kat reaches the mainland at Statenhoek with 17 men, they are much relieved, but have to spend the night in a blizzard while they are running out of food and drink. They cannot lie down to sleep, because their clothes are wet. Kat (1818: 18) writes:

In this plight we could imagine the sufferings of our Saviour Jesus Christ to some extent or at least properly appreciate them now that we had to endure sufferings ourselves.

Some days later, on 17 October, Kat and his men are again forced to spend the night in the open. They are so

desperate as to be ready to give up their souls to the Creator (28). Kat ends his account praising God (64):

I thank you God from the bottom of my heart for  
all the undeserved mercy bestowed on me, Hidde  
Dirks Kat!

Hoekstra (1828: 36-37, 71-73) dwells on his religious feelings even more. Before starting their march across the ice pack on 6 October 1826 he and his crew pray to the Lord. At the beginning of November all his crewmen had been lodged with the Inuit or with Danish settlers: he preached a sermon to thank God and they sang Psalms 27 and 28.

Martens on the Hamburg voyages to the North, Moubach in his description of the Arctic scene, Kat and Hoekstra struggling on to stay alive, all of them were anxious to show in their writings that they were true Christians. Martens regarded the voyages to the north as pleasing to God. Moubach considered nature as the Great Dictionary in which God revealed His might and wisdom. Kat and Hoekstra had God always in mind and praised Him for His mercy. The mode of thought of these four authors was determined by Christian doctrine. In the words of Psalm 27, sung by Hoekstra and his men:

The Lord is my light and my salvation;  
whom shall I fear?  
The Lord is the strength of my life;  
of whom shall I be afraid?

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#### Notes

1. Suikertop is the name Hoekstra gives to the place he first came ashore. It must have been somewhere north of Upernavik and cannot have been Sukkertoppen (Maniitsoq), which is far to the south.
2. Statenhoek and Kap Farvel on the map accompanying Kat's journal are two separate capes.

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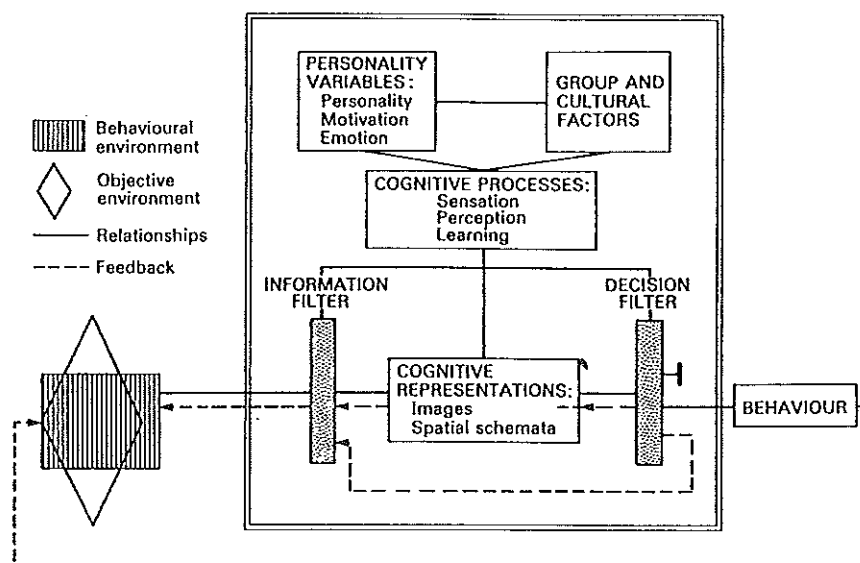


Fig.1. A paradigm of individual spatial cognition and behaviour (From Gold 1980: 42).



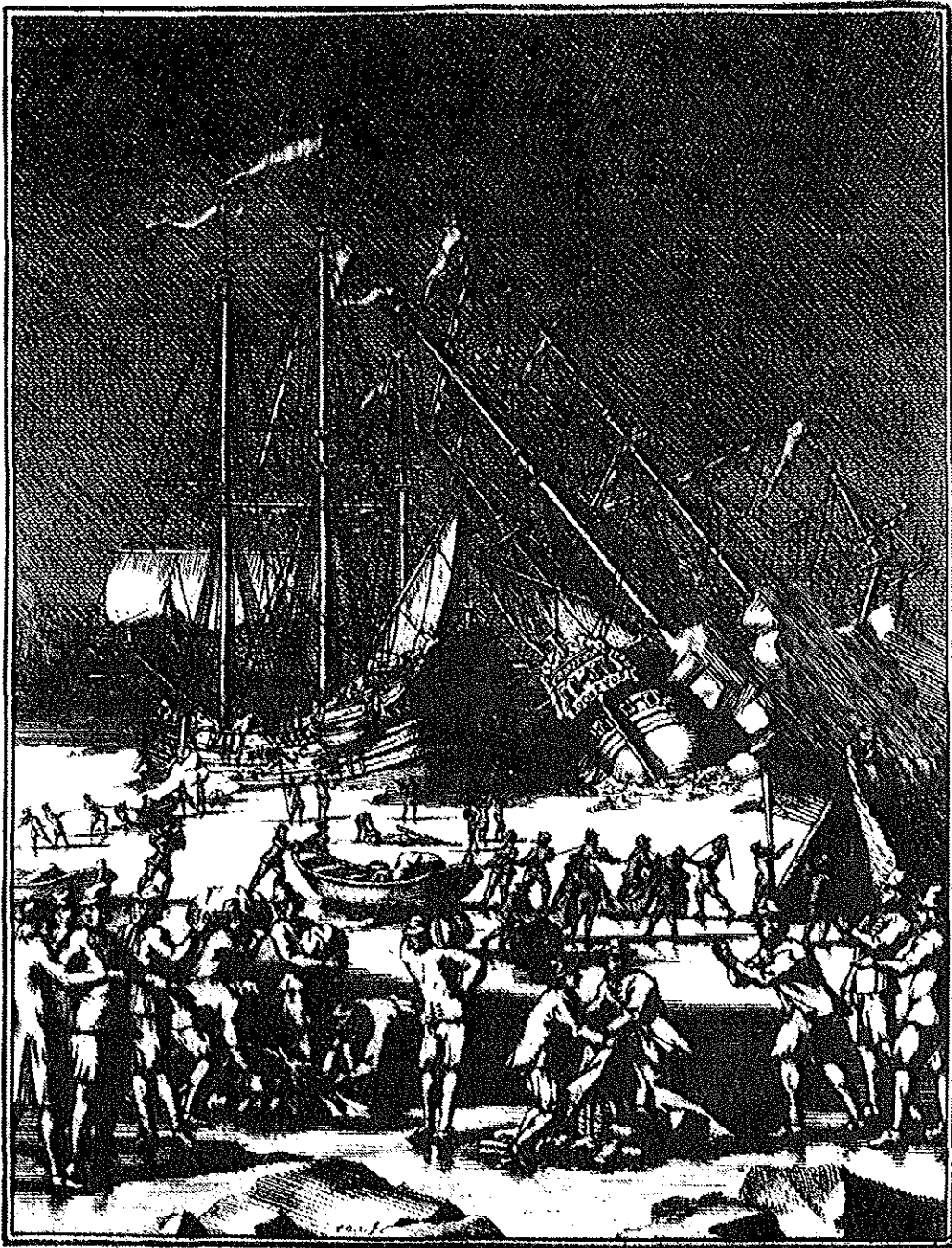
Fig. 2. Frontispiece of Moubach 1720.







*Fig. 5. Northwest-Spitsbergen according to F. Martens (1875).*



*Fig.6. Ships crushed in the ice pack (From Moubach 1720).*

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wild and dark public cleft,  
    there,  
carved from the ridge,  
    humid chasm  
        surrounded with steam from a fermenting river  
        bed

here,  
before the thin-skinned house, silent  
    near the cauldron  
        sitting on the boulders

through moss filters grit  
from a pre-human present

(near Narssarssuaq, 1972)

This poem is taken from: *The White Shaman* (Arctic Songs I), Amsterdam 1973.

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Hans C. ten Berge *Bivouac – a Poem*

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