Meddelelser om Grønland.

Carlsbergfondets Expedition

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udført i Aarene 1898—1900

under Ledelse af

G. Amdrup.

Anden Del.

Indhold.

Meddelelser om Grønland,

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I.

Notes

on

some specimens of rocks

collected by C. Kruuse on the East coast of Greenland between lat. 65° 35′ and 67° 22′ N.

By

Dr. Otto Nordenskjöld.

Owing to his having started for the South Polar regions, the author has had no opportunity of re-reading this translation in its final form, nor has he been able to correct any of the proof sheets.

Our knowledge of the petrographical conditions of the East coast of Greenland has hitherto been very scanty. H. Knutsen, a member of the Holm Expedition of 1883—85, certainly gives us some information as to the kinds of rocks which occur at and south of Angmagsalik[1], but no petrographical investigation appears to have been made.

A. E. Törnebohm[2], who described some of the material collected at Tasiusak (King Oscar's Harbour) during the Nordenskiöld Expedition of 1883 must therefore be regarded as a pioneer in these investigations, and the material he describes is of great interest for several reasons. The specimens in question include garnet-gneiss, pyroxene-gneiss, hypersthene-gabbro, and bronzite-diabase in blocks, besides some — in this connection less interesting — proterobase-aphanite and flint. According to his short notes, the pyroxene-gneiss consists of plagioclase, orthoclase, quartz, biotite, hypersthene, «omphacite», and exceptionally of hornblende and garnet. The gabbro consists chiefly of plagioclase, besides pyroxene and biotite and some diallage and quartz. The bulk of the broncite-diabase is composed of plagioclase and broncite besides magnetite and some biotite and apatite.

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1) Meddelelser om Grønland IX, p. 237 and following pp.

2) Geolog. Fören. i Stockholms Förh. VIII (1886), p. 439.

The above-mentioned kinds of rocks are of great interest on account of the rhombic pyroxene found in them, as the presence of this mineral often indicates the probability of the occurrence of rocks containing still more rarely associated ingredients. The moment was thus eagerly awaited when a more considerable material could be procured from this locality, in order to ascertain how widely distributed these peculiar kinds of rocks were in the district in question.

Only once since has a specimen of rock from the above-mentioned district been examined, viz. a brown gneiss from Angmagsalik brought by E. Bay in 1892 and very briefly described by him[1]) as consisting of felspar, quartz, broncite and biotite. Here again there is the same peculiarity, but that is easily explained by the fact that the specimen is from the very same locality as those collected during Nordenskiöld's visit.

Under these circumstances I was very much interested in getting the material collected by Mr. Kruuse for examination. It is not considerable, but it contains specimens from a great many localities about Angmagsalik, and also numerous small specimens from different stations along the coast between Angmagsalik and lat. 67° 22′ N.

The main result of the examination was, however, negative, as none of the specimens which I have had for examination exhibited any unusual mineralogical combination, nor more particularly, did I find rhombic pyroxene in any of the specimens[2]). The rock in question, consequently, does not seem to be widely distributed even in the district of Angmagsalik, or at any rate it does not appear to be so common on this coast as might be expected, judging from its frequent occurrence in the specimens previously examined.

[1]) Meddelelser om Grønland, H. 19, p. 176.

[2]) With the possible exception of the below-mentioned amphibolite-pikrite from »the gravel-pit».

Another question of great interest is the nature of the numerous dykes of basic rocks which traverse the main species of rocks of this district. All earlier explorers have mentioned them under the name of diabase, and Bay particularly emphasizes the fact that no basaltic dykes have been met with [1]. Kruuse, on the other hand, in his preliminary account of the expedition [2] mentions both basalt and diabase in a manner which seems to indicate that he is uncertain which of the names is the more correct. From what follows it will, however, be seen that this is not surprising, as petrology cannot always solve this problem, some of the rocks seeming to approximate in their characteristics to both the above-mentioned groups.

I shall now briefly describe some of the most important localities in which these rocks occur.

The district of Angmagsalik.

The greater number of the specimens which I have had for examination come from this district. The most complete series is from a place called «the gravel-pit» (Grusgraven) [3] situated at about lat. 66° 5′ N. and long. 35° 35′ W., some 55 miles NE. of the trading-station. According to Kruuse it is a valley surrounded by lofty gneiss mountains and partly barred by a greenstone dyke. Among the specimens collected at this place, of which some are loose fragments, which, however, can hardly have been brought there from any great distance, the following are noteworthy: — a light-coloured medium-grained

[1] Geographisk Tidsskrift Bd. 15, p. 64.

[2] l. c. p. 177. Nor did I come across any greenstone dykes in the immediate neighbourhood of the colony itself, the nearest I observed being about 16 miles off. C. Kruuse.

[3] Properly speaking, this lies outside the district of Angmagsalik, which only extends to Sermiligak, but it is mentioned here in this connection as being the northernmost point whence I was able to bring a fairly rich collection. C. Kruuse.

biotite-gneiss with numerous stripes of red orthoclase; a dark-green amphibolite; a micaceous gneiss with large «eyes» of an impure garnet; a white pegmatitic rock rich in biotite; and a garnet-gneiss where dark and light layers alternate; the former containing much hornblende, and the latter consisting exclusively of garnet and quartz. There also occurs another peculiar rock consisting largely of garnet, which is, however, completely decayed and coloured by oxide of iron and therefore indeterminable as is also the case with several other specimens from this locality. On the whole it may be said that the rock consists of biotite-gneisses very rich in hornblende and garnet, the latter sometimes supplanting the other mineral ingredients.

These rocks when examined microscopically do not exhibit any specially peculiar characters. The first-mentioned variety consists chiefly of orthoclase besides microcline, quartz and biotite. The quartz shows «myrmekitic intergrowths»[1]) in orthoclase, mostly in the smaller grains, but also here and there at the edges of the larger individuals. The rock has distinctly been subject to strong pressure, but the quartz hardly shows any undulating extinction and its present structure is undoubtedly due to re-crystallization.

The amphibolitic variety consists chiefly of a compact, somewhat bluish-green hornblende, besides some plagioclase and garnet. The latter is, as in all the other varieties, isotropic, and though it usually contains numerous interpositions of quartz, the specimen in question is singularly pure. There occurs, moreover, some iron-ore in skeleton-like crystals grown together with felspar.

Another specimen contains besides the above-mentioned minerals a great abundance of quartz interposed in garnet, and also a very strongly refractive mineral in numerous greyish-

[1]) Term introduced by J. J. Sederholm, Bull. de la Comm. Géologique de la Finlande Nr. 6, Helsingfors 1899.

brown elliptic grains, which is probably titanite. Other varieties contain biotite as well as hornblende. Apatite and zircon occur more particularly as interpositions in biotite. On the other hand, compact grains of ore are rarely found in these forms and a distinct succession of crystallization between the minerals can nowhere be traced.

Finally, a rather peculiar variety may be mentioned which occurs in a single piece and looks as if it had been found detached, though it evidently had not been carried very far. It consists of idiomorphic crystals of pale, yellowish-green hornblende with a perfect cleavage, lying in a mass that consists chiefly of irregular grains of a still paler, green mineral, sometimes showing imperfect cleavages, sometimes much laminated, and in the latter case showing a maximum extinction of about 18° towards the cleavages. The variety in question is doubtless an actinolitic amphibole. There occur further irregular grains both of colourless, fresh olivine and of a dark-green variety of spinel, besides a small quantity of a peculiar pink pyroxene which appears to have an oblique extinction, but otherwise bears a strong resemblance to the rhombic pyroxene in the rock from Angmagsalik. The rock, which may most properly be called amphibolite-pikrite, perhaps forms an ultra-basic link in the series described by Törnebohm and mentioned above, and it also reminds one strongly of the rock met with by N. Hartz at Kobberpynt in the interior of Scoresby Sound, and described by Bay and Ussing[1]).

From the district of Angmagsalik — i. e. from a more southerly part of it than the above-mentioned (lat. 55° 53′ N. and long. 36° 5′ W.) — there are two specimens, viz. from the graphite rocks at the entrance of Ikerasak. The

[1]) Meddelelser om Grønland, H. XIX, p. 157. On the rock at «the gravel-pit» a malachite-like covering also occurred, but so high up on the extremely precipitous face that its characters could not be ascertained with any certainty. C. Kruuse.

one is a coarse graphite schist[1]) which when examined microscopically was found to contain besides graphite a quantity of biotite, quartz, and plagioclase. Approaching close to this rock is an eruptive rock (probably a dyke) which when examined microscopically proves to belong to the same class of eruptive dykes as those reported below from some places around Cape Dan. It consists of a basic plagioclase in thin, elongated prismatic columns, particularly fresh and unbroken and showing a zonal structure; a greyish brown augite in the shape of somewhat irregular grains; crystals of magnetite; and a fine, fibrous mass of laminæ of a green mineral, doubtless chloritic, with a rather strong double refraction. Olivine also occurs along the cracks turned into a substance resembling or identical with the above-mentioned.

While, on the one hand, it is obvious that certain true diabases, viz. in Sweden, forms of the so-called Åsby type, are as well-preserved as the specimens in question, yet, on the other hand, it must be acknowledged that they are almost identical with the basalts occurring in numerous beds and dykes in the interior of Scoresby Sound, among which may be mentioned the intrusive beds of basalt in the Jura sandstone in the South-Eastern part of Jameson Land; and on comparing these rocks one cannot but conclude that the dykes in the district of Angmagsalik are undoubtedly nearly contemporary with the immense massive basalts on the more northerly coast.

A similar rock occurs in the collection from the island of Kumarmiut situated more to the south near Ingmikertok (lat. 65° 45′ N. and long. 36° 55′ W.). The plagioclase, augite and ore resemble those described above; and here as there

[1]) The graphite schist lies about NE.—SW. and dips 70° due NW.; the thickness is about 11 cm. The rocks are connected with the south side of Ikerasak and consist alternately of crystalline schists and of a light-coloured pegmatite gneiss (striped granite). The sides of the sound show lofty sections of rocks consisting of the same successions of layers.
C. Kruuse.

the rock has always been poor in olivine of which only a few fresh grains are left, while the rest has been altered into a yellowish-brown serpentine substance. No chloritic scales have been met with. I have also had an opportunity of examining some specimens from Erkiligartek (NE. of Cape Dan). The chief species is a very light-coloured biotite gneiss rich in garnet. Microscopical examination shows it to consists mainly of orthoclase and quartz, sometimes forming «myrmekitic intergrowths»; the quartz occurs in the form common in gneisses, with undulating, irregular and idented outlines. The species in question does not contain much plagioclase; the biotite has no interpositions, and the garnet shows nothing remarkable. In this rock there is a dyke similar in character to the above-mentioned basalts. It is somewhat coarser, the magnetite is not conspicuous, and I have not come across fresh olivine, but the serpentic and chloritic elements occur more abundantly. Notwithstanding this the rock has retained a comparatively fresh appearance, and I may add that several of the true basalts of this type from Scoresby Sound are more strongly metamorphosed than is the case with this rock.

I have further had an opportunity of examining some interesting specimens from the same district, from Anava, one of the Cape Dan islands (lat. 65° 38′ N. and long. 37° 7′ W.). To judge from the label there should be in the neighbourhood a granitic rock, but of this there are no specimens. Instead of this I found a moderately coarse, green amphibolite consisting of green hornblende with a centre or centres of a light-coloured mineral undoubtedly a pyroxene, both forming regular intergrowths with felspar; there are also specimens of quartz and garnet, which latter is always found surrounded by the lighter coloured minerals. Large individuals of titanic iron also occur.

This rock contains a vein of a pegmatitic rock, which consists of peculiar, and as it seems regular micro-pegmatitic intergrowths of singly-refracting garnet and quartz. In the same vein are also parts containing crystals of muscovite, an inch in length. Both these rocks are worthy of closer investigation.

The district north of lat. 66° N.

The specimens from this district have been collected from a few localities only, viz. Cape Wandel; Cape Jørgensen; and Ikersuak (Steenstrup's glacier) situated some 18 miles further south; the promontory opposite Langø (Ikerasarmiut); Lilleø, lying in the vicinity of the latter; and furthest to the north, Nualik, lat. 67° 15′ N.

The rocks collected from Cape Wandel consist of a moderately coarse, grey or reddish, granitic rock, and a greenstone which has doubtless traversed the former and which when examined microscopically proves to be a basalt of a type exactly similar to those described above from Cape Dan.

Among the specimens collected to the north of this locality, not a single typical granite or gneiss occurred, and of rocks which are known for certain to be Archæan, only the under-mentioned peculiar granulites from Nualik were found. Kruuse, however, particularly emphasizes the fact that these species of rocks constitute the chief part of the base of the rocks, and Lieut. Amdrup also mentions them from the districts lying further northward up to 69° latitude. How far this may be owing to a confusion with any of the under-mentioned species of rocks, or whether their non-appearance is quite accidental I cannot say for certain [1]).

[1]) I have not met with true massive granites north of Cape Wandel, where I found variously coloured (red, white, grey) granites, traversed by 3 greenstone dykes. Crystalline schists occurred as the chief kind of rock as far as I penetrated, but they were traversed by eruptive dykes so numerous and of such great size as to constitute more than one-third of the mass of the rock walls. As the expedition had also other objects in view I was prevented from bringing any larger collections, and I

All the specimens from Ikersuak[1]) are of greenstone, viz. both a collection labelled «Talus», and a light-grey, rather solid, eruptive rock, probably a dyke. The latter has a strongly diabase-like appearance, and the bands of plagioclase are more completely altered than is the case with the basalts of this district; this also applies to the augite. Chlorite and epidote, on the other hand, occur abundantly[2]); olivine I have not observed. In the former collection there is another eruptive rock which seems to be the margin of a dyke similar in type to the one just described. It is an augite-porphyrite with porphyritic crystals of a somewhat prismatical plagioclase, and augite in a mass so dense that its constituents cannot be distinctly separated from each other. Besides these rocks there are others of a different appearance, one of them a diabase of basalt-like type, but much altered, the augite being converted to uralite, and the titanic iron changed to leucoxene, while the presence of olivine cannot be identified with any certainty. Of more interest is a true amphibolite consisting of dark-green

consequently chose to gather everywhere small specimens of such rocks as appeared to me to be uncommon, and beyond this only to collect minerals from the numerous greenstone and pegmatite dykes. In a single case only I regret not having been able to collect specimens of a remarkable rock, viz. a peculiar conglomerate which occurs along the shore from Langø to Cape Christiansen and which formed the base of the islets (Smaaholmene) and of several promontories. It consisted of a black, grained base, with light coloured grains, 5—30 cm. in diameter, disseminated through it. C Kruuse.

[1]) The locality consists of a mighty wall of rock about 2000 feet in height and parallel with the coast; the rock is on the north side of the promontory between the two southerly glaciers and is traversed by eruptive dykes parallel to the wall, while at its foot in the shelter of a small promontory — a block standing in the back-ground some 50 feet in height — has been accumulated an immense talus of large sharp-angled blocks which have tumbled down from the rock wall. The work of demolition has been very violent, and many of the blocks have been broken off recently. C. Kruuse.

[2]) The wall of rock is, as it were, powdered over with light-green dust. C. Kruuse.

compact hornblende, plagioclase, orthoclase, quartz, some garnet, and ore, and titanite. The structure is that of the crystalline schists, without any distinct chronological succession between the minerals.

Some few specimens from Cape Jörgensen seem to be variations of the above-mentioned rock, viz. an unusually coarse crystalline diabase of the Åsby type, consisting of diallagic pyroxene, plagioclase, comparatively fresh olivine, brown hornblende and large grains of ore without leucoxene, but surrounded by brown mica.

The rock from Ikerasarmiut[1]) belongs to the basaltic type, but has undergone considerable alteration. I could not ascertain for certain whether it contained olivine.

A specimen of rock from the coast of Storø[2]) belongs to quite a different type, as it shows contact between a white pegmatitic granite, containing elements of quartz and felspar, which when occurring on large flats of druses are crystallographically well developed, and a dark-green porphyrite, which may most properly be regarded as the main rock. The latter consists of elongated prismatic crystals of plagioclase lying in a mass of irregular-shaped individuals of hornblende and biotite, which partly merge into the edges of the crystals of plagioclase; it also contains evenly disseminated grains of iron-ore. Mica and hornblende, on the other hand, often occur crowded together in compact masses, looking on the exterior of the rock like homogenous crystals of some kind of basic mineral. The boundary line between this rock and the granite is not very definite.

[1]) The promontory opposite Storø lat. 67° 4′ N. and long. 33° 20′ W.

[2]) Lat. 66° 55′ N. and long. 33° 34′ W. The northern coast of this island consists of porphyrite in the form of a very large dyke, but very much broken down, and well-preserved only where it is covered by pegmatite which forms a small promontory. The main part of the island consisted of crystalline schists. As far as I could judge from a distance, the pegmatite occurred in situ on the mainland about 5 miles westward, but only for a short distance (dyke). C. Kruuse.

The latter is composed chiefly of orthoclase and quartz besides some plagioclase. The quartz is mostly micro-pegmatitically intergrown with felspar.

The last and rather large and interesting collection of rock comes from Nualik. Among the specimens collected in this locality one approaches very near to those just described. It is labelled «vein in the gneiss» and consists of a white pegmatite granite exactly similar in character to those just described, only that the micro-pegmatitic structure is still more obvious. This rock is traversed by a band of solid greenstone, 2 inches wide. The latter is interesting: plagioclase appears to be its chief constituent, but otherwise it consists of a decidedly homogenous mass of even-sized grains of felspar, and of almost colourless pyroxene, besides some iron-ore and mica. As is the case with the specimen from Lilleø, the biotite when approaching near to the pegmatite boundary increases both in quantity and in the size of the individuals, and a fairly large quantity of green hornblende occurs simultaneously.

Among the specimens collected are several pegmatites of the same nature as the one described. One specimen shows a large druse with quartz crystals up to an inch in length, besides felspar and some calcite. Besides these there occur numerous peculiar types of rocks, among which may be mentioned a yellowish limestone, a drusy silica breccia, and two stratified specimens of rock of the type of the crystalline schists. One of these is a considerably weather-worn light-coloured rock, the other resembles a dark schist and, examined microscopically, is found to contain a very dense, granulitic mass of felspar (orthoclase), besides distinctly marked plagioclase, small evenly distributed grains of ore, and an abundance of a colourless monosymmetrical mineral in irregular grains, undoubtedly a light-coloured pyroxene. This mass occurs alternately with thin layers consisting of light-grey rather fibrous hornblende through which are dispersed grains of iron-ore, together with some biotite.

That these two last-mentioned detached[1]) pieces of rock belong to the Archœan rock is very probable, though here too, as in a previous instance, the absence of true, coarsely-crystalline gneisses and granites is remarkable.

The other specimens consist of dark, diabase-like rocks. One of them comes very near to the basalts described above, though it is a good deal altered, and the presence of olivine cannot be identified with any certainty. Another belongs to a more particular type, as it contains porphyritic crystals of fresh pyroxene, upwards of one centimetre in length, of which the outermost sides only have partly changed to uralite. They occur in a ground-mass, somewhat changed by weathering, rich in ore, and also containing a great abundance of calcite, and the most remarkable constituent of which is a brown, pleochroictic hornblende in the shape of long needles ($\mathfrak{a}$ light-yellow, $\mathfrak{b}$ dark-brown, $\mathfrak{c}$ dark-brown; $\mathfrak{c} = \mathfrak{b} > \mathfrak{a}$).

The remaining specimens from this district are not of any great interest.

[1]) The two specimens in question were certainly found detached, but occurred in the immediate neighbourhood of and belong beyond doubt to a series of very precipitous strata of strongly disintegrated schist. The ravine formed by the disintegration of the above-mentioned precipitous strata divided the peninsula of Nualik nearly parallel with the large pegmatite dyke. Several such ravines divided the eastern part of the tongue of land from the mainland, and at last broke it up into several islets and rocks. The limestone and quartz occurred in several places, but the specimens of druse and silica were collected from a playground for children in «the dead house». Its late inmates no doubt picked them up in the neighbourhood and brought them home as playthings, as is customary among the Esquimaux. A schist containing light-coloured mica and quartz was found in situ on the small islands of Aputitik just off Nualik and the late inmates utilized them as paving-stones for the floor in several tents as well as in the deserted house, and they also served as roofing material for the entrance to the house.
C. Kruuse.

Résumé.

As a summary of the petrographical conditions of the parts of East Greenland with which we have been dealing, the following points may be noticed: —

The rocks between Angmagsalik and about lat. 66° 30′ N. are chiefly composed of gneisses, generally rich in garnet. Besides this there are several specimens of pegmatites, and it is probable that true granites also occur, but this cannot be proved from the material collected. The latter contains, on the other hand, some greenstones (collected from dykes) of a nearly related type, which from a petrographical point of view resemble so closely some basalt dykes in the neighbourhood of Scoresby Sound that they ought doubtless to be classed with them. These dykes, however, do not seem to be common here.

Of the rocks containing bronzite, of which several varieties seem to constitute the bulk of the rocks around the trading station of Angmagsalik there are no specimens in this collection and they are therefore probably not widely distributed.

One of the specimens, however, found some 55 miles NW. of Angmagsalik approximates to them; it is an amphibolite-pikrite containing pyroxene and spinel, and is related to the rock from the interior of Scoresby Sound described by Bay and Ussing.

In the northernmost part of the district between lat. 66° 33′ and 67° 15′ N. the rocks seem to change their character. Of granites, only pegmatites and micropegmatitic veins occur. True gneisses are wanting in the collection, and from one locality only there are a few specimens of a rather peculiar granulitic schist. Basic rocks, on the other hand, are of much more frequent occurrence, most of them being diabases which approach more or less to the basalt type, and may very well belong to the same late- or post-mezozoic period of formation

as the dykes in Scoresby Sound. Others are still more altered, and porphyrites of rather different appearance also occur.

Lastly, amphibolites are also met with among the specimens, but no opinion can be formed of their geological appearance from the material in hand.

From the district between lat. 69° 25′ and 65° N. traversed by Lieut. Amdrup in the summer of 1900 there are no specimens, but from the short preliminary report [1]) it occurs, that the southern part of this district, up to lat. 68° N., consists of the same rocks that are found in the neighbourhood of Nualik, viz. Archœan rocks with greenstone-dykes, the latter in so great number that they almost surpass the former in mass. To the north and east of the great fjord Kangerdlugsuak basalts begin, which afterwards form a continuous mass all the way up to Scoresby Sound.

[1]) Geogr. Tidsskr. 1901—02, p. 34.

II.

Samples of the sea-floor

along the coast of East Greenland 74½—70 N. L.

By

O. B. Bøggild.

I. Introduction.

The samples of the sea-floor collected by the Danish expedition to East Greenland, are in many respects of very great interest. The physical conditions which generally determine the nature of sea-floor deposits are here most characteristic and peculiar, in comparison with those of all other localities hitherto examined. The coast is rocky with great deep bays into which large glaciers flow; outside this coast the sea is generally covered by immense masses of ice, consisting of an irregular mixture of sea-ice, coast-ice, and glacier-ice, drifted on by a constant current along the shore; these peculiar conditions combine to produce in the samples an appearance widely different from that of all deposits hitherto known.

The most important characteristics of such deposits, and those which together determine their nature are essentially of three different kinds, viz. 1) The variation in size of the grains found in the samples, 2) The mineralogical constitution of the inorganic material, and 3) The number and nature of organisms found in the samples. A few other characters may be named which are not absolutely dependent on any of the above mentioned ones, but which are, nevertheless, of the greatest importance in determining the general nature of the deposit, viz. the colour and the greater or less degree of coherence in the clay. These characters are generally very difficult to account for by the conditions of the locality where the deposits have been formed, even though important conclusions on that point may often be drawn, as will be seen below.

With regard to the size of the various grains, it is of course to be expected that the samples now under discussion will belong to the more coarse-grained of those which have been collected from the sea-floor. Both the coast erosion and the ice-transport may supply a large quantity of clastic material, whereto may still be added some derived from moraines or from the solid rock at the bottom itself. A closer examination also proves that the samples for the most part contain a very great number of pebbly ingredients, such as will be found in greater numbers scarcely anywhere, except in very shallow-water deposits. In this connection, it is natural to draw a comparison between these samples, and those from the Westcoast of Greenland, which in many ways bear a great resemblance to them. The transport-work of ice is however much less there, and consequently the West Greenland deposits are a great deal finer than those from East Greenland. The difference will be still greater, if we compare the latter samples with those obtained by the Fram from off the Northcoast of Siberia. Here there is no glacier-ice, and the coast consists for the most part of rocks such as sand and clay, which contain very few pebbles, consequently these samples are very poor in that respect.

There is however amongst the individual samples a much greater variation in the quantity of fragmental matter than might be expected. Even if the proportion of this is, on the average, very large, we find here and there a few samples where it is quite insignificant, or where no pebbles whatever are found. Such fine-grained deposits are sometimes found so situated in relation to the others, that it is impossible to tell the reason for this difference, but sometimes the variations may very well be due to the situation.

If we examine a geological map of East Greenland as given by Nathorst[1]) it will be seen that a number of different formations are found all along the coast explored by this expedition. This fact is of the utmost importance as regards the mineralogical constitution of the deposits; for the greater the difference found between the rocks of the various localities, whence the deposits have derived their material, the greater will be the possibility of determining the laws by which the individual ingredients are distributed. A closer examination now proves that, whereever a large tract of *archæan* rocks or of basalt extends to the coast, the samples which have been taken in the immediate neighbourhood of these, consist either exclusively or for the most part of these rocks. Somewhat farther away from the coast, however, they will be mixed up with a larger proportion of rocks derived from regions farther north. Beside these two chief ingredients, there are also various sedimentary rocks such as sandstones and slates, which are very plentiful in this part of Greenland. They however have not the same significance in the samples as the above mentioned rocks, as they are nowhere found in great tracts just near the coast, and on that account will always be largely mixed with other ingredients before reaching the sea. Moreover we are only able to determine sandstones and slates among the coarsest ingredients of the samples, and on this account a closer determination will always be somewhat unsatisfactory.

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[1]) A. G. Nathorst: Bidrag til nordöstra Grönlands Geologi. Geol. Fören. Förh. Stockholm Vol. 23, 1901, p. 275. Here and several other places reference is made to:
Die zweite deutsche Nordpolarfahrt in den Jahren 1869 und 1870 unter Führung des Kapitän Karl Koldewey Vol. II, Leipzig 1871, III, Geologi p. 471.
Den østgrønlandske Expedition udført i Aarene 1891—92 under Ledelse af C. Ryder. Part III, 5. E. Bay: Geologi. Medd. om Grønl. XIX, 1896, p. 145.

As has been proved, all the conditions are present which would allow of the samples being as varied as possible, both as to the size of the grains, and their mineralogical nature. With regard to the third important feature which serves to characterize the samples, the conditions for the preservation of organisms are very unfavourable. The amount of organic material contained in the samples is therefore exceedingly small. As the variation in appearance produced by the presence of large numbers of organic ingredients in the samples is usually of the most conspicuous nature — the samples being for the most part classified according to their organic contents — it will be seen that these particular ones must in any case have a rather uniform appearance. The small number of organisms in these samples is in the first place due to the great amount of inorganic material which is deposited all along this tract, and which perhaps nowhere else in the world is laid down to such a great extent. Moreover the number of small organisms, which live in this sea, is probably very slight. There is a possibility, however, that the organisms, as well as the inorganic ingredients may be derived in somewhat large numbers from the floating ice, being deposited at the bottom of the sea by the melting of this ice. A closer examination of the samples, however, proves clearly enough that the quantity of organisms derived in this way is also proportionately insignificant.

II. Mechanical constitution of the samples.

Thirty-eight samples have served as material for examination, and these were almost all obtained at long intervals along the East coast of Greenland, from about lat. $74^1/_2°$ to about lat. 70°. The distance from the shore varied somewhat as will be seen from the subjoined chart; as a rule it did not exceed a few kilometers.

In the following table XI will be given a general account of the situation of the deposits, the depth of the sea and the colour and general properties of the clay. Beside the localities of the above mentioned 38 samples, some have been mentioned in the table from which no samples have been taken, but where the nature of the sea-bottom is mentioned.

All the samples must, according to their nature, be classed with the grey deep-sea clay, though it might perhaps be correct to class some of them among shallow-water deposits. The limit between these two varieties is not determined by their petrographical nature, but is drawn as a rule at the depth of a hundred Danish fathoms (c. 200 meter). This is also approximately the depth at which the deposits begin to assume a more purely clayey consistency, while those formed in more shallow water often consist wholly or partly of gravel or sand. If, however, we take a single area, such as the above mentioned by itself, it is not possible to distinguish sharply between the two designations, since the nature of the samples is

Number of the sample	Lat. N.	Long W. of Grw.	Depth in Danish fathoms	Nature	Degree of coherence when dry	Colour
1	74° 18′	15° 25′	162	sandy and stony clay	rather coherent	pale brownish grey
2	74° 16′·5	15° 58′	152	—	—	brownish grey
3	74° 15′	16° 29′	124	stone		
4	74° 15′	16° 50′	116	coarse sandy and stony clay	slightly coherent	brownish grey
5	44° 15′	17° 10′	109	sandy clay	rather coherent	grey
6	74° 15′	17° 28′	108	—	—	pale brownish grey
7	74° 15′	18° 05′	79	stone		
8	74° 22′	18° 20′	84	sandy clay	rather coherent	grey
9	74° 27′	18° 40′	74	very sandy clay	slightly coherent	pale brownish grey
10	74° 03′	19° 11′	114	— stony —	very coherent	—
11	73° 55′	19° 11′	78	— — —	—	grey
12	73° 44′·5	19° 15′	87	— — —	—	pale brownish grey
13	73° 27	19° 32′	90	— — —	exceedingly coherent	—
14	73° 18′	19° 40′	146	clay	very —	grey
15	73° 13′	19° 55′	215	fine clay	exceedingly coherent	—
16	73° 06′·5	20° 07′·5	106	clay	— —	—
17	72° 58′	20° 20′·5	124	—	— —	—
18	72° 51′	20° 32′·5	124	sandy clay	very coherent	—
19	72° 45′	20° 42′	159	clay	exceedingly —	—
20	72° 39′·5	20° 50′	175	—		
21	72° 29′·5	21° 05′	139	—		
22	72° 18′·5	21° 22′	106	—	exceedingly coherent	grey
23	72° 10′·5	21° 25′	155	stone		
24	72° 02′·5	21° 27′	294	clay	exceedingly coherent	grey
25	71° 54′	21° 27′	226	fine clay	— —	—
26	71° 46′	21° 21′·5	161	stony and sandy clay	rather —	pale reddish grey
27	71° 38′·5	21° 21′·5	136	—	— —	pale reddish brown
28	71° 31′	21° 22′	114	stone		
29	71° 22′	21° 21′	160	sandy clay	rather coherent	grey
30	71° 17′	21° 21′	128	—	exceedingly —	—
31	71° 09′	21° 16′	128	very sandy and stony clay	slightly coherent	—
32	71° 01′·5	21° 13′	241	fine clay	exceedingly —	—
33	70° 53′	21° 11′	112	sandy clay	very coherent	—
34	70° 44′·5	21° 10′	159	—	— —	—
35	70° 35′	21° 15′	94	stone		
36	70° 29′	21° 21′·5	88	very stony clay	slightly coherent	grey
37	70° 21′	21° 28′	195	stony and sandy clay	rather coherent	—
38	70° 17′·5	21° 31′	228	clay	exceedingly coherent	—
39	70° 13′·5	21° 35′	247	sandy clay	rather —	—
40	70° 04′·5	21° 41′	223	stony clay	exceedingly —	pale brownish grey
41	69° 52′	22° 38′·5	90	stony and sandy clay	slightly coherent	—
42	70° 00′	22° 11′	136	—	—	brownish grey
43	South off Kap Hooker		135	sandy clay	rather coherent	—
44	71° 50′	22° 30′·5	142	fine clay	very —	greyish brown
45	71° 35′·7	22° 05′	202	—	— —	—
46	The mouth of Hurry Inlet		70		exceedingly coherent	reddish brown

largely dependent on other circumstances, which are not directly connected with the depth. A brief survey of the above table will show us, that there is no very direct connection between the nature of the deposit and the depth of its formation. As a rule it may be said that all the samples which contain the largest amount of clay were obtained from a greater depth than a hundred Danish fathoms, and thus may deserve the designation of grey deep-sea clay, but that the greater part of the samples which contain a large proportion of sand and clay are from very varying depths.

The character of the samples depends not only on the depth from which they are procured, for the greater or lesser distance from the shore at which they have been formed also exercises an influence on their composition. Generally these two influences go pretty much together, so that it is not easy to make sure whether one or the other plays the more prominent part, but in many cases it is possible to see the direct effect of one of these influences. It is thus fairly evident that the greater number of samples from 14—22 are almost pure clays owing to their having been obtained so much farther from the shore than the other samples. The influence of the depth is seen still more distinctly in some individual cases. Thus sample No. 30, which was taken from the immediate neighbourhood of the shore, is very fine-grained in comparison with its neighbours and is consequently from a much greater depth.

That the depth and the distance from shore combined are not always sufficient to determine the general nature of the deposits is proved in a very striking manner by samples No. 1—7, which were taken in a continuous line at right angles to the coast-direction. Here both the depth and the distance from shore decrease from Nr. 1 to 7, and in spite of this, the samples are rather finer at the beginning of the series. From this we may certainly conclude, that the greater number of the coarser ingredients in the samples cannot have been transported directly by the sea-water, for if this were the case, a gradual sorting of the material must take place, as is seen in so many other places. What other causes can have produced this strange result I shall not here enquire; we can only imagine two other ways in which the coarser ingredients can have got into the samples, viz. either from the ice or from pre-existing solid or loose rocks at the bottom of the sea; but which of the two causes is the more likely can only be determined by a closer examination of the mineralogical constituents of the samples.

The consistency of the samples varies very much, as will be seen by the table, and the same is the case with their degree of coherence when dry. This last property is nearly proportional to the amount of clay in the samples, as we have been already led to expect. There are however a few rather characteristic deviations from this rule, and even if the degree of coherence cannot be directly measured, but is only founded upon a rough estimate, these deviations are so conspicuous that they may be considered as definitely proved. Thus sample No. 28 which is designated «exceedingly coherent» contains a large amount of sand, and shows, as will be seen from the following table only 47.7 per ct. of its ingredients to be below 0.01^{mm}. Neither does Nr. 22, which is about the most coherent of all the samples, contain much clay; but it contains 49.1 per ct. of finer ingredients. Let us on the other hand consider Nos. 26 and 27 which are only designated «rather coherent», and yet they contain as many of the finer ingredients as the preceeding ones viz. 42.4 and 47.5 per ct. respectively. Moreover No. 43 is designated very coherent, although it is about the finest of all the samples with 76.6 per ct. clay. As all the samples were collected and kept in exactly in the same manner, the variations of the degree of coherence cannot be due to these circumstances, and must therefore be founded on the differences in the nature of the clay itself. It is impossible to say for certain wherein these variations consist, as they are probably dependent on the physical nature of the finest clay-particles. It is rather characteristic that two of the last-named samples No. 26 and 43, which have a slighter degree of coherence than would be expected from their constitution, are of a distinctly browner colour than the majority of the samples. This seems to show that the degree of coherence of the samples has a certain connection with the colour, though we are not yet able to judge on what this first quality is really founded. Further observations may possibly enlighten us on this point.

With regard to these samples the colours are unusually homogeneous. For the most part they are either grey or have a slight brownish or reddish tinge. Only 14 of the samples are designated brownish-grey, and 3 greyish-brown, one with a reddish tinge, and only one sample differs from the others in having a very strongly pronounced reddish-brown colour. Otherwise not a single sample comes nearer to brown than exactly half-way between grey and brown, and yet, in all samples examined from other localities distinctly brown-coloured ones have not unfrequently been found among the others. It is generally difficult to tell the reason for the differences in colour. They have no direct connection with the mineralogical or mechanical properties of the samples, but depend partly on the chemical nature of the clay; generally the samples of the most pronounced brown colour contain most sesquioxide of iron. There is every reason to suppose that the clay was of a grey colour when originally deposited, but that gradually by oxidation at the bottom of the sea, it becomes browner and browner. If this oxidation takes place in all the deposits, the colour must be in close connection with the rapidity with which they are laid down, so that the ones which are deposited most slowly will have the longest time in which to be subjected to the oxidation, and will thus obtain the strongest brown colour. The slowly-formed deposits will probably always be the finest, as they must be formed in places where the ice cannot be subjected to melting to any great degree, and where the coast erosion and the currents have had no opportunity of conveying coarser material. We must always expect to find that the samples of the most pronounced brown colour also contain most clayey ingredients. In other places this fact has been very conspicuous, here however it is less pronounced. None of the samples which are designated brownish-grey viz. No. 2, 3, 41 and 42 are finer than the average, nor is No. 26 of the greyish-brown ones. It is not possible in the case of all these samples to state anything which may explain their varying colours. Then of the ones which have been designated greyish-brown only the two samples No. 43 and 45 are left, and with them the dark brown coloured sample No. 46; these three are extremely fine compared with the others, they may therefore be supposed to have been formed much more slowly. By looking at the chart it will however be seen that these deposits have a position which rather differs from that of the rest, viz. in the bays Fleming Inlet, Carlsberg Fjord, and Hurry Inlet, so there is here another possible way of explaining the colours. The water here may have a different chemical composition from that of the open sea, this difference being due either to its containing a larger amount of oxygen or, what is more probable, to its being less salt. It is a well known fact that clay-particles are deposited much more slowly in fresh than in salt water, there is then the possibility that the greater part of the clay which is washed into the water by the rivers may be transported farther out, and not be deposited till it arrives outside the mouths of the bays. In order to be able to understand the fact of the samples being so exceedingly fine, we must suppose that not only has the greater part of it not been deposited in the said place, but also that the amount of coarser material conveyed thither must be exceedingly slight.

Washing analyses.

In order to get an exact idea of the mechanical constitution of the samples, they were all subjected to a washing process by the aid of Schöenes's washing apparatus and were sifted from the coarser ingredients.

First the ingredients larger than 0.5^{mm} were separated off by means of a sieve; these were then again sorted by the aid of coarser sieves, the meshes of which measured 1, 2, 4, 8^{mm} and so on. As these particular samples are for the most part very rich in coarser ingredients, the sorting of these is of the greatest importance in the examination of the mechanical constitution. It is especially on this, that conclusions with regard to ice transport and a great many other circumstances are based.

It is important to notice that the accuracy of the percentages, which can be estimated by sifting, decreases, as the size of the grains increases.

The percentages for the grains of more than 8^{mm} can only be stated approximately, as only a very limited number of these grains will be found in a sample of about a hundred grammes, which is the amount that has usually been at our disposal for this purpose. But a slight accident during the hauling up of the material may cause a greater or lesser number of stones to get into the sounding tube and affect the result very considerably, so that the graphical representations will also everywhere show great irregularities on the outermost right side of the curve. If an exact determination of the amount of these ingredients is to be made one would require to have a very great quantity of each sample, and then still larger ingredients, the determination of which would also be very inexact, would enter into the samples. On the other hand the percentages for the ingredients from 0·5 to 8^{mm} are exceedingly accurate.

The parts of the samples which are below $0{\cdot}5^{mm}$ in size were separated by washing into three parts 1) containing the ingredients below $0{\cdot}01^{mm}$, 2) those from $0{\cdot}01-0{\cdot}05^{mm}$ and 3) those from $0{\cdot}05-0{\cdot}5^{mm}$. The exactness which may be attained by the washing is perfectly satisfactory between the size-limits of the two last named ingredients, but not between the size-limits of the two first sizes of grains. However recently deposited the clay may be, it is always very difficult to get it finely divided by boiling, and the various samples are very unequal in this respect. By long and repeated boiling, one may perhaps in most cases succeed in getting the clay substance broken up, but the results thus attained will certainly not correspond exactly with the natural conditions under which the deposits were laid down.

As mentioned above clay is deposited much quicker in salt than in fresh water. The reason of this, as shown by experiment, is, that the single particles of clay, by coming into salt water, clot together into somewhat large, coherent masses, which as a rule, however, do not attain the size of 1^{mm}. This clotting only takes place to a very slight degree or not at all, if the clay is very finely divided, as will generally be the case if the clay originates from coast erosion or from coast rivers. Glacier-rivers, however, will often convey the clay in great quantities, and when it is washed into the sea by them the greater part of it will be deposited very quickly.

If we now take the samples singly, the clay in them will originally have been deposited in somewhat different ways. One part of it will have been deposited very slowly, and must thus be classified amongst the very finest ingredients of the sample. Another part has sunk to the bottom comparatively quickly, and must therefore be classified among the somewhat coarser ingredients, between 0·02 and $0{\cdot}05^{mm}$. It is very doubtful whether it is possible by washing, to separate even approximately the various parts of the clay from each other. It is most probable

Table of the proportions of the mechanical constituents in the samples.

The number of the sample	below 0·01 mm.	0·01—0·05 mm.	0·05—0·5 mm.	0·5—1 mm.	1—2 mm.	2—4 mm.	4—8 mm.	8—16 mm.	above 16 mm.
	per Ct.	per Ct.	per Ct.	per Ct.	per Ct.	per Ct.	per Ct.	per Ct.	per Ct.
1	44·6	22·8	18·0	4·6	2·7	2·7	2·1	2·5	
2	34·2	30·6	21·0	4·1	3·1	2·5	4·5		
3	36·2	14·1	36·2	5·3	2·9	2·5	2·1	2·8	
4	29·5	52·6	12·9	1·1	1·0	2·1	0·8		
5	40·1	35·1	16·7	1·9	1·1	1·9	2·2	1·0	
6	49·8	10·6	33·8	2·9	1·1	1·6	0·2		
7	21·6	34·9	39·7	0·6	0·4	0·8	0·7	1·3	
9	13·7	23·0	7·8	1·0	1·1	1·6	5·4	33·7	12·7
10	52·4	7·9	16·8	2·4	1·7	2·4	4·5	11·7	
11	15·9	29·8	22·1	6·5	6·3	10·0	7·5	1·9	
13	42·8	5·7	10·5	3·6	2·6	3·8	8·7	6·6	15·7
14	54·0	36·0	7·6	1·0	0·7	0·6	0·1		
15	73·9	19·9	6·2	0·0	0·0				
16	59·6	10·3	22·1	1·8	1·0	1·3	2·1	1·8	
17	36·3	61·3	2·2	0·1	0·1				
18	32·3	39·0	23·6	0·7	0·4	0·3	0·3	0·9	2·5
19	39·0	59·7	1·2	0·0	0·0	0·1			
22	49·1	31·1	10·3	1·3	2.5	3·5	2·1		
23	50·4	44·1	5·4	0·1	0·0	0·0			
24	74·3	25·4	0·3	0·0					
25	37·3	16·0	31·7	1·5	0·6	0·5	0·2	2·0	10·2
26	42·4	23·3	16·1	5·1	4·7	4·2	2·5	1·6	
27	47·5	33·3	17·3	0·6	0·4	0·9			
28	44·7	23·7	22·0	5·2	1·9	0·9	1·6		
29	25·0	13·8	37·0	4·7	7·0	2·0	3·2	7·3	
30	59·1	39·3	1·4	0·1	0·1	0·0			
31	24·1	20·5	47·0	0·9	0·9	1·1	1·4	4·1	
32	49·5	12·2	35·1	0·4	0·5	0·9	1·4		
33	15·7	21·2	15·2	1·1	1·0	5·0	6·0	27·5	7·3
34	23·3	20·7	25·6	8·1	3·7	3·2	2·0	4·1	9·3
35	74·1	6·7	13·9	0·7	0·9	1·1	1·9	0·7	
36	57·2	13·1	14·6	4·9	3·1	2·4	2·0	3·7	
37	44·8	29·9	6·8	1·9	2·4	3·2	2·2	8·8	
40	20·0	36·1	27·1	3·2	3·5	4·3	2·8	3·0	
41	24·9	18·5	19·5	4·2	3·0	4·2	8·2	7·3	10·3
42	54·2	27·5	10·3	1·9	1·9	3·0	1·2		
43	76·6	22·7	0·6	0·1	0·0				
45	48·0	48·9	2·1	0·4	0·2	0·4			
46	90·1	8·2	0·9	0·3	0·4	0·1			

that the clay, by lying a long time at the bottom of the sea, assumes in each place a uniform consistency, which, however, varies very much in the different samples. Even if by repeated boilings one could succeed in getting all the clay finely divided, no great result would be thereby attained. On this account these samples have only been subjected to a single boiling of about one hour's duration. The quantity of the clayey substance itself in proportion to the other ingredients will be shown by the graphical representations.

As is clearly shown by the table all the samples are exceedingly rich in coarser ingredients over 0·05^{mm}. The average quantity of these is in all the samples 13·2 per Ct., while in the corresponding samples from the Ingolf-Expedition along the coasts of Iceland and West Greenland, it does not reach 5 per Ct., and in the samples obtained by the Fram-Expedition along the North coast of Siberia it is far below 1 per Ct. With regard to the last place, the reason of the fineness of the samples is probably for the most part due to the fact that the coast is quite low, and formed of loose rocks such as sand and clay. On the other hand, the difference between the samples now described, and those from the Ingolf-Expedition can only be ascribed to the much greater quantity of floating ice found near East Greenland, as, in all other essentials, the localities are alike.

If the average quantities of all the individual sizes of grains are calculated, the following numbers are obtained:

below 0·01 mm.	0·01—0·05 mm.	0·05—0·5 mm.	0·5—1 mm.	1—2 mm.	2—4 mm.	4—8 mm.	8—16 mm.	above 16 mm.
42·6	26·9	17·3	2·2	1·7	1·9	2·1	3·5	1·8

Herein is shown that the clayey and sandy ingredients, as was to be expected, are in decided majority in comparision with the coarser ones in the samples. It is rather strange that smaller quantities are found between 1 and 4^{mm} of the ingredients than of the somewhat coarser ones. This is mainly owing to the circumstance that moraines at the bottom of the sea probably supply large quantities of coarser ingredients, whereas the sand and clay for the most part must have been derived from the land.

It is rather interesting to compare the mechanical constitution of these samples with that of till. The average composition of 9 samples from Funen is[1])

below 0.01 mm.	0·01—0·05 mm.	0·05—0·5 mm.	0·5—1 mm.	1—2 mm.	above 2 mm.
31·7	13·9	46·2	1·6	2·7	3·9

On the whole there is a rather strong likeness between the samples and the till. The most conspicuous difference between the two is that the till is very rich in ingredients between 0·05 and 0·5^{mm}, and has a correspondingly smaller proportion of the finer ingredients. With regard to the coarser parts, the samples contain much more than the till, yet we must here notice that this larger proportion of coarse material is almost confined to a few samples which are very rich in pebbles, the remaining samples containing much less. The 9 samples of till on the other hand are unvaryingly homogeneous. This homogenous character alone is sufficient to enable us to distinguish, with tolerable certainty, between till and sea-floor deposits. If the latter were found to have a composition resembling that of till, they must have been deposited in an icefilled sea, and we cannot but think that currents, and many other circumstances would, in that case cause them to vary very much in the individual localities. Besides the till itself if deposited on rugged ground would probably show a somewhat varying constitution.

[1]) Beskrivelse til geol. Kort over Danmark, Kortbladet Hindsholm by N. V. Ussing and Victor Madsen. Danm. geol. Undersøgelse. 1. Række, Nr. 2, p. 77.

Graphic representation of the mechanical constitution of the samples.

In order to give a better general idea of the constitution of the samples, a graphic representation of part of them has been prepared. The different sizes of grains are taken as abscissæ, while the percentages are taken as ordinates. In determining the units on the abscissa-axis the question of employing an algebraic or a geometrical progression might arise. The former is inadequate for giving an exact representation of the differences between the samples. As these contain ingredients up to about 50^{mm} we might for example mark off on the abscissa-axis 50 units of 1^{mm} each, but it will easily be seen that, as by far the greater number of the ingredients are smaller than 1^{mm}, the curve would rise to an inconveniently great height at the extreme left; and if we further consider that the majority of the ingredients is smaller than $0{\cdot}05^{mm}$ it will be seen, that the curve for the first twentieth part of a mm. must reach such a height, that it cannot be plotted on the same sheet as will at the same time indicate the small quantities of the larger ingredients present.

By employing a geometrical progression to illustrate the series of the grains, we get a representation which gives a far more distinct idea of the constitution of the samples. The most simple way is with 1^{mm} as a basis to mark off equidistant divisions toward both sides, those to the right being designated 2, 4, 8^{mm} etc., while those on the left stand for $^1/_2$, $^1/_4$, $^1/_8{}^{mm}$ etc. Such a curve system is unlimited in either direction, and may easily be employed for all sorts of mechanical rocks, even the coarsest grained.

The plotting of the curve for the ingredients greater than $0{\cdot}5^{mm}$ is easily accomplished by marking off as ordinates the percentages of each size of grain. In washing, limits have been employed, in the case of the finer ingredients, for the sizes of grain which do not fit in with the numbers on the abscissa-axis viz. $0{\cdot}05^{mm}$ and $0{\cdot}01^{mm}$. Their positions however are easily calculated to be 4·32 and 6·64 respectively, to the left of the starting point. Thus, as the percentages of the ingredients between 0·05 and 0·5 extend from 4·32 to 1, it is necessary, in marking them off, to divide by 3·32 and employ the value found as ordinate. The ingredients between 0·01 and $0{\cdot}05^{mm}$ extend from 6·64 to 4·32, and the percentages for this size of grain must therefore be divided by 2·32. The greatest difficulty is met with in the representation of the finest ingredients below $0{\cdot}01^{mm}$. If, we are to be able to mark off any definite height, we must have a lower limit for this size of grain, and as we cannot arrive at such a one in any empirical way, the choice must be a somewhat arbitrary one. This circumstance however will not influence us against the use of the curve, as our attention must be specially directed to that part of the curve which represents the finest particles; and if the lower limit is the same for all the samples any differences will be very conspicuous. Here $^{1}/_{10000}{}^{mm}$ is everywhere fixed as the lower limit, so that, as this value lies 13·33 units to the left of the starting point, the sizes of the grains below $0{\cdot}01^{mm}$ will extend over 6·69 units, and the percentages found, must be divided by this number to determine the height the part of the curve in question will attain.

Where the heights determined for the curves are marked off as horizontal lines, the curves will have a very jagged appearance. As this representation of the case would be misleading the curve has been smoothed throughout its length. If, for instance, the size of a grain comes between two others, one of which is present in very large, the other only in very small quantities, the curve must slope evenly down from the former to the latter. If a considerable number of one size of grain is found, and smaller numbers of the two sizes represented next to it, the curve must be highest at the middle, and decrease gradually towards both ends. By actual examination of the ingredients it will be found in all cases that the real proportions are in accordance with the calculated ones. The left side of the curve has everywhere been drawn evenly downwards. It may be taken for granted that wherever the lower limit for the size of the grains be placed, the quantity must gradually decrease towards this limit.

The left part of the curves has been divided into two areas of which the upper indicates the quantity of clayey substance, while the lower which is connected with the main part of the curve, indicates the finer sandv ingredients. The ratio between the two parts has been found by direct microscopic examination. The ratio of the ingredients between 0·01 and 0·05^{mm} can be determined fairly correctly by counting the grains; that of the finest ingredients can only be conjectured, as we cannot distinguish clearly between grains of clay and grains of quartz in the case of such very fine particles.

The curves for the samples which are of special interest will further be given below.

The deposits No. 1—7 lie, as will be seen from the chart, in a series along the shore outside the Sabine Ø and Kap Borlase Warren; we notice in these samples the very peculiar fact that the outermost ones, as shown by the curves for No. 1 and 3, are far coarser than the innermost ones represented by No. 4 and 7, to which also No. 5 and 6 bear a very great resemblance. It has been mentioned above that this fact is in contrast with the general rules by which the fineness of the samples increases with the increasing distance from shore and with the depth, and both distance and depth are greater in the case of the first three samples. The distance from shore is, however, too great for their coarser ingredients to have been transported directly thence, so they must have been derived either from icebergs or from the bottom of the sea.

That the difference in the deposits should be due to icebergs is not very probable; all the deposits have originated from the so called Northbay in the floating ice, which during summer forms a free passage from the open sea towards the East-coast of Greenland. Generally speaking we may suppose, that, in places where there is little ice during the summer, less material will be deposited by the ice at the bottom of the sea, than where there is closely packed ice. Consequently throughout the region herein described, the ice will be of no great importance as determining the constitution of the samples. It might be imagined however that the melting of the ice would be sufficient to explain the great number of coarser ingredients found in these samples, if the amount of finer material conveyed from the land is less in proportion. We cannot so easily understand the reason why the outermost samples are considerably coarser than the innermost ones, for, as far as we can gather from all accounts, there is no very great difference in the number of icebergs in the outer and inner part of the tract.

Assuming then that the coarser ingredients of the three first samples originated from the rocks at the bottom of the sea, here we have again two possibilities, namely that they have been derived either from solid, or from loose rocks. The first supposition is not very probable; in the first place we cannot thereby explain the circumstance that the samples become finer nearer land. If the bottom of the sea has ever been above sea-level, this must have been the case with the whole tract, and many submarine rocks must then have been found also nearer land, and would hardly have been entirely covered by later deposits. Moreover we always notice that, where the material of the samples originates from solid rocks of the sea-floor, it will always be of a rather homogeneous nature in each individual sample, and will often vary very much from one sample to another, but this is not the case here as will be proved later.

Then we have the possibility left that the richness of coarser ingredients in the samples now under discussion is due to the presence of loose rocks of earlier formation at the bottom of the sea, these being most likely of the nature of till. The theory of the presence of such a moraine has already been propounded by Bay (Medd. om Grønland. XIX, p. 185) and is founded partly on the belief that no deposit due to icebergs is found north of Scoresby Sund, partly on the nature of the rocks which have been brought to light by trawling. The first evidence is not very convincing, as the occurrence of icebergs must of necessity be very irregular, and very varying from one year to the next, and even if the ice only deposited small quantities of material, this would in the course of many years, form very extensive deposits. The evidence which is founded on the nature of the rocks is of far greater importance, and will be given more fully later in the following. It suffices here to mention that an examination of the rocks of the samples in question almost always shows a remarkable affinity to the solid rocks of the country nearest to them, so it is quite natural to suppose that they must originate partly from moraines at the bottom of the sea.

As the samples No. 1—7 are the only ones which have been taken in a connected series at right angles to the coast direction, we might expect more particularly from these samples to find a proof of the presence of a moraine. With regard to the depth, we have already seen that it decreases gradually as we approach the shore. The conclusions arrived at will however be different if we take into consideration locality 1) (p. 186) mentioned by Bay. This is situated very near station 1 of this expedition, being only about 2½ kilom. farther east, and the depth is stated to be 127 Danish fathoms while that of station No. 1 is 162 D. fathoms. We have then here the only really certain case in which the presence of a submarine moraine is clearly proved by the relief of the sea-flor. We may then conclude that the ice during the ice-age had its outermost limit at Bay's locality 1), then during its retreat, it remained for a longer period over the tract occupied by the deposits represented by the samples 1—3 of this expedition, and finally retreated very quickly across the inner tract. This is the only probable explanation of the strange phenomenon that samples 1—3 are much coarser than those obtained from the inner tract. This evidence is however only based on the inference that drifting ice only deposits a very small amount of material in such localities as these, for the moraine formations would otherwise very easily have been hidden. Morainic matter cannot, like submarine rocks, continue for long periods to project from the bottom of the sea, and maintain its influence on the deposits.

Samples No. 1—7 are otherwise of no special interest. From the rather irregular shape of the curves for No. 1 and 3 can be directly seen, that their existence must be due to several different causes. As, however, they consist in great part of the morainic matter from the bottom of the sea which is itself of a very irregular constitution, it is impossible to determine the influence which other factors may have had upon them. The curve of No. 4 is on the other hand of a much more regular appearance, the whole giving the impression that it consists of rather well-sorted material, most of the grains being between $^1/_{32}$ and $^1/_{64}$ mm. The amount of the clayey ingredients is small in proportion to that of the others. The extension of the curve to the right, shows an influx of coarse material which is quite independent of the chief bulk of the sample. Here the material from the moraines at the bottom of the sea must be out of the question, as these must have been covered by later deposits. We must then suppose that these coarser ingredients have been conveyed by icebergs, and we get thus directly from the curve a good idea of the ratio between the two different influences, that of the ice, and that of the land. The ice must also have contributed a large quantity of the finer material, but this will certainly be of less importance than that derived from the land.

The sample No. 7 shows a very great resemblance to the last-named; also here is plainly seen the influence of the ice in the extension of the curve to the right. Moreover the curve shows very distinctly, that this sample has been obtained from nearer the shore, as the greater number of the grains attain a size of about $^1/_{20}$mm, viz. about double the size of those in No. 4, besides the main part of the curve has a rather regular shape, and thus suggests a like cause of deposition.

The samples No. 9—13, obtained in a continuous series from the coast between Kap Borlase Warren and Kap Broer Ruys, are characteristic as being some of coarsest of all the samples. The curves are all very irregular, but have two rather distinct maxima of which the one is situated far to the right among the coarsest ingredients. The depth of deposition is not very great in any of the samples, as it varies from 78 to 114 Danish fathoms. The distance from shore is however so great that the coarser ingredients can hardly have emanated directly from there. Were this so the ingredients must consist entirely of basalt which is far from being the case, seeing that they have a very mixed constitution. For the same reason we cannot well imagine that they have originated from rocks at the bottom of the sea. Then there only remains, as in the samples 1—3, the choice between the floating-ice and moraine-formations, and here the mineralogical constitution cannot decide the question, as we must expect a mixture of granitic, basaltic, and sedimentary material, such as is found in these samples both from the icebergs of the far north, and from the land-ice.

It is not at all probable that icebergs have conveyed the enormous amount of coarse material in these samples, as there is nothing to account for their having such great influence here, in comparison with that which they exercise on most of the other samples. As far as we know, this particular tract is rather free from ice in summer, so that proportionately few icebergs would melt here. We are then obliged to suppose, that the above-mentioned moraine bends inwards along this tract, which may perhaps be explained by the high coast lying inside it. It is strange that deposits from the land or from the ice have not completely covered this moraine since the ice-age, but no other explanation is probable.

The complicated shape of the curves with respect to the 4 samples is thus connected with the fact that one part of the sample originates from the original moraine — or stratified material from the ice-age, the other and finer part, on the other hand, from material conveyed hither at a later period.

No. 9 is the most regular of all the samples. We cannot imagine a better illustration of a sample consisting of two quite different parts. The remarkable height of the curve between 8 and 16^{mm}, and the great slope towards both sides, indicates that originally a gravel with grains of an unusually uniform size was deposited in this locality. After the ice-age finer material was deposited here, partly by transport from land, partly by icebergs, this being also of a rather regular constitution, with maximum between $^1/_{32}$ and $^1/_{64}{}^{mm}$. This material must have been laid down among the coarser ingredients, or has at any rate become mixed with them during the hauling up.

The three following samples Nr. 10—11 and 13, are far more difficult to account for. It seems as if the originally-deposited rock, in these cases was in itself of a rather irregular constitution. If we draw up curves for morainic rocks we always get a rather irregular figure with more maxima, and this is especially the case with such rocks in mountainous parts. It will be impossible to determine with regard to these samples how great a part emanates from later deposits. Probably however at least half of the finer ingredients was thus derived all the curves show a somewhat pronounced rise with respect to these parts.

The curves for No. 10 and 13 are open to the right, and seem to indicate that these samples contain a great deal of still coarser ingredients, which the sounding tube has not been able to take up. As mentioned above too many conclusions must not be based on the shape of the curves for the coarsest grains, as it depends on mere chance if more or less pebbles are got at the same time, and even a single one may produce a great difference in the appearance of the curve. It must thus certainly be mere accident that No. 10 has no ingredients over 16^{mm}, as the shape of the curve seems to indicate a rather considerable number of these ingredients.

With regard to the finer ingredients, there is a very great resemblance between No. 10 and 13, as both these samples contain a comparatively large quantity of clay-substance. No. 11 on the contrary bears a greater resemblance to No. 9, as the greater part of its finest ingredients are between $^1/_{32}$ and $^1/_{64}{}^{mm}$. It will hardly be possible to find the cause of this.

Samples No. 14—19, the deposits of which form a connected series outside the bay between Kap Hold with Hope and Kap Parry, are of quite a different type from the preceding ones. As will be seen by the curves they are all comparatively fine, as only a few percentages of the ingredients or sometimes none at all are found to be over $^1/_2{}^{mm}$. The change is very sudden, as the distance between No. 13 and 14 is not much more than about 13 kilom., and the difference between the constitution of these samples is, as will be seen by the curves, very marked.

It is impossible to imagine that the greater distance from shore can be of any importance in this matter, as the difference between the samples is not very great in this respect; neither can the difference in the number of icebergs affecting them be very marked. After passing the projecting Kap Hold with Hope, the ice-bergs have more room for spreading out, and certainly obtain thereby more freedom of motion; this is the reason for their not remaining any length of time above each individual place and they cannot therefore deposit so much material. Yet even this factor does not seem sufffcient to explain the great difference in the constitution. Here we must then again remember the above mentioned moraine, which, in this locality, must be supposed to form a projection into the sea, caused partly by the greater depth, partly by the greater transport of ice which has taken place from Franz Joseph's Fjord.

There are moreover variations in the individual samples, as will be seen by the curves.

The contiguous samples No. 14 and 15 have a rather similar constitution, and are both rather regular and fine. No. 14 contains a number of ingredients over $^1/_2{}^{mm}$, which are absent in No. 15, and for this no other reason can be imagined than that the former deposit is situated nearest the moraine, from which it may have received a few ingredients. Moreover the curve shows that the chief mass of the sample itself is somewhat finer in No. 15 than in No. 14, and that a considerably larger amount of clayey substance is found in the former. This is due to the fact that No. 15 was obtained from a considerably greater depth so that the finest parts had better opportunities for being deposited. These finest parts must in the case of both the samples have been derived directly from land.

Sample No. 16 is somewhat coarser than the preceding ones probably because it was formed right outside the Bontekoe Ø. However it is hardly possible that a direct transport of material from this island can have contributed in any great degree to the formation of the deposit, as the distance is rather great, i. e. about 35 kilom. It is more probable that the island checked the movement of the ice somewhat during the ice-age, so that the moraine approached slightly nearer the island; yet the number of coarser ingredients in the sample is not so great but that it might be explained in other ways, for example, by icebergs.

With respect to the finer particles, the curve very characteristically shows two maxima, viz. a smaller one at about $^1/_8{}^{mm}$, and a larger one in the ingredients under $^1/_{100}{}^{mm}$. It is not easy to account for this circumstance. The mineralogical constitution of the sandy ingredients plainly shows, as mentioned below, that they cannot have been derived in any quantity from the Bontekoe Ø, their presence may then possibly also be connected with the proximity of the moraine; the original rock thus consisted of pebbly sand, in which case all the finest ingredients have been introduced later by the sea. There may also have been a morainic rock here originally which had an almost similar constitution to the now existing sample. If this were the case only a very small amount of clayey ingredients can have been conveyed hither since the ice-age, which is hardly probable.

The samples No. 17—19 are very regular, as will be seen by the curves. This is especially the case with No. 17 and 19, the composition of which is very much alike. Hardly any ingredients over $^1/_2{}^{mm}$ are found, and very small quantities over $^1/_{20}{}^{mm}$, so that these two samples belong to the very finest of those procured by the expedition. The curves are very regular with the maximum at about $^1/_{64}{}^{mm}$. As the distance from shore is comparatively great, the deposition cannot have taken place very quickly. The lack of coarser ingredients plainly shows that the ice must have had an exceedingly slight effect, and that the moraine did not exercise the least influence here. The curves also give us a good idea as to how sorted material appears in graphic representation. The currents must in these parts be very regular and permanent, so that just the size of grain which is found in the greatest numbers in these samples has time to be deposited, while the coarser ingredients sink to the bottom nearer land, and the finer ones are transported still farther away. If the currents change in direction and force, it will be seen that several different sizes of grains will appear in the samples, and thereby the curve will become broader and lower. Something like this is the case with sample No. 18, but as it is situated between two others the difference between them is quite inexplicable, and likewise the circumstance that in No. 18 is found a number of the coarsest ingredients. This phenomenon can hardly be explained otherwise than as a mere accident.

Sample No. 22 shows, as is seen by the curve, the same phenomenon as so many of the former samples, viz. that it consists of two rather well-separated parts, viz. a smaller one with the maximum between 2 and 4^{mm} and a larger one with maximum at about $^1/_{100}{}^{mm}$. As it is not probable that the above-mentioned moraine comes so close to the shore, we may suppose that the comparatively great amount of coarser ingredients is due to icebergs, or possibly the two causes may be acting in concert. The nature of these coarser ingredients is rather mixed, and cannot explain anything for certain either one way or the other.

Sample No. 24, situated outside the mouth of Davys Sund, is of a very fine-grained nature. The curve has a very regular and symmetrical form with maximum between $^1/_{128}$ and $^1/_{256}{}^{mm}$, and there is a comparatively large amount of clay-substance. The most characteristic feature in the sample is, however, the very small amount of larger ingredients, as it only contains 0·3 per Ct. over $0·05^{mm}$, which is less than in any of the other samples, much less even than in any of the samples from the Ingolf-Expedition, which are on the whole considerably finer than the ones described here, and a great number of which were obtained in deep water at a great distance from land. The depth is not especially great, viz. 226 Danish fathoms; the sample No. 23, which was obtained near it, was at a depth of 294 Danish fathoms, and forms on the whole a transition between No. 22 and 24, for which reason it has not been mentioned further. In order to bring about this remarkable constitution all the different physical circumstances of the place must have acted in concert to prevent the deposition of coarser ingredients; but as most of these circumstances are not very well known, it is impossible to account for the phenomenon definitely. We can only say that the melting of icebergs must have been almost out of the question here; in summer they must therefore always pass outside this place. Moreover, all the directions of the currents must constantly be such that they cannot convey hither material from the rather near-lying tracts of land, Van Dyk Rock and Canning Land. If just now and again a somewhat powerful current came from one of these places, much of the material formed by the coast erosion may have been conveyed to the deposit, and it would thereby contain a larger amount of sand. However it is hardly possible that these causes alone would be able to produce a constitution like that of the sample, a very great amount of clay must also have been conveyed into the sea at this place. The colour of the sample, which is pure grey, indicates that it cannot have been deposited very slowly. It is impossible to say for certain if a very great amount of clay can be conveyed out of Davys Sund, as most of the natural conditions of this territory are very little known. In this connection it will be of great importance whether the salinity of the water in the bay is perceptibly less than in the sea; this may in itself be the cause of the deposition of an especially large amount of clay outside a large bay like this one.

By proceeding from No. 24 to No. 25, one of these sudden, rather inexplicable changes in the constitution of the samples again occurs, to which we have already drawn the attention above. This sample was obtained at a somewhat less depth than the former (relatively 161, and 226 Danish fathoms), and the distance from shore is not much less, and yet the difference with regard to the constitution is very conspicuous as will be seen by the curves. The great amount in the sample of ingredients over 16^{mm} is very striking, but may be due to chance circumstances, as a quite small number of pebbles of this size is sufficient to bring about such a result. More characteristic is the rather large amount of sandy ingredients viz. 31·7 per Ct., an amount which is perhaps not very great in comparison with the majority of the other samples, but which is very conspicuous when compared with the 0·3 per Ct. in No. 24. Here we can scarcely imagine any other reason than this, that a rather powerful current runs direct from Canning Land above sample No. 25 without coming in contact with No. 24. It might also be imagined that the difference of depth which distinguishes the two samples, might cause the current to be so powerful above No. 25, that the clayey particles cannot easily be deposited there. Possibly the two causes act in concert.

Sample No. 26 which was obtained outside the mouth of Carlsberg Fjord, differs from the last-named mainly by a more even distribution of the larger ingredients, as from $0·05^{mm}$ and upwards there are found equal amounts which do not decrease in quantity until from 4 to 16^{mm}. The coarser ingredients may be supposed to have the same origin as in the last-named sample, having been conveyed hither by the current direct from land. It is not easy to explain why we have here such a great quantity of the ingredients between 0·5 and 4^{mm} in comparison with those of the last-named sample. Possibly the somewhat closer proximity to the shore, together with rather less depth, may have enabled the same current which only conveyed ingredients between 0·05 and $0·5^{mm}$ to the above-mentioned to convey ingredients up to 4^{mm} or more.

The next samples No. 27—33, have been taken along the

Liverpool Kyst, rather near land. As their situation is much alike with regard to the coast, they might be expected to be of similar consistency and yet they are so different, as to have scarcely any feature in common; they will therefore be treated below separately.

No. 27 is rather fine as compared with the rest of these samples, and the curve shows a very smooth, and symmetrical shape with the exception of a smaller independent part with maximum between 2 and 4^{mm} which was probably derived from icebergs. The rest must have been derived directly from land, and cannot have been conveyed very far, presumably it came from the land near Murray Ø.

No. 29 has quite a different appearance from the last named. The curve is of a specially irregular shape, and the great number of sandy and pebbly ingredients is most conspicuous, while very few clayey ones are found. The circumstance that the samples are situated at a comparatively slight depth, 128 Danish fathoms, is presumably a sufffcient explanation of the finer ingredients being so few in number; probably the current is so strong that deposition cannot take place. If, however, we want to account for the existence of so large a proportion of coarser ingredients the case will be different; they are too large to have been conveyed direct from land, and must therefore have had their origin in one of the three factors: icebergs, morainic formations at the bottom of the sea, or solid rocks from this same place.

To determine which of the three factors has been the most important is rather difficult. It is not likely that the ice has had any great influence. There is no special reason for supposing that ice can have conveyed such enormous quantities of material to this locality, and to others which will be mentioned below, seeing that its influence otherwise seems to be somewhat slight Moreover the adjacent samples No. 27 and 30, have either no coarser particles, or only a very insignificant quantity of them, and they could probably not have failed to contain such, if a great number of icebergs had melted in these parts.

That the presence of the coarser ingredients in the samples may be due to morainic material is more probable. During the ice-age a number of glaciers may have flowed out from the Liverpool Kyst in various directions, and large ice-streams from Davys Sund and Scoresby Sund may have spread over the whole territory herein described. By this means, great variations in the constitution of the loose rooks of the ice-age may very well have been produced, even in adjacent places. It is, however, scarcely probable that these, being so near land could escape being covered over by later deposits. On an open coast like the Liverpool Kyst, a rather considerable amount of erosion must take place, and a corresponding transport of material into the sea, so that it is not at all probable that we should be able to obtain in the samples any material directly connected with the ice-age.

We must then suppose that at any rate a great proportion of the coarse material has been derived from the rocks of the sea-floor. Even if deposition of the finer ingredients takes place on a comparatively large scale, these rocks will only be covered during very long geological periods, and will always be able by their weathering to provide for a deposition of material in their neighbourhood. This material can have all sizes of grains from the finest clay to the largest pebbles, the size depending on the proximity of the solid rock. It will thus be understood that even adjacent samples may be rather different in their mechanical constitution, where an essential part of their material has this origin. There is however another circumstance which must also be taken into consideration here, viz. the petrographical nature of the coarser ingredients of the sample. If they originate from the solid rocks of the sea-floor each individual sample will have a comparatively homogeneous constitution, as several different kinds of rock will not generally be found assembled in one small area. This is also partly the case with this sample No. 29, as will be seen later, for, out of 29 rock-fragments over 4^{mm}, this has 23 consisting of granite or gneiss, the remaining ones being sedimentary. We then arrive at the result that the greater part of the granitic material has its origin in the sea-floor, while the rest together with the sediments originates from icebergs or moraine-formations. Even supposing this last-named material be covered over by later deposits, wherever it is situated in a somewhat flat place, yet, wherever it was originally deposited in a somewhat more undulating tract, it may still project in some places and contribute its share to the constitution of the samples.

Sample No. 30 deviates in its constitution greatly from the surrounding ones, as it is almost devoid of coarser ingredients over $0{\cdot}5^{mm}$, and has very few ingredients between 0·05 and $0{\cdot}5^{mm}$. This peculiarity is directly connected with its occurrence at a greater depth viz. 241 Danish fathoms. Owing to this unusually large quantities of finer material are deposited, the conditions for such deposition being less good in places at a higher level, where the deep-seated currents sometimes may be very strong. Hence what may originally have existed of morainic deposits is covered, while those derived from icebergs are so slight compared with the amount of finer material that they cannot be noticed in the sample. For the sample to be so fine as is the case here, it is also necessary that no solid rocks should exist in the neighbourhood, as the presence of such will always bring about the deposition of coarse ingredients in large quantities. The very regular curve shows that the deposit or at any rate the greater part of it, must have originated from one single source; the greater part of it was evidently derived directly from land.

The samples No. 31 and 32 are of a quite different appearance. Compared with the last-named sample they are of much coarser consistency, the maximum size of the ingredients being between 0·05 and 0·5^{mm}. This is most easily explained by the fact that the lesser depth of deposition viz. 112 and 150 Danish fathoms respectively* may produce a current which is strong intermittently, and which will prevent the finer ingredients from being deposited, whereas at other times other circumstances may prevail. Though most of the material in the samples is of a somewhat variable nature, we must yet suppose that it originates for the most part directly from land. The coarsest ingredients on the other hand seem to form a strongly marked separate maximum to the right of the curve. These ingredients are of a very different nature in the two samples, No. 31 containing a mixture of granitic material and sediments, while No. 32 contains only the former. This might indicate that the material for the most part has its origin in rocks at the bottom of the sea, at any rate it is unlikely that icebergs would be able to deposit material of such a different nature in adjacent places. At the same time part at least of the coarser material may originate from moraines at the bottom of the sea. The influence of this factor is, however, very difficult to account for here, as also in several of the other samples.

Sample No. 33 was obtained from very near the shore outside Kap Hodgson, and at a very small depth viz. 88 D. fathoms. We should therefore expect the sample to be of a very coarse consistency as is clearly shown by the curve to be the case. This curve breaks up very conspicuously into two parts, the left part somewhat flattened with maximum at about $^1/_{50}$^{mm}, and a very steep part on the right with maximum between 8 and 16^{mm}. Possibly this last maximum ought to be placed even farther to the right, as ingredients of over 16^{mm} very rarely enter into the samples.

The finer part of the sample originates for the most part directly from land. The small quantity of the ingredients under 0·01^{mm} is partly due to the proximity of the shore, which causes sandy particles to be washed into the sea in proportionately large numbers, and partly to the slight depth at which deposition took place. This in conjunction with the current prevents the clay which has been washed into the water from having any chance of being deposited. The pebbles in the sample have been derived almost exclusively from the rocks at the bottom of the sea, as is also seen by their very uniform petrological nature, 70 out of 74 consisting of granite or gneiss. This circumstance entirely excludes the possibility of transport by icebergs, and also makes it very improbable that moraines at the bottom of the sea can have had any great influence. It is not likely that moraines formed in this locality so near the mouth of Scoresby Sund would contain so homogeneous a collection of rock-fragments.

The samples No. 34—36 were obtained outside the mouth of Scoresby Sund in rather deep water. It might therefore be expected that their constitution would somewhat resemble that of No. 24, found at the same depth outside the mouth of Davys Sund. There is however a very great difference, for No. 24, as has been shown, was the finest of all the samples, while those mentioned here are rather coarse, and contain great quantities both of sandy and of pebbly ingredients. The former ingredients are probably due to the closer proximity of land, and especially to the circumstance that the three deposits are so situated at the southern end of the Liverpool Kyst, that a strong southward current would transport material from the land directly to the three localities. The material thus transported will be sorted according to size, and the curves also show that No. 34 contains far less of the finer ingredients than the other two. Of these No. 36 contains somewhat less fine material than No. 35, probably owing to the fact that the first-named of these samples was obtained somewhat nearer land on the southern side of Scoresby Sund.

With regard to the coarser ingredients of these three samples, No. 34 and 36 contain a considerably greater amount than No. 35. The two first-named, which consist of rather homogeneous material, mainly sediments and basalt, were probably derived for the most part from rocks at the bottom of the sea. The small proportion of stones found in No. 35, as also the still smaller quantities in the two other samples, have been derived from icebergs. Whether these icebergs came from Scoresby Sund itself, or from the ice-floes further north, is not easy to determine. The circumstance that samples No. 42 and 46 which were obtained in Scoresby Sund itself, contain so exceedingly few rock-fragments makes it appear that the ice from this bay cannot convey great quantities of these ingredients. Bay also says (Medd. om Grønl. 19, p. 182), that the icebergs and the ice in Scoresby Sund can hardly be considered important as a means of transport along the outer coast, as but little ice seems to pass out of the mouth of the bay.

Sample No. 37, was obtained from the south-east of Kap Brewster in rather deep water (223 Danish fathoms), and as would be expected from this greater depth of deposition, the main part of the sample is also rather fine, with maximum at about $^{1}/_{64}$ mm. Yet some coarser material is also found in it, namely, a small amount of sandy material, which we may presume emanates directly from the not far distant shore, and also a larger proportion of rock-fragments, which, on account of their homogeneous basaltic nature, must be supposed to have originated from rocks at the bottom of the sea.

Sample No. 40, obtained very near land, southwest of the preceding station, was found at a depth of 90 Danish fathoms. The main mass of the sample, viz. the part originating from land, is not, however, of a particularly coarse nature, though perceptibly larger-grained than the last sample. No very great amount of rock-fragments is found; these may have been derived either from rocks at the bottom of the sea or from some small rocks in the immediate neighbourhood of the deposit. They consist exclusively of basaltic material.

Sample No. 41 was obtained even nearer the main-land than the last, and belongs therefore to the very coarsest of the samples. The shape of the curve is rather characteristic, as there is an almost equal amount of the different sizes of grains, yet with an indistinctly marked maximum between 0·05 and 0·01^{mm}, and an indication of a pronounced rising on the extreme right. On account of the evenness of the curve throughout its length, it is impossible to distinguish its various ingredients; their origin is essentially similar to that of the last-named sample.

The four last samples are of special interest as they were obtained in the bays themselves, where the conditions for deposition are very different from those of the open sea. The coast-erosion especially, which generally produces most of the material in the samples, is considerably less here than in the open sea. For the rest, there is naturally a very great difference between the individual samples according to their different situations.

Sample No. 42 was obtained in Scoresby Sund, south of Kap Hooker, at a depth of 135 Danish fathoms; further details with regard to its position are not known. The main part of the sample consists of rather fine material with maximum of the curve at about 0·01^{mm}, to this is added a proportionately large amount of coarser ingredients right up to 8^{mm}, which must have a different origin from the rest, and for this we can scarcely imagine any other cause than that of drift-ice. According to Bay (Medd. om Grønl. 19, p. 182), the flat icebergs inside Scoresby Sund are sometimes quite covered with stones, and since they very seldom seem to come out into the open sea, they may become the cause of a plentiful deposition of this material. He does not mention whether the icebergs in the bays convey any great amount of clay, but this is hardly likely, as, everywhere along the coast, rocks are found, which cannot cause any great deposition of clay on the coast-ice, and something the same will probably be the case with the glacier-ice. Consequently we may suppose that only the especially-developed right part of the curve has its origin in ice-transport, and that by far the greater part of the material originates from the coast erosion. This curve, as also many of the others, must only be considered as a somewhat imperfect representation of the sea-floor, as all the larger stony ingredients are entirely absent, and these must necessarily have occurred here in great quantities, as so many of them have been observed on the icebergs. With regard to this sample, we are thus better able than in any of the others to determine, by direct observation, that the coarser ingredients must have been deposited in very great quantities from a geological point of view; moreover as an examination of the sample shows that a comparatively considerable amount of finer ingredients is deposited, we may conclude that the coast erosion, and the thereby-ensuing transport of material, must also take place with great force inside the bay. As the deposition takes place comparatively quickly, it can scarcely be supposed that any material of the sea-floor can have originated from the formations of the ice-age.

The three last samples No. 43, 45 and 46, have a quite different appearance, but they were obtained from smaller, shut-in bays, where no icebergs, or hardly any, ever came and where the current must have been rather slight. All three samples are of the very finest description, as they contain only very little sandy or stony material. The absence of the last-named material must be due to several concurrent causes. In the first place no ice-masses, or hardly any, come into the bays from without, otherwise greater quantities of stony material would have been conveyed hither, especially in the case of those currents coming from Scoresby Sund. Moreover special circumstances must be called into play with regard to the ice which is formed in the bays themselves. It is clearly impossible that stones and gravel should come down on the ice from the shores, which are often steep. Either the ice thus formed in the immediate neighbourhood of the shore cannot be loosened, by the surf, and so will melt in the same place, or, if the ice really comes out into the bay, it will only stay there a comparatively short time before it is conveyed farther out; if this were not so the sea bottom would be much richer in stones than is really the case. Finally, no projecting stones and rocks can be found at the bottom of the sea, at any rate not in the immediate neighbourhood of the samples in question. Whatever the explanation of this absence of stones may be, it will at any rate prove one of the most striking phenomena in the samples from these parts. One would never have expected beforehand that the samples nearest land, and in the places which do not seem to be very well protected against the surf, would be considerably finer than the great majority of samples from the open sea.

It is not only the slight amount of stony material which characterises these samples, but also, to an even higher degree, the almost entire absence of sandy ingredients, so that No. 43 and 46, in this respect, are only exceeded by the above mentioned No. 24 obtained outside the mouth of Davys Sund. This is a case which probably only occurs elsewhere in shut-in and quiet bays, while No. 43 and 45, obtained from the mouths of Fleming Inlet and Carlsberg Fjord respectively, are rather exposed to the influence of the open sea.

There is also a probable explanation of the slight quantity of larger ingredients in the samples if we suppose that the clayey ingredients would be deposited in especially large quantities in these bays. Even if the coast-erosion in such places were less important than it would be right out in the open sea, the rivers would nevertheless be able to convey clay into the sea, and, the amount would be approximately alike for a tract of coast of equal length, whether this tract is situated in the bays or out in the sea. It will thus easily be seen that the water in the bays must contain comparatively very large quantities of clay. Even if now a fair proportion only of this clay is deposited in the bay itself, it is evident that the deposition here will take place much more quickly than in the sea. This explanation however gives rise to the great difficulty, that it is impossible to find any reason why the sandy particles should not be deposited in corresponding quantities. As the above-mentioned localities are situated very near land, even fairly coarse sand-particles would easily be washed out together with the clay. Moreover the colour of the samples is against the supposition that they are formed especially quickly. The brown colour is, as mentioned above, generally a sign of slow deposition, even if it may be due to other circumstances, and of all the samples herein described, No. 46, is particularly distinguished by a very pronounced brown colour. We shall hardly be able to decide these questions without a closer acquaintance with the natural conditions of these localities. Moreover, as shown by the curves, there is some difference between these samples as regards details. No. 43, which came from near the mouth of Fleming Inlet, is the finest as it has no ingredients at all over 1^{mm}, and only 0·7 per Ct. between $^1/_{20}$ and 1^{mm}. The curve forms a quite regular arch with maximum between $^1/_{128}$ and $^1/_{256}{}^{mm}$. Very characteristic is the large amount of clay-substance found in the sample, larger indeed than is found in any of the other samples. This seems to indicate that the transport of material to the locality in question must be very slight.

No. 45 was found at the mouth of Carlsberg Fjord. It differs from the last-named by having a very small quantity of sandy and stony ingredients, but as the sample came from very near land, as is seen by the chart, it is very remarkable that these ingredients are not present in far larger quantities. The main mass of the sample is also somewhat coarser than the last-named with maximum at about $^{1}/_{64}{}^{mm}$. This is in agreement with the fact that the sample was found in closer proximity to land, but also nearer the open sea.

No. 46, which came from the mouth of Hurry Inlet, without any closer indication of the locality, resembles the last-named sample in the small amount of its ingredients between $^{1}/_{20}$ and 4^{mm}. This sample contains the largest amount of the ingredients under $0{\cdot}01^{mm}$ viz. 90·1 per Ct. The curve is an exceedingly regular and symmetrical figure, with the exception of the small quantity of material over $0{\cdot}05^{mm}$ which was derived probably from the ice. The regular shape indicates a uniform and regular conveyance of the ingredients. The colour of the sample is very characteristic compared with that of the others, as it is of a very pronounced reddish-brown colour. This is probably in some way connected with its fineness as the two last-named samples were also of a brownish colour; but no real explanation of the difference in colour has been given as yet.

The preceding pages will have shown that the various samples differ greatly in their mechanical constitution. These variations are often very conspicuous, especially when they occur in the case of two adjacent samples which we should have imagined would be alike in everything. There can scarcely be many parts of the world where such great contrasts are seen between adjacent deposits at the bottom of the sea. In most cases therefore it will be very difficult to account for the natural conditions which have determined the deposition of each deposit, moreover the various factors which must be taken into consideration are only somewhat imperfectly known. It is possible from the constitution of the samples to draw various conclusions with regard to several of these conditions, and in a later chapter the most important results will be given. As, however, the mineralogical constitution of the samples may also tend to account for the manner in which the deposits obtained their material, it will be necessary first to make this the subject of a closer examintion.

III. The mineralogical constitution of the samples.

As the samples of this expedition contain comparatively large quantities of coarse ingredients, it has been possible to determine the nature of the rocks that enter into the samples with much greater accuracy than is generally the case. The examination of the minerals contained in the sand, which is generally of the greatest importance, is here of only secondary moment. It is evident, that much more can be discovered by an examination of the rocks, than by examining the sandy material. Many rocks such as slate and limestone, are very rarely found in the grains of sand, as they are very easily dissolved and shattered when reduced mechanically to a very small size. The same is the case with basalt, though in a much slighter degree. With regard to this rock, an examination of the sand will always give good results, when only a comparison between the different samples is wanted. Sandstone and quartzite, which in these samples play a rather prominent part, will in the sand become grains of quartz which cannot be distinguished from that which originates from the granite. It is therefore only possible to distinguish the sand formed by these rocks by the granitic sand containing a small, but rather varied amount of other minerals such as felspar, garnet, hornblende etc., which minerals are found either not at all or only in quite insignificant quantities in sand originating from sandstone. All these minerals have less power of resistance against mechanical and chemical influences than the quartz, and disappear in the course of time, partly during the hardening of the sandstone, partly during its later erosion. As the ratio between these minerals and the quartz is somewhat variable (generally between 5 and 20 per Ct. in primary sand, i. e. sand formed directly from granite or gneiss), it is difficult to distinguish the primary from the secondary sand (formed from sandstone), even if they are found unmixed, but if they are mixed up it is impossible, even approximately, to determine the percentages of each.

Even if an examination of the sand does not give any particularly good idea of the ratios between the individual rocks which have contributed to the formation of the deposit, we may yet obtain from it certain results, which would not be reached by an examination of the rock-fragments in the sample. In the first place these are abtogether absent in some of the samples, or they are present in such small amounts that we cannot draw any conclusions from them as to the ratio between the different ingredients. Secondly it often happens that the sand has been deposited in a quite different way from the stones, so that we can draw no conjoint conclusion with regard to these. The stones must have originated either from moraines or rocks at the bottom of the sea, the sand must have been derived from these same factors, or directly from land. The following statistics will show that there is on the whole a close connection between the different ingredients of the sample. The most essential difference is that the sandy ingredients are almost always particularly rich in quartz, which circumstance is especially striking in the samples in which the coarser ingredients consist totally of basaltic material. In the samples from the south of Iceland something of the same occurs, for quartz is hardly ever quite absent in sand, even if it seems almost impossible for it to be conveyed to the locality in question. The only explanation is, that the ingredients of the basalt have a very great difficulty in appearing in the form of sand, so that even a very small conveyance of quartziferous material will be observable in the sand. Hence arises the characteristic phenomenon, that in the localities where the coarser ingredients would be expected to be far richer in quartz than the finer ones, the opposite is almost always the case.

Only two different sizes of ingredients in the samples have been examined, viz. the stones over 4^{mm}, and the sand between 0·05, and $0{\cdot}5^{mm}$. The ingredients lying between 0·5, and 4^{mm} are not very well adapted for examination, as they are too small for the rock to be determined by them, and too large for a direct microscopic examination. Nor have the ingredients under $0{\cdot}05^{mm}$ been taken into consideration, partly because they are rather small for an exact determination, and partly also because they have a constitution which is closely related to that of the sand, the only difference being that the amount of quartz is even larger for the reasons that have been stated above.

The stony ingredients of the samples.

(Over 4^{mm}.)

No. 1.

Granite-Gneiss 4.

Sediments 4. Consisting of: quartzite 1, finely grained grey sandstone 1, loose sandstone-slate with mica 1, grey slate 1.

No. 2.

Basalt 2.

Granite-Gneiss 5.

Sediments 2. Consisting of: quartzite 1, sandstone-slate with mica 1.

No. 3.

Granite-Gneiss 5.

Sediments 4: hard sandstone 1, loose sandstone 1, grey-slate 2.

No. 4.

Sediments 3: hard, white sandstone 1, compact, fine-grained red sandstone 1, grey-slate 1.

No. 5.

Sediments 10: loose, greyish sandstone 1, grey slate 1; and eight pieces of clay somewhat hardened with numerous grains of sand up to 2^{mm}, consisting almost exclusively of quartz.

No. 6.

Granite-Gneiss 1.

No. 7.

Sediments 1 (grey slate).

Basalt 2.

No. 9.

Granite-Gneiss 4.

Sediments 7: quartzite 3, compact grey sandstone 1, incoherent grey sandstone, grey slate 2.

Basalt 8.

No. 10.

Granite-Gneiss 6.

Sediments 9: quartzite 2, hard sandstone 2, loose sandstone 2, grey slate 3.

Basalt 5.

No. 11.

Granite-Gneiss 12.

Sediments 13: quartzite 4, hard sandstone 4, loose sandstone 1, grey slate 2, red slate 2.

Basalt 6.

No. 13.

Granite-Gneiss 7.

Sediments 5: compact sandstone 1, loose sandstone 1, sandstone-slate with mica 1, grey slate 2.

Basalt 10.

No. 14.

Granite-Gneiss 1.

No. 16.

Granite-Gneiss 2.

Sediments 4: quartzite 1, compact sandstone 1, loose sandstone 1, grey slate 1.

Basalt 1.

No. 18.

Granite-Gneiss 1.

Sediments 2 (grey argillaceous sandstone with mica).

Organic 1 (bivalve).

No. 22.

Granite Gneiss 3.

Sediments 4 (hard sandstone).

Basalt 3.

No. 25.

Granite-Gneiss 1.

Sediments 1 (red, fine-grained argillaceous sandstone).

Basalt 1 (red, disintegrated).

No. 26.

Granite-Gneiss 7.

Sediments 13: white quartzite 2, grey quartzite 2, fine-grained red sandstone 1, grey sandstone 3, white sandstone 1, grey slate 1, black slate 1, reddish slate 2.

Basalt 2 (reddish).

No. 28.

Granite-Gneiss 4.

Sediments 5 (hard, grey sandstone 1, loose, reddish sandstone 1, loose, greyish sandstone 3).

No. 29.

Granite-Gneiss 23.

Sediments 6 (reddish quartzite 1, hard, grey sandstone 3, loose whitish sandstone 1, slightly hardened, reddish clay 1).

Nr. 31.

Granite-Gneiss 4.

Sediments 6 (quartzite 1, hard, reddish sandstone 1, hard greyish sandstone 1, loose, white sandstone 1, reddish sandstone-slate 1, reddish slate 1).

Basalt 1.

No. 32.

Granite-Gneiss 7.

No. 33.

Granite-Gneiss 70.

Sediments 4 (hard, red sandstone 1, loose, grey sandstone 1, greyish sandstone-slate 1, reddish slate 1).

No. 34.

Sediments 5 (reddish quartzite 1, hard grey sandstone 1, loose, grey sandstone 3).

Basalt 1.

No. 35.

Granite-Gneiss 2.

Basalt 12 (1 with a bluish radiated zeolite).

No. 36.

Sediments 1 (hardened clay).

Basalt 12 (black).

No. 37.

Sediments 1 (loose, grey sandstone)

Basalt 13 (black or greyish, sometimes altered).

No. 40.

Basalt 17 (for the most part of a porous, or somewhat loose consistency, greyish or brownish).

No. 41.

Granite-Gneiss 2.

Sediments 18 (8 black, or greyish-black, hard, and 10 loose, greyish, much altered).

No. 42.

Granite-Gneiss 1.

Sediments 3 (grey sandstone slate 1, grey slate 1, grey phyllite).

Basalt 5 (black, often rather loose).

The rocks found in the samples correspond on the whole rather closely with the solid ones of the land near the sea, and we may suppose that only a very small part of them at most can have been derived from more distant parts, though it cannot be proved that such rocks are quite excluded. The geological conditions of this part of East-Greenland are very various, and not a single fragment is found in the sample, which may not have originated from known formations.

If we consider the nature of the fragments, the ratio between the individual rocks of the samples will generally be somewhat remarkable. The archæan rocks are generally present in comparatively small quantities, except in the samples which were obtained in the immediate neighbourhood of the Liverpool Kyst, these occupying, however, the largest areas within the younger formations. This fact shows plainly enough that the glacier-ice cannot play a very great part in the transport of the fragments, for by far the greater part of the glaciers in this part of the country are found within the territory of the archæan formation. But, as has been mentioned before, the glaciers from the large bays, probably, seldom reach out into the sea, and the archæan rock fragments which are found at the bottom of the sea must therefore have another origin, being derived either from moraines or rocks at the bottom of the sea itself, or from the drift-ice which comes from the north.

The moraines of the bottom of the sea will be especially likely to contain a great quantity of rocks from the archæan formation. During the ice-age the glaciers must everywhere have reached the mouths of the bays, and perhaps even a good way out into the sea, and the bottom — and surface — moraines conveyed thither by them will therefore necessarily contain an equal mixture of rocks from all the parts where the ice passed through, as is seen in the moraines of Scandinavia. And not only will much material from the archæan formation have become deposited in the terminal moraine from the ice-age, but the ice-bergs which were formed at that time will probably have conveyed the same rocks farther out to sea. The result will therefore be, that most of the rock-fragments belonging to the archæan formation will occur either in or outside the moraine which runs parallel with the coast. As will be seen, a comparatively large amount of material from the archæan formation was also found in the three first samples, obtained rather far from the coast, as in No. 1, 4 fragments out of 10 belong to this class, in No. 2, 5 out of 7, and in No. 3, 5 out of 9, whereas, in almost all the other samples found nearer land, these are subordinate in quantity as compared with the other ingredients. The rocks of the archæan formation which were found in the samples obtained from within the moraine were derived from solid rocks at the bottom of the sea, or from drift-ice whcih has came from more distant paıts where the archæan formation extends nearer to the coast. Of these two factors now one, now the other predominates, and this point must be examined separately in each individual sample. As the rocks of the greater part of the coast which comes nearest the sea, consist of basalt, probably those at the bottom of the sea near the coast will also consist of this material.

With regard to the individual ingredients of the archæan rocks, it is scarcely possible to distinguish different kinds, in fragments of the size in question ($4—32^{mm}$); they have therefore been treated collectively.

In the case of the sedimentary rocks, the sandstone and the quartzite play the most prominent part, as would be expected seeing that they form by far the greater part of the solid rocks on land. It is remarkable that a comparatively large amount of slate is found in the samples, as very little of this rock is found on land. The Silurian formation is found in the inner parts of Keiser Frans Joseph Fjord and Kong Oscar Fjord, may contain a mixture of all the various sedimentary rocks, but it is not very likely that any of this formation would be able to get into the open sea, for reasons which have been mentioned above. Moreover what came out during the ice-age is found outside the territory from which the samples of this expedition were taken. We have a proof that this formation does not occur in the samples in the fact that not a single limestone or dolomite has been found in them, although these rocks according to Nathorst (p. 288) contribute to form the Silurian formation. The Devonian, which has a vide distribution in the outer parts of the two bays just mentioned, and may therefore be supposed to have contributed much more largely to the formation of the deposits, is not stated to contain slate, and this rock was therefore probably derived from the tertiary formation. This formation has only a very limited extent in the country inside the territory explored by the expedition, but is found in far greater amount north of Hochstetters Vorland, and possibly still farther towards the north. It therefore seems most probable that at least a great part of the slate found in the samples was derived from icebergs which came from the north though some part of it may have originated from rocks at the bottom of the sea. Nor is the possibility excluded that greater masses of tertiary existed formerly and were eroded during the ice-age, but these rocks should, as shown above, be found only in the very outermost samples.

The basalt is found solid near most of the samples, and its presence is very easily accounted for, as it may either have originated from coast-ice or from rocks at the bottom of the sea.

The first three deposits occupy a peculiar position as compared with the rest in as much as they are situated on, or in the immediate neighbourhood of the moraine which must exist at the bottom of the sea. We have already seen that they contain, in consequence of this, a larger amount of fragments than the deposits found further inland. It has also been already mentioned that they contain much more granite than the majority of the other samples, namely altogether 14 fragments out of 26. Of the other 12, 10 are sediments, and only 2 basalt, which circumstance is rather difficult to explain, as the basalt occupies a far larger area of the inland country than is composed of the sedimentary formations. It is possible, however, that much greater quantities of the latter existed formerly, but were eroded during the ice-age. Of the 10 sediments, 4 are quartzite or hard sandstone derived probably from the Silurian and the Devonian formations which must extend towards the north inside Clavering Ø. Three, are loose sandstones probably derived from the Jurassic, and 3 are clay-slates from the tertiary formation, thus all the solid formations from inland are represented in the fragments of the three samples, which fact is well in accordance with their having originated from the moraine.

Samples Nos. 4—7, which were obtained immediately on the inland side of the preceding ones, show a quite different constitution. If we leave out of consideration 8 pieces of clay in No. 5, which may perhaps have been hardened at the bottom of the sea, only 9 rock-fragments altogether are found in the 4 samples; of these only one is granite, while 6 are sediments and 2 basalt. Most of these must be supposed to have been conveyed hither by icebergs. The proportionately large quantity of sediments is somewhat remarkable.

Samples Nos. 9—13 are, as above mentioned, some of the coarsest of all, and contain a great number of fragments which must be supposed to have originated from the moraine. The composition also shows a certain analogy with that of the three first samples, as 29 fragments out of 92, or about a third part consists of granitic material. They also contain fragments of 34 sediments, half of which are quartzite or hard sandstone, the greater part of these originating from the Devonian; 6 are loose sandstone, and 11 slate. These samples differ, however, from the first in containing a large amount of basalt, 29 fragments in all, this being due to the wide distribution of basalt in the country inland from Kap Broer Ruys.

In samples 14—19 very small quantities of rock-fragments are found, so that we can hardly draw any decided conclusion from the ratio between them. Altogether in the 6 samples there are 11 fragments, where of 4 are gneiss or granite, 6 sediments, and 1 basalt. These must presumably have been derived from icebergs. They also show a somewhat similar ratio in their rock-fragments as was seen in the samples 4—7, the only difference being that these contain a somewhat smaller amount of granite. The one bivalve found in sample 18 must also have been derived from the ice, as it was found at a far greater depth than that at which it could originally have lived.

Sample No. 22 shows an equal mixture of the different ingredients and here, as before mentioned, we must imagine that the fragments originated from icebergs for the most part, though it is not possible to draw any certain conclusions from their nature.

The samples obtained from along the Liverpool Kyst show a somewhat characteristic mixture of rocks. As the country inland from the coast consists as far as we know exclusively of granite or gneiss, these rocks would be expected to predominate in the samples, but this is not at all the case in the greater number of these. The first few samples Nos. 26, 27, 29 and 31, show about the same composition as regards rock-fragments; taken together they contain 38 of granite-gneiss, 30 sediments, and only 3 of basalt. This last circumstance excludes the possibility that many of the stones were derived from icebergs coming from farther north, as it has been already proved that this being the case, the amount of basaltic material would not be much less than the other ingredients. Neither could it be imagined that the fragments originated from moraines at the bottom of the sea, as, in that case, the deposition of material at the sea-bottom must have taken place much more slowly than we have otherwise reason to suppose likely. If the fragments had been derived directly from land or from rocks at the bottom of the sea, as it would seem most natural to expect they probably would have consisted exclusively of granite or gneiss. The sediments must therefore have a different origin, and we can hardly imagine otherwise than that they came with the coast-ice from the outer parts of Davys Sund, and from Fleming Inlet and Carlsberg Fjord. If we consider the constitution of the sedimentary rocks, this corresponds very well with the geological conditions of these parts. Out of 30 rock-fragments, 17 are quartzite or hard sandstone which may have been derived from the Devonian, 7 are loose sandstone from the Jurassic, 6 are slates, the origin of which cannot be closer determined, seeing that the geological conditions at Fleming Inlet and Carlsberg Fjord are not as yet known. Moreover the three fragments of basalt indicate that at least some ice-drift must have taken place from distant parts, and that an equal amount of the other rocks must be ascribed to this cause.

In the two samples from the southern part of the Liverpool Kyst i. e. Nos. 32 and 33, the above-mentioned transport of sediments decreases perceptibly, at least these rocks disappear entirely from among the rest. Out of 81 stones the two samples contain only 4 sediments, the remaining ones granite and gneiss, and not a single basalt.

Sample No. 34, which was obtained from the northern part of the outlet of Scoresby Sund, has a very remarkable constitution, as, out of 6 rock-fragments, 5 are sediments and 1 basalt, while not a single granite fragment is found and this in spite of the fact that the deposits were situated just at the southern point of the Liverpool Kyst. If any conclusion can be drawn from the proportionately small number of fragments, it would be that, at the bottom of the sea, in the neighbourhood of the sample, solid sandstone must be present. There is, however, always the possibility that this rock may have come with the ice from the bay, even if, as has previously been mentioned, there is good reason to suppose that such a transport was very slight.

Nos. 35 and 36, which were found in the southern part of the outlet of Scoresby Sund have a constitution which corresponds perfectly with their place of origin, as, out of 27 fragments, 24 are basalt, while only two are granite and 1 sediment. These last named ones may have been conveyed hither by the ice, while the basalt was derived from land or from rocks at the bottom of the sea.

Samples Nos. 37, 40 and 41, which came from the south of Kap Brewster, are as might be expected still richer in basalt; out of 51 stones, 48 consist of this rock, while 2 are granite and only one, sandstone.

Sample No. 42, south of Kap Stewart, contains 9 fragments, 1 of which is granite, 3 sediments, and 5 basalts, which is just such an admixture as would be expected when we consider the surrounding formations.

2. The sandy ingredients in the samples.

(0·05—0·5^{mm}.)

The examination was carried out in the following way: A preparation in Canada balsam was made of each sample; then, by a gradual shifting of the object-glass 100 consecutive grains were counted off. The result is given in the following table.

The numbers in the above table cannot claim to be absolutely exact in detail as it is often very difficult or even impossible in sand-preparations to distinguish one mineral from another, and several of the different kinds pass into each other. Quartz and felspar are together very easily distinguished from all other minerals though it is rather difficult to distinguish them from each other. As it would be a quite endless task to find axial images for the individual grains, refraction has been chiefly employed in the separation; the grains with a slighter refraction than the Canada balsam are classed under felspar, those with stronger refraction under quartz, and those in which twin-striation or cleavage cannot be seen are probably so small in number in proportion to the quartz and the rest of the felspar, that they can have no appreciable influence on the result. The optically homogeneous felspar is certainly orthoclase in most cases, though a few grains of albite or oligoclase may also enter into this division.

While the ordinary green hornblende cannot easily be mistaken for other minerals, augite and olivine are very difficult to distinguish. The augite is almost always of a quite pale violet or brownish-grey colour. The olivine is colourless, or of a quite pale greenish colour. The augite has a somewhat

Number of the sample	Quartz	Feldspar homogeneous	Feldspar with Microcline striation	Feldspar with Plagioclase striation	Hornblende	Augite	Olivine	Zircon	Rutile	Tourmaline	Muscovite	Biotite	Garnet	Opaque grains	Basalt	Clay or slate	Aggregates or uncertain
1	59	7	.	2	8	3	.	.	.	2	2	1	1	2	.	4	9
2	70	12	.	.	1	3	1	.	.	.	.	.	3	1	2	1	6
3	64	14	.	3	2	2	2	.	.	1	.	.	2	1	3	.	6
4	67	8	.	1	.	1	.	1	.	.	.	.	.	2	5	2	13
5	59	12	.	1	1	6	1	.	.	.	.	.	1	2	4	2	11
6	67	7	1	.	2	2	.	.	.	1	.	1	.	2	8	1	8
7	38	14	.	1	1	18	1	.	.	.	.	.	.	3	16	.	8
9	44	8	1	2	1	18	.	.	.	.	.	.	2	3	6	2	13
10	53	14	.	.	.	17	.	.	.	.	.	.	1	3	4	4	4
11	55	12	.	1	2	9	1	.	.	.	1	1	4	5	4	.	5
13	43	12	.	.	.	15	2	.	.	.	.	1	3	4	15	.	5
14	40	5	.	.	2	13	2	1	.	.	1	.	6	14	7	2	7
15	57	7	.	1	1	13	1	.	.	2	.	.	4	1	5	1	7
16	63	7	1	3	.	9	.	.	.	2	.	.	2	.	4	3	2
17	53	4	.	.	2	6	1	.	.	.	.	.	2	1	12	10	9
18	69	11	.	1	.	4	2	.	.	.	.	.	.	1	4	4	4
19	50	12	5	1	2	3	2	.	1	.	.	.	1	2	3	16	2
22	46	13	1	.	.	7	1	.	1	.	.	.	2	5	1	8	15
23	50	14	1	1	5	6	4	.	.	.	.	.	3	4	1	3	8
24	56	12	.	3	.	3	.	.	.	.	.	.	.	.	2	18	6
25	52	20	4	.	.	4	1	.	.	.	.	.	.	.	5	8	6
26	59	8	1	.	2	3	2	1	.	.	.	.	1	3	3	6	11
27	55	14	2	.	4	4	1	.	1	.	.	.	3	.	6	5	5
28	55	11	4	1	9	5	2	.	.	1	.	.	1	2	.	5	4
29	54	8	2	.	10	9	4	.	.	.	.	.	1	6	2	1	3
30	51	21	1	.	13	3	1	.	.	.	1	.	1	4	1	3	.
31	52	13	.	2	12	7	3	.	.	.	.	1	.	4	2	1	3
32	30	18	2	2	16	13	5	.	.	1	.	.	2	9	1	.	1
33	25	23	1	.	22	11	4	1	.	.	.	.	4	5	2	1	1
34	49	16	.	.	14	8	1	.	1	.	.	.	4	3	1	3	.
35	36	17	.	.	8	13	4	1	.	.	.	.	5	5	2	5	4
36	19	11	.	1	4	34	3	.	.	.	.	.	.	11	17	.	.
37	16	5	.	.	4	40	1	.	.	.	.	.	.	10	22	1	1
40	14	3	.	.	1	51	3	.	.	.	.	.	.	16	10	1	1
41	10	4	.	.	2	46	2	.	.	.	.	.	.	14	17	2	3
42	33	4	.	.	2	35	1	1	.	.	.	.	1	10	9	2	2
43	48	16	.	.	1	4	.	1	.	.	.	.	2	4	3	14	7
45	55	11	.	.	5	9	2		.	.	.	1	.	5	3	3	6
46	56	15	1	.	2	4	2		.	.	.	.	2	7	3	2	6

less double-refraction, but there does not exist any convenient way to distinguish between them in rounded grains of sand. The consequence is that the numbers given for these minerals, especially for the olivine, which is always found in small quantities, must be considered as rather inexact; the total sum however is of much greater importance. As they must both have been derived mainly from the basalt their separation is of no very great importance.

It is very difficult to distinguish between the opaque grains and the basalt. A great part of the first mentioned consist certainly of magnetite, while another part must be supposed to consist of basalt, which is very rich in iron. Generally most of the basalt grains are translucent in several points of their edges and are of a dark brown colour, in some of them the whole grain is also somewhat translucent. Grains of transparent brown glass have not been found in any of the samples, but a very large number of the grains which are classified as basalt have certainly a glass-like ground-mass, sprinkled with a great many small dark particles.

Under the heading clay or slate, have been classed grains of greyish colour and of a very smooth, fine-grained consistency. Their number does not play any very prominent part in the determination of the origin of the sand, as they may largely originate from more or less coherent clayey particles in the sample, which it has been impossible to separate by boiling, partly perhaps owing to the fact that concretions rich in iron and manganese have already begun to form in the clay.

Under the last heading: «aggregates or uncertain», are classed a number of different fine-grained rocks, which it is impossible to separate in the preparations. These are generally found in somewhat small quantities or not at all, in samples which contain few sedimentary rock-fragments, as is the case with most of the samples from No. 30—40. This may perhaps indicate that some of these grains are fine-grained sandstone, or sandstone-slate, but this coïncidence may be more or less accidental.

With regard to the ratio between the individual minerals, there are several striking peculiarities.

It has been seen that quartz has a special tendency to appear in great quantities in the samples, even where one would expect it to be almost absent. In samples Nos. 37, 40, and 41 from the south of Kap Brewster, though the sample seems to consist almost exclusively of basaltic material we see that there is from 10 to 16 per Ct. of quartz present. This is connected with the wellknown tendency which quartz has to appear in grains of sand, so that the percentage of it in a sand deposit is always many times greater than its percentage in the rocks from which it was derived. Sand which originates from granitic material will thus contain 60—70 per Ct. of quartz, while much less than half of the granite consisted of this mineral. If we determine the ratio between the different rocks which have contributed to the formation of the sand in a sample, we must always reduce the amount of quartz very considerably, and must also make smaller changes with regard to the ratio between the other minerals. In the three samples above-mentioned we should probably come very near to the real ratio if we fixed the quartz at 3—5 per Ct., then the total amount of quartz, felspar and hornblende would become about 10 in these samples, which number would about represent the amount of granitic material contained in them.

For the rest, the amount of quartz is fairly equal through out the samples; it culminates at 70 per Ct. in No. 2; and thus corresponds pretty closely with the amount in some of the samples obtained during the Ingolfexpedition to the West-coast of Greenland. There the collective mass of quartz and felspar reaches 80 per Ct., while it here, in No. 2, amounts to 82 per Ct., which is perhaps the highest percentage generally reached in granitic sand. It must, however, be remarked that the ratio for the East-Greenland samples is somewhat difficult to determine, for on the one hand the proximity of basalt, slate etc. will diminish the amount of quartz, on the other hand the presence of sandstone will augment it, as sand originating from this rock will probably contain very nearly 100 per Ct. of quartz.

With regard to the felspar, this is found in all the samples in less quantities than the quartz. The ratio between the two minerals is generally between $^1/_3$ and $^1/_8$. As might be expected, the proportionately smallest amount of felspar is found in the samples, where part of the material originates from sandstone. In the case of samples, where the quantity of granite and gneiss among the coarser ingredients, far surpasses that of the sediments as is the case in Nos. 30, 32 and 33, the amount of felspar will become much larger, viz. from half the amount of quartz up to about the whole amount. This last ratio, which occurs in No. 33, is very striking and rare, and cannot be explained altogether by the absence of sandstone, but the solid rocks which are found nearest this deposit either on land or at the bottom of the sea, must be very poor in quartz, as would be syenite or hornblende-schist.

The felspars with distinct microcline structure have no great distribution in the samples, though somewhat more so than in the samples of the *Ingolfexpedition*, where never more than 1 per Ct. was found. Here the microcline is missing in the greater number of the samples, but in a few it is found in comparatively large amount, chiefly in No. 19. This fact might perhaps have been considered accidental, were it not subsequently found to obtain also in samples Nos. 25—33 from along the *Liverpool Kyst* in which about two grains are found in each sample. This circumstance must here be connected with the nature of the rocks.

The total amount of grains of plagioclase is about as large as that of microcline, but they are found to be more evenly dispersed in all the samples. It is strange that none of this mineral is found in the samples consisting mainly of basaltic material. This feature which was also noticed in the samples of the *Ingolfexpedition*, is caused by the fact that the labradorite, though it is found as chief-ingredient in the basalt, must very rarely appear in the sand, owing chiefly to its small size and its form, like flat tables. Not a single grain of labradorite with twin-striation has been found in any of the samples.

The hornblende is found in very varying amounts in the samples; as a rule there is remarkably little of this mineral compared with what is generally found in quartz-sand, this appearing especially in all the samples up to No. 27. In the following samples obtained along the Liverpool Kyst to Kap Brewster, we find, on the contrary, very large amounts, a fact which indicates that the country lying inland from the coast must contain a considerable amount of rocks rich in hornblende, syenite, diorite or hornblende schist. In the last samples, smaller amounts are again found, yet more than in the first samples. In samples 37—41, found south of Kap Brewster, this characteristic is even more striking, as the chief mass of the samples originates from basaltic material. This indicates that the contributions coming from the north, must mainly have originated of the rocks of the Liverpool Kyst, from which they were probably conveyed by coast-ice.

The amount of augite also varies, but generally much larger than the amount of hornblende. It naturally bears a certain relation to the amount of basalt in the fragmental stony ingredients of the sample, but it generally only reaches half the percentage of this rock. The great inclination of this mineral appear as grains of sand is remarkable, and it does not seem, in this respect, to be much inferior to quartz.

In samples Nos. 1—6, which in 40 fragments contain only 2 of basalt, the augite in the sand is also present in smaller amount than in any of the other samples, namely on the average $2^2/_3$ per Ct. In the samples No. 7—15 on the contrary the basalt was found in rather large quantities, namely 31 out of 96, and here augite is found to an amount averaging

14 per Ct. In samples No. 16—25, very few fragmental ingredients are found for instance as in 23, where 4 are basalt, thus about 17 per Ct. From 3 to 9 i. e. an average of about 5 per Ct. of augite is found in these samples, so that the amount of basalt in the samples is perhaps not so large really as would be imagined from the comparatively few fragments.

In the following samples the amount of augite seems to increase somewhat in proportion to the amount of basalt, in samples Nos. 26—30, only 2 fragments out of 60 are found to consist of basalt; here the amount of augite in the sand reaches an average of about 5 per Ct., thus an even larger percentage than the basalt. The ratio of the next samples Nos. 31—34, undergoes still greater variation, as, in them, only two basalt fragments are found out of 98. The augite here is found in an average amount of about 10 per Ct., and we must thus suppose that at any rate a great deal of it has its origin in various other rocks, which however cannot be accurately determined in the comparatively small fragments. These are the same samples as those which contain very large amount of orthoclase and hornblende, and a closer geological examination of the rocks of the Liverpool Kyst will presumably be of great interest.

In the samples rich in basalt near Kap Stewart, the old ratio between the basalt and the augite reappears, and here it can be stated with greater certainty, as only a very small amount of foreign rocks can have entered into these samples. In samples Nos. 35—41, out of 78 stones, 72 are basalt, thus about 92 per Ct. Of augite about 37 per Ct. is on the average found in these samples, hence we may conclude that about 40 per Ct. of pure basaltic sand will be augite; in sample 40, the amount of augite mounts to 51 per Ct., so that we may be somewhat justified in terming the sand Augite-Sand. This amount is larger than in any samples of the Ingolfexpedition, a fact which does not prove the Icelandic basalt to be of another nature than the Greenland one, but merely admits that in most of the Icelandic samples an unusually large amount of volcanic glass is found, which has probably fallen down as ash for the most part, and this changes the percentage of the augite.

In the sample No. 42, were found 5 basaltic stones out of 9, thus about 55 per Ct., while the amount of augite in the sand is 35 per Ct. In the three last samples (Nos. 43—46) no fragmental ingredients are found, so that it may be possible, from the amount of augite, to form a judgment of the part which the basalt has played in the formation of these deposits. No. 43, which is situated in Fleming Inlet, has 4 per Ct. of augite; we should thus expect that about 10 per Ct. of the ingredients of the sample were of basaltic origin, probably originating from the country near Kap Moorsom. No. 45, situated in Carlsberg Fjord, has 9 per Ct. of augite, but probably only a part of it originates from the basalt, while the rest must come from the above-mentioned rocks at the Liverpool Kyst. The same is probably the case with the augite in No. 46, obtained from Hurry Inlet.

The olivine is found everywhere in smaller quantities than the augite, and generally stands in a certain relation to it with regard to amount, wherefore it is of no special interest.

Rutile, Zircon and Tourmaline, are, as might be expected, only found in very small quantities in the sand, and the same is the case with the mica which is even strikingly sparsely represented.

Nor is garnet present in very great amounts in any of the samples at the highest the percentage is 6, while in a single of the West-Greenland samples from the Ingolfexpedition it was 17, and in the next East-Greenland one taken near Angmagsalik, it was 9,5 per Ct. A large amount of garnet in the samples generally indicates that these for a great part must have their material from crystalline schists while smaller amounts of garnet, or none at all, indicate an origin from eruptives or sediments. If we look at the table, rather conspicuous differences between the individual samples will be noticed. The first seven contain, on the whole, small amounts, such as an average of 1 per Ct., while the next eight (Nos. 9—17) contain on an average $3^1/_2$ per Ct. This must correspond with some difference in the nature of the rocks of the country inland. On examining the chart it will be seen that deposits Nos. 9—17 can get material from Clavering-Ø and its neighbourhood, whereas the deposits above mentioned cannot, there will therefore be found in this part some rocks rich in garnet. If we proceed we shall see that samples No. 18 to 31, contain very small amounts of garnet, only 1 per Ct. on an average. With regard to the first of these, this circumstance is connected with the large amount of sediments that enter into it; in the deposits along the northern part of the Liverpool Kyst on the other hand, the small amount of garnet must have originated in some special way with the archæan territory on land.

Along the southern part of the Liverpool Kyst, a larger amount of garnet suddenly appears (2—5 per Ct.), and therefore some crystalline schists must occur here. As might be expected, absolutely no garnet is found in the deposits south of Kap Brewster.

The amount of opaque grains is obviously connected with the amount of basalt in the samples; only in the samples from along the Liverpool Kyst is a comparatively larger amount found, a fact which is probably due to special conditions in the rocks of the country.

IV. General view of the factors which contribute to the formation of the deposits.

A brief survey will now be given of the degree in which the various factors already mentioned contribute to the formation of the deposits. The different ingredients in these must have been mainly derived from one or other of the following four sources, 1) the land, 2) the drift ice, 3) moraines at the bottom of the sea and 4) solid rocks at the bottom of the sea. It is impossible to say for certain which of these factors plays the most prominent part in the district now under consideration, we can only say that they have each contributed considerably to the formation of the deposits. The material they supply is of a very diverse nature.

1. The transport direct from land which, in other parts of the earth, is by far the most important of the factors which supply the bottom of the sea with mineral material is here subordinate to the other factors mentioned. The mode of origin of the material belonging to this class is somewhat varied; probably only a small amount is loosened directly by the waves lashing against the rocks of the coast, the greater part being conveyed hither by larger or smaller rivers; sometimes the wind will also be able to convey a considerable quantity of material into the sea. At any rate the particles

which have been conveyed direct from land soon become sorted by falling through the water. Even if only a slight current is present, the finest particles will be conveyed several miles from the place where they were washed into the sea, the rock-fragments will sink to the bottom almost immediately, while the medium sized grains will be deposited in the space between. If the current runs parallel with the shore, the ingredients from the different places will be mixed up with one another, so that nearest land will be formed a very mixed deposit, whereas some of the finest material will be conveyed some distance away from the shore. If, on the contrary, the current flows at some distance from the shore, as is especially the case near projecting points, the ingredients will be far more completely sorted, so that almost exclusively coarse material will be deposited near land while all the finer material will be conveyed far out sea.

Various circumstances may however influence deposition which is thereby rendered very complicated. Thus, instances have been given above of the influence on the fineness of the deposits exercised by differences in depth, which may sometimes be very great. If there is a somewhat straight coast-line along which runs a fairly constant current as is the case with the Liverpool Kyst, the difference between adjacent deposits at the same distance from land will be very great, provided there is a great difference in the depth. When the current runs over a comparatively deep place, the speed will be slight and the finest particles will have time to get deposited in such great quantities that the sample will be almost pure clay, whereas in the less deep parts, the current will be so rapid that sand and stones will be almost exclusively deposited.

In the bays it is rather different, especially in the smaller ones, where the area is not large enough for the tide to produce currents. There almost all the ingredients will be able to be deposited on the spot, a fact which causes very fine deposits, especially as also the other formerly above-mentioned factors will be of no great importance here. The samples which were found in Carlsberg Fjord, Fleming and Hurry Inlets belong, as has already been shown, to the very finest, while, on the contrary, a sample obtained from Scoresby Sund is of much coarser consistency.

Generally speaking, it will be very difficult to determine what proportion of the ingredients of a sample have been deposited by transport direct from land. We have here two things to go by, namely the size of the grains, and the mineralogical constitution. With regard to the size of grains, it has already been explained what the size will be in deposits which have been formed exclusively in this way. The other factors which contribute to the formation of the deposits will in most cases produce a very mixed deposit with finer and coarser ingredients intermingled. In almost every case we can, therefore, only be sure that the material conveyed from land will form a certain part of the finer ingredients of the deposit; how great a part, it is often impossible to determine. Ice-transport, for instance, may deposit large quantities of clay at the bottom of the sea, which cannot in any way be distinguished from other clay; we have therefore hardly any facts to go by except that there must probably be a certain proportion between the finer and the coarser particles in the material conveyed by the ice, this proportion being tolerably persistent everywhere. If in a sample very few rock-fragments are found we may suppose that only an insignificant part of the clay in the same sample can have been transported by ice. But the circumstances are rendered still more complicated by the fact that part of the material may have originated from the bottom of the sea, and this part may consist of all sizes of grains, and we have no means whereby we can determine the quantities of each of these beforehand. Only after a close examination of the curves for each individual sample can any conclusions be drawn.

The case will be somewhat altered if we take the mineralogical nature of the ingredients of the sample into consideration also. Here, more specially with regard to the deposits lying nearest land, we can draw fairly certain conclusions as to the nature of the material transported direct from land. That is to say it must be rather closely related to the rocks of the country inland, whereas ingredients transported in other ways have as a rule a very mixed constitution.

Speaking generally it is most probable that, in the case of deposits nearest land (inside of 20—30 kilom.) the greater part of the sandy and part of the clayey ingredients have originated direct from land. In the case of more distant deposits however, the portion which has been transported by the currents will always be less the farther we get from land, and will only consist of the finest ingredients.

2) In order to realise the value of the second of the abovementioned factors viz. the deposition of material at the bottom of the sea by the ice, the samples of this expedition offer facts of considerable interest. We should have expected that a very large number of the deposits were formed in this way, but the more the samples are examined in detail, the more is it proved that the influence of ice must on the whole be somewhat slight.

The question as to how great a quantity of material was transported by ice to East-Greenland, has been discussed already by Nordenskiöld, Eberlin and Bay, and I shall not enter further into this matter here as no further observations for the elucidation of this question have been made. I shall therefore only discuss the part played by ice-borne material in the formation of the deposits. Even if ever so little material may be observed on the icebergs, yet, in the course of very long periods, this would form enormous deposits, provided the other factors which contributed to their formation worked on a still smaller scale.

The material conveyed by ice is, as far as has been observed, of somewhat different kinds. The sheet-ice, which forms by far the greater part of the whole ice-mass, transports almost exclusively the finest ingredients, while the icebergs and the coast-ice must certainly be able to convey some rock-fragments, although according to Bay, such material is very insignificant in amount in the water north of Scoresby Sund. The comparatively few expeditions which have penetrated into these parts are however insufficient for the purpose of determining anything with certainty in this respect. In other parts of Greenland, icebergs have frequently been observed to be quite laden with rocks and gravel, and some such may very well exist in these parts, though they have not been observed.

It is impossible to tell how a deposit formed exclusively by ice would appear in these parts, as long as we do not know anything about the ratio between the amounts of the pebbly and clayey material conveyed. Nor does an examination of the samples furnish us with a definite answer to this question, as not a single sample is found in which we can suppose that the material deposited by the ice forms the chief mass. There may possibly be some difference between the different localities owing to the fact that in a few places is a comparatively large number of icebergs found, while in other places they are perhaps rarely found; but on the whole the material deposited by the ice must be rather homogeneous. Especially may we be justified in concluding that if we have two adjacent deposits whereof one is exceedingly fine while the other contains large amounts of pebbly ingredients, then a great part of these deposits cannot have been formed by ice.

But, as has been shown above, in the samples of this expedition a number of cases have been found in which adjacent deposits differ very widely with regard to their mechanical constitution, which differences must certainly be due to purely local relations of the bottom of the sea.

If we consider the mineralogical nature of the samples, we shall be able to draw from it certain conclusions with regard to the depositing power of ice. As icebergs have their origin in so many different localities, the material they convey must also be very mixed; if therefore the samples show pronounced mineralogical differences directly connected with the geological nature of the nearest tracts of land then in such cases the influence of the ice must have been rather slight. These considerations prove plainly that in the samples nearest land the deposition of ice has played no great part. In the deposits lying farther from land the case is somewhat different, for these will generally contain a very mixed material conveyed in other ways, and which cannot be easily distinguished from that which has been conveyed by ice; there is, however, as has often been mentioned above, sufficient reason to suppose that in these also the influence of the ice is comparatively slight.

On the other hand, merely from the mineralogical nature of the samples we can conclude that the drift-ice must be of some importance with regard to deposition, and that, in these parts, at least some transport of pebbles must take place. For, it will often be seen that beside the chief ingredients of the sample, which plainly show by their homogeneousness that they have originated in rocks of the neighbouring land or of the bottom of the sea, there will be found a few others, which cannot have been derived from any neighbouring place, and must thus have been conveyed hither by icebergs. For instance, if, out of 100 grains, we have 90 granite, and the rest sediments or basalt, which last is not found solid in any place in the neighbourhood, we may conclude that these, together with a corresponding amount of the granite, have been conveyed hither by ice, while the chief mass of the granite has originated in the solid rocks of the immediate neighbourhood. It has been proved in this way that in none of the samples can a greater part than about $^1/_5$ or $^1/_6$ be supposed to originate from the ice, this is stated in reference to the samples that were found nearest land; with regard to the others, it is impossible to state anything with corresponding accuracy.

3) The third source of those mentioned above from which the deposits may have derived material is the moraines, or other ice-deposits at the bottom of the sea. Such deposits can sometimes be obtained directly by aid of the sounding-tube, in which case we have not to do with a true sea-floor deposit. In the case of moraine-derived material we must suppose that deposition at the bottom of the sea took place exceedingly slowly, and near land we cannot suppose that such could be the case, while at a greater distance from land it will appear more likely. If moraine-ridges are left at the bottom of the sea from the ice-age, there is some probability that they may be quite uncovered by later deposits for their greater height in proportion to the surrounding territory will generally cause a fairly strong current to run above them, so that the finer ingredients which generally form the greater part of the deposit cannot be laid down. If, on the contrary, the moraine material is not found at any specially great height, the whole tract will propably have been covered over since the ice-age by a thin layer of deposits through which large quantities of ice-borne pebbles may project, and these later on by their disintegration will produce material for the samples.

With regard to the mechanical constitution of the ingredients which the deposits get from moraines at the bottom of the sea, it will be clear from what has been said that they will be the coarser ones contained in the samples. All original moraine-material is as a rule coarser than the material of the samples, and from moraine-ridges where the currents are strong part of the clay will always be washed away, so that we must imagine such parts at the surface almost exclusively covered by larger or smaller pebbles, and in the spaces between them sand and clay will be found. If the sounding-tube rests on one of the pebbles no sample will be taken up, but, as a rule, we may suppose that it will be dragged some distance along the bottom of the sea or, will of its own accord slide down from the projecting pebbles. Such samples will be of a very varying constitution, but are as a rule rather coarse. The best proof of the fact that we have to do with moraine-deposits is that, when we find a row of coarser deposits away from land, and others nearer land considerably finer, such a difference can hardly be explained in any other way.

An examination of the nature of the pebbles which have been taken up may tell us a great deal with regard to the presence of morainic material at the bottom of the sea. By looking at the geological map we can draw fairly certain conclusions as to what the constitution of the moraine-material will be in each locality, and, in the places where the real facts correspond with these conclusions we are somewhat justified in supposing that the coarser ingredients of the samples were derived from the moraine. As a rule, the moraine-material in the samples now under discussion will be of a very mixed nature, as each ice-current will have passed through several different formations, but still there are some characteristic features by which it can be distinguished from other material especially that which has been ice-borne. The basaltformations north of Scoresby Sund are only found at the outmost parts of the country, and consequently the icebergs of the present day cannot contain basaltic material; the coast-ice may perhaps convey some, but this will only be a small quantity. The ice from the ice-age, which filled up the bays right to the mouths, must on the contrary have eroded a large amount of the basalt territory, and this accounts for the fact that, although the basalt occupied all the outermost tracts except in the case of Liverpool Kyst, comparatively little of it is found in the samples nearest the coast but much more in deposits farther out. When we come very close to the shore larger quantities of basalt will again be found, which have their origin direct from the coast.

4) The 4th factor whereby material is conveyed to the deposits is the solid rock of the sea-floor. Where we have to do with such, the mechanical constitution of the samples is most varied, according as they have been obtained in close proximity to some rock or at some distance from it. The existence of submarine rocks is often shown by just such a seemingly unreasonable variation between adjacent deposits. Something the same is the case with regard to the mineralogical nature of the samples. As each mountain consists as a rule of only one kind of rock, a deposit which gets its material from such will be of a very homogeneous consistency. We have a still more certain sign of the presence of submarine rocks, when the fragments vary suddenly from one sample to another, if, for example, we have two adjacent samples, one of which consists of basalt, and the other of granite, we may conclude with certainty that they must procure their material from rocks at the bottom of the sea, unless they have been obtained so close to the shore that the

appearance of various rocks in the samples can be explained thereby.

The existence of rocks at the bottom of the sea can now be proved in many different parts of the territory herein described, but still only in the neighbourhood of the shore. The presence of such rocks indicates that those tracts were, in a comparatively late geological period, higher situated than at present, so that the rocks could be worn away by the atmosphære, and by the erosion of the water. Otherwise we can hardly imagine any power which would produce rocky ground at the bottom of the sea itself, where the deposition of loose material tends to level the floor. We can on the other hand state with equal certainty, that if no submarine rocks are found the territory cannot have been raised at any late geological period.

It is impossible to determine with certainty how great has been the sinking which has taken place in these parts. The fact that a few of the deepest-lying deposits (over 200 D. fathoms) contain a large amount of material derived from rocks at the bottom of the sea, does not prove that the locality from which the sample was taken has been raised above the sea, it is sufficient if one or more rocks in the neighbourhood have been raised. It seems probable that the sinking may have been about 100 D. fathoms, which is somewhat less than the sinking which has taken place round Iceland.

It is impossible to say for certain, to what part of the quaternary period this higher situation of the country must be reckoned; the phenomenon itself can only be conjectured from the conditions prevailing at the bottom of the sea and can probably not be connected with other geological phenomena. Both in Greenland and Iceland raised layers of shells are found showing that the country at times has been considerably lower than now, but we cannot at present draw any conclusions as to the order in which these different changes of level succeeded each other in either country. In southern Scandinavia, sinking of the country has taken place twice since it was covered by ice, and in the interval it has been raised above the present level of the sea; possibly the same changes have taken place in Greenland.

V. The organic ingredients of the samples.

An account of the third characteristic feature of samples is still wanting, viz. their organic contents; but whereas these contribute in the highest degree to the character of samples generally the case is quite different in the samples now under discussion, they being almost devoid of organisms. This fact may arise from one of two causes, either that inorganic ingredients have been deposited in uncommonly large quantities or that remarkably few organisms live in these waters. Probably both factors worked in concert. The result is that only in comparatively few of the samples have organic remains been found, and these belong to comparatively few groups of animals viz. bivalves, echini, sponges and foraminifera.

The bivalves have been found only in very small numbers namely one whole bivalve with both shells[1]) in No. 18, and a few small indeterminable fragments in No. 19. Both have a certain interest in that they were found at greater depths than those at which these animals can have originally lived, viz. at 124 and 159 D. fathoms, and must therefore like the bivalves and snails mentioned by Jensen[2]), serve either as a proof that the sea-floor was formerly situated at a higher level than

[1]) Astarte crenata, Gray; determined by Jensen.

[2]) Om Levninger, af Grundvandsdyr etc. Vid. Medd. Nat. Foren. 1900, p. 229.

now, or they must have been transported to this place by ice or by some other means of transport. The first supposition is, as has been shown above not so very improbable for there is sufficient reason to suppose that the bottom of the sea was situated formerly at a considerably higher level than now. We have only here the difficulty which also seems to exist with regard to the mollusca in deeper water, that it is not probable that they should have been able to avoid having been covered over by later deposits during the long period which must have elapsed since the sinking began. As, however, Bay[1]) has observed shells on the ice in these very parts, we may suppose that the bivalves found in the samples were conveyed thither in this manner.

A small number of spines of echini have been found in a single sample (No. 13), and are of no special interest.

The foraminifera have the greatest distribution of all the organisms, although they are not found in great numbers in any of the samples. The most common ones are:

a. The sand-tube foraminifera have been found in eight different samples (No. 1, 7, 18, 27, 30, 35, 43 and 45) distributed over the whole territory; in each sample only one or two specimens are found.

b. The rotaliform foraminifera have been found in four samples; in two of these (No. 23 and 30) occur only 1—2 specimens which are therefore of no great interest; in No. 40 more have been found, and in 33 they even amount to 11 per Ct. of the ingredients between 0·5 and 1^{mm}. Both these samples were obtained much nearer the coast than most of the others, and only a single other sample (No. 41) was obtained as far in. This proves that these foraminifera must be deposited in specially large numbers near land, seeing that we have every

[1]) Medd. om Grönl. XIX. 1896. p. 179.

reason to suppose that the deposition of inorganic material must here take place much more quickly than in the open sea.

c. Of nodosarine foraminifera only 1 specimen has been found (in No. 30), and the same is the case with

d. Haplophragmia one specimen of which has been found in No. 42 in a rather significant place, namely in Scoresby Sund; otherwise these two forms are of no special interest.

Sponge spicules are only found in five samples from along the southern part of the Liverpool Kyst; they occur in comparatively large numbers, yet not so as to influence the general appearance of the sample. These five samples are No. 30, 32, 34, 35 and 36. As the deposition of inorganic material so near the coast takes place very quickly, unusually large numbers of sea-sponges must grow at the bottom of the sea in this region.

Explanation of the tables II—IX.

The area, bounded by the curve, represents the percentage of the different sizes of grains in the samples; of the two lots wherein each of the figures is devided the upper one, to the left, shows the amount of clay substance, the rest represents the amount of the other mineral ingredients, and herein is also included the very small number of organisms. Further explanation is to be found on pages 34—36.

Indhold.

Meddelelser om Grønland,

udgivne af

Commissionen for Ledelsen af de geologiske og geographiske Undersøgelser i Grønland.

Otte og tyvende Hefte.
2den Afdeling.

Med 7 Tavler og 1 Kort.

Kjøbenhavn.
I Commission hos C. A. Reitzel.
Bianco Lunos Bogtrykkeri.
1909.

Pris: 7 Kr. 25 Øre.

Hos C. A. Reitzel faas følgende af Commissionen udgivne Skrifter:

Gieseckes mineralogiske Rejse i Grønland (Bericht einer mineralogischen Reise in Grønland, 1806—1813) med biografiske Meddelelser om Giesecke af **F. Johnstrup**, samt et Tillæg om de grønlandske Stednavnes Retskrivning og Etymologi af Dr. H. Rink. Med 3 Kort. 1878. Kr. 7.

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III. Conspectus Florae Groenlandicae. 1ste og 2den Afdeling: Fanerogamer og Karsporeplanter ved **Joh. Lange**; Grønlands Mosser ved **Joh. Lange** og **C. Jensen.** 1880—87. 3die Afdeling: Lichener, Svampe og Havalger, samt Tillæg til Fanerogamer og Karsporeplanter ved **Deichmann Branth, Grønlund, Kolderup Rosenvinge** og **Rostrup.** Med 2 Tavler og 3 Kort. 1887—94. Kr. 14.

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VI. Forberedelser til Undersøgelsen af Grønlands Østkyst ved **Wandel** og **Normann,** og Undersøgelse af Ruinerne i Julianehaabs Distrikt 1880 og 1881 ved **G. Holm.** Med 35 Tavler og 2 Kort. 1883. Andet Oplag. 1894. Kr. 6.

VII. Undersøgelser af Grønlandske Mineralier ved **Lorenzen** og **Rørdam**; de hydrografiske Forhold i Davis-Strædet ved **Wandel**; entomologiske Undersøgelser ved **Lundbeck**; Bemærkninger til Kortet fra Tiningnertok til Julianehaab af **Bloch**; Bidrag til Vestgrønlændernes Anthropologi ved **Søren Hansen.** Med 14 Tavler og 2 Kort. 1882—93. Kr. 6.

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IX—X. Den østgrønlandske Expedition i Aarene 1883—1885 (Angmagsalik) ved **G. Holm, V. Garde, Knutsen, Eberlin, Steenstrup, S. Hansen, Lange, Rink, Willaume-Jantzen** og **Crone.** Med 59 Tavler. 1888—89. Kr. 20.

XI. The Eskimo tribes, their distribution and characteristics, especially in regard to language. Af Dr. **H. Rink.** Med et Supplement og 1 Kort. 1887—91. Kr. 7 Udsolgt.

XII. Om Grønlands Vegetation af **Eug. Warming.** 1888. Kr. 3.50.

XIII. Bibliographia Groenlandica ved **P. Lauridsen.** 1890. Kr. 3.50.

XIV. Undersøgelser af Grønlandske Nefelinsyeniter af **N. V. Ussing.** Mineralogiske Undersøgelser i Julianehaab-Distrikt af **Gust. Flink.** Undersøgelser i Egedesminde-Distrikt i 1897 af **Frode Petersen, Helgi Pjetursson** og **C. Kruuse.** Med 12 Tavler. 1898. Kr. 8.

III.

The minerals from the Basalt of East-Greenland.

By

O. B. Bøggild.

Amongst other material of scientific interest brought back by the Carlsberg expedition to East-Greenland, were a variety of zeolites and other minerals, obtained from cavities in the basalt. It was proposed to me that I should undertake the examination of this material. At first I thought it would be desirable to wait until the Geologist of the expedition, Dr. O. Nordenskjöld, had published an account of the Geology of the district explored, thinking that I might thus become acquainted with the mode of occurrence of the minerals and the conditions of their formation. In the mean time, however, Dr. Nordenskjöld undertook to be at the head of a South Polar expedition and some considerable time may therefore elapse before the publication of his results. Moreover, I am now engaged in working out a general description of Greenland minerals and cannot therefore omit from such a work an essential part, such as the description of the minerals in question, I have therefore decided to undertake the examination of these minerals now, confining myself, in the present treatise, mainly to an account of their crystallographic properties.

In addition to the minerals brought back by the above-mentioned expedition, I have also examined a collection of zeolites made by Harz and Bay, who were members of the Ryder expedition in 1891—92. Further, I have collected and restated facts already recorded in literature, with regard to the minerals of the East-Greenland basalt, so that the account contained in the present treatise may be complete. Finally, I shall also mention a few zeolites, found in basalt, fragments of which have been obtained at various times from drift-ice off the south coast of Greenland being probably derived from the basalt region of East Greenland. Although many of these zeolites have a very characteristic crystallographic development, yet, in no case, has it been possible to discover definitely whence they originated, and that in spite of the fact that one would consider them to be very easily recognisable. The basalt territory of East-Greenland is, however, so extensive and has been so little explored, that it would be the merest chance if one were able to indicate any locality whence the fragments would have been derived with absolute certainty. Moreover, there is always the possibility that they may have originated from unknown Arctic regions situated even further north.

Our knowledge of the Geological structure of East-Greenland has been rendered fairly complete by the various expeditions that have been sent out during the last century[1]). The

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[1]) Here and in the following is referred to the following works:

Scoresby, Journal of a voyage to the northern whalefishery etc. Edinburgh 1823, with App. I. Jameson, List of specimens of rocks brought from the eastern coast of Greenland with geognostical Memoranda, p. 399.

Die 2te Deutsche Nordpolarfahrt in den Jahren 1869 und 1870, Leipzig 1874, together with the following treatises in II. Bd.: Toula, Allgemeine Uebersicht der geologischen Beschaffenheit Ostgrönlands, p. 475, and Lenz, Specielle Darstellung der geologischen Verhältnisse Ostgrönlands, p. 481.

Den östgrönlandske Expedition udført i Aarene 1891—92 under Ledelse af C. Ryder with the paper of E. Bay, Geologi. Meddelelser om Grönland 18, 1896 p. 145.

Nathorst, Bidrag til nordöstra Grönlands geologi. Geol. fören. förh. Stockholm. 23. 1901, p. 275.

Carlsbergfondets Expedition til Östgrönland, 1898—1900, under Ledelse af G. Amdrup with the following papers in Meddelelser om Grönland. 27, 1902: III. Hartz Beretning om Skibsekspeditionen til Grönlands Östkyst 18. Juli til 12. Sept. 1900. p. 153. IV. G. Amdrup, Beretning om Kystexpeditionen langs Grönlands Östkyst 1900 p. 183. V. J. Koch, Bemærkninger vedrörende de paa Expeditionen opmaalte Kyststrækninger p. 273.

results obtained show us that the basalt covers a considerable tract of country, but that it is not continuous, as it occupies two regions some distance apart.

1) The northern basalt-area stretches from Shannon Ö to Davys Sund, a distance of about 300 kilometres, in a SSW. to NNE. direction. It forms quite a narrow belt, embracing all the outermost islands and peninsulas along the coast-line in that region. The basalt presents immence plateau like surfaces and somewhat higher basalt cones project but rarely. Basalt-veins occur here also fairly frequently and follow, as a rule, the direction of the coast-line.

The rock-samples examined were proved, with very few exceptions, to consist of different varieties of typical basalt.

2) The southern basalt-area covers an extensive tract of country. It begins, on the north at Scoresby Sund, the southern side of which consists almost entirely of basalt, as do also a great part of Gaaseland and Milnes Land. It also exists in the form of horizontal veins between the Rhaetic Lias beds of Hurry Inlet. From Scoresby Sund, basalt extends all along the coast down to Kangerdlugsuak, a distance of about 400 kilometres and it most probably stretches far inland in this region, as no other rocks can be seen anywhere from the coast.

Very little is known as regards the nature and occurrence of the basalt.

Jan Mayen is fairly well known geologically and was also examined by the members of this expedition. With very few exceptions, only basaltic rocks are found here, varying, however, considerably in their nature.

It is impossible to obtain a very reliable estimate of the nature of the minerals contained in the basalt cavities or of their relative abundance. Generally speaking, only a few more or less isolated localities have been examined, and the choice of these has, for the most part, depended on the condition of the ice or on other chance circumstances. When an unusually large quantity of minerals has been obtained from any place, it is generally due to the fact that the expedition stayed there some considerable time. On the other hand, there may be many places, exceptionally rich in minerals, from which we have only a few specimens or none at all, simply because the expedition did not stay there long enough for collections to be made. All along the coast, from Kap Dalton southward to Kangerdlugsuak, no minerals were obtained, as the boat-expedition had neither sufficient time nor room for collecting rocks and minerals. Another entirely unknown region is the south coast of Scoresby Sund, between Kap Brewster and Sydbræ; this coast is very difficult of access and has never been visited by any expedition.

Moreover, the description by Lenz of the zeolites found in the northern basalt region, is very incomplete.

As far as can be judged from the material at my disposal, the minerals of the basalt are distributed in the various districts as follows:

The district from Kap Dalton to Kap Brewster is rich in various minerals, none of which can be said to predominate.

No zeolites have been obtained from Kap Dalton, but small quantities of quartz, calcedony and calcite have been found there.

In the large, conspicuous medial moraine of Henry Glacier, various minerals were found, such as stilbite, heulandite, chabazite, levynite, thomsonite and calcedony.

Henry Land is fairly rich in minerals, laumontite and stilbite having been obtained thence in comparatively large quantities; most of the other East-Greenland zeolites have also been found there in smaller quantities.

The district around Turner Sund is also fairly rich in minerals, especially stilbite; in lesser quantities analcime, natrolite, mesolite, scolezite, thomsonite, calcedony, quartz, calcite and aragonite were found to occur.

On Manby Peninsula no minerals were collected and, on Stewart Ö, only small quantities of calcedony.

The district round Kap Brewster is fairly rich in minerals and various zeolites were found but none in large quantities; calcedony and quartz were present. Jameson quoted from this locality: calcedony, cacholong, grey and white amethyst and a fibrous zeolite.

The basalt along Scoresby Sund contains large quantities of chabazite and differs in that respect from that of the district mentioned above; thomsonite and levynite are widely distributed here, but stilbite, heulandite, apophyllite and calcite occur only in insignificant quantities.

Very few zeolites have been found in the regions further north. The expedition brought back very small quantities of scolezite and stilbite from Sabine Ö. Lenz mentions other zeolites, chiefly chabazite as being conspicuous in the rock of Pendulum Ö and minerals such as quartz, calcedony, calcite and aragonite, which were found in various localities, will be treated of later.

No zeolites have been seen in Jan Mayen up to the present time; the expedition brought back, however, small quantities of calcite and aragonite.

Owing to our very slight knowledge of the East-Greenland minerals, it is difficult to draw a comparison between them and those of the other basalt-regions situated nearest to them, namely West-Greenland and Iceland.

Both of these regions have been carefully examined and considerable quantities of different minerals have been obtained from them, also a very much greater number of specimens of the individual minerals. The basalt of the northern regions and that of Scoresby Sund seem to agree most closely as regards the minerals with that of West-Greenland. This agreement consists in the small size of the zeolites and the predominance of the mineral chabazite. On the other hand, the basalt south of Scoresby Sund resembles more the Iceland basalt, the distance from Iceland being also inconsiderable. The zeolites in this basalt, more especially the stilbite attain a considerable size and, possibly, by a closer examination of the country, we might discover that zeolites were present in comparatively large quantities.

A description of the places where the various minerals were found will be given later, as also an account of the more prominent characteristics of the minerals belonging to each locality. For the position of the localities, reference should be made to the maps accompanying the various accounts of the expedition given in the Meddelelser om Grönland vol. 27. Maps of the northern territory will be found in the account of the German North Polar expedition and in Nathorst's treatise.

Quartz.

In the basalt-region of East-Greenland, quartz was found in few localities and generally in small quantities. It was either in very small crystals or amorphous.

Kap Dalton. A fairly large quantity of quartz was obtained from the walls of a cavity in the basalt on the slope of Station-mountain. The walls of the cavity were thickly studded with quartz-crystals to the length of 1 centimetre. Form of crystals a short prism of the ordinary combination of faces: $m\{10\bar{1}0\}$, $r\{10\bar{1}1\}$, $z\{01\bar{1}1\}$. The faces, especially the rhombohedral faces are well developed and bright. The crystals are semitranslucent and of a whitish colour.

From the same locality was obtained a quartz fragment, which filled a cavity. This is covered on the outside by impressions of disintegrated calcite-crystals.

Henry Glacier. The specimen is a fragment of the wall of a fissure, consisting of calcedony covered with small quartz crystals of very irregular shape; the most prominent form is: $r\{10\bar{1}1\}$; $z\{01\bar{1}1\}$ is quite insignificant. As a rule no prism-faces are developed.

Turner Sund. At Turner Sund or its immediate neighbourhood, various fragments of quartz were obtained, which have no particular relation to one another.

1) From the Sound itself, — no further particulars as to locality being stated —, was obtained the in-filling of a cavity, the outer part of which was formed of a thick layer of calcedony, covered inside with quartz crystals. The crystals were about 5^{mm} in length and were of the ordinary combination: $m\{10\bar{1}0\}$, $r\{10\bar{1}1\}$, $z\{01\bar{1}1\}$; they were fairly clear and transparent.
2) Another specimen from Turner Sund consisted of a cavity, quite filled with quartz, without any distinctly developed crystals.
3) On the mountain-slope by the Sound a larger cavity (ca. 2 dm.) was found. The walls of the cavity are lined with a thin layer of greenish calcedony and inside this are small ($1—2^{mm}$) transparent quartz-crystals. All the interior of the cavity is filled with fibrous aragonite. The quartz crystals are of a very characteristic form namely $r\{10\bar{1}1\}$ with very well-developed bright faces; at the lower end each of these is bordered by two symmetrically-situated faces, which resemble scalenohedral faces, but are of compound nature and rough surface, so as not to produce the least reflection. The prism and negative rhombohedron are not developed.
4) From Turner Ö was obtained a smaller fragment, consisting of a crust of calcedony and opal, on which groups of minute quartz crystals of the ordinary from are developed.
5) On the mainland, from the north-west extremity of Turner Sund, another specimen was obtained. This is a cavity (ca. 12 cm.) lined with calcedony and filled in with quartz, having no distinct crystal form.

Flache Bay and Sabine Ö From these localities Lenz quotes (page 486, 489) numerous cavities containing quartz crystals.

Calcedony.

This mineral, like quartz, has only been found in small quantities in East-Greenland and is not very characteristically developed. It has already been mentioned as occurring in conjunction with quartz. It was found most plentifully in the following places:

Kap Dalton. On Depot mountain, a few cavities (up to 8 cm.) were found filled with white and grey agate. In some cases the cavity is quite filled in with quartz.

Mount Henry; east side. A few quite small cavities in a grey dolerite are filled with finely banded bluish or greyish agate.

Turner Sund. The specimen shows a bluish-grey, very translucent calcedony, forming a layer on the walls of a cavity of about 2 centimetres thickness. This is coated over on the inner side with quartz crystals.

Stewart Ö This is a smaller fragment of blue translucent calcedony, with small quantities of white opal.

Kap Brewster. Jameson quotes from this locality: botryoidal calcedony, ordinary calcedony, agate and several other forms of quartz.

Sabine Ö and Pendulum Ö. Lenz mentions as occurring here ordinary calcedony and "blutjaspis".

Calcite.

Calcite has been found in most of the localities in East-Greenland where zeolites occur, but generally in rather small quantities. It is sometimes found in the form of crystals, which are usually small and insignificant, sometimes it occurs as a granular mass or, again, it may be an individual crystal filling all the space between the zeolites. Wherever calcite has been found with zeolites it is younger than these.

Kap Dalton. On Station mountain a single fragment was found consisting of granular quartz; all over the outer surface of this are distinct impressions of calcite crystals, to the size of 4 cm., the calcite itself having completely disappeared. The crystal form is that of acute rhombohedra $f\{02\bar{2}1\}$ with bright, well-developed faces.

Mount Henry. In a few cavities, some small ($2—10^{mm}$) bright, colourless crystals are found, associated with laumontite, embedded in coarse-grained masses of whitish calcite. The crystals are all acute rhombohedra $f\{02\bar{2}1\}$; the faces of the larger ones are irregular and curved, but those of the smaller are generally bright and well-developed.

Turner Ö. Optically-continuous masses of calcite are found filling the spaces between stilbite and natrolite in the cavities. Also loose cleavage-fragments of about 4 cm. occur; these are semi-transparent and of a pale yellow colour.

Kap Brewster. Calcite appears here in various forms:

1) As small crystals ($1—3^{mm}$) on the walls of a fissure in a grey fine-grained basalt. The crystals are acute rhombohedra $d\{08\bar{8}1\}$; the faces being very rough and dull and the colour a dark yellowish-brown.
2) As the infilling of a cavity, between columnar masses of mesolite and penetrated by fine mesolite needles. Here the calcite is for the most part fine-grained, but sometimes crystals 2 cm. long are found, in the form of acute rhombohedra $f\{02\bar{2}1\}$ with rough, dull faces. The colour is a light-brown.
3) In small quantities calcite occurs as the infilling of cavities, in association with small heulandite crystals. There is usually only a single calcite individual in each cavity and the colour is greyish.

The south side of Gaasefjord. Among the incoherent masses found here was a single fragment of a breccia, consisting of black vesicular basalt, with a cementing material of white, granular calcite. In cavities in the latter, many small crystals ($1—3^{mm}$) were found in the form of acute rhombohedra $f\{02\bar{2}1\}$ with rough and dull faces.

Danmarks Ö. Cavities in a solid reddish basalt were filled in with calcite together with small chabazite crystals. The calcite forms a single individual of about 5 cm. and also extends into several adjacent cavities.

Kap Broer Ruys and Sabine Ö. Lenz mentions calcite scalehonedra as occurring here, but gives no details as to the mode of occurrence.

Pendulum Ö. Lenz mentions the occurrence of calcite here in different forms:

1) A rhombohedron (size 5 cm.) white in colour with fine twin-striations.
2) Somewhat large crystals of a pure yellow colour in amygdaloidal basalt.
3) A yellow, opaque, calcareous tufa.

Shannon Ö. Lenz mentions from here also an yellow, opaque calcareous tufa.

Jan Mayen. Here, very small indefinitely-shaped calcite crystals were found in the cavities of basalt and basalt-breccia. These were unaccompanied by other minerals, with the exception of aragonite crystals, which were found in one cavity. The crystal-form was that of irregularly formed rhombohedra $r\{10\bar{1}1\}$; in a few cases scalenohedra occurred, presumably $v\{21\bar{3}1\}$ with strongly-curved faces.

Aragonite.

This mineral has been found in many places in East-Greenland and also in very small quantities at Jan Mayen. In the latter place, however, it was crystallised, whereas, in all the others, it was found in the ordinary form of columnar aggregates.

T u r n e r S u n d. A single rather large infilling of a cavity (about 2 cm.) was obtained from here. The outer lining consists of a layer of small quartz crystals, while the inner part is quite filled with columnar aragonite of a brownish colour.

F l a c h e B a y. According to LENZ, whitish aragonite was found here, both in the fibrous form and in masses with radiating structure.

S a b i n e Ö. LENZ mentions from this locality very fine amygdaloids of whitish, prismatic aragonite.

S h a n n o n Ö. According to LENZ, a radiating group of aragonite crystals, with a strong vitreous lustre was found here.

J a n M a y e n. Small, colourless aragonite crystals (size 2—3mm) partly arranged in radiating groups, were found in one cavity in a grey fine-grained basalt, the other cavities containing calcite crystals. The crystal form is that of longish prisms, in the combination $b\{010\}$, $m\{110\}$, $k\{011\}$, $i\{021\}$. Most of the crystals are twinned, often repeatedly so. One of the most commonly occurring forms is seen in figure 1. The crystals are rather irregularly developed and the faces are generally very rough.

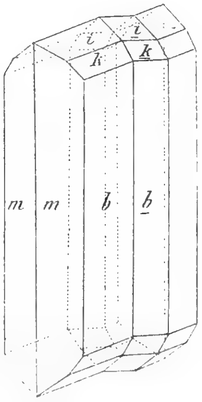

Fig. 1. Aragonite; Jan Mayen.

Thomsonite.

This material has been found in a few localities in East-Greenland. The crystals are very small as is usual with this mineral, and the crystalform is, wlth one exception, badly defined. — The localities are:

Henry Glacier. In a bloch of brown basalt from the medial moraine numerous cavities were seen, containing various zeolites, such as chabazite, levynite and thomsonite. This last-mentioned mineral was found partly as lining in a cavity in which no other zeolites were present and partly as a globular mass on the levynite crystals. In both places exceedingly small crystals were found on the surface, projecting freely and flattened parallel to $a\{100\}$; any more accurate determination of the faces was impossible. The colour was greyish or brown.

Henry Land.

1) From the east side of Mount Henry was obtained a single fragment of grey basalt, the cavities of which are almost

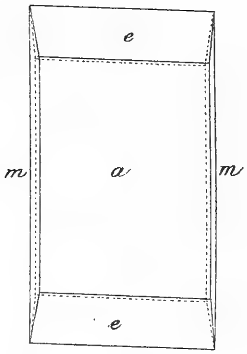

Fig. 2. Thomsonite; Henry Land.

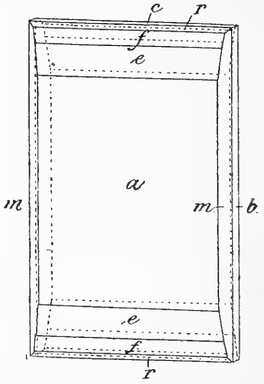

Fig. 3. Thomsonite; Henry Land.

entirely filled with snow-white columnar thomsonite. The crystals generally radiate from a single point on the side of the cavity. A few of the cavities contain crystals in the form of very thin rectangular plates parallel with $a\{100\}$. The breadth of the crystals is about 2^{mm}. The commonest form, represented in fig. 2, consists of $a\{100\}$, $m\{110\}$ and $e\{801\}$. A few of the crystals show narrow faces of $f\{601\}$, $r\{101\}$, $c\{001\}$ and $b\{010\}$. The combination of all the faces is shown in fig. 3. The form $f\{601\}$ which has not been found before in thomsonite is determined by[1])

	Average value	Variations	Number of measurements	Calculated value
$f:a = (601):(100) =$	9°12′	8°45′—9°53′	4	9°20′

The faces of the crystals are generally dull and coated over by a brownish film; occasionally they are quite bright.

2) From the hot spring a specimen was obtained which seemed to be an incrustation, without any of the rock. This consisted mainly of stilbite crystals, interspersed with a number of small, spherical bodies formed probably of thomsonite. The surface is rough and striated, without distinct crystals. Colour, a brownish white.

Turner Ö. Among larger masses of columnar scolecite are found a few, small (up to 1 cm.) radiating masses of thomsonite. In one cavity there occurred small (1—2^{mm}) projecting crystals in the form of very thin plates, the faces of which could not be more closely determined.

The north coast of Gaasefjord in Scoresby Sund. Here thomsonite is found in very large quantities and is, with the exception of chabazite, the most common zeolite obtained from the isolated basalt blocks in the moraine. It is found in two somewhat different forms:

1) In a reddish-coloured basalt, all the walls of the cavities were found to be lined with a crust of thomsonite about 1^{mm} thick. The internal surface of this crust has a well-marked velvety appearance, due to some minute, closely-packed crystals, the breadth of which does not exceed $0{\cdot}1^{mm}$. The crystals have the form of thin, rectangular plates and are very regularly developed, but the marginal

[1]) Here, as elsewhere in this paper, the value of angles is calculated according to the axial ratios given by Dana (System of Mineralogy 1892) unless otherwise stated.

faces cannot be determined because they are so very small. The colour is brownish or greyish. In addition to thomsonite, only a few chabazite crystals were found in these cavities.

2) Other blocks consist of a reddish grey basalt, in the cavities of which about equal quantities of chabazite and thomsonite crystals are seen. The thomsonite here has the form of small regular spheres (about 1^{mm} diameter) from the surfaces of which numerous crystals project. The form of these crystals cannot be definitely determined; the colour is brownish.

Natrolite.

This mineral has only been found in a few places and in rather small quantities. The crystals are always small and very badly developed.

Mount Henry. Natrolite was found here in radiating masses of 2—3 cm. without any surrounding rock and unaccompanied by other zeolites. In one cavity needle-shaped crystals were found, projecting freely. These were all much decomposed and had no determinable faces.

Turner Ö. Radiating masses of natrolite were found in cavities here, associated with stilbite. Freely-projecting crystals are also occasionally found, similar to those mentioned above, being also decomposed and without determinable faces. In some of the cavities free calcite was also found.

Kap Brewster. A few radiating masses of natrolite were found in a cavity which was almost filled with stilbite. The masses measured about 1 dm.

Mesolite.

Mesolite was only found in two localities.

Turner Ö. A small detached fragment was found, consisting of a crust of about 3^{mm} thickness. The mineral was fibrous mesolite studded on the inner surface by numerous short needle-shaped crystals. The mesolite was much disintegrated and of a brownish colour.

Kap Brewster. The specimen found here was a block with a single cavity, the walls of which were covered with radiating groups (about 2 cm.) of snow-white mesolite. The central part of the cavity is almost filled with calcite, into which fine mesolite needles project everywhere. When the calcite is dissolved out with hydrochloric acid, the hair-like radiating crystals are very distinctly seen.

Scolecite.

This mineral has only been found in a few localities in East-Greenland and in rather small quantities. Well-developed crystals are not found.

Mount Henry. The specimen is a loose block consisting wholly of scolecite, without any surrounding rock and unaccompanied by other zeolites. The scolecite is found in crystals arranged in radiating groups; the length of the crystals may reach 6 cm. and the breadth 1—2^{mm}. The faces developed are $m\{110\}$ and $b\{010\}$; no terminal faces are developed. The crystals, generally speaking, are somewhat decomposed, opaque, white on the inside and brownish outside. The faces are quite dull.

Turner Ö. A few pieces of scolecite without any surrounding rock, are accompanied by small masses of columnar and crystallized thomsonite. The scolecite forms radiating masses to the size of 5 cm. More rarely, freely projecting crystals are found bordered by $m\{110\}$ and $b\{010\}$ without terminal faces. The colour is generally snow-white, sometimes reddish.

Sabine Ö. A couple of small fragments have been obtained from here, of about 3 cm. in diameter. They consist of scolecite, the crystals of which are arranged parallel to one another. The surface of the fragments is worn and disintegrated.

Apophyllite.

Apophyllite is very rare in East-Greenland as it has only been found on three fragments from two different localities. It varies very much in its development in the different places; as a rule the crystals are of a fair size.

Kap Brewster. From here we have a single amygdaloid, without surrounding rock. The apophyllite fills the greater part of the cavity and is not accompanied by other minerals. The size of the crystals varies from 1 to 15^{mm}. The crystal form is almost cubical (fig. 4), with $c\{001\}$ and $a\{100\}$ most prominent; on the corners are little faces of $p\{111\}$. The faces are rather badly developed and dull. The crystals are brownish-white and semi-transparent.

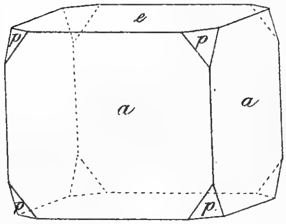

Fig. 4. Apophyllite; Kap Brewster.

Sydbræ, in Scoresby Sund.

1) In one of the basalts with cavities containing thomsonite and stilbite, which are so frequent in these parts, a few crystals of apophyllite were found. These were developed on the thomsonite crystals, some singly and some in groups. The size of the crystals is about 15^{mm}. The form is that of acute pyramids, with $p\{111\}$ and $a\{100\}$ predominant. Very small faces of $c\{001\}$ and $y\{301\}$ are also developed. The faces are curved and very rough. The crystals are semi-transparent and of a greyish colour.

2) A fragment of basalt was found, having no connection with the specimens mentioned above and with regard to which it is expressly stated that it was found in situ. Within it are columnar masses of apophyllite without crystal-faces.

The length of the individual crystals may be as much as 4 cm. They are semi-transparent and of a greyish-white colour.

Analcime.

This mineral has been found only in very few fragments in East-Greenland, from three different localities. As a rule, the crystals are fairly large. They have not been found in association with other zeolites.

The east side of Henry Land. Here the analcime was found crystallized in cavities in grey basalt. The crystals usually fill the greater part of the cavity so that distinct faces are rarely seen. The crystals are always icositetrahedra and may attain a length of $1^1/_2$ cm. The part nearest the basalt is clear and translucent, the rest of the crystals is whitish and semi-transparent.

Turner Sund, opposite the landing-stage. From here was obtained a small fragment of a grey, compact basalt containing numerous cavities, the walls of which are thickly studded with crystals, the smaller cavities being quite filled up with them. The size of the crystals is somewhat insignificant i. e. up to 4^{mm}. The crystal form is that of the icositetrahedron with fairly well-developed, bright faces. The crystals are semi-transparent and whitish.

Kap Brewster. Numerous cavities were seen to occur here in a dark-grey compact basalt, the walls of the cavities being covered with analcime crystals varying in size from 1 to 10^{mm}. The smaller cavities are usually quite filled up. In one of the larger cavities, the spaces between the chabazite crystals are partly filled with calcite The crystals are exclusively icositetrahedra. The faces are usually very well-developed and bright in the case of the smaller crystals, in the larger ones, however, they are rather strongly curved. The smaller crystals are semi-transparent and greyish, the larger ones are white and opaque.

Stilbite.

Stilbite is the most widely-distributed zeolite in East-Greenland. It has been found in especially large quanties iu the district south of Scoresby Sund, in which locality the crystals are of comparatively large size. In the Sound itself and to the north of it, this mineral is less plentiful and occurs in much smaller crystals. Stilbite is most commonly found in isolated crystals, or in masses consisting of few individuals. Well-developed sheaf-like or cauliflower-like forms are very rare.

Bartholins Bræ. Stilbite was found in the smaller cavities of a brown dolerite rock, in which were also cavities containing chabazite and levynite. The crystals were small ($2—3^{mm}$) and plate-like, they were bounded by the faces $b\{010\}$, $c\{001\}$, $e\{011\}$, the last-mentioned being somewhat narrow; $m\{110\}$ and $f\{\bar{1}01\}$ are almost equally developed. The crystals are colourless rather bright and translucent.

Henry Land.

1) On the east side of Mount Henry, a small fragment of an amygdaloid was found, the walls of which consisted of very small quartz crystals on which were a few stilbite crystals, to the size of 15^{mm}. The form here is very different from that of any other East-Greenland stilbite specimens, as the crystals are very sheaf-like, with $f\{\bar{1}01\}$ well-developed and $m\{110\}$ insignificant or absent; $c\{001\}$ and $e\{011\}$ are also found. The colour is almost pure white and the crystals are semi-transparent.

2) Also on the east side of Henry Mountain, but rather near the shore, some more stilbite was found, this being the most important occurrence of stilbite as yet known in Greenland. The diameter of the cavities in which it is deposited varies up to 2 dm. The walls are coated with layers of dark, cloudy lithomarge; inside this are large quantities of small quartz crystals (about 1^{mm} long), which

form, in a few places, a layer of several centimetres in thickness. The quartz layer is sometimes deposited on the stilbite crystals themselves. The length of the stilbite crystals is from 3—4 cm. and they fill the greater part of the centre of the cavities. They are flattened parallel to *b* {010} and show the combination: *c* {001}, *b* {010}, *e* {011}, *m* {110} and *t* {130} (Fig. 5). The last mentioned form is rare in stilbite, but occurs very commonly here. It is determined thus:

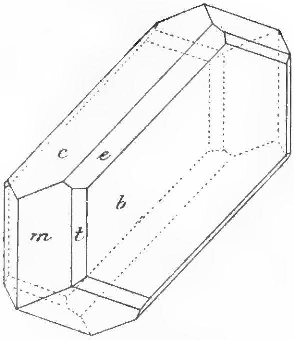

Fig. 5. Stilbite; Henry Land.

	Average value	Variations	Number of measurements	Calculated value
$t:b$ = (130):(010) =	28°53′	27°40′—29°53′	4	29°52½′

The accuracy of the calculation is very close, considering that stilbite, on account of its curved faces is, as a rule, not at all well adopted for measurements. The crystals are of a light reddish colour and slightly transparent.

3) On the beach, at the foot of Mount Henry, stilbite crystals have been found. They cover the walls of a fissure in grey basalt. The crystals are covered, especially on one of sides, with a layer of rounded, grey, calcite crystals. The stilbite crystals are about 5^{mm} long; their form is rather broad with *c* {001} about as large as *b* {010}; *m* {110} and *f* {$\bar{1}$01} are also found. The surfaces of the crystals are cloudy and of a brownish colour; the inner part is whitish and semitransparent.

4) From the hot spring some rather small stilbite crystals of the ordinary flattened form were obtained, in association with small spherical masses of thomsonite.

Turner Sund. The specimens were derived from the vicinity of the mainland. One label was marked «opposite the landing-place», the others bore no definite statement of locality. They consisted of partly coherent amygdaloids of an irregular shape and without surrounding rock, numerous stilbite crystals occurring in them. The rock, which is now quite disintegrated was probably tufa. The stilbite is unaccompanied by other zeolites, though sometimes irregularly formed crystals of clear calcite are found in the cavities. The length of the crystals is generally 2—8^{mm}, and they occur in plates flattened parallel to $b\{010\}$. Other forms which also occur are: $c\{001\}$ and $m\{110\}$; more rarely $e\{011\}$ as very narrow faces. The crystals are rather cloudy and their colour is whitish, tinted slightly with brown or red.

Turner Ö.

1) The inner wall of Fyrböderdal. From here we have small bright crystals, size 1—2^{mm}, in the cavities of a black basalt. The crystals are in flattened plates of the ordinary form.
2) The summit of Fyrböderdal (700 metres above sea-level). Here the stilbite occurs in irregular cavities, probably in tufa. It is associated with natrolite and a few irregularly-formed calcite individuals. The stilbite crystals may attain a size of 2 cm. but are rarely at all freely developed, as the cavities are, as a rule, completely filled up by them. The crystals are in the form of plates, flattened parallel with $b\{010\}$. Other predominant forms are $c\{001\}$ and $m\{110\}$; generally also $e\{011\}$ and $t\{130\}$ in the form of narrow faces. The colour is a pale reddish-white; the degree of transparency slight.

Kap Brewster. In a single tufa cavity some large (up to 3 cm.) stilbite crystals were found, together with some small heulandite crystals. The stilbite crystals are somewhat sheaf-like, with $b\{010\}$ and $f\{\bar{1}01\}$ about equally developed. The crystals are semi-transparent and of a greyish colour.

Gaasefjord in Scoresby Sund.

1) The south coast. A few small amygdaloids were found here isolated from their surrounding rock. The interior was almost completely filled with stilbite, so that crystals faces ($b\{010\}$, $c\{001\}$, $m\{110\}$) were only found in a few places. The length of the crystals was about 1 cm.; they were cloudy and of a greyish colour.

A few loose fragments of basalt were also found here, which contained almost exclusively chabazite. One fragment, however, had a few stilbite crystals developed on the chabazite crystals. The stilbite crystals are of the same form and size as those mentioned above and are also very irregularly developed.

In addition to these, a pale grey dolerite rock had some of its cavities filled with levynite, but others contained both levynite and small ($1—2^{mm}$) stilbite crystals, or, in some cases, stilbite crystals only. The form of the crystals differs from the ordinary one, as $b\{010\}$, $c\{001\}$ and $f\{\bar{1}01\}$ predominate and $m\{110\}$ is only seen as small faces at the corners. The crystals are clear and transparent, with irregular curved faces.

2) Gaaseland. In a single block obtained from a moraine and perhaps of identical origin with the specimens mentioned above, a few cavities were found containing, in addition to chabazite, small stilbite crystals of the ordinary form. The crystals are small, semi-transparent and colourless. Most of the cavities in the rock were filled exclusively with chabazite.

Sabine Ö. Stilbite was found here only as a single small fragment. It seems to be partly columnar and partly in the form of small sheaf-like crystals ($1—3^{mm}$), of the combination $b\{010\}$, $c\{001\}$, $f\{\bar{1}01\}$ and $m\{110\}$. The last-mentioned occurs only occasionally. The crystals are cloudy and of a reddish colour.

Heulandite.

This mineral is found only in a few localities in East-Greenland and in rather small quantities. The crystals vary very much being often very differently developed even in specimens from the same locality.

Henry Glacier. Heulandite was found in the medial moraine of the glacier in two, very different forms:

1) A brownish-grey dolerite rock was found to contain several cavities, the greater number of which were devoid of zeolites, while a few contained heulandite crystals. The length of the crystals is 3—6^{mm}; their form somewhat resembles the pseudo-tetragonal complex (represented in fig. 6), which this mineral has also been observed to assume in other localities. Combination $b\{010\}$, $c\{001\}$, $t\{201\}$, $s\{20\bar{1}\}$, $m\{110\}$. The faces are generally bright and well-developed, occasionally somewhat curved. The crystals are semi-transparent and of a whitish colour.

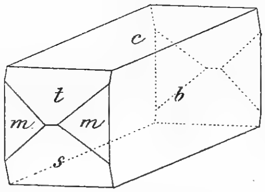

Fig. 6. Heulandite; Henry Glacier.

2) Other specimens consist of a breccia-like rock in which fragments of an exceedingly compact basalt are cemented together with zeolites. In only a few places do these take the form of freely-developed crystals. The main mass of zeolites consists of chabazite, on which are grouped small heulandite crystals (length $^{1}/_{2}$^{mm}), which are developed as shown in fig. 7. The crystals form plates parallel to $b\{010\}$, the edges of which are bordered by $c\{001\}$, $t\{201\}$, $s\{20\bar{1}\}$ and $r\{501\}$.

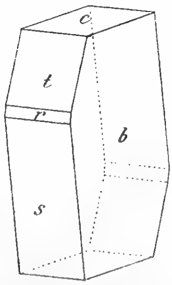

Fig. 7. Heulandite; Henry Glacier.

the last-mentioned face, which is always very narrow, has not been observed before in heulandite; it is determined by the angle:

	Average value	Variations	Number of measurements	Calculated value
$r:c = \{501\}:\{001\}$ =	77°54′	76°53′—78°53	4	$77°58\frac{1}{2}'$

The comparatively large variations in this angle are mostly caused by the faces both of $r\{501\}$ and $c\{001\}$ being usually somewhat broken and facetted so that, as a rule, several distinct reflexes are produced by them; the form must, however, be considered to have been definitely determined.

These small crystals are perfectly clear and transparent with very bright faces.

Mount Henry, east side. Grey fine-grained basalt, which was found here, contains a few cavities almost completely filled with heulandite. Very few crystals are found, their length being about 2^{mm}. The following combinations occur: $b\{010\}$, $c\{001\}$, $t\{201\}$, $s\{20\bar{1}\}$, $m\{110\}$. The colour is a deep red.

Kap Brewster. Here the heulandite is found in two very different forms:

1) It occurs with stilbite in a single amygdaloid, probably obtained from tufa. The heulandite crystals are small ($1—2^{mm}$), few in number and are interspersed among the large stilbite crystals. They have the form of plates parallel to $b\{100\}$, bordered by $c\{001\}$, $t\{201\}$ and $s\{20\bar{1}\}$. The faces are bright and fairly well-developed; the crystals are of a pale reddish colour.

2) Many heulandite crystals were found in cavities in a dark brownish very fine-grained basalt. The crystals are small ($1—2^{mm}$), well-developed and unaccompanied by other zeolites. Sometimes the space between the crystals is filled

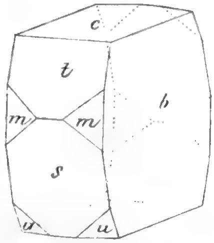

Fig. 8. Heulandite; Kap Brewster.

with calcite. The crystal form is shown in fig. 8. Combination: $b\{010\}$, $c\{001\}$, $t\{201\}$, $s\{20\bar{1}\}$, $m\{110\}$ and $u\{\bar{1}11\}$. The faces are generally bright and well-developed. The crystals are greyish and semitransparent.

Gaaseland in Scoresby Sund. In the brownish basalt of this district, the cavities of which contain almost exclusively chabazite and thomsonite, a single fragment was found with cavities containing heulandite, associated with the chabazite. The heulandite crystals are 2—3mm long and of the ordinary heulandite form $b\{010\}$, $c\{001\}$, $t\{201\}$, $s\{20\bar{1}\}$ and $m\{110\}$. They are fairly clear and transparent.

Float ice near Iluilek in South-Greenland. Heulandite is the particular kind of zeolite which has been found in largest quantities in the loose blocks obtained from floating ice. This fact is remarkable as heulandite is of only secondary importance in East-Greenland. It is found on the ice in three different forms, none of which is exactly identical with those mentioned above, nor can the varieties of basalt, in which it occurs, be identified with any of the heulandite-containing basalts of East-Greenland. Another remarkable feature is that all the basalt-fragments with heulandite that were found on the ice were accompanied by a soft, bluish or greenish mineral, perhaps celadonite, which has not been found in East-Greenland proper.

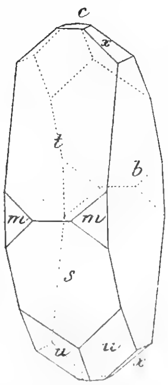

Fig. 9. Heulandite; Float ice near Iluilek.

1) In the cavities of a small fragment of compact, reddish-brown basalt, small heulandite crystals were found, of about 2mm length. The walls of the cavities are covered with a thin layer of bluish celadonite. The crystal-form, which is rather characteristic, is shown in fig. 9. Combination $b\{010\}$, $t\{201\}$, $m\{110\}$, $s\{\bar{2}01\}$, $u\{\bar{1}11\}$, $x\{021\}$ and $c\{001\}$; the two last forms are very small, especially $c\{001\}$.

The crystals have bright faces and are rather well-developed. They are of a pale reddish colour.

2) Heulandite crystals were also found in the cavities of a reddish-brown compact basalt, enclosed in a thin layer of pale-green celadonite. The length of the crystals is about 5^{mm}. The form mostly resembles that shown in fig. 8. The faces are bright, well-developed, and the crystal fairly clear, transparent and colourless.

3) In a pale-grey dolerite rock numerous cavities were found with quite small heulandite crystals (length about 1^{mm}). The walls of the cavities are covered with a thin layer of bluish-green celadonite. The form closely resembles that shown in fig. 8, but $c\{001\}$ is far less developed. The faces are rather curved; the crystals are clear and colourless.

Chabazite.

Chabazite has only been found in a few places, but in one of these, namely in Scoresby Sund it is found in such large quantities, as to far exceed, in total amount, all the other zeolites. The chabazite crystals, however, are always of rather insignificant size and crystallographically very simple.

Henry Glacier on the medial moraine. Here chabazite was found in the cavities of a brownish-coloured basalt, which also contained several other zeolites such as stilbite, heulandite, levynite and thomsonite. The length of the crystals is generally about 2^{mm}, but may be as much as 5^{mm}. The crystals consist, as a rule, exclusively of the fundamental rhombohedron, $r\{10\bar{1}1\}$ but a few crystals also have narrow faces of $a\{11\bar{2}0\}$, $s\{02\bar{2}1\}$ and $e\{01\bar{1}2\}$. Penetration twins occur twinned about $c\{0001\}$; in a few cases, twin formations about $r\{10\bar{1}1\}$ are also found. The crystals are usually colourless and rather transparent; the faces are, as a rule, well-developed and bright.

Henry Land east side. The specimen found here consists of a single small fragment of basalt, with a cavity containing small chabazite crystals (length 2^{mm}). The crystal form is that of the fundamental rhombohedron: $r\{10\bar{1}1\}$, rarely with narrow faces of $e\{01\bar{1}2\}$. There are occasional twin formations about $c\{0001\}$. The crystals are greyish-white and semi-transparent.

Sydbræ in Scoresby Sund. A few fragments of basalt, obtained from here, have chabazite in their vesicular cavities, this mineral being sometimes accompanied by apophyllite and thomsonite. The crystals are $2—5^{mm}$ long and are all in the form of the fundamental rhombohedron; there are a few twins about $c\{0001\}$.

Gaasefjord in Scoresby Sund. Many fragments of rock were found both on the north and south sides of Gaasefjord, all containing chabazite, either by itself or in association with other zeolites. The fragments were all obtained from detritus-cones or moraines and, in the latter case, it naturally is difficult to determine whence they originated. The specimens obtained from the different sides of the bay seem to differ from one another and will, therefore, be described separately.

1) The north side of the bay: — the numerous fragments obtained from the north side were found in a moraine. Most of these contain mainly thomsonite in the form of spheres or incrustations, the surface of the mineral in the latter case being studded with a few chabazite crystals. In other blocks are cavities filled exclusively with chabazite. The length of the crystals varies from $3—8^{mm}$. The fundamental rhombohedron $r\{10\bar{1}1\}$ is the commonest crystal form; the other forms with the narrow faces mentioned above occur more rarely. Twins occur about $c\{0001\}$ and, less commonly, about $r\{10\bar{1}1\}$. The crystals are usually semi-transparent and greyish.

2) Southside of bay. The fragments from the south side of the bay contain as a rule chabazite only. This mineral is sometimes found in crystals, resembling exactly in form and

size, those mentioned above. In a few cases it is seen in smaller crystals, 1—2mm in length, which, in addition to $r\{10\bar{1}1\}$, almost always exhibit well-developed faces of $a\{11\bar{2}0\}$ and $s\{02\bar{2}1\}$. One fragment contains very small crystals (about ½mm) together with stilbite; here $r\{10\bar{1}1\}$, $s\{02\bar{2}1\}$ and $e\{01\bar{1}2\}$ are almost equally developed.

Danmarks Ö in Scoresby Sund. A few loose blocks of basalt were found here containing small chabazite crystals unaccompanied by other zeolites, but sometimes associated with calcite crystals. The form is almost exclusively that of the fundamental rhombohedron. The crystals are semitransparent and greyish.

Floating ice near Iluilek in South-Greenland. On the drift-ice a fragment of a grey fine-grained basalt was found. This has numerous cavities, some of which contain chabazite crystals, others levynite, while others are lined with a quite thin layer of a soft, sky-blue mineral: celadonite or lithomarge. The basalt is not quite like any variety found in East-Greenland and the minerals also differ from those of known localities. The chabazite occurs in rather small crystals of 2—5mm in length. The only form is that of the fundamental rhombohedron: $r\{10\bar{1}1\}$. Twin formations are very common, especially about $r\{10\bar{1}1\}$. The same crystal may be twinned about different faces of the rhombohedron. The crystals are colourless and semi-transparent.

Levynite.

Levynite has been found in a few localities in East-Greenland, though not in large quantities.

As however this mineral is, generally speaking, rarer than the other zeolites, we must suppose that on the whole it is more common in East-Greenland than elsewhere.

Henry Glacier, the medial moraine. A brown fine-grained basalt was found here with numerous cavities containing various zeolites, chiefly levynite, chabazite, thomsonite and stilbite. Only one zeolite is found, as a rule, in each cavity, but, in one case, thomsonite was found on crystals of levynite. The length of the latter crystals is 1—2^{mm}; the form varies somewhat. In some cavities they are thin and plate-like, in others rather thick. The form comes close to the ordinary levynite form with $c\{001\}$, $r\{10\bar{1}1\}$ and $s\{02\bar{2}1\}$. Penetration-twins twinned about $c\{0001\}$ are almost always found, so that $r\{10\bar{1}1\}$ is only developed in the re-entrant angles.

Measurements of the better-developed crystals of the thicker type reveal a circumstance which is probably also to be noticed in other levynite crystals, but which is here very marked. From the positions where the two rhombohedra should be situated no reflex, or hardly any, is seen, but, on the other hand, reflexes appear from two scalenohedra which are situated not very far from the rhombohedral faces. Owing to the striation, the angles vary considerably, but the forms can, with fair certainty, be determined as being two new ones $v\{2\,.\,10\,.\,\bar{12}\,.\,1\}$ and $u\{10\,.\,2\,.\,\bar{12}\,.\,11.\}$ The faces $s\{0221\}$ and $r\{10\bar{1}1\}$ are very small and give only very feeble reflexes. The axial-ratio generally employed for levynite, namely $c = 0{\cdot}8357$ (HAIDINGER) is not applicable to the crystals from this locality, for which $c = 0{\cdot}80101$ has been calculated.

The following angles have been measured:

	Average value	Variation	Number of measurements	Calculated value
$z:c = (10\bar{1}1):(0001)$	= 42°46′	42°42′—42°54′	5	
$s:c = (02\bar{2}1):(0001)$	= 61°28′	60°49′—61°53′	3	61°36′¼
$r:s = (10\bar{1}1):(02\bar{2}1)$	= 49°12′		1	49°37′½
$u:c = (10.2.\bar{12}.11):(0001)$	= 43° 6′	42°55′—43°15′	4	43° 7′
$u:r = (10.2.\bar{12}.11):(10\bar{1}1)$	= 6°14′		1	6° 7′
$v:c = (2.10.\bar{12}.7\ ):(0001)$	= 55°42′	55°26′—56°25′	4	55°48′
$v:u = (2.10.\bar{12}.7\ ):(10.2.\bar{12}.11)$	= 33°50′	33°20′—34°15′	3	33°55′¾

As will be seen from the indices, the scalenohedral faces v and u are both situated in the zone $rs = \{10\bar{1}1,\ 02\bar{2}1\}$.

They are striated parallel to their intersections with the faces of this zone. Moreover since the zone $cv = \{0001,\ 2.10.\bar{12}.7\}$ contains the face $u\{2.10.\bar{12}.11\}$, the two scalenohedra u and v lying in this and in similar zones meet in horizontal edges.

A penetration-twin with the above-mentioned scalenohedral faces is represented in fig. 10. The twin formation is however, not always equally perfect, so that sometimes the larger part of the crystal may belong to a single individual The thinner crystals are partly developed in the same way, but here the forms $r\{10\bar{1}1\}$ and $s\{02\bar{2}1\}$ are generally more prominent; the exact relations are not easily made out owing to the very narrow faces.

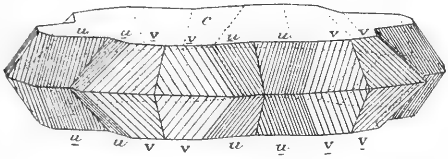

Fig. 10. Levynite; Henry Glacier.

Gaasefjord. On the south side a single fragment of a light grey dolerite rock was found. This is labelled «main rock» and contains several cavities with small levynite crystals from 1—3mm in length. Small stilbite crystals are also present, sometimes in the same cavities as the levynite, sometimes in separate ones. The levynite has the form of flat plates, with curved irregular faces. The form is almost the same as that mentioned above, as both rhombohedra and scalenohedra are developed. The crystals are transparent and colourless. On the north side of Gaasefjord, among many fragments of basalt with chabazite, a few were found with the cavities containing levynite. These crystals are quite small about 1—2mm in length, and of approximately the same crystal form as the preceding ones. In a few cavities, a peculiar kind of crystal was found, which has been observed before in West-Greenland, but which I do not think has as yet been described. Both basal planes are covered with a thin layer of threads of a silk-like lustre, placed perpendicularly to the plane. In transverse sections of the crystal these look like stripes with a well-marked silky lustre, surrounding the central, vitreous part of the crystal. The crystals of this nature, which have been found in this locality, are situated in special cavities and have no marginal faces, but, as typical levynite crystals with the same silk-like layer have been found in West-Greenland and on the drift-ice (as is mentioned below), it is probable that the crystals described above are composed of this mineral.

Float ice near Iluilek in South-Greenland. In the rock that has already been described under the heading of chabazite, cavities containing levynite also occur. These crystals are of rather insignificant size ($2—3^{mm}$ in length) and are in the form of very thin plates. They consist of the combination: $c\{0001\}$, $r\{10\bar{1}1\}$, $s\{02\bar{2}1\}$, without development of the above-mentioned scalenohedra. Twins about $c\{0001\}$ occur, as shown in fig. 11; penetration-twins which, as a rule, are common in this mineral are not found here. The rhombohedral faces are well-developed and bright, almost without any trace of striation. The base is quite plane, but always velvet-like and dull and gives no reflex on the goniometer. The reason for this is that the face is overlaid by the very thin layer of silk-like threads above-described.

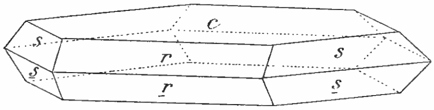

Fig. 11. Levynite; Float ice near Iluilek.

Laumontite.

This mineral has been found only in a single locality in East-Greenland.

Henry Land. A basalt-breccia is found near the hot-spring[1]) consisting of fragments of a disintegrated greyish-black compact basalt, cemented by a rather incoherent aggregate

[1]) Mentioned by Hartz l. c. page 159.

of laumontite crystals. There is no trace of other zeolites, but the cavities are sometimes filled by large calcite individuals. It is not as yet known whether this development of laumontite is connected in some way with the presence of the hot spring, in which case it might be of comparatively recent origin, or whether the fact that it occurs near the spring is accidental. The only fact recorded about the water is that it contains sulphuretted hydrogen and that the temperature is 38° C.; we know nothing with regard to the occurrence of any mineral deposits.

The laumontite crystals which, in a few of the cavities, are rather well-developed, may attain a length of 1 cm. and are of the ordinary form. They are usually bordered by $m\{110\}$ and $c\{001\}$; more rarely by quite small faces of $a\{100\}$ and $e\{\bar{2}01\}$. A few twins about $a\{100\}$ occur. The crystals are incoherent as is usually the case and crumbling; their colour is a reddish-white.

IV.

Contributions

to

the Anthropology and Nosology

of the East-Greenlanders.

By

Knud Poulsen.

The small tribe of Eskimaux — counting 350 to 400 members — at Angmagsalik on the East-coast of Greenland about $65^1/_2°$ lat. N. has in so far special interest in physical respect, as it in contradistinction from the West-coast Eskimaux is known free from European intermixture and is the only surely unmixed Greenland group of Eskimaux.

During the second Danish expedition to East-Greenland, conducted by lieutenant Amdrup in 1898—99, I made during the wintering of the expedition at Angmagsalik some anthropological measurings and put down some notes on the structure of the population. I found opportunity of examining 40 grown-up individuals, 29 men and 11 women, besides a few children. All these visited our wintering station during the winter. The material though not great may still possibly be of some interest when compared with and supplying the measurings and examinations made by the head of the Danish woman-boat expedition, the present captain G. F. Holm. Then 46 grown-up individuals from the district of Angmagsalik were examined, and besides 45 individuals from the southern part of the East-coast — by the then lieutenant Garde — together with a similar number from the southern part of the West-coast. On the basis of these examinations the police-surgeon, doctor Søren Hansen, gave a representation of the structure and other physical properties of the East-Greenlanders[1], a representation,

[1] Søren Hansen: Bidrag til Østgrønlændernes Anthropologi, Meddelelser om Grønland. X. Bd. Pg. 1—41. Kbv. 1886.

which contains the substance of our knowledge of this question, our former acquaintance with it being based on spread and little informing notes in different travels (Clavering—Graah).

The named representation gives a full portrait of the appearance of the East-Greenlanders, and when I nevertheless think that the following remarks may be of some interest, it is essentially because the material has been added to by my measurements — from 46 to 86 — and my material, the measurements having been made according to the same principles, may be compared with the former.

The greater the number of examined individuals, the better, of course, the chance of a reliable result.

I have not measured individuals already measured by captain Holm in 83—85. It might certainly have been tempting to measure just the same individuals again to examine how the nearly 14 years had influenced the development of the structure of their bodies. But partly I believe that by so small differences that would be in question here, no guarantee could be obtained of sufficient exactness with the employed systems of measurement and two different examiners, partly it would certainly have been possible to examine only very few of the formerly measured. — Having had opportunity to examine only the Angmagsalik-Eskimaux, the following remarks will of course only refer to these. The representation is based solely on the examination of living individuals. A collection of craniums and some bones of the pelvis brought home by the expedition will namely later on be revised by another together with the very considerable and interesting material of Greenland craniums in the possession of our anatomical Museum.

The average size of the 40 measured is for men 1611, for women 1477^{mm}. But excluding respectively 3 men and 1 woman the average numbers become 1624 and 1491 (max.: 1745 and 1550, min.: 1490 and 1398). These 4 are mentioned as 17—18 years old, but in my notes as not yet wearing natit, an article of dress that covers the sexual organs and is applied by the young East-Greenlanders when they, he or she, think themselves and are thought by their cognates to be full-grown. Søren Hansen found for 31 men and 15 women the average size to be 1647 and 1551 (max.: 1760 and 1650, min.: 1540 and 1450), thus 23 and 60^{mm} more. If the average size is calculated according to all measurements in hand from Angmagsalik, the result is seen to be about 163·1 and about 152 cm. The average size of grown-up West-Greenlanders calculated on a very great number of individuals from the whole of the West-coast is stated to be 162 and 152 cm.[1]). After this there seems to be no reason to insist on the theory of the East-Greenlanders being taller than the West-Greenlanders, provided that the collected number of individuals from Angmagsalik is thought sufficiently great, what it likely must, when it is taken into consideration how considerable a fraction it forms of the whole population.

In the treatise of Søren Hansen on the anthropology of the West-Greenlanders, he also remarks that the difference of size found according to the measurings then in hand, is so small, that it is doubtful if any importance may be ascribed to it.

As substantiated by Søren Hansen, it also appears from my measurements that the size of the East-Greenlanders is somewhat, but not much smaller than the established size of the European nations (1650^{mm}), and that they, as little as the Greenlanders altogether, can be stated to be very small people.

As to the proportions of the body Søren Hansen writes the following according to the examinations of Holm and Garde: "The arms strong and muscular; the length between the outstretched hands nearly the same, most frequently a little smaller than the size of the body; but the chest being very much

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[1]) Søren Hansen: Bidrag til Vestgrønlændernes Anthropologi. Meddelelser om Grønland, VII. Bd Pg. 163—250. Kbhvn. 1893.

developed and the breadth of the shoulders taking up therefore a proportionally great part of the length between the outstretched hands, the arm itself must certainly be stated to be short, if anything. The nether extremities short; the muscling slightly developed. The chest very strong. The abdomen well proportioned, not very prominent".

I have made measurements of the length between the outstretched hands (measured over the back), of the stature in sitting posture, of the distance from the spinal process to tubera ischii and of the extent of the chest. These measurements as well as my general notes on the circumstances appertaining here, lead to the very same result, wherefore I shall not tire with recounting of numbers. But in this connection I presume to draw the attention to a hypothesis set up by Søren Hansen in: Bidrag til Vestgrønlændernes Anthropologi, in the section of the proportions.

He writes here: "Starting by the theory that a series of races may develop themselves in a similar way as a series of species of the animal or vegetable kingdom, there is a reason to believe that this development is analogous with the development of the single individual in the way that the lowest link of the series corresponds with a more childish or at least juvenile degree of development and the highest one with the most developed phase. Starting by the supposition that the place of the Eskimaux in physical respect is in the lowest end of the system we must — if the hypothesis is right — look for juvenile features in their structure". After having discussed the influence of the occupation on the proportions, he arrives at the result that the proportions of the West-Greenlanders in several particulars offer juvenile traits — thus the small feet and the relatively short arms. As to the nether extremities it might be expected according to what has been set up that they also were shorter in the Eskimaux than in all other human races because they — as the upper extremities — are relatively shorter in children than in grown-up people. According to the measurements of Søren Hansen on the West-Greenlanders their nether extremities are slightly developed, if anything, but still not so short as might be expected.

Their relative length seems to be smaller in the East-Greenlanders. This appears partly from the general remarks on this circumstance in Søren Hansen's: Bidrag til Østgrønlændernes Anthropologi, partly from my measurements.

The hands and feet of the East-Greenlanders are practically always remarkably small and well-formed.

As to the form of head and face my measurements are very consistent with the former in hand, as may be seen from the comparison undernoted. The main race-character of the head is its breadth-index, the proportion between its greatest breadth and greatest length. It stands thus:

	Men			Women		
	Average	Maxim.	Minim.	Average	Maxim.	Minim.
According to Søren Hansen's measurings ...	76·9	84·2	71·8	75·6	81·2	69·9
According to mine....	76·5	80·2	73·2	75·7	78·9	72·0

The greatest length of the head is:

	Men			Women		
	Average	Maxim.	Minim.	Average	Maxim.	Minim.
According to the measurings of S. H	19·2	20·1	18·5	18·7	19·5	17·8
According to mine...	19·2	20·5	18·1	18·4	19·3	17·8

The greatest breadth of the head is:

	Men			Women		
	Average	Maxim.	Minim.	Average	Maxim.	Minim.
According to the measurings of S. H....	14·7	15·7	14·0	14·1	15·3	13·1
According to mine ...	14·7	15·6	14·2	14·0	14·6	13·4

The congruity between the two groups of measurings is, as may be seen, even surprisingly great which is not quite without importance, I presume. The fact is, that when as here two different examiners at different times have arrived at so to speak the same result by measuring a number of individuals, not quite small in proportion to the whole population, and not the same individuals the two times, it may surely be said to prove that the result is correct, not only that the measurings have been fairly correctly executed both times, but also that the number has been sufficiently great to give a trustworthy expression of the real facts. The result, then, becomes this, that the form of the head of the East-Greenlanders, as also stated by Søren Hansen, is pronounced mesaticephalous, yet more particularly tending to dolicocephalism and not pronounced dolicocephalous as formerly stated for the Eskimaux generally by Broca, Virchow and Girard de Rialle among others.

To determine the length of the face I have like the former examiners measured the length of the face viz. the distance from glabella to the kin, the "breadth of the zygoma" or more correctly the distance between the two zygomata and the breadth of the nether jaw viz. the distance between the angles of the nether jaw, measured when the mouth was open. From these measures Søren Hansen has calculated three indices, namely:

index facialis superior, viz. the proportion between breadth of zygoma and length of face.

index gonio-zygomaticus, viz. the proportion between breadth of zygoma and breadth of nether jaw, and

index facialis inferior, viz. the proportion between length of face and breadth of nether jaw.

The averages of these indices are:

	According to Søren Hansen	According to my measurings
index facial. sup.	103·8	100·9
index gonio-zygomat.	82·3	80·4
index facial. inf.	85·4	81·1

My indices correspond with the following average measures:

Length of face..........	140·5
Breadth of zygoma	141·7
Breadth of nether jaw ...	113·9

which is in good conformity with the statement of Søren Hansen that the length of the face is a little smaller than its breadth and that this is about 1/5 greater than the breadth over the angles of the nether jaw. The differences of the found indices are also so small that scarcely any significance can be ascribed to them; at any rate, Søren Hansen remarks in full conformity with my measures and observations that the form of the face is oval or perhaps rather elliptic on account of the lower part of the face being relatively broad.

To determine the form of the nose I have measured the distance from the root of the nose to the place of meeting between septum nasi and the upper lip, and the distance between the outermost points of the wings of the nose. This measure, stated by Broca, has been used by Søren Hansen on the West-coast and is recommended in preference to the distance between the bottoms of the furrows behind the wings of the nose (Virchow), a measure, used by Holm on the Woman-boat expedition. In this point then Holm's and my measurements cannot be compared, my average index becoming higher: 70·2 against 62·8. The form of the nose is besides individually very different in the East-Greenlanders, so different that an average index after all does not give any impression of it. According to my measurements index varies between 88·4 and 59·3, according to those of Holm even between 81·1 and 40·3. According to the measurements of Holm a considerable difference of sex is found, index being for men 63·9, for women 60·9; according to mine there is a similar difference of sex, but in opposite direction, index being for men 69·2, for women 72·9. According to the very extensive measurings of Søren Hansen on the West-coast the average index is there for men

76·2 and for women 77·3 (the measures after Broca) — thus greater for women and on the whole not little greater than that found for the East-Greenlanders. But so great differences between the results of the different observers and so great distances from maximum to minimum in the series of examinations of the same observer partly indicate very great individual differences, but also that measuring of the dimensions of the nose is a difficult thing, perhaps on the whole scarcely possible to execute with sufficient exactness to give a trustworthy impression of the form of the nose.

The measures are also so small that errors in themselves insignificant may give quite misleading results, and to him who has tried a few times it will soon appear, how difficult it is to measure exactly the distance between the outermost points of the wings of the nose. Partly the wings of the nose are very easily pressed together, and partly with many people an involuntary play of the wings of the nose is found, so that these do not take up the same position in a constancy. At any rate I have often by repeated measurings of the same individual obtained different sizes of the breadth of the nose, certainly only slight differences, but yet sufficient to influence the result. Though not believing that any greater significance may be ascribed to the measurings of the nose, I will just mention the considerably higher nasal index, found by Søren Hansen for the West-Greenlanders than by me for the East-Greenlanders, of measurings executed in the same way. Certainly my measurings are less numerous, but yet sufficient to make it improbable that the great difference might be due to a mere accident, and as the crossing of the West-Greenlanders with European elements must be thought to have worked towards a lower nasal index, it is not quite out of the way to think that the found fact might suggest a difference of tribe. — In my notes I have everywhere to the measures affixed short remarks on the form of the nose. According to these it is very variable as has been said. In about the half part of the cases is noted: Prominent, straight, well-formed or nearly straight, rather well-formed or the like. In about $^1/_5$ is found noted: Great, curved, slightly hunched or beautifully formed, slightly curved and in the rest broad, flat or retrousé. But there are all forms of transition from pronounced Mongolian nose to pronounced Indian nose.

That which characterizes the eyes of the East-Greenlanders the most is their Mongolian shape produced by the forming of the so-called Mongolian fold — the fold of the skin immediately over the upper eyelid prolonging itself and covering the inner angle of the eye. Thus Søren Hansen describes the Mongolian fold of the West-Greenlanders in whom it is often found, though less developed than in the Mongols. Being very general in the East-Greenlanders it was only missed in hardly 10% of the observed and was often very strongly developped. But the palpebral fissure itself is nearly always horizontal. Its presence suggests kinship with the Mongols and its more rare appearance in the West-Greenlanders is probably a consequence of the crossing. The colour of the iris of the eye is brown in different shades, most frequently dark-brown. I have not seen a single East-Greenlander with blue eyes, and if it appears on the whole it is certainly a very uncommon thing.

The hair is black or dark-brown, always straight. The growth of the beard is scarce as the hairiness on the whole. Yet the hairiness of pubes is often rather well developped. The colour of the skin on the covered parts is light tawny or light olive. On the lumbar region darker, often with a rather strongly bluish tint that seems to be strongest in young individuals, perhaps being a rest of the blue spot found on the cross of infants. This much mentioned spot was present in the few infants I saw. As to its importance I refer to Søren Hansen. The uncovered skin is tawny or reddish brown. The skin of genitalia pronounced bluishly pigmented.

The teeth are on the whole strong, but much worn. Only once I saw a carious tooth. They are often rather misplaced, but holes in the series of teeth are so to speak never seen, not even in old people in whom they are nearly worn away. The eye-teeth are often chisel-formed.

As to the outer ear I shall lead the attention to an anomaly of form which I found in the great majority of the individuals observed. The ear being else well-formed, not less than 36 of 44, examined on this question, were found to have the little lobulus auris grown fast with its front edge in its whole extent to the skin of the face, and lobulus was in most cases moreover so small that there really was no one at all. Only in one individual, a grown-up man, it was found tolerably well developped on both sides; in one it was present on the right side, but not on the left, and in the resting 6 it was only present by way of suggestion.

As is well known, the want of lobulus auris like anomalies of form of the outer ear on the whole have been looked upon as one of the outward signs of intellectual or moral degeneration by many anthropologists and criminalists. Starting by this hypothesis numerous statistics have been collected in prisons and lunatic asylums to show the special frequency of such anomalies in criminals and deranged persons. But the material was collected starting by a preconceived hypothesis, and later examinations and comparisons with the outward ear of normal individuals have shown that the examination is utterly doubtful.

But it is a fact that heredity asserts itself very much in this domain, the same anomaly of the form of the ear being very generally seen to repeat itself generation after generation. That the said peculiarity of the outward ear of the East-Greenlanders might be due to a mere accident, is scarcely probable; it is too frequent for that. That it might have any relation whatever with what is called with one word degeneration is naturally excluded, and its exceedingly frequent presence in the East-Greenlanders not at all degenerated, neither mentally nor bodily, might almost prove the untenability of the said theory. Possibly one might imagine the inhabitants of Angmagsalik, at any rate those examined by me, being descended from some very few families in whom the abnormity had accidentally been present and descended by heredity from generation to generation. How far it may be thought to have any importance as race-character for the East-Greenlanders or Eskimaux on the whole can naturally only be decided by far more extensive examinations on this point, also of other races of unmixed Eskimaux. Such are not in hand, as far as I know. However, the great variability of the fact in other races rather tells against the possibility of ascribing such an importance to it.

As may be seen from the preceding, there is on the whole a rather exact coincidence between mine and the former measurings and observations, so exact, that it must be thought permissible in most points to take all measurings together and use the mean of the averages of the former measurings and mine as an expression of the real facts.

If the main characters of the bodily structure of the East-Greenlanders should be named in a few words the characterization would be as follows: People strongly built; somewhat but not much under the average tallness; muscular; arms a little short, if anything; rather tiny and short legs; a very strong, arched and broad chest; a rather well-formed abdomen; small, well-formed hands and feet. The head mesaticephalous, almost amounting to dolicocephalism, the length of the face a little shorter than its breadth; the lower part of the face broad. The nose very variable in form; most frequently of an average breadth, rather often broad, as a rule straight, rarely slightly curved. The eyes dark-brown with the Mongolian fold, but not "oblique". The ears well-formed, but with fast-grown or missing lobulus auris. The hair dark and straight. Growth of beard and other hairiness rather scarce. The teeth strong, worn. Colour of skin tawny or light olive, darker on the parts not covered by clothes. Genitalia and the lumbar region with a more or less bluish tint.

The measures employed for the examination are:

1. The stature.
2. The length between the outstretched hands (measured over the back).
3. Height of the seat.
4. Distance from vertebra prominens to tubera ischii.
5. Extent of the chest (just over the papilla); for grown-up women also beneath the mammae.
6. The length of the head (from glabella to the most prominent point of the nape of the neck).
7. The greatest breadth of the head.
8. Length of the face (from the kin to glabella).
9. Breadth of the zygoma.
10. Breadth of the forehead (vertical over the outer angle of the eye).
11. Breadth of the nether jaw (by open mouth).
12. Height of the nether jaw (from kin to row of teeth).
13. Length of the nose (from the root of the nose to the place of meeting between septum nasi and the upper lip).
14. Breadth of the nose (between the outermost points of the wings of the nose).

List of the measures.

Sex ...... Age	M. c. 40	M. c. 25	M. c. 45	M. c. 22	M. c. 20	M. c. 18	M. c. 28	M. c. 37	M. c. 30
Measures 1	1·562	1·586	1·745	1·736	1·645	1·568	1·684	1·682	1·652
2	1·600	1·594	1·710	1·655	1·670	1·554	1·642	1·704	1·643
3	0·802	0·836	0·966	0·949	0 865		0·908	0·905	0·902
4	0·552	0·592	0·688	0·677	0·598	0·554	0·628	0·630	0·624
5	1·002	0·912	0·975	0·932	0·890	0·846	0·936	0·936	0·940
6	0·194	0·188	0·196	0·188	0·193	0·191	0·198	0·186	0·200
7	0·153	0·150	0·150	0·148	0·149	0·147	0·148	0·145	C·152
8	0·150	0·140	0·142	0·134	0·150	0·133	0·148	0·140	0·139
9	0·150	0·145	0·154	0·148	0·148	0·138	0·146	0 146	0·145
10	1·128	0·121	0·129	0·124	0·118	0·114	0·114	0·122	0·116
11	0·122	0·112	0·120	0·110	0·125	0·110	0·112	0·118	0·114
12	0·048	0·046	0·046	0·046	0·054	0 044	0·047	0·043	0·047
13	0·059	0 054	0·052	0·042	0·053	0·044	0·050	0·053	0 043
14	0·037	0·032	0·035	0·030	0 033	0·033	0·034	0·036	0·038

		M.	M.	M.	M.	M.	M.	M.	M.	M.
Sex		M.	M.	M.	M.	M.	M.	M.	M.	M.
Age		c. 25	c. 25	c. 18	c. 25	c. 50	c. 40	c. 26	c. 25	c. 17
Measures	1	1·612	1·490	1·530	1·640	1·638	1·614	1·670	1·670	1·458
	2	1·610	1·510	1·488	1·658	1·664	1·598	1·680	1·624	1·412
	3	0·816	0·774	0·815	0·864	0·863	0·856	0·825	0·908	0·762
	4	0·568	0·534	0·580	0·584	0·610	0·606	0·574	0·635	0·527
	5	0·896	0·807	0·876	0·980	0·952	0·968	0·822	0·955	0·736
	6	0·184	0·181	0·192	0·198	0·193	0·188	0·182	0·205	0·187
	7	0·144	0·142	0·142	0·145	0·147	0·149	0·146	0·156	0·142
	8	0·141	0·137	0·138	0·140	0·149	0·141	0·148	0·150	0·143
	9	0·140	0·139	0·136	0·143	0·145	0·140	0·144	0·146	0·134
	10	0·112	0·110	0·114	0·114	0·114	0·111	0·114	0·115	0·110
	11	0·111	0·104	0·107	0·115	0·116	0·114	0·113	0·114	0·109
	12	0·049	0·045	0·048	0·050	0·044	0·050	0·043	0·054	0·046
	13	0·047	0·049	0·050	0·049	0·052	0·049	0·048	0·052	0·048
	14	0·032	0·030	0·032	0·037	0·038	0·035	0·032	0·032	0·035

Sex		M.	M.	M.	M.	M.	M.	M.	M.	M.
Age		c. 23	c. 25	c. 32	c. 23	c. 23	c. 40	c. 35	c. 25	c. 45
Measures	1	1·620	1·580	1·663	1·610	1·662	1·517	1·636	1·594	1·606
	2	1·558	1·590	1·630	1·545	1·624	1·492	1·622	1·602	1·620
	3	0·835		0·885	0·926	0·887	1·850	0·882	0·875	0·834
	4	0·650	0·905	0·610	0·628	0·580	0·602	0·620	0·650	0·572
	5			0·975	0·926	0·973	0·922	0·920	0·934	0·935
	6	0·187	0·194	0·195	0·198	0·197	0·195	0·192	0·190	0·194
	7	0·145	0·145	0·149	0·146	0·147	0·149	0·145	0·142	0·143
	8	0·130	0·140	0·151	0·154	0·148	0·143	0·139	0·155	0·149
	9	0·128	0·144	0·143	0·146	0·146	0·152	0·142	0·154	0·141
	10	0·115	0·136	0·117	0·120	0·122	0·122	0·111	0·118	0·112
	11	0·106	0·118	0·116	0·122	0·119	0·121	0·112	0·125	0·112
	12	0·042	0·050	0·049	0·050	0·044	0·044	0·042	0·052	0·044
	13	0·055		0·056	0·052	0·050	0·044	0·048	0·050	0·049
	14	0·035	0·034	0·035	0·034	0·034	0·036	0·036	0·035	0·034

Sex		M.	M.	W.	W.	W.	W.	W.	W.	W.
Age		c. 17	c. 17	c. 19	c. 23	c. 30	c. 35	c. 22	c. 30	c. 28
Measures	1	1·484	1·545	1·542	1·540	1·467	1·516	1·514	1·434	1·398
	2	1·462	1·562	1·560	1·568	1·442	1·550	1·544	1·398	1·420
	3	0·788	0·814	0·799	0·818	0·815	0·810	0·808	0·810	0·750
	4	0·545	0·575	0·575	0·598	0·590	0·566	0·564	0·576	0·538
	5	0·866	0·917	0·870	0·950	0·908	0·900 0·820	0·923 0·814	0·900 0·846	gravid
	6	0·180	0·189	0·182	0·193	0·180	0·178	0·182	0·186	0·183
	7	0·142	0·146	0·140	0·139	0·146	0·141	0·137	0·136	0·134
	8	0·136	0·138	0·130	0·136	0·136	0·139	0·132	0·134	0·132
	9	0·134	0·141	0·138	0·137	0·144	0·141	0·134	0·132	0·130
	10	0·111	0·117	0·116	0.118	0·120	0·126	0·113	0·112	0·109
	11	0·110	0·116	0·110	0·119	0·115	0·115	0·110	0·108	0·105
	12	0·048	0·044	0·040	0·045	0·046	0·049	0·044	0·048	0·042
	13	0·046	0·043	0·042	0·043	0·039	0·043	0·042	0·044	0·044
	14	0·031	0·033	0·030	0·034	0·030	0·032	0·030	0·032	0·034

Sex Age		W. c. 40	W. c. 19	W. c. 17	W. c. 16	W. c. 15	W. c. 14	W. c. 12	W. c. 10	M. c. 14	M. c. 10	M. c. 9
Measures	1	1·492	1·550	1·460	1·334	1·330	1·330	1·160	1·143	1·246	1·278	1·152
	2	1·452	1·485	1·445	1·303	1·290	1·330	1·182	1·132	1 225	1·270	1·060
	3	0·766	0·856	0·766	0·702	0·678	0·674	0·658	0·628	0·660	0·682	0·600
	4	0·520	0·602	0·542	0·500	0·480	0·465	0·442	0·405	0·450	0·460	0·378
	5	0·815	0·985 0·860	0·890 0·802	0·728	0·724	0·685	0·652	0·570	0·710	0·712	0·602
	6	0·180	0·189	0·182	0·176	0·171	0·174	0·170	0·171	0·172	0·182	0·172
	7	0·140	0·143	0·143	0·141	0·137	0·143	0·133	0·137	0·139	0·142	0·141
	8	0·131	0·138	0·136	0·131	0·120	0·130	0·120	0·115	0·123	0·125	0·120
	9	0·138	0·137	0·137	0·130	0·124	0·126	0·117	0·112	0·119	0·127	0·115
	10	0·113	0·116	0·111	0·113	0·103	0·116	0·096	0·103	0·106	0·106	0·104
	11	0·111	0·113	0·112	0·113	0·104	0·101	0·095	0·094	0·098	0·102	0·094
	12	0·042	0·052	0·047	0·040	0·041	0·040	0·043	0·038	0·040	0 044	0·032
	13	0·050	0·043	0·044	0·042	0·049	0·041	0·038	0·040	0·039	0·040	0·037
	14	0 034	0·030	0·030	0·030	0·029	0·028	0·028	0·027	0·025	0·030	0·026

To the above remarks on the structure of the East-Greenlanders I shall attach a few notes on their nosological and hygienic conditions. One cannot obtain a very complete impression of their illnesses by living among so small and scattered a tribe one single winter — during the whole of the summer the expedition travelled outside the inhabited district — few illnesses of course appearing within so short time.

My notes originate therefore partly from verbal communications, from the East-Greenlanders themselves, and from the Danish people living at the station. That all resorted to me to consult me in old and new, considerable and inconsiderable cases of illness when the population had begun to realize what a doctor is, and that I was a doctor, is no wonder, there having been no one before on the coast. The East-Greenlanders are on the whole a sound and strong race, well adapted to hold their own in the rough climate and under the bad hygienic conditions caused by the stowing of the relatively great number of persons in the small winter-houses where ventilation and cleaning are so to speak unknown. The temperature will often rise to more than 30° C. in the afternoon and evening in such a winter-house when all inhabitants are at home and all train-oil lamps are lighted, while the temperature is outside ÷ 15 to ÷ 30° C. Inside the house both grown-up people and children wear as a rule so to speak nothing, and it does not inconvenience them to walk out into the cold in the same light dress — only increased by a pair of leather boots; thus I remember once to have seen two quite young girls walking almost naked on the beach at about 15 minutes' walk from the house, gathering sea-weed, though the temperature was about ÷ 15° C.

That the East-Greenlanders on the whole are such a sound and strong race, and that individuals of a delicate health are so rarely found among them, is mainly due to the selection of the nature, the delicate individuals most often perishing during the first years of life; the art does nothing here as in civilized countries to keep them alive; on the contrary it is not rare at all that children thought at their birth to be less capable of living, are immediately drowned by their parents or housemates. All the same, illness is no rare guest, and the East-Greenlanders are very anxious about all that may be called internal illness in contradistinction from their strongly marked hardiness towards toils and outward injures.

As has been told, many children perish during the first years of life, because nothing is done, and perhaps nothing can be done to preserve the delicate. The disturbances of digestion of infants, so general and often dangerous with us, yet seem to be rather rare which finds its natural explanation in the fact that every mother of course suckles her child. If it happens that the mother dies in childbed, or while the child is still an infant it must die, if no other woman can overtake the suckling. No other domestic animals than dogs being kept, milk is not known, and artificial nourishment therefore so to speak an impossibility. The suckling is as a rule continued for a long time, often even till the third or fourth year of life, but then certainly in connection with other food. It is besides rather astonishing what is offered to the stomach of such a little Greenlander.

At any rate I believe that flesh of soals and blubber would agree very badly with our domestic shoots of one year. I remember to have seen a boy of 3 years one day sucking his mother and a few days afterwards smoking tobacco from his father's pipe. It is not very much in accordance with our principles of education and hygiene of children but the boy looked nevertheless all the better for it.

Acute catarrhs of the stomach or intestines are general in greater children and grown-up people; they appear not rarely as house-epidemics and are certainly most often due to the eating of flesh of soals or sharks, rotten in whole or in part. It seems to be an exception when these poisonings have a fatal issue; at any rate I could not find any certain instance of it. I shall remark nevertheless that the expedition found an abandoned place of residence far outside the inhabited district, where numerous skeletons of Greenlanders were found in a winter-house; they were according to what we learned later on certainly rests of some families that had gone northward from the inhabited district 20 years before. Most probably they had died of hunger; but it is in no way impossible that illness and then most likely poisoning from rotten flesh may have been at any rate a concurrent cause. Small epidemics of furunculosis sometimes appear, certainly another manifestation of the named poisoning. Bronchitis as well acute as more chronic is a rather general illness both in children and grown-up people. If pulmonary inflammation in the form of our croupous pneumonia is found I don't know. Phtisis certainly appears. I have seen myself a female patient offering at any rate clinically undoubted signs of this illness, and according to what has been told to me, a pulmonary suffering with hæmoptysis, lingering cough, expectoration and emaciation is not rare. But its course seems to be milder than our phtisis generally is. It happens for instance that the Greenlanders the day after such a hæmoptysis unpunished go to their kayaks, and the illness is said to pass often and relatively quickly into recovery. The patient, I saw, having clinically a rather extensive phtisis, had walked some miles in high snow, having hæmoptysis while walking, and returned the next day the same way. Half a year afterwards I heard that she had recovered. The illness having a fatal issue is not at all rare. I had unfortunately no opportunity of examining microscopically the expectoration. It might be interesting to see if the illness is really due to the same substance of infection as phtisis.

Every Greenlander housing no end of lice, it is no wonder that scratchings and in consequence eczematous skin-affections are general. Also extended — most frequently acute — eczemas are found rather often. I did not see other cutaneous diseases, for instance not scabies. Sexual diseases are unknown.

Snow-blindness is general, though snow-spectacles made of wood are known and used.

It is certainly a great misconception to believe that people of nature should not be nervous, as it is generally thought. Not only slight nervous cases are found very frequently among the East-Greenlanders, but also real hysterics with so serious hysterical symptoms as palsies and convulsions. These latter cases were told me to be undoubtful and not quite rare. Really it is no wonder either that the monotonous and during very long periods inactive life led especially by the women, may give opportunity of excessive personal observation and consequently overestimation of their small perceptions. These become, which is not quite unintelligible, the most interesting thing they have to think of and speak about, and women are also in East-Greenland thus made that the one will not be behind the other, no more so, when the question is whether which is the more ill. I have seen no case of proper mental disease, but such are mentioned by the natives, for instance, as appearing in connection with confinements. I saw one pronounced case of puerperal fever with a fatal issue, which does not seem to be very rare. It is really wonderful, if anything, that births on the whole can pass away without infection, no measure of cleaning whatever being known during the birth and the hygienic conditions of a Greenland cottage being the worst imaginable. That it is not more frequent is certainly because the substance of infection is not brought into the parts of generation by internal examination or artificial delivery; when it does take place I think that the birth-giving woman herself infects her parts of generation with her own dirty fingers. Assistance of others is namely not used during the birth; when this has been gone through, the navel string is cut over with a mussel-shell or a similar blunt instrument. Ligature of the navel string is not known, so the bleeding must be thought to stop on account of the blunt cutting. There is no doubt that mechanical disproportions may occur during the birth. Instances are known of the mother dying during the birth without being delivered. Having not seen nor heard about any case of rachitis, I do not believe that rachitic deformations of the pelvis are the causes of the mechanical disproportions.

More considerable deformities are certainly very rare, children with such being as a rule undoubtedly killed shortly after having been born. The only one I saw was a young man whose left hand was somewhat deformed, being first nearly 4 ctm. shorter than the right one; the outermost points of the three middlemost fingers were besides stiff, and between these, being very delicate, a web was distended reaching nearly the outermost point. —

The East-Greenlanders do not know anything of cure of illness beyond the magic arts of the Angekoks. Yet they have during the last years sought medical aid from the missionary of the colony, and they were very anxious to get medicine from me. I vaccinated a considerable part — about $^2/_3$ — of the popoulation which they highly appreciated. Though I tried to explain to them the meaning of the vaccination, yet they certainly ascribed supernatural powers to it. And then it was to be like the Europeans, something, they preferred to all in the world.

V.

On the Geology and Physical Geography of East-Greenland.

By

Otto Nordenskjöld.

1907.

The expeditions under Koldewey and Payer, Ryder and Nathorst, which had previously visited the parts of East-Greenland in question, returned with a number of observations on the geology and geography, the main characteristics of which were thus already known before our visit. In consequence, I considered that the time I spent up there as a member of the Danish expedition of 1900, should be devoted in the main to observing phenomena that had not up to that time been the object of special study.

Among my chief aims I took upon myself to collect a considerable petrographic material from a number of interesting rocks, the occurrence of which in this region has already been known since Scoresby's time. He mentioned the occurrence of a series of porphyritic rocks, but little was known about their age and nature at the time of our expedition. Then there are a series of syenites and of peculiar basic eruptives, that were first met with by Nathorst. Although we only worked in the outskirts of the districts where these occur, while the time that could be devoted to their study was also extremely short, yet I succeeded in collecting a not inconsiderable material for a petrographic examination, calculated to clear up, in some degree at least, the nature, age and distribution of these rocks. Then there is the study of the archæan rock, which has not hitherto been the object of special investigation in these parts of the world; and, finally, the basaltic rocks, which occur in very large masses with rich petrographic variation, and the study of which proved specially interesting owing to the important contribution our expedition succeeded in making to the question of the age of the whole group of the North-Atlantic Basalts.

Not less interesting is the study of East-Greenland's sedimentary fossiliferous beds, of which a comprehensive material was collected during the expedition. In this work I received most valuable assistance from mag. sc. N. Hartz, the leader of the expedition at that time. In the main each has devoted himself in the same degree to the work, but the collecting of fossils from the Rhaetic and Jurassic deposits in the SE. part of Jameson Land has been carried out by Hartz alone. The collections brought back have already been described in part, viz. the marine Jurassic Fossils by V. Madsen[1], Sauria by E. Fraas[2] and tertiary marine fossils by J. P. J. Ravn[3], while the triassie fossils will later on be described by K. Grönvall, and the plant fossils that were brought home by Hartz himself.

I shall touch on various points bearing on the results of these investigations in the following pages.

Besides these questions, special attention was devoted during the expedition to another point, which, especially in Polar regions, should be of great interest, viz., the morphological study of these regions from a dynamico-geological point of view, the characterising of their varied, often peculiar, surface features, and the study of the forces that have produced them, some of which operate here with an intensity that finds no parallel elsewhere. In these respects the district under consideration is of remarkable interest by reason of the exceptional variations it offers, and by reason of its great freedom from ice, despite its proximity to the mighty sheet of land-ice.

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[1]) Meddelelser om Grønland XXIX: 157.
[2]) Meddelelser om Grønland XXIX: 277.
[3]) Meddelelser om Grønland XXIX: 93.

A particular interest attaches in this respect to the study of Jameson Land, which is covered with Quaternary beds. Even if, as will be shown later, the work that has been carried out here has not yielded the contributions to the question of the glacial formations in general that might have been expected, it has, however, given rise to various interesting interpretations of the geological development of the district.

Some of the results of these investigations are contained in the following pages. That these investigations are incomplete is willingly admitted; they necessarily suffered from the same difficulties that always attend expeditions of this nature: the splitting up of the time upon various tasks, the comparatively short time available for each of those (during the summer there were in all about 35 days on which any considerable time could be devoted to work on land along the Greenland coast, and some of these, moreover, under unfavourable circumstances), and the impossibility of remaining on one spot and carrying out special investigations there. But at the same time it is incumbent on me to give expression to the exceeding kindness which the leader of the expedition extended to me, and which enabled me to pursue my investigations with a freedom that is not usually within reach of those who take part in expeditions.

The district, the examination of which is the chief basis of the description that follows, is composed of the stretch of coast between Cape Dalton at 69° 25′ N. and Scoresby Sund, of the tracts round the 3 large fjords, Scoresby Sund, Fleming Inlet and Davy Sund, and Kong Oscar Fjord with its southernmost forks, Segelsällskapets (Royal Yacht-Club) Sund and Forsblad Fjord. A few days were also spent on Sabine Ö situated considerably further north (74° 30′ N.), besides which a landing was made at C. Borlase Warren. Observations taken at these places may serve to amplify the remaining results. The same is true to some extent of the observations taken in the course of the journey at a few other arctic and subarctic spots, namely, on Jan Mayen and in the NW. territory of Iceland between Dyrafjord and Önundarfjord, observations which are referred to here only in so far as they supply further knowledge of phenomena investigated in Greenland.

The mapping-out of the first-named territory, begun by Ryder and continued by Nathorst, was proceeded with during the recent expedition and completed in its main features; I may, therefore, refer in this place to the maps that have now appeared. The best maps of the more northerly stretches of coasts will be found in the account of the Second German North Polar Expedition[1]). Up to the present time we are indebted, for our knowledge of the geological formation of the district in question and of the contiguous tracts, to the expeditions mentioned below[2]). Geological maps of different lo-

[1]) The most important chartographic material will be found in the following works:

Die zweite deutsche Nordpolarfahrt in den Jahren 1869 und 1870 unter Führung des Kapitän Karl Koldewey. Bd. I und II. Leipzig 1873—74.

J. Payer: Die oesterreichisch-ungarische Nordpol-Expedition in den Jahren 1872—74 nebst einer Skizze der zweiten deutschen Nordpol-Expedition 1869—70. Wien 1876.

C. Ryder, Meddelelser om Grønland XVII: 1.

A. G. Nathorst, Två somrar i norra Ishafvet. II. Stockholm 1900, and Ymer, 1900, p. 145.

For the Danish Expedition of 1900: Meddelelser om Grønland XXVII.

[2]) Of works on the geology of East Greenland which are referred to in this paper, the most important are:

William Scoresby jr.: Journal of a voyage to the northern whale-fishery, etc. With an appendix: Jameson: List of specimens of the rocks brought from the Eastern coast of Greenland. Edinburgh 1823.

Die zweite deutsche Nordpolarfahrt —— unter Führung des Kapitän Koldewey. Bd. II. Wissenschaftliche Ergebnisse. 3. Geologie (Papers by F. v. Hochstetter, F. Toula, O. Lenz, O. Heer och A. Bauer). Leipzig 1874.

Meddelelser om Grønland. Bd. XIX. (Papers by E. Bay, B. Lundgren och N. Hartz).

A. G. Nathorst: Bidrag till nordöstra Grönlands geologi. Geol.

calities will be found in the words of Hochstetter and Bay; a comprehensive geological map of the whole littoral was published after our return (1901) by Nathorst[1]. This latter is in several respects supplemented by the results of the Amdrup-Hartz Expedition and therefor I have considered it useful that a new general geological map of the district should be appended to this paper to which I refer in the following pages.

To the best of our knowledge, the whole interior of Greenland in this region is composed of a mighty mass of primary rock, broadly speaking quite monotonous, though in detail, as far as I know it, built up of a richly varied series of gneisses and other crystalline schists. All the large fjords extend with their inner branches into this district, most of which is, as far as we know, covered by a mass of inland-ice.

Outside this central mass lies a coast-belt of varying breadth — averaging from about 50 to 70 Eng. miles — consisting of a rich alternation of greatly divergent rocks, chiefly of more recent formation. One would be inclined to think that these rocks constitute the remnants of a huge, sunken area, the central mass remaining as a vast "Horst"; but this view is scarcely borne out at present by the observations taken though by this I will not deny that a great part of the rocks of the littoral zone may owe their present state to dislocation.

In this coast-belt can be distinguished, from S. to N., four sections, each about 2 degrees of latitude in length. The two

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Fören. i Stockholm förh. XXIII (1901): 275 (with petrographic descriptions by H. Bäckström).

O Nordenskjöld: Notes on some specimens of rocks collected — — on the East coast of Greenland between lat. 65° 35′ and 67° 22′ N. Meddelelser om Grønland XXVIII: 1.

[1]) The geological map published by O. B. Bøggild in his paper "on the samples of the sea-floor", Meddelelser om Grønland XXVIII: 17, must be regarded as founded exclusively on this older map, as on account of my abcence in the South Polar regions no results of this last expedition could be included.

southernmost of these areas were first made known in detail through the Ryder Expedition, the third through Nathorst, the fourth through the German Polar Expedition.

The most southerly of these areas, which according to Amdrup's observations may be considered to begin in the region of Kangerdlugsuak Fjord (32° W. long.) and stretches north to Scoresby Sund, consists chiefly of a mighty mass of basaltic rocks of the same kind as those already known from Iceland and the Faroes. It was our expedition that first discovered in these basalts large isolated pieces and intervening layers of tertiary sediments, generally of inconsiderable extension but specially interesting because, together wich plant fossils, they contain a well preserved marine fauna.

The next two areas resemble each other in that they consist for the most part of sedimentary rocks, and from a topographical point of view in that they are traversed by perhaps the most magnificent system of fjords in the world. In other respects they are quite dissimilar. In the south lies, as a protection against the sea, the mass of primary rock of Liverpool Land, and the tract within, which is comparatively low, is built up almost exclusively of Jurassic rocks, with an underlayer of older formation in the NE. only.

No rocks as recent as this are to be found, as far as we know at present, in the third area, which may be said to begin in the region of Davy Sund. Almost the whole of this section of the coast-belt consists of paleozoic rocks. These, first discovered by the German Polar Expedition, were held by Toula to correspond to the Hekla Hook formation of Spitzbergen. They were afterwards examined by Nathorst, who found in them traces of Silurian fossils, and could also indicate the presence of beds of Devonian age. At the extremity of the coast here occurs, in a state of fairly considerable development, a series of more recent eruptive rocks, already found by Scoresby and examined later by Bäckström from specimens brought home by the Nathorst Expedition. I shall return to these rocks later.

The extent of distribution of the various types is not yet known.

The fourth area consists of the tracts N. of Mackenzie Bay. Here the primary rock everywhere approaches much closer to the outer coast-line, the littoral zone having at the most only a breadth of nearly 20 miles. Just as in the southernmost area, it is composed chiefly of basalt with intervening "layers" of partially fossiliferous tertiary rock; however, there are also strata belonging to the Jurassic system, somewhat more recent than those at Scoresby Sound. Beside the true basalt also acid porphyritic surface-rocks occur at Cape Broer Ruys.

The Danish Expedition has brought back new material of general interest from only the two southerly of these areas, although in the two others as well observations and collections were made which amplify our previous knowledge and help to give a picture of this part of the East Coast in its entirety.

I will now pass on to a petrographic description of the rocks of the district, confining myself in the first place to the crystalline types of rock and to some hitherto little known non-fossiliferous or only slightly fossiliferous sedimentary formations. A brief survey of the stratigraphy of the district will also be included. I will then proceed to give an account of the topography of the district and the witness it bears to the history of its development.

Petrographico-geological Description.

I. Archæan rocks.

As already stated, the archæan rocks constitute the bulk firstly of all the Greenland central mass, and secondly, within the tract with which we are here concerned, of the isolated and elongated peninsula north of Scoresby Sund, called Liverpool Land. Already by reason of their position, far from each other, each of these tracts must be dealt with separately, and the same applies to the various districts situated far from one another at the bottom of the great fjords, where up to now opportunity has been afforded of getting to know the structure of the central mass. The following description will therefore be an account of the different localities.

A. Structure of the Central Mass within Scoresby Sund. During the Expedition of 1900 we never penetrated so far into this fjord that I had an opportunity of studying the features of the primary rock in situ. The Ryder Expedition of 1891—2, on the other hand, brought back from here a considerable collection of rocks, which I had an opportunity of examining both as specimens and in thin sections, and on these, as well as on the description given by Bay[1]), the following summary is based.

The material in question, taken from a considerable area, shows that the rocks there are unexpectedly uniform and consist almost everywnere of gneiss, usually grey micaceous gneiss,

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[1]) Medd. om Grønland. XIX, 147 seq.

very often containing garnet. Incomparably the most common are coarse biotite gneisses with pronounced schistosity; in these layers of hornblende schists were frequent, so, for instance, on Danmark I., and, according to Hartz, inside Gaase Fjord, there together with chlorite and talc schists, and traversed by dikes of a peculiar amphiboline peridotite[1]. Not rarely the gneisses are fine-grained, at times the mica retires, and now and then we find garnet-bearing, compact, finely banded forms, the appearance of which strongly reminds one of the true Saxon granulites. Nor are rocks similar to mica-schists wanting. From Danmark I. a small mass of archæan limestone is reported. It is especially remarkable that granitic rocks seem to be very scarce. From Bregne Point on Milne Land comes a specimen which may be a coarse biotite granite, while a fine specimen of coarse red granite (according to Hartz, a "dike-formation in gneiss") was met with in Hjörnedalen inside the fjord. Moreover, pegmatitic veins were found in some places, but otherwise such kinds of rock seem to be lacking, in contrast to the state of things in the coast-belt, where granites together with red gneisses and hornblende schists play the leading part.

In Nordostbugten (North-east Bay) I myself collected a series of blocks, among which were several grey gneiss-granites, but along with these also limestone and a more recent-looking syenite; it is conceivable that the latter was brought in by drift-ice from outside the coast-belt, and this may possibly be the case with the former as well.

Under the microscope, too, these rocks show the same uniformity; they are destitute of any characteristics unusual in gneisses. They often contain microcline and garnet, the structure is the typical one, with pronounced lobate limitation in the grains, which, perhaps by reason of secondary growth, often poikilitically enclose lesser individuals. Relic structures

[1] For the petrographic description of this rock cfr. Bay loc. cit. p. 159.

indicating that the rocks were originally composed of normal granites, have not come under my notice; indications, too, of porphyritic structures are rare.

A strongly weathered biotite-gneiss from the interior of West Fjord contains, besides garnet, a mineral that seems to be a rhombic pyroxene. In the same fjord lies a locality called "Black Point" (Sorte Pynt), the hornblende rock of which also has a peculiar appearance; it has probably been originally a pyroxene rock. Noteworthy are also the rings of garnet that here surround hornblende individuals.

A remarkable quartzite formation appears in the middle of the archæan rocks, on Milne Land right opposite Röde I. One is inclined to connect it with the peculiar conglomerate that appears on this island, and, as a matter of fact, it presents an appearance that is very young for a quartzite of archæan age, but microscopically it reveals itself as entirely crystalline, and no proof can be produced that we have here a deposit younger than the youngest primary rock. If only for the help this rock might offer to the understanding of the tectonics and the problem of fjord formation of the district, a closer examination would be of interest[1].

B. The Central Mass within Kong Oscar Fjord. Here I had an opportunity myself of collecting a series of specimens at the bottom of Forsblad Fjord. The rocks here show very striking dissimilarities to those appearing at Scoresby Sund. The chief rock is a medium grained biotite-hornblende gneiss, often finely striped, with now the one and now the other mineral predominatingly or exclusively present, and alternating with lighter layers where both retire. More or less plentiful in the rocks is garnet, which sometimes collects into lumps of more than

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[1]) A thin-slated quartzite of youthful appearance was found by Nathorst in Alp Fjord, within the district inside Kong Oscar Fjord, to be described presently.

5 cm. in section. Fine-grained granulite or hornstone-like varieties are also to be found.

Besides stratifications of amphibolite, we find in these rocks dikes of dioritic rocks, of which a few that were examined microscopically proved to be garnet- and pyroxene-bearing rocks of amphibolitic appearance, while in another case amphibole is practically the only component present, with only traces of biotite and felspar. Whether some narrow dikes of a black compact rock, which occurred high up in the mountain traversing the gneis, belong to this or to some other more recent series, has not been determined. Limestone also occurs in blocks.

Furthermore, I here came across irregular veins of a light pegmatite, which possibly is connected with some lenticular masses of light granite that could be observed further out in the fjord. From these granites derive presumably a number of blocks collected in part right inside Forsblad Fjord, in part in Polhem's Dale, further out within the Cambrian-Silurian territory. One of these rocks, apparently corresponding to the light pegmatite veins, is almost free of mica, contains some garnet and has a fairly gneiss-like structure, as several of the mineral individuals show markedly laciniated outlines. Another, again, is a fine biotite granite, with ore and zircon and large felspar individuals, with their idiomorphic outlines very clearly defined. This is less the case, on the other hand, with the smaller individuals in the mass proper, as secondary accretions here play a much greater part; and yet it is still observable that the quartz, as the last crystallized mineral, fills up irregular spaces between the other individuals.

Here were also found blocks of coarse rocks rich in hornblende, of somewhat divergent type.

The district in question resembles Scoresby Sund in that grey gneiss forms the chief rock in each, but differs from it in the very varying appearance that the rocks display in so limited an area. In how far the same is true of the other parts of the central mass inside the system of Kong Oscar and Franz Joseph Fjords, is not easy to decide from the descriptions that are to hand. We only find that the gneisses, here too, are often garnet-bearing and that granites do not seem to play any great part.

It is from a fjord system situated far further north that we presumably have a series of blocks that were collected by me on the shore at Cape Borlase Warren. The rock in place is coarse basalt. Amongst the boulders brought home are coarse, almost pegmatitic rocks which most often have clearly been subjected to pressure. Characteristic is a coarse, grey hornblende-granite, also a coarse red granite in contact with a lighter, striped gneiss rock. Also more recent rocks, clay-slates and sand-stones, occurred abundantly as blocks on the shore.

As regards the character of the archæan rock on the stretch of coast S. of Scoresby Sund, I may refer to the description of the rocks collected by Kruuse which I have published on a previous occasion[1]).

C. Liverpool Land. As far as we know, all this district, too, is formed, in its bulk, of archæan rocks. Still, it is at once evident that these are of quite another kind and appearance than those that occur within the known and neighbouring parts of the central mass. This is true not only of the west side and especially the tract nearest to the inmost creek of Hurry Inlet, where the great variation may be bound up with other factors, but also of other parts of the district. So far, however, we have only material from a few places, i. e. (apart from the west side) from a point on the southern extremity (Cape Tobin), and a spot on the east coast (Cape Greg)[2]). I will first describe these places.

1) Meddel. om Grønland. XXVIII, 1.

2) Still further north on this coast, on the northernmost point, Nathors

Cape Greg is a sheer spur at the extremity of a peninsula, situated about midway up the east coast of Liverpool Land. A short landing was made here; but, already by reason of the sheerness of the cliff, it was impossible for me to penetrate inland. Vegetation was very scanty; hence the variation in colour at the base of the rock, from red to dark green and white, was remarkable from a distance. The main rock seems to be a medium-grained, ruddy or green gneiss, which in the samples examined proved to have a fairly granitic appearance: large felspar individuals (perthite or microcline) show sharp outlines with indications of crystalline form, and it is only in the fine-grained intervening mass that the re-crystallization has gone further on. Here the individuals often very actively invade one another with their laciniated border-lines, and numerous individuals of beautiful "myrmekite" are to be seen. The rock has been subjected to pressure, and at times one could almost speak of a "mortar-structure".

In this rock lie large and small lumps and lenses of a dark biotite-hornblende-rock, with some garnet, microscopically developed as a typical amphibolite. The lenses are sometimes drawn ont into long, plicated bands, in which the rock often runs into a fine, pure biotite schist.

Interspersed among both the rocks just described we find, following the strike of the schists, numerous layers or dikes of light, often ruddy pegmatite, now quartziferous, now almost free from quartz and then composed almost exclusively of perthitic felspar and large areas of biotite. Pegmatite rocks with large hornblende individuals also occur. I did not see any typical granites here, but do not doubt that the rocks described are composed of injected, strongly metamorphosed eruptives.

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collected a series of rocks from Murray I. They are formed of hornblende gneiss, diorite schists and pegmatite, and thus seem to resemble those at Cape Greg.

Aeruginous weatherings on the mountain-walls indicate the presence of copper pyrites or cupriferous iron pyrites.

Cape Tobin. The southernmost part of Liverpool Land is low and easy of access; broadly speaking, the rock is fairly monotonous, while in detail it reveals abrupt changes. Predominant is a coarse crystalline gneiss, in part grey granitic, in part, and this is the commonest, a banded form, where in the grey gneiss we find irregular, often undulated bands soon

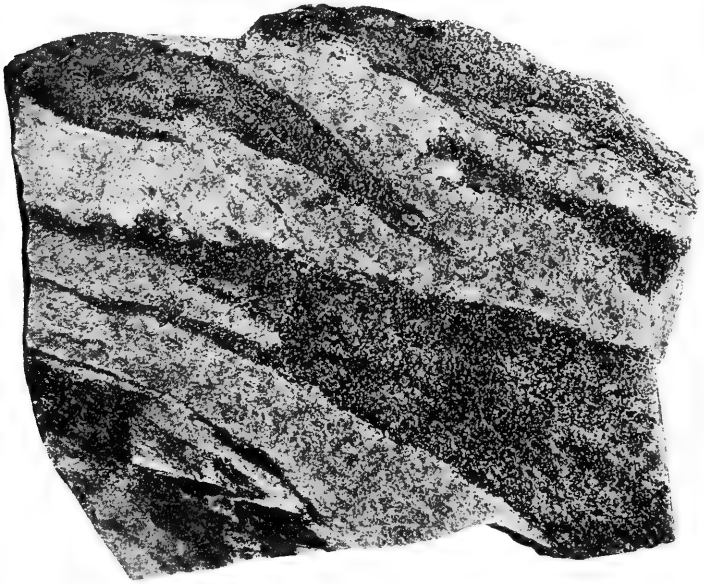

Fig. 1. Sample of the rock from C. Tobin, showing irregular red bands in the head-mass of grey gneiss.

pinched out and consisting of a red, rather coarse crystalline mass, which is often purely pegmatitic and then occasionally rich in hornblende, often in the form of large, well developed crystalline individuals. Besides these rocks there are fine-grained hornblende schists; the different varieties often show alternating stratification.

A coarse, red pegmatite granite corresponds perhaps to the rock which forms the red bands in the grey gneiss, already described. Numerous blocks of basalt occur, as also of a dark, coarse crystalline rock, which seems to consist largely of pyroxene.

Microscopically I have only examined a slide of the typical, banded grey gneiss. It reveals nothing remarkable except the combination, characteristic of the whole district, of hornblende and biotite in about equal quantities. For the rest it is rich in epidote of a fairly primary appearance. No distinctly granitic characteristics are to be found; the secondary re-crystallization reveals itself in the abundant presence of myrmekite.

The West Coast of Liverpool Land, near the southernmore of the two large glaciers that push on towards Hurry Inlet. It is interesting to see how much more varied the rocks appear on the west than on the east side of the country. The rocks at the landing place indicated above consist mainly of a series of gneisses in quickly varying layers, chiefly a grey mica gneiss, and also amphibolite and mica-schist-like forms. Curious is a type met with somewhat further inland, which there seems to have a by no means inconsiderable distribution. Macroscopically a marked schistosity presents itself in close rows of small, red felspar eyes, and in a streakily arranged green mineral. Microscopically it can be seen that the rock has been subjected to very strong pressure; porphyritic crystals of both orthoclase and very strongly dismembered plagioclase (?) lie in a groundmass, which together with biotite and chlorite is almost exclusively formed of irregular stalk-like quartz individuals extended in the direction of the schistosity. What this rock originally was, it is hard to say; in any case it shows what strong transforming powers have been at work in this locality.

In one spot a dike of fine, fresh basalt was met with. Besides this there occurred, in the same district, two rocks that deserve special mention. One is a limestone, part white with mica and some tremolite, part malacolitiferous and somewhat greenish, and occuring in the gneiss in rather small quantities. Interspersing thin irregular veins and stripes of a red quartziferous and feldspathic rock may possibly be connected with more recent granite injections.

The other series of rocks is composed of true granites, which were not observed by me with any degree of certainty on the east coast, and even here they occur only in small quantities. That they are really granites, however, can be seen partly by the manner in which they often intersect like true dikes the stratification of the gneiss, partly by the fact that they sometimes contain sharpedged inclusions or fragments of basic rocks.

Another rock from the same locality shows microscopically a fairly gneiss-like appearance, the mineral grains having through secondary growths assumed an irregular, lobated limitation, while large plagioclase individuals have kept their idiomorphic form. The rock is somewhat pressed and disintegrated and shows a number of curious intergrowths of quartz and felspar· whose nature — if they are to be considered as micro-pegmatite or as myrmekite — I could not determine.

To this series belong also some rocks, that attracted my attention owing to their almost "mealy" appearance, which I attributed to chemical weathering. Under the microscope it can be seen that they are very strongly crushed, in reality it is possible that a part of the rock-meal that penetrates it is directly due to mechanical crushing. Still, it is more probable that ordinary felspar weathering, combined with the crushing of the rock, may here have gone rather far. In any case, the rocks deserve a more detailed examination.

A block of a coarse sandstone conglomerate, collected by Kruuse in this district, seems, according to information received, to indicate that here too more recent sedimentary rocks occur in place, possibly corresponding to those described below from the innermost part of Hurry Inlet.

Liverpool Land at the innermost part of Hurry

Inlet. Both petrographically and also in other respects, this tract offers a unique geological interest, and it is much to be regretted that, although two expeditions stayed here for several days, it is not yet possible to draw up a geological map of the district, on which the various crystalline rocks and the quaternary phenomena could be entered. Even now the topographical basis which could make this work possible for a future expedition, is wanting. Nathorst has furnished a short survey of the geology of the district[1]). The sweep of the fjord is continued along a broad deep valley, which, broadly speaking, divides the two chief formations: in the west, Jurassic with an underlayer of Rhaetic, and a series of still older sedimentary rocks; in the east, chiefly primary rock and some curious strata, to which I shall return later. Moreover, on the Fame Islands as well as on the mainland, basic eruptive rocks of the labrador-porphyritic type were met with, besides which Nathorst had already found blocks of the alnöitic rock that I shall describe later on.

In this place we will only dwell on the archæan rocks. The district in so far reminds one of that just described, as both limestone and granite occur here too, and moreover in far greater quantities than there; above all it is granite, at least in places near the shore, that is the predominant rock, while gneiss retires. Here we find a red, coarsely crystalline even-grained granite, consisting almost exclusively of felspar and quartz. Microscopically it reveals considerable pressure: the different grains are sharply defined, but with sinuous outlines which are scarcely primary. The plagioclase is strongly weathered, while microcline and, as a general rule at least, the orthoclase are quite fresh.

The granite that forms in a mixture with basalt the curious breccia which is described later, is more strongly pressed, and

[1]) Geol. fören. i Stockholm förh., 23 (1901), pp. 282—285.

at the border between the larger individuals a new mineral mass seems to be on the point of forming. Several intergrowths between quartz and felspar remind one of micropegmatite.

Deserving of mention is also a macroscopically gneissoid rock, which was collected further north. It is more strongly crushed and presents in its best preserved parts an almost granulitic appearance, but at the same time characteristics that remind one of true granites, e. g. micro-pegmatitic intergrowths.

The other chief rock in this district is only come across further inland at a height of about 500 m. It is a grey, garnetiferous gneiss, rich in felspar, quite unlike the other types known to me from this coast. Microscopically it looks as if the large, sharp, often crystallographically rectilinearly bordered felspar individuals (mostly plagioclase) were, so to speak, cemented together by a mass of strongly pressed quartz; moreover, in the intermediate mass garnet and some altered biotite occur plentifully. We also find in the rock beds that pass over into true garnet-rock; the rounded, completely isotropic grains of garnet are cemented together by quartz, micaceous substance and ore.

Just as at the spot further south, described above, so here in the primary rock there occurs limestone in the form of large, apparently lenticular masses. These limestones are of special interest owing to their close connection with young alnöitic rocks. It is well known that such a connection could apparently be pointed out wherever similar eruptive rocks occur, and for this several explanations have been adduced, among others, that the limestone might constitute a direct crystallization product of this extremely basic magma. However at the place here described it does not seem probable that this has been the case, at least not to any large extent.

The limestone forcibly reminds one in its appearance of the corresponding rock from Alnön in Sweden, for instance, in its richness of foreign minerals, which, however, also applies to the more southerly occurrences on this coast where no alnöite has been pointed out. We find, particularly, in close connection with the pure limestone veins, lenses, or irregular patches, of a green rock-mass, that consists principally of a pyroxene mineral, partly in orientated penetration with green hornblende. Furthermore, both the limestone and the green rock are traversed by red, granitic masses, and it was my opinion that this was a young intrusive granite that had broken through the limestone and in some places had penetrated into it, forming in part a breccia (exclusively with the green pyroxene rock), in part narrow injected veins.

But these questions demand a closer examination from nature, and at the same time the question as to whether this light rock is a true granite or simply a curious development of other rocks, should be solved. What I have seen of it microscopically resembles the other granites of the district: apparently an old, pressed, almost gneiss-like rock. When large masses of it come in contact with limestone its appearance is altered, and it gives a more basic impression.

In addition to what has been mentioned, even the purest limestone contains a number of foreign minerals, which for the most part could not be recognized under the microscope without a close examination. Particularly noticeable is a mineral with the interferential colours of titanite, but, as it seems, with still stronger refraction. Then we come across a sap-green hornblende, that sometimes appears implicated with quartz; and in particularly abundant quantities a light malacolite-like pyroxene mineral. One of the balls resembling a concretion consists of iron pyrite (or markasite).

I have had at my disposal neither the time nor the material for comparison necessary for a more exact study of those minerals, but hope that they will later be subjected to examination by some specialist[1]).

[1]) Cfr. the appendix at the end of this paper.

So much is clear from the foregoing description, that the rocks of Liverpool Land, in a comparatively restricted area, show far greater petrographic variations than those we know from neighbouring parts of the central mass. This is true already of the E. and S. parts of the Land, with their pegmatites and very pronounced hornblende rocks, but especially of the area nearest the inner part of Hurry Inlet, where granite occurs in greater quantities than anywhere else in the known parts of E. Greenland, and where both limestone and curiously developed crystalline schists contribute to make the rock formation varied.

Later on in this paper I shall give a more detailed description of the very interesting alnöite-like eruptive rocks which appear in the same region as dikes and small masses, but will pass on now to describe the more recent sedimentary rocks of the district.

II. Post-archaean sedimentary Rocks.

Thanks to the labours of the last Expedition we have now got so far in our knowledge of the geological formations of East-Greenland that, even if an immense amount of detail work still remains to be done, the time seems to have come for us to attempt to offer a complete survey of what we know. Little by little we have got to know a large number of series of formations, the majority of which, however, are either entirely lacking in, or are only very scantily supplied with fossils. It is, consequently, only through careful stratigraphic studies that one can hope, where indeed it is possible at all, to elucidate the question of their age, and such studies have not been carried out hitherto. And so, as a rule, we must confine ourselves to descriptions of certain localities, although we shall see that, notwithstanding this, we can go a good way towards drawing conclusions as to the age and reciprocal relations of the sedimentary rocks.

Within the area in question the following systems are clearly proved to occur: Silurian, Devonian, Triassic, Jurassic, (Rhaetic-Liassic as well as Middle and Upper Jurassic) and Tertiary (Eocene). Except that the series of strata characterized by Silurian fossils perhaps overlaps, in its lower part, into the Cambrian, the following non-fossiliferous local series, arranged in the order I consider they were most probably formed, may for the present be distinguished: Cape Fletcher series, Hurry Inlet series, Cape Brown series, and Cape Leslie series[1]).

To the result of the paleontological examinations of fossils from this district, I shall only refer very briefly in the following, but, on the other hand, I shall dwell more exhaustively on a petrographically descriptive account of the different systems and series, setting out from those rocks whose age can be determined from the fossils they contain. I will divide them here into two main divisions: the reason for this classification will be gone into more fully when I come to formulate my views of the stratigraphy of the district.

A. The older Prae-Rhaetic series.

(Mottled Rocks.)

1. Silurian and Devonian (with possibly Cambrian strata). These rocks, which occur within the system of Kong Oscar and Franz Joseph Fjords, have been described in detail by Nathorst, who was also the first to point out fossils in them, and thus determined their age. However, they are very poor

[1]) To these must be added the so-called Röde Ö (Red I.) conglomerate, described by Bay, which occurs quite isolated and about the age of which nothing can be said, but which I prefer to consider as prae-Rhaetic. The specimens of conglomerate pebbles seen by me seem to consist chiefly of gneiss and quartzite, also quartz; the matrix consists of splinters of quartz and felspar, joined together and coloured by iron oxide, besides which calcite is not altogether lacking. Iron pyrites, even in large lumps, seem to be common, and to their disintegration the red colour, which gives the locality its name, presumably owes its origin.

in fossils, though their petrographic variation is unusually strong. Nathorst, to whose description[1]) I refer, mentions, among other varieties, white, yellow, grey and black limestones and dolomites, red, green, and dark schists, and red, green, grey, and yellow sandstones.

Within the area of these rocks I myself only landed at one spot, viz., in Polhems Dale, (Segelsällskapets Fjord), quite

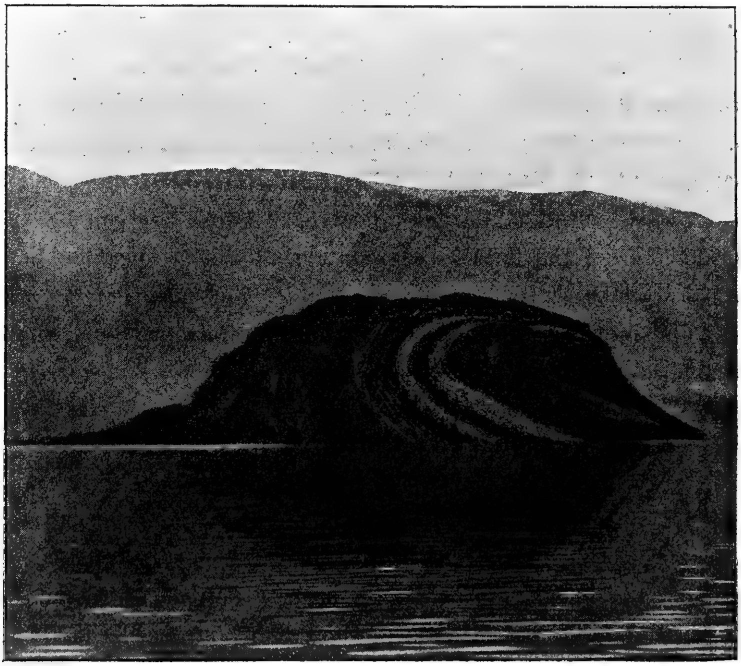

Fig. 2. Åkerblom I., near the entrance of Segelsällskapets Fj., showing folded manycoloured silurian rocks. (C. Kruuse phot. 28: 8: 1900).

near the limits of the primary rock. The fact that we were so close to the base of the formation gives the observations taken a certain value. Although I had no opportunity, except at a distance, of observing the line of junction itself, yet it was evident that, as Nathorst has

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[1]) Op. cit. pp. 288—298.

pointed out from other places, we have to deal with a superstratification, not with two series of rocks separated by a fault. Possibly, therefore, the rocks I collected here belong to the Cambrian System. They have, as a matter of fact, a very old appearance. At the very bottom, on the shore, is found a green, dense, hard schist, quite different from the one we shall describe later as typical at Cape Brown and in Hurry Inlet. Above that we find quartzite and hard limestone in huge banks, of a fairly crystalline appearance; also a dark clay-slate. Among the rocks was observed a fine violet-red quartzite, but for which it really looks as if here, at the bottom of the series, the red divisions of the formation had retired to some extent[1]).

2. The Older Triassic System (Fleming Inlet Series). Fleming Inlet, which was first made known in detail through the Danish Expedition, is a comparatively broad, open bight between sheer, often perpendicular shores, the cliffs of which shine out in glaring red colours mixed with yellowish white, green, grey, etc. In a few places broad, deep side-valleys open, of which Örsted Dale is the chief.

The expedition stayed here two days and made several landings, especially on the west shore and at the inmost part of the fjord. In both places were found, partly by me, partly by Hartz, traces of fossils, of which, however, only the last, taken from the slope opposite Pingels Dale, have so far proved determinable. They have not yet been described, but according to a preliminary communication, kindly supplied by Dr. K. Grönwall, they derive from the Triassic Period, of which hitherto no fossiliferous strata are known from Greenland[2]).

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[1]) In the adjacent Berzelius Mountain, however, the mottled and red colours appear most brilliantly (cfr. Pl. XI, also Fig. 2 above, showing the bright-coloured, folded layers on Åkerblom I, at the entrance of Segelsällskapets Fjord).

[2]) If we look aside from the Rhaetic beds.

Further information cannot yet be given, but for the present account this is sufficient, even if an examination of the material, which is very desirable, should change our opinion in some details.

Broadly speaking, the strata here are fairly horizontal, and, however variable their petrographic character may be, there is no reason to assume that a continuous series does not exist, though from this it does not follow that dislocations cannot occur further off in the same district.

The rocks themselves have, in the main, a rather young appearance. We find yellowish, grey, and more or less bright red sandstones, red, green and black schists, and dense, hard, grey and red, also dark, limestones. The latter are often developed as fine oolites and varieties appear that consist entirely of balls, several centimetres in diameter and consisting of concentric layers. In a grey-green clay-slate I saw a ball of dark, flint-like mass. In these respects the rock forcibly recalls the one at Cape Fletcher. Among the schists the lustrous types, so characteristic at Cape Brown, are as a rule wanting, yet at times there occur both red and green, loose, very likely calcereous, sandstone schists, which at the surface of the strata are resplendent with mica-scales.

It is unfortunately impossible for me to show any sections of these rocks[1]. The sequence of beds seems to be such that at the shore, at least towards the bottom of the fjord, bright red rocks predominate, while it seems as if the light, coarse sandstone prevailed higher up. So, for instance, I found on the W. shore at 180 m. a fine lustrous red schist, at 240 m. partly a narrow intervening layer of a green thinly laminated rock, partly loose, light sandstone, recalling the Jurassic series. But above these, as can be seen in several places, red schists again crop out, while, conversely, down by the shore at Cape

[1]) Partly because a number of notes made at the time were lost through an accident.

Seaforth a coarse, yellowish sandstone crops out, with pebbles of quartz and of a green slaty rock, up to a centimetre in length. It does not look, therefore, as if the division of the series on purely petrographical lines was possible. Also in Pingel's Dale at the S. E. corner of the fjord, at 300 m. above the sea-level, a dark-green, lustrous schist, not unlike the one from Cape Brown, was found by Hartz. At 380 m. a fairly coarse, light sandstone with intervening layers of schists cropped out, and at 570 m. a red, non-lustrous, thinly laminated rock was met with. It was in blocks of sandstone schists from this series that the best preserved fossils were found. And still higher up, at circa 800—900 m., Koch found a black, bitumenous or (in other layers) a greenish schist, partly also a reddish conglomerate that recalls very closely what is described below from Vargudden in Hurry Inlet. The rock is loose, the intermediate mass is very calcareous and contains numerous rounded mineral grains which, however, are frequently combined so as to show that they derive from older rocks, as well as true rock-fragments, among which some that derive from porphyritic surface rocks. To decide from the single sample I saw whether the rock is related to the similar conglomerates from Cape Brown and Hurry Inlet, is of course impossible, but a suggestion as to how the order of the strata may ultimalety be settled is contained in the similarity just pointed out.

Almost at the same spot, close to the shore, in a little river, I came across several blocks of a curious limestone, which both at the surface of the cleft and, as it seems, in connection with concretionary formations, contains a fairly rich quantity of a dark metallically lustrous copper mineral, according to the determination of Böggild cuprite (red copper-ore), and interesting as being the first occurrence of this mineral in Greenland. Green, malachitish disintegration products give the rock a striking appearance.

3. Cape Brown and Hurry Inlet series. Cape Brown is the most northerly headland on the E. shore of Fleming Inlet. The Expedition here landed but for a very brief space, which only enabled me to collect what was cropping out nearest the shore. There were mighty banks of red and green schists, sometimes compact and more hornstone-like, but as a rule well characterized by the plentiful presence of a micaceous mineral which gives the surface of the strata a vivid sheen. From this I got an impression that the rock was rather crystalline, which is however disproved by the microscopical examination. The green rock here seems to consist of angular grains of quartz, while plagioclase and other minerals are less abundant, with lamina of muscovite and green chlorite or chloritic biotite, cemented by a strongly doublerefractive carbonaceous mass. The structure is thus purely clastic. The schist is sometimes shattered and cemented into a breccia by crystalline limestone or it contains veins of calcite of a few centimetres in breadth.

Furthermore I here came across, near the shore, a still more remarkable rock, viz. a coarse, firm conglomerate with an intermediate mass of red, green and dark grains the size of a pin's head and very many rounded balls of the most varied petrographic character, granites of varied appearance, some of them coarse; further, grey quartzite, and a mixture of different kinds of many-coloured porphyries and porphyrites. I have microscopically examined both the matrix and a number of the balls. The former consists of a fine-grained, micaceous mass in which lie now angular, now rounded grains of quartz, felspar and heterogeneous fragments of rock. Among the balls the porphyries offer most interest. There are varieties both with and without porphyritic quartz, while all the specimens I examined contain phenocrysts of green chloritic mass which in its often regular hexagonal form shows that it is the pseudomorph of biotite, very like those described from the eruptive rocks at Cape Fletcher. The ground-mass is now dense, micrograuitic, now a splendid granophyre. We also find balls whose ground-mass seems to consist of individualized cryptopegmatitic intergrowths, and the small grains show great variety, but it was impossible for me to set up any well defined types. It is true that I found no analogy to the basic tephritic forms of the Cape Fletcher series, but these even there occur in subordinate mass, and on the whole the resemblance to the rocks of the area mentioned, distant only about 12 miles, is too great for us not to be able to assume with certainty that the balls derive from that group of eruptive rocks. To this question I will return when describing the conglomerates in Hurry Inlet.

To settle the very interesting question of the age of this series of rocks in relation to the Triassic bed further in in the fjord, it would be necessary not only to be acquainted with the nature of the superposed bed but also to examine the E. coast of the fjord. Koch stayed some time at this place and climbed the highest mountain, from the top of which (850—900 m. above the sea) he brought back, it is true, some red lustrous schists of the same kind as those from the shore. But as similar schists, even if subordinate, are also met with in the Upper Triassic series it is by no means precluded that the conglomerate cropping out on the shore can be at the base of this formation and itself belong to the same epoch. This is also the opinion to which I most incline, but until a detailed examination has been undertaken the possibility is always present that we have to deal with an older, Paleozoic series, which by dislocation is separated from the more recent beds.

The oldest Hurry Inlet series. Nathorst, on his visit, already came across, in the innermost part of Hurry Inlet, at the foot of the archaean hills of Liverpool Land, firstly a coarse gneiss conglomerate, and secondly, nearer the shore, a black or grey clay-slate. However, he had no chance of determining their relations either to one another or to the series of non-fossiliferous, red, white and green sedimentary rocks which here underlie the Rhaetic strata, and to which he also referred a ruddy sandstone and a calcareous conglomerate, which was met with on the Fame Islands underlying a sheet of Labrador porphyrite.

By reason of their stratigraphic situation and petrographic character Nathorst hesitatingly classed these last-mentioned rocks as Keuper. I had no opportunity myself of examining the strata on the W. side of Ryders River, but on the shore I collected a few samples during a single, short tour. From the Fame Islands Dr. Deichmann brought back a few samples, about which I shall have something to say below.

During my own wanderings I came across, on the W. slope of Liverpool Land, a curious conglomerate that is probably identical with the one pointed out by Nathorst and mentioned above. In the main it forms a firm mass, the pebbles of which, it is true, stand ont plainly against the matrix, but yet are so firmly connected with it that they cannot easily be isolated even with the hammer. Since the matrix itself both preponderates in bulk and presents a tolerably compact appearance, while the fragments show angular shapes, the whole strongly reminds us of a volcanic breccia. But we have none such here; firstly a stratification can already be seen macroscopically, and secondly the microscope shows conclusively that we have here a clastic rock consisting of numerous grains, mostly quartz, but also felspar, and besides, in certain thin ledges, much garnet and iron-ore. As a rule these grains are sharp-edged, and as a typical cementing material is only sparsely present, the rock has a fairly crystalline look. But there occur also numerous grains, often well rounded, of rock-fragment, among them even micro-pegmatitic intergrowths of quartz and felspar, and their shape already shows that the whole is, after all, a clastic mass. That this is the case appears still more plainly in some intervening layers of green or red true clastic schists, of the same appearance as the one met with at C. Brown. The green colour is probably caused principally by thin micaceous and chloritic scales; moreover, there is a dense, sericitic mass; nor is calcite lacking as a matrix.

I also came across similar schists at another spot underneath the conglomerate rock. There were both green and red schists of the same appearance as those just described and, in addition, lighter, hard, granulite-like layers which create a fine banded texture, while certain layers swell out into small lenses which may cut off the adjacent ones. In this series I also found veins or irregular layers of a dense, dark-grey limestone.

The conglomerate that here rests on the schist, differs from that just described in having a much looser character, which, as shown under the microscope, is closely allied to a well-marked crushing structure, and unless the foreign, well preserved pebbles were there one would be inclined to consider it a dislocation breccia rather than a clastic conglomerate. As it is, no other explanation can be given than that a dislocation has really taken place, chiefly affecting the conglomerate along the contact where it rests on the Archaean rock. In this conglomerate, too, I found an intervening layer of schist, whose intense red colour was created by a fine dust of iron-oxide which transverses the cementing mass, whilst the numerous splinters of quartz which constitute the bulk of the rock are pure and uncoloured. In its structure the rock is exactly like the green schist just described.

Of great interest are the pebbles in this conglomerate, which I tried to examine somewhat closer. True crystalline schists play no part, the chief mass is made up of red granites, of which, however, many, by their general habitus or their passing over into syenites, show that they do not belong to the normal archaean rock series, but to the more recent series of eruptives which are found cropping out further north on the coast and which are later to be described, chiefly from the specimens brought home from C. Fletcher. Besides, already macroscopically, red porphyries, mostly poor in quartz, are very prominent, and further bind together these rocks with those just named.

Microscopically we can distinguish several varieties of porphyries among the pebbles, with often a very dense, aphanitic though not really micro-felsitic ground-mass. Among the phenocrysts we very often find chlorite accompanied by apatite and ore, and in a distinct crystal form that seems to derive from biotite, even if occasionally hornblende should suggest itself. The resemblance to the acid extrusive rocks of C. Fletcher and the conglomerate pebbles of C. Brown is striking. Then I came across a fine granophyre granite. I have also examined a red, rather porphyritic granite. It is hard to determine where this rock should be classed. The quartz is fairly hard pressed and shows no crystallic shape, but is sometimes intergrown with plagioclase in a way that reminds one of a very coarse micropegmatite structure. The plagioclase itself usually shows idiomorphic outlines, and microcline is absent, through which the rock differs from the red granites, already described, which crop out in the district and with which in other respects a certain resemblance is to be seen.

The rocks in the valley between Liverpool Land and Jameson Land (Ryder's Valley). These rocks, just described, were met with a little way up the slope towards the higher gneiss-area. Down in the valley itself the rocky foundation is not often exposed, but where it is to be seen, for instance near Vargudden, it consists, just as it does on the Fame Islands, for the most part of a coarse ruddy conglomerate which differs from the one just described in its looser consistency, and in that the pebbles and grains are mostly composed of quartz. Besides these, grains of granitic rock occurred, while in the specimen examined by me only a few small pebbles of micro-granite were seen, though their type could not easily be determined. The matrix chiefly consists of calcareous mass.

In the rock occur in many places rather large intrusive sheets of a basic eruptive rock with large porphyritic plagioclase crystals. In one place, on the border of the sedimentary rock, here strongly metamorphosed, it touches on a glassy structure, otherwise it scarcely differs from the tertiary olivine basalts of the district, with which it may presumably be closely allied.

On one of the Fame Islands Dr. Deichmann came across, according to the report in situ, a curious greenish rock, which, as it appears, is completely crushed. It looks very much as if the original material had been a conglomerate, but both the pebbles and the mass are changed beyond recognition.

Age of the conglomerate rocks. Thus, at four spots within a somewhat restricted area we come across curious conglomerate rocks which have this common characteristic, that their material includes porphyritic surface rocks, which are otherwise very rare in Greenland, but occur just here, though very likely not to any great extent. These conglomerates strikingly resemble one another by twos; on the one hand Fleming Inlet and the lowland round Ryders Elv, on the other C. Brown and Liverpool Land. This does not enable us, of course, to establish any safe comparison between them, but everything points to the conclusion this if ever a comparison by their petrographic characteristics alone of sedimentary rocks of tolerably settled age is possible — they are all younger than the C. Fletcher eruptives and older than Rhaetic — this may be applied to these rocks. The conglomerate at Fleming Inlet is older than Rhaetic and more recent than the Triassic fossils met with there. To the strata in Ryders Dale one is most inclined to assign the same older Triassic age, if only because of its stratigraphic situation. The rocks at C. Brown are probably somewhat older than those at Fleming Inlet, yet in point of age we cannot give them a place among the older Paleozoic epochs; we are inclined to think that they belong to the oldest Triassic or possibly to the Permian. There is no reason to believe that the conglomerate and the schists on Liverpool Land do not belong to the same period, situated as they are on the level immediately below the Ryders Dale rock mentioned above and not far from it.

The crushed rocks that occur on several places in the same district, indicate that the boundary between the Archaean rock and the more recent fossiliferous formations on the west side of Liverpool Land is marked by a zone of dislocation.

4. The sedimentary rocks of C. Fletcher. As we have already seen, the beds cropping out at C. Brown, in the most north-easterly part of Fleming Inlet, apparently belong to a somewhat older series than the Triassic inside the fjord. Still further along the coast-band, about 20 km. SSE. from C. Brown, the expedition made another landing at Cape Fletcher, the SE. cape of Canning Land at the entrance of Carlsberg Fjord (cfr. fig. p. 197). As the district between these two capes is still unknown it is not possible to express any opinion about the series of rocks at that place. The series at Cape Fletcher, however, it could easily be shown, must be older that those at C. Brown, traversed as they are by several dikes or bosses of the same porphyry rocks that are represented amongst the pebbles of the conglomerate at the foot of C. Brown.

During our landing I devoted myself chiefly to studying and collecting these porphyry rocks, which shall be described in a later chapter. But I also got some conception of the sedimentary formation, though I cannot report on the stratigraphic conditions. The types of rock alternate very considerably; there are firstly hard, undoubtedly dolomitic limestones of a grey or black colour, and often of a very fine oolithic structure. The limestone alternates at times in thin bands with chert or silicious schists, and often contain small, rounded lumps of flint. Characteristic is a coarse, light-grey dolomite breccia. Furthermore, we came across, as a more irregular mass, a black, hard chert- or flint-like rock which, however, under the microscope proves to be quite crystalline, even if extremely compact. Then I found a violet coloured, phyllitic schist, that revealed at the same time a conspicuous alternation of strata and a very apparent cleavage. Nor were red rocks lacking: there was both a coarse, vermilion sandstone with bright spots, and a fine-grained, red, micaceous sandstone, the grains of which, now rounded, now angular, consist largely of felspar, while a red pigment colours the not very abundant intermediate mass.

The petrography of the series is obviously sufficiently unlike the Fleming Inlet series, even if there were no other reasons for believing it to be older, for us not to group them together without further investigation. Nathorst mentions a loose stone of black chert from the Silurian area inside the fjord, but beyond this I do not know of the recurrence there of silicious rocks. In other respects, however, the petrographic conformity with these formations is sufficiently marked for us to be able to assume that we may possibly have here a recurrence of the Silurian-Devonian series. In any case this C. Fletcher formation is probably paleozoic.

B. Rhaeto-Liassic and more recent sedimentary rocks.

(Sandstone and schists without conspicuous colour.)

5. Rhaeto-Jurassic formations. In contrast to the rocks I have described above, which are always extremely poor in fossils but which, despite their greatly varying ages, must all be brought together in one petrographic group, characterized partly by the frequent occurrence of dolomitic, often oolithic limestones, partly by the variegated, often red colours so frequently recurring in strata of the most heterogeneous character, we find in these parts of East-Greenland also formations, most commonly richly fossiliferous, in which limestones are of insignificant occurrence, and the sandstones of which are always light-coloured or colourless, while the more retiring schists can also be grey or greenish, but never red. These rocks belong partly to the Rhaeto-Liassic, partly to more recent subdivisions of Jurassic, partly to the Tertiary.

Strata belonging to the Jurassic system were first pointed out from East-Greenland by the German North Pole Expedition, viz., from Kuhn I., situated somewhat N. of Sabine I., and thus rather far from the districts where the Amdrup-Hartz Expedition had its proper field of work. The rock here consists partly of brownish sandstone with small coal-seams belonging to the Dogger, partly of light sandstone and marls of the most recent Jurassic, the Aucella-beds. The petrifactions discovered have since been described by Toula.

From the material collected during the Danish Expedition of 1891—1892 by Hartz and Bay, it was also shown that the rocks, that build up the SE. part of Jameson's Land, and in a steep escarpment (the so-called Neill's cliffs) form the shore of Hurry Inlet, belong to the Rhaetic and Jurassic systems. At C. Stewart, where the oldest strata are visible, there lies at the very bottom a mighty series of grey, sandy clay-slate with numerous, well-preserved fossil plants, deriving from the Rhaeto-Liassic. Above this lies light sandstone in which was found an intervening layer, about 2 metres thick, of very impure greyish limestone, rich in not particularly well preserved petrifactions, classed by Lundgren with the older strata from Kuhn I. (Kelloway). Then follow schists and light sandstones with banks of basalt. About the strata further north, Nathorst has communicated a number of notes; he also found new fossiliferous horizons.

I made no collections or examinations myself of the sea-cliffs at Hurry Inlet[1]). However, I succeeded in making some interesting contributions to our knowledge of the Jurassic beds of Greenland, during my excursion to the inner and northern

[1]) Hartz, who carried out the work here, has published a few notes of his observations in Madsen's work, quoted below.

parts of Jameson's Land together with Dr. Deichmann and during excursions from our landing places during a boat-journey along the W. and S. coasts of the same land. In the former case I could establish the fact that within the whole district traversed by me, up to the so-called Fossil mountain[1]), the rock consists of monotonous, light Jurassic sandstone, in which fossiliferous banks are not rare, and ammonites are now and again so plentiful that the ground at the weathering of the rock is thickly strewn with them for long stretches[2]). In the W. parts of Jameson Land the rocky foundation is covered by such deep quaternary beds that it could not be observed anywhere, but we may presume that the Jurassic beds continue here and on the SW. side of the land they were also found, though only in a few places in the banks of large rivers. Only in one place did I find fossil remains, which are, however, of great interest and consist chiefly of Aucella Pallasii Keys; close by occurred also badly preserved ammonites.

The petrifactions collected by Hartz and myself, have been described by Victor Madsen[3]), to whose work I need only refer. It appears that the Cape Stewart beds, which have long been known, belong to the Callovian and are found the higher up the further N. one reaches; here belong presumably the ammonites (among others Macrocephalites Pompeckji Mads.), which I found at a height of about 500 metres above the sea, right inside the innermost bay of Hurry Inlet. Underneath this series were found in Nathorst Mountain fossil remains that are assigned to upper Bajocian or Lower Bathonian. On the other hand the beds I came across, both furthest SW. and NW., are essentially younger; the former (Aucella- beds) belong to the Lower Volgian, the latter are considered by

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[1]) Cf. Koch's map, Meddel. om Grønland, XXVII, plate 8, also the map in the paper by V. Madsen cited below.

[2]) Owing to the difficulty of carrying specimens during this long excursion, very little material could be collected, unfortunately.

[3]) Meddel. om Grønland, XXIX, 157—210.

Madsen, if his determination of a Simbirskites is correct, to belong to the youngest Jurassic or possibly the Lower Cretaceous.

Nothing is known as to the continuation of the formation further north. Nathorst's observations at Antarctic Harbour are characterized by himself as uncertain, no distinct fossils having been noticed, but the petrographic descriptions tally with a continuation of both the monotonous Jurassic beds and the motley Triassic series. However, the statement quoted above shows that one must by no means exclude the assumption that still more recent beds, of the cretaceous formation, may be met with in this district on some future occasion.

As to the petrographical character of the Jurassic bed there is not much to add. At the shores of Hurry Inlet numerous blocks of a Scolithus sandstone, already observed by Bay, were seen. It may be mentioned that red formations are not altogether lacking, So, in the interior of Jameson Land, I found, for instance, a glaring brick-red sandstone alternating with the normal or light-coloured. But the colour is very unlike that found in the older formations and points rather to a secondary colouring in later times.

Finally I may mention that conglomerates do not seem to be unusual, but that, in sharp contrast to the older formations, the pebbles most usually — exceptions may occur — are composed of quartz. This, too, most probably is connected in some way with the obviously divergent conditions under which these strata were formed, a knotty problem into which I cannot enter here.

The new plant fossils from Hurry Inlet district will be described later by Hartz.

6. The Cape Leslie sandstone. During the expedition of 1891, in the most easterly part of Milne Land, i. e. opposite Jameson Land, Bay came across a fairly large series of sandstone resting on gneiss, with intervening layers of coarse conglomerate, but, so far as known, without any fossils. He expresses no opinion as to the age of the rock. Both from Bay's own description[1]) and from the specimens collected by him which I have seen, it is clear, however, that the rock recalls, petrographically, certain strata in the Jurassic beds of Jameson Land: a loose, greyish yellow sandstone, consisting of grains of both quartz and felspar, of a youthful appearance. That the rock is more recent than Triassic seems probable to me from every point of view. It is, of course, possible that it is even more recent than Jurassic, i. e. that it belongs to the Tertiary or Cretaceous system. Yet there seems to be no reason to assume this, and on the map I have therefore marked it with the general colour of the Jurassic beds.

From the sea Bay thought he noticed a rock recalling the Cape Leslie sandstone at a spot on the W. side of Jameson Land. I am not quite sure that the rock in situ is visible at all in that part from the sea, and, as we have seen, it belongs to the Jurassic formation. But if the opinion expressed by me above is correct, then Bay is also right, even if in a way be did not mean.

7. The Tertiary Sedimentary Rocks. I am not going to enter into the history of our knowledge about these deposits. For nearly all we knew about the Tertiary rocks of E. Greenland prior to the last Danish expedition we have to thank the German Polar Expedition, which discovered Tertiary fossiliferous strata at several places near the most northerly part, then known, of the east coast. On Sabine I., in the so-called Hasenberg, were found plant-bearing strata, whose not very well preserved flora was shown by Heer to be identical with the common Arctic Tertiary flora, usually classed as Miocene. On Hochstetter Land there occurred mighty banks with remains of marine mussels, of which,

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[1]) Medd. om Grønland, XIX, 162.

however, only very few specimens could be brought back and these were so badly preserved that only their genus could be determined.

The Tertiary rocks in this district are closely bound to the basalt, which has certainly contributed to protect these easily destroyed rocks. As a result of our work in 1900 it could be proved that also in the large basalt territory S. of Scoresby Sund Tertiary sediments occur. I shall return to these investigations directly; meanwhile a few words about our observations in the N. basalt region, where I only visited Sabine I.

The Tertiary rocks have a very considerable distribution here, in comparison with the S. region. In many places low mountain ridges occur, formed exclusively of sandstone, and also huge layers between the sheets of basalt. So for instance Hasenberg is formed, to a considerable extent, of Tertiary beds, and here I succeeded in finding leaves of plants, which, though badly preserved, were of interest in enabling me to determine positively the age of the sedimentary rocks of that place.

Incomparably better preserved fossils were found by Hartz in Germania Bjerg, in a piece of dark clay-slate of about 12 m. in length, inclosed in the basalt and somewhat burnt by it. This find is described by him in "Medd. om Grønland", Vol. XXVII, pag. 156. The flora, however, seems to be very poor in species.

As to the petrographic character of the rock, it is composed everywhere of loose, yellow or grey sandstones, very subordinately of dark schists. Conglomerate also occurs at times with pebbles of foreign rocks, granite, etc. On the other hand limestones and all rocks of red colours are lacking, even more consistently than in the Jurassic beds.

Our most resultful investigations into the Tertiary beds of Greenland were carried out within the southern basalt-region. From here, from Cape Brewster, Scoresby had already brought back brown-coal, but since the rock here is evidently made up for the most part of basalt, the conclusion was drawn that his material was only composed of erratic pieces. Our landing at this spot has shown that this was not the case, in that the basalt here really, and richly, in particular in one horizon, contains pieces of charred or petrified wood, and, apart from that, of indurated sediment of probably Tertiary age. But no connected layers were come across in this spot.

However, this was the case at a few more southerly places. Thus, for instance, at several spots on Turner Sound we could see far extended but not very broad intervening layers in the basalt of schists and light sandstone, in which, however, despite a careful search, we were unable to discover definite petrifactions. Hartz, op. cit. p. 162, has already given some account of these investigations.

What I saw of these rocks was in general strongly metamorphosed by basalt, yet the stratification seemed to me to point to an intervening layer contemporaneous with it. This applies still more obviously to the most important and largest of these southern occurrences which I found on a terrace-like plateau about 300 m. above the station at C. Dalton. Besides the plant remains, not very well preserved, which have not yet been described, but according to Hartz belong to the ordinary Arctic Tertiary flora, there occurred here numerous remains of Pelecypoda, Gastropoda and Crustacea, which have been described by J. P. J. Ravn[1]); he classes these beds among Eocene, comparing them more exactly with the London Clay, Bagshot Beds and Sables de Cuise.

The petrographic types of rock are reported on in Ravn's work. He distinguishes a coarse whitish sandstone, a brown argillaceous shale with numerous concretions, greenish sandstone and dark calcareous sandstone, rich in fossils.

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[1]) Medd. om Grønland XXIX, 95—140.

It is not easy to determine exactly the stratigraphic relation of these rock to the basalt. We do not get the impression of a normal layer between the eruptive sheets, but they are obviously not older than the lower basalt-banks. Should that have been the case the only possibility would have been that the whole sandstone area was a mighty fragment broken off by the basalt, but this theory cannot be supported by one who has visited the place; moreover, it is evincibly wrong. Professor N. V. Ussing, in conjunction with Ravn's work, has examined the different varieties of Tertiary rocks petrographically, and has shown that certain of them are wholly or partly formed of basaltic material, which must consequently be older than these sedimentary rocks [1]).

In two respects the investigation of this locality is of considerable importance for our understanding of the geology of the Arctic North Atlantic region. In the first place for a more exact knowledge of the age of the Arctic Tertiary flora; as this will be dealt with by Hartz, I will not enter into the question here. Secondly, because here for the first time it has been conclusively shown that volcanic activity in this large basalt area was in full swing already in the Eocene time, while it has usually been assigned to the Miocene period. I shall return to this question when I come to describe the basalts of this territory.

Retrospect of the Sedimentary Rocks of E. Greenland.

Our knowledge of the geological conditions on the E. coast of Greenland is not yet sufficiently extensive for it to be possible to show the exact sequence of the formations there in sections. If, despite this, I have ventured to draw up and here present a few strictly schematized sections [2]), I have done so chiefly in order to make clear the opinion I myself hold to be

[1]) Cfr. the description in Ravn's paper.

[2]) On the geological map accompanying this paper.

the most likely. A general survey of the district lies behind us; we now come to the point when detailed stratigraphic observations should be made. For those who will in the future devote themselves to this work it will probably be an advantage to set out from the view presented here as a working hypothesis.

Perhaps the most interesting feature about the sedimentary rocks of the district is the very considerable dissimilarity in appearance between the older, pre-Jurassic and the more recent rocks. This is most marked in the occurrence of huge, intensively red strata in the former series, but also in its scarcity of fossil remains and the common occurrence of limestones (probably dolomitic); possibly also in the character of the included conglomerates.

For the present I can offer no satisfactory explanation of these decided differences and the subject is too specialistic for me to enter into it here. It does not seem as if it were bound up with a formation of the rocks at different depths of the sea during different periods. As to the red colour, its presence in the older strata could be attributed to the formation of laterite in the polar areas only being able to take place during these periods. It would be interesting if something of the sort could be proved, but the conditions seem to point rather to the cause of the differences being of a more local nature.

What is said here applies, of course, in the first place only to the strata whose age has been determined with certainty. Yet it seems to me that there is no great doubt that the non-fossiliferous series here described, those at least examined by me, really belong in any case to the main division in which I have placed them. As to their reciprocal ages, I refer to the detailed account.

As far as the stratigraphic conditions are concerned, it is difficult to be more precise about the area N. of Davy Sund. Nathorst himself lays stress on the possible occurrence at Traill I. of more recent (and perhaps also older) strata than those given in the map[1]). It is not until we reach the districts examined by the Danish Expedition that the facts relating to the eastern frontiers grow clearer, though still a good deal is left to be done. In the extreme E. we have Archaean rock. On this, at C. Fletcher, rest Paleozoic strata. Then, if we follow the boundary southward, we shall find that in the contact to the Archaean rock more and more recent rocks appear. This may partly be connected with faults and with the erosion which was at work in connection with the origin of Hurry Inlet; besides, this circumstance depends on a general though very slight inclination of the rock towards the S. It looks as if the same dip should assert itself on the W. frontier towards the Archaean rocks of the central mass, since even here furthest south the older formations seem to be lacking on the boundary between Jurassic and Archaean rocks. But here the real facts are too little known to allow of any conclusion being drawn.

Above the C. Fletcher formation, at Fleming Inlet, lie strata of the Triassic system, and between the two the formation at Cape Brown, which in age should be nearest the latter. How the Triassic strata appear to the west, we do not know, no observations having been made; possibly they are covered by Jurassic, but still farther west we should most probably come to older and older strata, dipping to the E., as Nathorst's map also shows. In the interior of Hurry Inlet, between Jurassic and Archaean, we find formations which should correspond to the strata at C. Brown and Fleming Inlet, which were classed as Triassic.

III. Post-Archaean Eruptive Rocks.

Scoresby's investigations already intimate the occurrence in the coast-belt of both basalt and acid porphyries. The former

[1]) Op. cit. p. 295.

rock has since had its distribution and its character made known through Koldewey's and Ryder's Expeditions. As to the occurrence here of other eruptive rocks, it was the Swedish Expedition under Nathorst that first enlarged our knowledge. The material collected during this expedition and afterwards described by Bäckström, consists partly of a rhyolitic quartz-porphyry from C. Broer Ruys, partly of quartziferous aegirine syenite and a tinguaite from C. Parry, partly of an alnöitic rock of the monchiquite group, a block of which was found on the Fame Is.

The discovery of the last series of rocks was of great interest, but the material collected did not suffice to give a survey of their appearance in this area. The Danish Expedition collected a fairly extensive material both of these as also of the basalt rocks, though not so extensive as the interest in these rocks advocated. As we shall see, formations are not altogether lacking which seem to connect the basalts with the remaining rocks, but in the main these two groups must be regarded as essentially separate, since, at least in their bulk, the former must be considered much younger than the other.

A. Older Eruptive Rocks.

(Age presumably Paleozoic.)

With the material before him Bäckström felt justified in connecting the monchiquite, found on the Fame Is., with the rocks from C. Parry, bringing forward as a possibility that the block in question had been carried by the ice from the more northerly area. Since then I have succeeded in coming across the rock in situ on Liverpool Land. I do not know the rocks from C. Parry except from Bäckströms description, but, in return, I found a new occurrence at C. Fletcher, from where an extensive series of samples was brought back. These rocks differ from those at C. Parry in that plutonic rocks with a granitoid structure are entirely wanting, but otherwise there can be no doubt that they belong to the same eruptive series of rocks rich in alkali.

On the other hand, I do not dare to express an opinion as to the connection with the rock from Liverpool Land. A certain relationship is undeniably present, but when we see, for instance, in Scandinavia how the eruptions of alkaliferous magma have taken place during different periods, and that it is not possible to directly compare with regard to their age the various occurrences in, let us say, the area of Christiania, Alnön, Ragunda, etc., I, for my part, prefer to describe these groups of occurrences apart from each other.

1. The Eruptives of the C. Fletcher Series. Canning Peninsula is only known to us through the short landing that the Expedition made at C. Fletcher. The series of probably paleozoic sedimentary rocks that we have here has already been described by me. Down by the shore we can see how these are interspersed with several broad dikes, consisting for the most part of a grey granite-porphyry with large, red orthoclase eyes and smaller, porphyritic phenocrysts of green plagioclase. Very closely connected with this rock — as far as I could see, passing over into it in the same dike — is a red porphyry, obviously more basic than the former, with which we may connect the fact that it is rich in dark, basic enclosures of varying appearance and texture, which point to a strong differentiation in the original magma.

Somewhat further from our landing-place the rocky wall rises steeply to a height of about 600 m. Already from a distance can be seen, some way up the cliff, a huge, lenticular mass in the shape of an intervening layer of porphyritic eruptive rocks, which have undoubtedly intruded into the sedimentary beds. I had no time to make the ascents that would have been necessary in order to closely examine this mass in place and at its contacts, but I managed to collect a large material

Fig. 3. The promontory of C. Fletcher (Canning Land). Rock of the C. Fletcher series, probably dolomite, with injected porphyries. (C. Kruuse phot. 1: 9: 1900.)

of undoubtedly local blocks, which, petrographically, should represent all the most important varieties. The appearance varies very considerably, even if the main mass consists of moderately acid porphyries. As for the many divergent forms, it is, unfortunately, impossible as a rule to decide whether they are formed as a kind of endogenous magmatic precipitations, or whether in this case there have been several different epochs of eruptions.

That to some extent at least, the latter has been the case, is indicated by some dikes of dark rock which were observed to penetrate the sedimentary beds. I shall describe them below; at least one of them, a true basalt, is presumably much more recent than the remaining rocks.

We will pass on to a description of the various main types that I saw on the spot.

a. *Coarsely crystalline, syenite-like rocks.* In the material collected, we come across a single specimen of a plutonic rock, macroscopically a deep-red granite without anything especially peculiar in its appearance. Microscopically, however, one can see that the quartz occurs exclusively as rounded, sharply defined aggregates, often surrounded by or in close connection with areas rich in chlorite and of an appearance that is foreign to the ordinary mass of the rock. It is not easy to decide if we are in the presence of remains of an older rock, destroyed by fusion, or secondary secretions in a kind of miarolitic cavities. For the rest, the rock consists of large individuals of strongly reddened orthoclase, which embraces small fresh crystal individuals of plagioclase. However this rock may have originated, it is evidently no normal plutonic rock; undoubtedly it must be regarded as a local type, closely related to the following surface rocks.

b. *Acid orthoclase-bearing porphyries.* The specimens in this case derive to a large extent from the above-named dikes in situ, which, already macroscopically however, show great variation in colour and appearance, and contain both endogenous and exogenous inclusions. We can distinguish quartziferous forms and forms devoid of quartz, which again can be more or less rich in orthoclase, plagioclase and ferromagnesian minerals.

First among these may be mentioned a variety, collected as a block, of brick-red colour, with small, inconspicuous porphyritic crystals, among which felspar is predominant; yet, especially in certain areas, a larger quantity of quartz stands out. Microscopically we can see numerous little dihexahedra of quartz, while the larger individuals are composed of felspar, predominantly of plagioclase, which is strongly weathered and kaolinized. The ground-mass is microgranitic, yet it is quite possible that what seems to be individuals consists really of intimate intergrowths between quartz and feldspar.

This variety has been analyzed by Miss Naima Sahlbom, B. A., and the following is the result of her analysis:

SiO_2	75·14	per cent
TiO_2	0·16	—
Al_2O_3	12·50	—
Fe_2O_3	1·20	—
FeO	0·87	—
MnO	traces	
CaO	0·83	—
MgO	0·43	—
K_2O	3·50	—
Na_2O	3·00	—
Loss at ignition	2·55	—
	100·18	per cent

Thus, in its chemical constitution the rock reveals nothing especially striking. The considerable loss at ignition seems to stand in connection with a radical decomposition of the felspars. The proportion of soda is high, just as seems to be the case with the more basic formations of the series.

The remaining varieties examined by me contain, at least somewhat more abundantly, ferro-magnesian minerals. As a type I should choose the main rock in the large dike already spoken of. It is a grey or, further inside the dike, a ruddy porphyry, with large reddish orthoclase crystals and numerous little individuals of greenish-white plagioclase together with a dark green mineral. The ground-mass itself rather retires, but the dike in several places contains sections which are indistinguishable from the main rock, except in that here the porphyritic crystals recede, and possibly in their somewhat more basic constitution. Under the microscope we see that both orthoclase and plagioclase are considerably kaolinized; the orthoclase occurs in large, not very numerous individuals, often as Carlsbad twins. Phenocrysts of quartz, much corroded, only occur subordinately. Sometimes we come across irregularly bordered areas of calcite, which seem to fill up miarolitic cavities. Small crystals of iron ore abound. The green mineral is entirely composed of chlorite, and its appearance here seems to indicate that it is pseudomorphous from biotite. The ground-mass is a not especially well developed granophyre.

From the same dike I examined a specimen of a divergent appearance taken at the line of contact. Porphyritic felspar (probably orthoclase, but strongly weathered) occurs only very subordinately; the ground-mass is very compact and stands midway between granophyre and felsophyre. In it occur numerous thin laminæ of chlorite, pseudo-morphs from biotite, while on the other hand other large porphyritic individuals consist of a serpentinic mass. They usually show rounded outlines, at other times we find laths or vestiges of hexahedral borders. The original mineral cannot have been mica; most likely it was an amphibole mineral.

While these contact facies occur rather isolated, we find, among the blocks collected, many that correspond to the main type. Orthoclase is never predominant, but always occurs in rather large individuals. It is lacking altogether at times, even where quartz occurs. Remarkable is, that fresh mica so rarely occurs and that more hornblende or augite is not to be found; it is often difficult to decide from what mineral the chloritic pseudomorphs, often associated with carbonaceous mineral, derive, though biotite seems here to have been the predominant mineral. Calcite of very primary appearance is common in many types, through which they ally themselves with the well-known Swedish calcite-granites. The ground-mass is sometimes very compact, but never vitreous; in fact, it is rather of such a kind that in polarized light it resolves itself into sections which themselves seem to constitute cryptopegmatitic quartz-felspar intergrowths, as is the case with certain of the Swedish porphyries from Elfdalen.

But in the main these types are not specially noticeable petrographically. They are quartz-porphyries, which, however, in their abundance of alkalies and — among the minerals — biotite, show that they correspond to the basic rocks described below. We find more curious developments especially in strongly differentiated varieties, a few of which may be mentioned here.

On the one hand, then, we have varieties whose main mass consists of the same type of rock as has just been described. One of them is a splendid, somewhat orthoclasiferous mica-porphyrite, almost the freshest of the varieties I saw. The ground-mass is plainly holocrystalline, with a tendency to pass over into micropegmatite. The porphyritic plagioclase crystals seem to have a moderately basic constitution corresponding roughly to labradorite or andesine. This rock contains a fragment of a black porphyritic rock with phenocrysts of quartz, plagioclase, biotite and green chloritized pseudomorphs, which must have originated from pyroxene or hornblende. The ground mass is extremely compact and entirely interspersed with a fine, black powder which, curiously enough, shows a pretty fluidal arrangement. That the rocks are, however, closely related to one another is obvious, but in the light rock, where it borders on the dark, lies what seems to be a fragment of a foreign gabbro-like rock. A mass enclosed in another sample must derive from some almost completely assimilated fragment of a foreign rock; in it we find several large grains of garnet together with large felspar individuals. The surrounding mass is curious, partly micropegmatitic, partly consisting of large individuals which are perfoliated, with a certain regularity, by a fine powder and, moreover, embrace thin needles or scales which appear to consist of chlorite.

A curious enclosure, met with in another slide, consists of a single individual, some centimetres in length, of a colourless mineral, entirely intergrown with biotite, yet without crystallographic orientation. Nepheline it is not, and I can only class this mineral as orthoclase, though with uncertainty.

Of a somewhat different type is another of the samples collected. The main mass looks more basic and externally forms a transition to the group of rocks immediately following. In it lie numerous, rounded balls or pebbles of red porphyry, but also of other rocks, among which are such as recall in appearance clay-slate. One is inclined to call the rock a volcanic conglomerate. Microscopically, the main mass shows nothing remarkable, save that it is more disintegrated than usual; this holds good especially of the felspar phenocrysts, which are usually entirely transformed. There are moreover mica, generally converted into chlorite, and a little quartz. The porphyry "pebbles" are of several types: some contain quartz, some do not; biotite, more or less well preserved, is almost always present, and the felspar is strongly disintegrated. In one piece there are some peculiar pseudomorphs, forming in the transverse section very pointed rhombohedra; I cannot recall any certain interpretation, but possibly these were amphiboles that appeared in an unusual crystalline form. Interesting is the ground-mass, which must have been very compact, but is now very strongly polarizing, and in the transformation seems to have gone over into a carbonaceous mass. Obviously these rocks when fresh had an unusual chemical constitution, showing their affinity with the more divergent types, to which I will now pass on.

c. *Basic rocks of lamprophyric type.* The group of rocks to which I have now come is closely connected by means of intermediate links with the last-named group. Yet its constitution is throughout more basic: most of the rocks contain normally neither orthoclase nor quartz, and in some varieties no porphyric felspar occurs at all. As the samples were mostly collected as blocks it is possible that some of the varieties do not appear as independent forms but as subordinate transition forms or small differentiated sections in the main mass. However, it is impossible to give a certain proof of this; I shall therefore describe the most interesting forms without expressing an opinion about their reciprocal connection.

One of these rocks shows macroscopically large — up to a centimetre in length — isolated crystals of felspar (orthoclase) and of green chloritic mass, as well as numerous irregular miarolitic cavities filled with calcite, surrounded by a ring of small red quartz individuals; elsewhere, too, quartz occurs as the last product of crystallization. Under the microscope can be seen, moreover, of large individuals only chlorite, whose origin I could not determine; the rock also contains a good deal of apatite. The ground-mass itself consists to a great extent of irregular lath-shaped felspar and of minute scales of chlorite which in thin sections vividly recall the aegirine needles in certain tinguaites. It is possible that this rock should be referred to bostonite.

Here belongs another variety with solitary felspar crystals, completely transformed, with numerous areas in which calcite and often idiomorphic individuals of quartz occur together in a way that suggests an origin associated with the last period of the solidification of the rock; with phenocrysts of altered biotite and also large green individuals that are secondary either after amphibole or pyroxene, and with a compact ground-mass perfoliated with calcite, chlorite and fine micaceous scales.

A somewhat dissimilar appearance is presented by two other varieties of rock. Of large felspar crystals only plagioclase occurs; then we find a light-coloured serpentinized mineral, surrounded by dark grains of iron-ore, which mineral either represents an old rhombic pyroxene or possibly sprang from an amphibole mineral; in one of the rocks biotite is also present. We may also mention pseudomorphs which now almost entirely consist of carbonate. In addition to this, the rock is altogether traversed by irregular, amygdaloid, light-green secretions which seem to consist of serpentine and some thin needles (zeolite?). The ground-mass is extremely compact and strongly altered, but it looks as if it had originally been formed of large sections which possibly consisted of intimately intergrown individuals.

Furthermore, we must mention a greenish basic rock, which is interesting because the felspar or any corresponding mineral is almost completely absent among the porphyritic crystals. On the other hand it is rich in large biotite crystals, partly transformed into chlorite, and also in green serpentinized masses mostly devoid of regular crystal shape; I can express no opinion about their origin. The ground-mass is closely perfoliated with the same serpentinized substance; for the rest it is quite crystalline and seems to consist mostly of a comparatively fresh (new-formed?) felspar-mass.

Lastly we can add to this series another, more divergent, rock which in certain respects forms a transition to the group following. It contains some large individuals of rounded hexahedral form, which now consist of serpentine and a carbonate mineral, but otherwise it consists mainly of biotite and lath-shaped felspar; in addition to this quartz (secondary?) occurs as a last product of crystallization, the whole mass of rock being densely penetrated by calcite. The biotite is interesting because it shows, especially in large individuals, a marginal zone of the usual brown colour, while the core is very light, almost colourless. The felspar seldom shows twin formation, but often a zonal extinction; the borders, too, often consist of fresher substance than the middle zone. Of the rocks I have seen this one reminds me most of some forms of bostonite, but I presume that its constitution is more basic.

d. *Dike rocks of nepheline-tephritic type.* Besides the already described lenticular or boss-shaped rocky mass with its various types, and the red or grey porphyry dikes that belong to the same, the sedimentary rock at C. Fletcher is interspersed with some darker dikes of a different appearance, and of which one proved to consist of ordinary basalt and is therefore mentioned among the basalt rocks. Two other, fairly narrow dikes, belong, on the other hand, to another and interesting type, which is described herewith [1]).

Two of the specimens, in spite of their macroscopically divergent appearance, form such an obvious transition to the one last described that they ought certainly to be classed with it. We find, porphyritically, now biotite partly discoloured and bleached, and rich in inclusions of regularly arranged fine needles, now light pseudomorphs, entirely transformed into serpentine and carbonate, from a mineral which I hesitatingly hold to have been amphibole. In addition there are areas that can very well have been composed of olivine. True felspar phenocrysts seems to be lacking. The ground-mass consists chiefly of lath-shaped, strongly altered felspar, while it is interwoven with a carbonate mass; ore (titanic iron ore?), apatite, and fine micaceous scales also occur. To what extent a pyroxene or am-

[1]) The samples examined are, it is true, not taken from the dikes in situ, but were found in such a position that their origin from them can scarcely be called in question.

phibole mineral has originally entered into the composition cannot be determined.

Finally we come to what is perhaps the most interesting of all these types[1]), and which was the object of detailed examination, though even now its nature cannot be quite determined. Macroscopically it is a grey, compact, almost hornstone-like rock, with numerous porphyritic crystalline agglomerations of a light, bronze-coloured mica; other phenocrysts, whether lighter or darker, only appear on the polished surface.

Under the microscope we can distinguish now biotite of the ordinary appearance, often in the form of hexagonal scales, now a yellowish green, not especially pleocroitic, fresh hornblende with maximal extinction of 16°, then furthermore one or two light, much transformed minerals, the nature of which is more difficult to determine. Some of them are individuals with idiomorphic outlines of approximately hexagonal form and consisting partly of a carbonate mineral, partly of an almost isotropic, serpentinic mass. I do not think it possible that here a felspar was originally present. However, it looks as if this mineral were connected by transitions with others which by their weak, flamy, varying double refraction indicate that they consist of sub-microscopic intergrowths; as a rule they do not contain carbonate, but they contain other inclusions or decomposition products, which in part make them almost isotropic. The shape is often rectangular or rectangular with blunt truncations on two sides. The double refraction recalls, in the purest sections, felspar, and as felspar we should class

[1]) While on a visit to Heidelberg I had an opportunity of showing a few of the specimens here described to Professor H. Rosenbusch, and in the main he confirmed the opinions I had myself arrived at. I was especially interested in hearing from a scientist of such ripe experience an opinion about these particular rocks; he compared them to certain trachy-dolerites and tephrites, and especially to nepheline-tephrites from the area of the large East-African depressions. I seize this opportunity of expressing my sincere thanks to Professor Rosenbusch for so kindly placing his time at my disposal.

lath-shaped individuals which are plentifully scattered about in the mass and sometimes show twinning. The extinction forms an angle of some few degrees on the length of the laths.

The minerals just described belong most nearly to the ground-mass against which they only stand out in polarized light. This is, moreover, very weakly doubly refractive; I am inclined to think that also the main mass of it is formed of the minerals mentioned, which only appear, however, when unusually pure and free from inclusions. Whether, and to what extent nepheline occurs in the rock I have not been able to ascertain with certainty. An attempt to etch the rock with cold hydrochloric acid showed, unexpectedly enough, little effect; no strong gelatine formation could be observed.

Miss Naima Sahlbom, who has analyzed this rock, found it to be constituted as follows:

SiO_2	44·43	per cent
TiO_2	1·40	—
Al_2O_3	17·89	—
Fe_2O_3	4·00	—
FeO	4·94	—
MnO	traces	
CaO	12·60 [1])	—
MgO	2·40	—
K_2O	3·02	—
Na_2O	2·55	—
Loss at ignition	6·25 [2])	—
	99·48	per cent

[1]) I have not had an opportunity of comparing these figures with the original analysis journal. In the copy I made myself the figures run CaO 2·40 % and MgO 12·60 %. But it seems very probable that there is some mistake in the latter figures and that the result should be as given above.

[2]) From this H_2O, determined according to Penfield's method, 5·16 %, remainder 1·09 %, presumably CO_2.

It cannot be concluded with any certainty that all the rocks here described are connected, but their appearance as well as their character makes it highly probable. We have then a peculiar series, intimately connected by transitions, alternating between very acid up to ultrabasic formations, but all distinguished by certain mineralogic peculiarities — among other things the common occurrence of biotite, often as large phenocrysts, completely transformed into chlorite — and by chemical analogies, in that all are evidently rocks that are rich in alkali. We have here probably a strongly differentiated effusive analogy to the aegirine-syenite from C. Parry[1]) described by Bäckström.

As to the age of the rocks we only know that, as has already been shown, the conglomerate at C. Brown, which is presumably of paleozoic age or belongs to the oldest triassic, contains boulders which seem to correspond to the medium acid forms described above. On the other hand, they are younger than the C. Fletcher beds, which must, however, also derive from the paleozoic age. During what epoch of that period the eruption took place cannot be determined at present.

2. Alnöitic rocks from the Hurry Inlet coast of Liverpool Land. As has been already mentioned, Bäckström, from a block found on the Fame Islands, described as monchiquite a dark rock with large porphyritic hexagonal biotite slabs, brown hornblende and violet-red augite, together with a ground-mass of the same minerals embedded in a colourless, almost isotropic mass which has been interpreted as nepheline. He also calls attention to the really striking resemblance to the alnöite from Alnö, from which, however, the specimen examined differs in that melilite, olivine and perowskite are wanting.

I came across the same rock in situ right opposite the

[1]) A block of a grey aegirine-syenite rock was found by me on the shore of Jameson Land a good way inside Scoresby Sund. Similar rocks, consequently, seem to occur in several areas along this coast.

Fame Islands, a few km from the coast, inside a little valley, the topography of which will be described later in this paper. The rock occurs here in close connection with the limestone referred to the archaean formation and already described, partly as dikes, partly — at least in one place — as a smallish lenticular mass bordering on a somewhat disintegrated, light granite, from which it is separated by a curious mixed breccia. The granite itself has already been mentioned (p. 169). It is red or reddish yellow, fairly rich in quartz, with considerably weathered orthoclase, and moreover it has been subjected to strong pressure. Nearer the line of contact, as far as I could see without any sharp border against the typical breccia, the rock is still more altered, traversed by zones that consist of completely recrystallized crushed mass, which abundantly contains beautiful little rhombohedra, strongly refractive and doubly refractive, evidently a carbonate mineral. The felspar, here too, is strongly disintegrated; besides orthoclase there occurs much plagioclase, partly as perthitic intergrowths.

It is not easy to explain how these changes in the appearance of the granite stand in connection with the basaltic eruptions. It is not precluded that, connected with these, dislocations have taken place. However, that the rocks are not directly divided by a line of dislocation is clear from the two quite dissimilar transition forms which are herewith described. The one is a true fusion rock, acid and fairly rich in quartz; in its mass can be observed numerous angular fragments of green-coloured rocks. Under the microscope one can see that the rock chiefly consists of large crushed quartz and felspar individuals, which show by their appearance that they derive from the surrounding granite; between them there is often a mass which to a great extent consists of needle-shaped felspar individuals and resembles the products of re-fusion and solidification often found at magmatic contacts. In other places a similar, curious mass of limited and local origin is perfoliated by thin biotite scales, and biotite with iron-ore and apatite seem also to be abundant in the dark, irregular masses and veins with which the rock is interwoven, and which, in my opinion, derive from basalt mass that has penetrated into the granite.

It appears to me almost as if the rock just described passed over into the true breccia which is extensively met with on the border between granite and the alnöitic basalt rock. In it we find everywhere numerous angular fragments which presumably derive from the latter, besides which there is a more or less abundant mass of a lighter colour, which evidently consists to a great extent of the granite minerals. In the only one of these varities that I examined closely this mass retires; that it is not a normal granite can be seen from this, among other things, that it now and then contains large crystallized biotite individuals of the same appearance as in the alnöite. On the other hand, granite occurs as well as basalt in the form of angular fragments. A small piece of this kind, which was examined microscopically, was almost destitute of quartz and very violently crushed. For the rest, one can see, under the microscope, that the matrix consists of a really new formation and is largely composed of a compact mass rich in carbonate, in which lie a number of fragments of crystals and rocks, which must mostly come from the granite, but to a great extent also from the basalt or rocks closely allied to it. The larger fragments of basic rock show no specially remarkable qualities and are described along with the main type.

This however does not yet exhaust the breccia rocks of the district. The alnöitic rock itself in the little mass, whose contact I have described here in the first place, forms a true breccia, in that it contains exceedingly numerous pieces of varying size and character, belonging to the most varied types of rock: granite, gneiss, basic rocks, quartzitic forms, and, from notes I took at the time, also limestone. All these forms of rock appear, when seen under the microscope, greatly metamorphosed by contact: the granites are surrounded by a fusion zone of new-formed rock with felspar in the shape of thin needles, such as has already been mentioned from another contact-rock. Interesting are the basic rock forms which must originally have consisted of lath-shaped plagioclase and augite, ore and some large crystals, now perfectly transformed, and which must consequently have had a diabasic appearance.

Remarkable is a new-formed mineral which occurred at the contact with a large fragment of gneiss. It recalls titanite, but seems to have stronger interference colours than that mineral, and in comparison with material from Alnön it is impossible not to be struck by the likeness with the curious mineral baddeleyite, which occurs there. Yet it is scarcely conceivable that this should be met with at the contact with an acid rock, and I have been unable to decide what mineral it is that we are in presence of.

We will pass on to the description of the pure eruptive rock, which is best revealed in the two dikes. Its appearance is somewhat variable. The ground-mass is dark, basaltic, and in it we come across large crystals, up to an inch in length, of augite and brown mica. But these are somewhat irregularly distributed, now forming the main part of the rock, now solitary, and in the one dike both forms of large crystals are rare, while especially thin scales of mica give rise to a fine porphyry structure, somewhat recalling the lamprophyric minette rocks from C. Fletcher. In the little mass, too, the very large crystals play a minor part, the whole rock here looking more compact.

It is the last described dike that was the object of the most detailed study, and of which Miss Naima Sahlbom has made an analysis that resulted as follows:

SiO_2	36·29	per cent
TiO_2	4·60	—
Al_2O_3	10·91	—
Fe_2O_3	7·55	—
FeO	5·52	—
MnO	0·23	—
CaO	13·48	—
MgO	9·29	—
K_2O	1·40	—
Na_2O	3·42	—
H_2O[1]	3·65	—
Further loss at ignition (Probably CO_2)	3·85	—
	100·19	per cent

Microscopically this rock corresponds closely to the one already described by Bäckström. The phenocrysts consist of a dark-brown, strongly pleochroitic mica, which was not closely examined, and may be partly an anomite, and also brownish pyroxene, the extinction on (010) being about 38°, absorption colour ‖ a brownish, ‖ b yellowish-green. At times a contrast can be noticed between a light core and a darker outer border. In contrast to these larger individuals we see a ground-mass consisting of stalk-like pyroxene, abundance of ore and also apatite; furthermore a not insignificant quantity of calcite, sometimes occurring with primary appearance, but usually pseudomorphically replacing some other mineral; finally there is a compact, brownish, almost isotropic mass, which may very well be rich in nepheline, though no proof of it can be adduced. By cold diluted hydrochloric acid it is only slowly decomposed. Olivine seems to be lacking in the slide examined; melilite has not been proved to be present, though it by no means follows that it could not be met with in fresh parts of the rock; a few almost opaque crystal individuals might possibly be perowskite.

[1]) Determined according to Penfield's method.

Already the somewhat strong decomposition of the material before us makes it difficult to decide how to class this rock. However, so much seems to be certain, that it is closely related to the true alnöite, though we cannot give it this name as long as melilite is not proved to occur. Of all the rocks known to me from literature it seems to me to stand closest to the ouachitite from Arkansas, described by Williams and Kemp. The analysis also recalls Kemp's, the higher percentage of soda here only showing a still closer relationship with alnöite.

The rock in the other dike is somewhat more holocrystalline, but in other respects shows really only the difference that it is rich in small serpentinized crystals which are undoubtedly secondary after olivine. Round these individuals there are accumulated brown mica-scales. The ground-mass itself consists chiefly of elongated individuals of pyroxene, together with ore and some biotite; besides this there is a brownish, strongly polarizing mass, but it was impossible to prove with any certainty the presence of any felspathic mineral whatever. The rock evidently belongs to the monchiquite group; whether it should be regarded as olivine-ouachitite or receive another appellation is a question that can only be decided when more abundant material has been collected and examined.

Also the volcanic breccia in the little mass of rock is closely allied to the preceding types. I could not point out olivine with any certainty: fine grains of ore perfoliate the mass still more abundantly, and the real, compact ground-mass, presumably rich in calcite, is so weakly double refractive that one is inclined to think it to be partly vitreous. Large isolated rounded grains of felspar probably derive from melted abyssal rocks. — In this connection may be mentioned the large round grains of brown mica that occur here and there: here it is evidently the rock's own large crystals which have afterwards been partly melted or corroded.

It is impossible to say anything more precise about the age of these rocks or about their relationship to some others in the same district. But I think we may assume with great probability that they are connected in some way with the rocks at C. Parry and C. Fletcher, and, consequently, like the latter are of paleozoic age. In any case it must have afforded some interest to have given a somewhat more detailed account of this curious group of rocks than has been offered before. It was of interest to observe that it not only occurs in dikes, but also in greater masses, and that like the rocks at Alnön, it occurs in combination with limestone and, to a very great extent, constitutes a true breccia. A more exact geological examination of this district will undoubtedly lead to very interesting results[1].

B. Tertiary Basalts.

Around the NW. parts of the Atlantic basin, as has long been known, a monotonous series of basaltic surface rocks present themselves within an immense area. They have their greatest distribution on Iceland, the 100,000 km^2 of which rest, as far as we know, throughout on these rocks. The Faroes, too, though much smaller, are built up entirely of basalts. Along the W. coast of Scotland and the N. coast of Ireland we again find the same rock predominant in extensive tracts, and if we go in the opposite direction it has already been pointed out by Scoresby that within the most projecting and accessible parts of E. Greenland basalt is almost the predominant rock in the coast-belt.

The three first of these areas have been made known by numerous researches, in the first place by James Geikie's

[1]) Professor A. G. Högbom in Uppsala has most kindly placed at my disposal, for purposes of comparison, the rich material of alnöitic and nepheline-syenitic rocks which he collected from Sweden and elsewhere; moreover, he has examined and expressed an opinion about several of the most interesting rocks described above. For this kindness I beg to express to him in this place my warmest thanks.

classic investigations [1]. This is not the place to enter into the many questions, among others the history of the origin of the sheeted lava rocks, which are dealt with there. We will simply recall that all these areas are generally considered, if not at one time united, at least to have been much more extensive than now, and that consequently the question of the origin of the northern part of the Atlantic Ocean is most closely bound up with the study of these basalts. As to the time of the formation of the rock-mass itself, we know it was spread over a long period; on Iceland the volcanic activity and formation of basaltic rocks continues to this very day. But generally speaking, the supposition is accepted that the bulk came into existence during the Miocene period, the same epoch as that from which, as we have seen, it has been assumed that the bulk of the Arctic Tertiary plants derives. Our discovery at C. Dalton of marine Tertiary formations of the Eocene age (probably corresponding to the London clay and Bagshot Beds), younger than a part of the true basalt formation, is thus not less important for the question of the age of the basalts than for that of the plant fossils. In this area at least the basaltic eruption was in full swing already in Eocene times, an interesting result, the application of which will be of the highest importance for many geological questions touching the latest geological periods. However, I will not dwell on these points here, but pass on to a short petrographic description of the rocks and the different localities.

As we already know, the basalt occurs in two large areas in E. Greenland, divided by Davy Sund and Scoresby Sund and the gneiss mass of Liverpool Land lying between the two. Both areas, as far as we know, are confined exclusively to the coast, which they follow, put together, for a distance of at least ten degrees of latitude. The southern area takes in a widely

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[1]) J. Geikie: The Ancient Volcanoes of Great Britain.

extended peninsula, and thus stretches further inland than the northern, which latter I will now describe.

The Northern Basalt Area is only known to me personally from our visit to Sabine I. and from a short landing at C. Borlase Warren. Up to now our knowledge of this area is chiefly indebted to the second German Polar Exp., which wintered there; since that Nathorst has also published a number of notes about it. I shall therefore confine myself to a few observations. Sabine I. is characterized chiefly by the huge and extensive stratifications of Tertiary sandstone found in the basalt; nowhere in the basaltic area of E. Greenland south of Hochstetters Land are they so extensive as here. That the basalt is in part more recent than the Tertiary strata, whose age is not exactly fixed, is proved by the dikes that intersperse it, as also by the traces of contact metamorphism I spoke of before. Still, the basalt itself is the prevailing rock, and round Germania Harbour it can be seen in its typical development, formed of apparently horizontal sheets piled on each other. Towards the interior of the island numerous dikes appear, and in Hasenberg, built up for a good part of schists and sandstone, we find also intervening layers of tufaceous rocks and volcanic scoriæ. Microscopically viewed, the forms I examined are only noteworthy in their being considerably better preserved and more thoroughly crystalline than the sheeted rocks in the southern area, but I do not know whether this can be said of such forms as, for instance, those around Germania Harbour, which are of similar appearance as in the region mentioned.

Also the rocks at C. Borlase Warren are coarsely crystalline, doleritic, and slightly porphyritic. No fresh olivine is to be found in them at the present moment.

The Southern Basalt Area. This has never before been the object of detailed observation. From the southern side of Scoresby Sund to Kangerdlugsuak, where the coast makes its bend to the south, and where its southern boundary has been fixed by Amdrup, basalt is everywhere predominant; to the west it appears as far as the "South Glacier" (Syd Bræ), directly S. of Danmark I., after which its substratum, gneiss, rises higher and higher. Around the whole of Gaase Fjord, however, according to Bay, this rock is covered by basalt. More detailed observations as to the course of the boundary line between these two rocks do not seem to have been taken, and yet an investigation into the matter in this area, where the boundary for stretches of many miles lies exposed, would be extremely valuable and might contribute to the solution of a number of important questions of geological and early topographical interest. Dikes may also occur at greater distances from the true basaltic mass, thus, for instance, occasional ones on Liverpool Land and on Jameson Land, in the N. part of which we even find basaltic rocks in large masses and of different appearance (see below), while the most northerly dikes I saw were at C. Fletcher and could be looked upon just as well as belonging to the N. area as to the one in question[1]). Whether the sheets of porphyrites from Fame I. and Fleming Inlet can really be classed among this series, is a question that cannot be answered at the moment. In the W. dikes, still from the innermost part of West Fjord, have been described by Bay, in the NW. dikes from the NE. part of Milnes Land, but not from North-West Fjord. In the South, Amdrup has described similar conditions: basalt as a covering, and at the contact an Archaean rock, interspersed with exceedingly numerous basalt dikes[2]). As to the presence of basaltic

[1]) The S. part of the N. basalt area is moreover little known, and it looks as if certain divergences from the usual types should occur here, so for instance at C. Broer Ruys, described by Toula and Nathorst.

[2]) An excellent idea of the great contrast between the Archæan rocks, rounded by the erosion by water and ice, and the steep and rugged basalt cliffs, is given by figures 4 and 5, reproduced from photographs taken by Amdrup not far from one another, near the southern boundary between the two formations.

dikes further S. on the same coast, I may refer to my former description of these rocks[1]).

Within this mighty area — the district where basalt forms the rock bed, in the S. area alone, can be estimated at 40,000 km² — the basalts, in splendid development, show the marked stratiform alternation of variously constituted sheets which have so often been described from other places. My investigation have not been extensive enough for me to contribute anything to the problem the origin of similar basalt

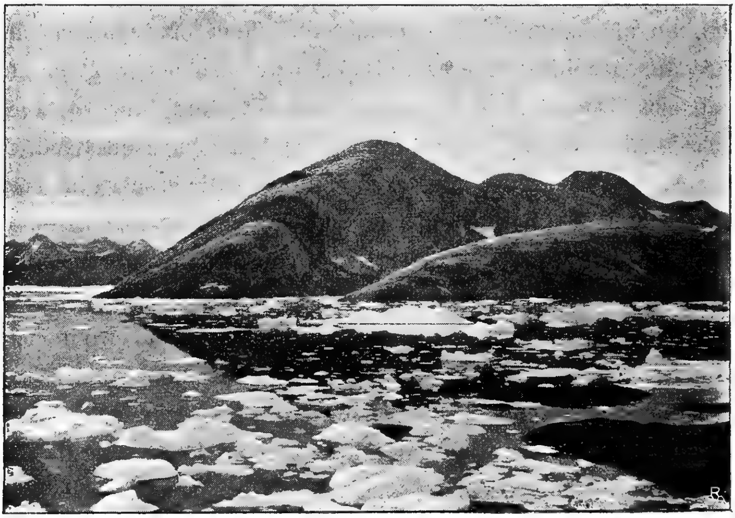

Fig. 4. Rounded gneiss hills (the first seen on the way southward from Scoresby Sund) on the E. side of Kangerdlugsuak.
G. Amdrup phot. 8: 8: 1900.

plateaus. Nowhere did I come across transitions to the true volcanic type. While dikes of basalt are very common, even in the basalt itself, I could never with certainty point to one so connected with a superposed sheet of basalt that one could be sure that it had served as an eruptive canal for the same. On the other hand in the dikes themselves there often occur irregularities that point to the lava not having

[1]) Medd. om Grønland. XXVIII, 1—16.

flowed evenly but having lumped itself in some places. In the hope of being able to contribute to the question of the fjord formation, and possibly to that of the occurrence of faults in these districts, I made several attempts to follow a connected sheet in the basalt throughout its length. When I had to do with stretches up to several kilometres, there were always great difficulties, as either the sheets pinch out, or they are cut off by smallish faults, which are evidently not rare, though I never saw that they were connected with the formation of the fjord.

Fig. 5. Steep basalt cliffs at the entrance of Jensens Fjord.
G. Amdrup phot. 6: 8: 1900.

Of foreign rocks within the basalt area there occur, as far as we know, only Tertiary sandstones, and even these very subordinately. I have already dealt previously with their origin and appearance: they remind us, generally speaking, mostly of enclosed fragments; only at C. Dalton is there a real intervening layer. Enclosed fragments of other foreign rocks were not noticed by me anywhere.

In a few places I took vertical sections at accessible parts of the sequence of rock varieties, in order to be able to compare the different sheets with one another. Macroscopically, the following main types can be distinguished:

1) Compact, aphanitic, dense, black basalts, often showing columnar structure, while spheroidal structure and weathering are to be looked for rather in diabasic forms that are transitions to the next type.

2) Coarse crystalline, doleritic forms.

3) Porphyrites, which however seem to play only a small part among the sheet-like basalts.

4) Red basalts, coloured by iron ochre, often of slaggy structure.

5) True amygdaloids, perhaps the commonest form of all, very varied in appearance.

To give a more exact account of any of these vertical sections would scarcely be of interest. However, the rock at C. Brewster is remarkable. It looks, as if we had here two main divisions in the basalt series. The lower consists mostly of a rather dense, even grained, somewhat yellowish grey mass, with indistinct amygdaloidal structure. Above it lies a real tufa, with black scoriae in a yellow vitreous mass. Above this, at the point of contact with the upper division, there is a grey, dense basalt, a red burnt amygdaloid, and an intensively red, sandstone-like rock. Whether it is to this middle zone that we can also assign the numerous fragments of foreign, presumably Tertiary, sandstone, metamorphosed by contact, and also the different-sized pieces of petrified wood-trunks, which characterize this locality, is not certain, but seems to me probable.

On this follows a huge upper zone, which at the line of contact and in its lower part is made up of a dense, greyish yellow rock. Further W. this zone sinks more and more, until finally it reaches down to the shore. The rock here is a fine, thoroughly crystalline, normal basalt, without prominent surface structures.

To what extent the sequence of rocks observed here is a local phenomenon, or is be continued over a large district, I could not decide from a single landing. Anyhow, the volcanic zone with tuffs and scoriae is very conspicuous.

Volcanic surface forms in the basalt are also to be found in other places, for instance, on Dunholm, a little further S., where the lava sheets show splendid flow-forms.

Interesting is also a locality on the S. of Henry Peninsula. Here lies a very fine series of varying, partly very irregular sheets of basalt, mostly amygdaloidal. A very prominent, yellowish zone proved to be a crushed breccia, cemented together mainly by zeolites, especially laumontite (see below). In the breccia are also to be found veins of a lighter, presumably silicious mass, also green efflorescences, which are perhaps coloured by a copper-salt. Under it lies a compact basalt without visible scoriaceous structure. I was much interested to find, at the boundary between both these forms of rock, a hot spring containing sulphuretted hydrogen and with a temperature of 38° C., jutting out of the perpendicular mountain wall, expelling a quantity of vapours, and strongly marked also by the rich green algous vegetation, which thrives in the warmish water running down to the shore in the form of a little brook[1]).

Microscopically examined, it turns out that all these varieties are very closely related. All, without exception, are basalts, composed of augite and lath-shaped plagioclase, often with some ore, the minerals contained showing great variation in quantity when compared with one another. Already macroscopically one is struck by the rarity of fresh, doleritic or coarsely crystalline forms, and this is confirmed microscopically; in none of the samples of the basalt sheets that I examined did I find fresh olivine, althougt green transformations show that

[1]) The only warm spring hitherto known in Greenland is situated on the Island of Unartok in SW. Greenland; its temperature is about 40° C.

it existed, nor glass. Really porphyritic structure is rare, but both augite and plagioclase often appear in an older generation of large individuals; possibly the rock tried to assume doleritic structure in an intratelluric epoch. The rocks are traversed and coloured in a very variable degree by a red ferric oxide mass.

It cannot be denied that, though this is true to some extent also of other districts with fine sheeted basalts, it is very curious that a rocky mass of such immense extent, formed, in all probability, during a very long period and during numerous separate eruptive epochs, can show, mineralogically viewed, such great uniformity. Whether this is equally great chemically, is a question that in any case demands closer investigation.

Strongly divergent rocks are very rarely to be met with. On the other hand, considerable variations in the same basalt-sheet often appear. It can frequently be noticed that the lower part of a well developed sheet is plainly crystalline, while the structure upwards becomes ever compacter and more aphanitic, until the mass finally passes over into amygdaloid or scoria. The upper part of a bank not rarely shows red colouring, and once at least I noticed a bank of this kind pass over at the top into an intensive red, jaspidean, compact rock.

Worth mentioning are also the minerals which in great variety fill the amygdaloidal spaces. I myself have only observed them in so far as I collected specimens of them wherever they were fine enough to seem suited to a mineralogical analysis. Nowhere are they so finely developed as in the famous localities on Iceland and the Faroes, but at a few spots really well developed crystals were found, and a mineralogist with plenty of time at his disposal would probably reap a good harvest there. The most important of these places are Henry Land with environs up to Bartholins Glacier[1]) and C. Brewster. The

[1]) Also called Henry Glacier in Böggilds work.

samples collected have been described by Böggild[1]), following whom I add the following list:

Henry Land: Quartz, Chalcedony, Thaumasite, Chabazite, Levynite, Desmine, Scolecite, Analcite, Heulandite, Laumontite[2]).

Turners Island: Quartz, Chalcedony, Thaumasite, Desmine, Scolecite, Natrolite, Mesolite, Analcite.

C. Brewster: Chalcedony, Desmine, Natrolite, Mesolite, Analcite, Apophyllite, Heulandite.

Moreover, we may mention that on Sabine I. within the N. basalt area, Scolecite and Desmine were found.

It still remains for me to deal with the qualities of the basalts when they appear as dikes or in contact with other rocks. Such dikes within the gneiss are in many places exceedingly common, for instance, in certain parts inside Scoresby Sund, and also, according to Amdrup, at the S. boundary of the basalt area. These dike basalts are, to judge from the samples I saw of them, fresh, clearly crystalline, typically developed plagioclase-augite rocks, and it is especially characteristic that, in contrast to the sheeted basalts, fresh olivine almost always was observed here.

From Danmark I. Bay[3]) brought back a specimen of the contact itself between gneiss and a basalt dike. The former at the point of contact is almost irrecognizibly transformed and forms a mass that reminds one somewhat of a porphyry breccia; the "matrix", probably through fusion of basaltic material, has received a basic composition, while the irregular "fragments" lying in it are composed of the strongly changed remains of the original rock: quartz in individuals strongly corroded by fusion and showing sinuous outlines (the bottle-

[1]) Medd. om Grønland, Vol. XXXII.

[2]) Laumontite, which is by no means common in Greenland, and was not seen before on the E. coast, occurs very plentifully in the breccia in the hanging wall of the hot spring mentioned above.

[3]) Medd. om Grønland, XIX, p. 152.

shaped curves characteristic of the corroded phenocrysts of quartz-porphyries do not occur) surrounded by rings of thin, strongly refractive prisms, and felspar interspersed with a compact, fine pigment, and in spots quite transformed through new mineral formation. The basalt dike itself at the point of contact is a true olivine-bearing augite-porphyrite, with a hyalopilitic ground-mass.

In the isolated gneiss area of Liverpool Land, out by the coast, the basalt dikes seem, curiously enough, to be very scarce, which seems to indicate that the two large basalt areas were not connected earlier. The dikes I saw showed nothing remarkable.

In the sedimentary formations basalt dikes occur both in the Röde Ö conglomerate and the C. Leslie sandstone, according to Bay, and also in the Jurassic strata of Jameson Land. Here, however, it is almost exclusively in the shore cliffs at Hurry Inlet that one has a chance of noticing them; we find both dikes, and stratified, not lens-like, banks, so splendidly regular that one is tempted to look upon them as volcanic sheets contemporaneous with the surrounding Jurassic strata. This, however, is not the case: occasionally one can observe how they suddenly cut off the sandstone strata, or even that two basalt strata cross over each other (cf. the fig. Pl. XIV). A finer example of typically intrusive sheets would be hard to find elsewhere[1]). A specimen which I examined microscopically was remarkable in that the augite, to an even greater extent than usually, forms a kind of matrix, in which the lath-shaped felspar-individuals swim, as it were. Fresh grains of olivine were still visible[2]).

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[1]) The circumstances must have been observed already by Bay; cf. the figure in Medd. om Grønland, XIX, p. 166.

[2]) The interior of Jameson Land is so completely covered by post-tertiary strata that one rarely has an opportunity of observing the basalt dikes. On the other hand, I found in the N. part, as dikes and even small masses in the Jurassic sandstone, curious alternatingly light and dark, compact rocks recalling basalt; similar types are also found as blocks

Lastly, as has already been mentioned, a basalt dike of normal appearance[1]), macroscopically as well as microscopically, was found interspersing the sedimentary rocks and the curious eruptive series at C. Fletcher. At C. Brown, too, basalt seems to occur. Here, however, we are already nearer the N. basalt area.

Topographical Description.

As has been hinted above, two main types, topographically, can be distinguished in the parts of Greenland under consideration, viz. an inner central mass, to which only the larger fjords with their deeper forks extend, and which can be characterized as a kind of plateau-land in which distinct ridges and for the inner regions also peaks may be lacking or unobtrusive, and an outer, more or less sharply broken up coast border. This latter, in its turn, may be divided into two main

in the river inside Fleming Inlet, and thus seem to be charactistic of this area. The few specimens I could bring along from these remote parts belong to a curious type, characterized by the mineral combination of plagioclase-augite-biotite with iron ore and a green chloritic or serpentinoid mass, derived perhaps from olivine. One specimen (block) contains phenocrysts of plagioclase, augite and ore, while the groundmass has an almost granophyric appearance and contains, besides biotite, felspar and the green decomposition products just mentioned, a good deal of quartz and hornblende. Another slide shows a light, plagioclase-augite mass with the former mineral dominating, a somewhat disintegrated diabase, but also dense dark fragmentary patches, which consist chiefly of the first mentioned, characteristic minerals. These rocks cannot be older than Jurassic, but it seems difficult to group them together with the usually monotonous basalts; nor is there any reason to class them with the syenite and monchiquite series which have already been described. Perhaps they fall under the class of the curious porphyrite rock from the interior of Hurry Intet (Fame Islands).

[1]) But with large prominent plagioclase phenocrysts.

divisions, viz. an inner part, including chiefly the surroundings of the fjords, and an outer, the real coast with its islands. While the central mass, presumably quite independent of the generally very monotonous nature of the rock, is rather uniform in its configuration, the districts that are occupied by the two latter divisions vary very much topographically, in which respect, as we shall see, they show that they are largely dependent on the variations of the rock.

In consideration of this variation, we can set out in our description from a somewhat divergent and more detailed classification, and herewith distinguish the following types:

The coast-border: Liverpool Land Type (Archaean rock).
Basalt Territories.
Type of sedimentary rocks.
Jameson Land Type (Quaternary).

The central mass.

1. Liverpool Land[1]). We will begin with the description of the part, the topography of which shows the strongest contrasts, a type which, in these districts, recurs especially in Liverpool Land or the large "island" of Archaean rock that forms the stretch of coast between Scoresby Sund and Davy Sund. This tract, discovered and described by Scoresby, has since been visited by Nathorst, who gives a characteristic picture of its external coast[2]), which is also seen on the picture opposite, from a sketch by Ditlevsen (Fig. 6), as well as on the attached painting Pl. XII.

No words could describe the wonderful wildness of this coast as it first strikes the eye as you approach it from the sea, and in this respect it is scarcely excelled by any other stretch of coast, and that

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[1]) In all previous descriptions this tract has been called by the name given by Scoresby, Liverpool Coast. This designation, however, is evidently inappropriate for the whole peninsula, and should be changed to Liverpool Land.

[2]) In his "Två somrar i norra ishafvet", II, 194.

despite the fact that the mountains do not exceed 1000—1200 metres in height. The dip to the sea is usually very sheer, often impossible to climb, but not very high. At about at right angles to the coast-line a number of valleys intrude, rather short but comparatively very deep and broad, and often filled with huge glaciers. Islands outside the coast only occur in small number; the tendency to develop longitudinal valleys has obviously been very weak[1]). The highest peaks lie somewhat inland, but

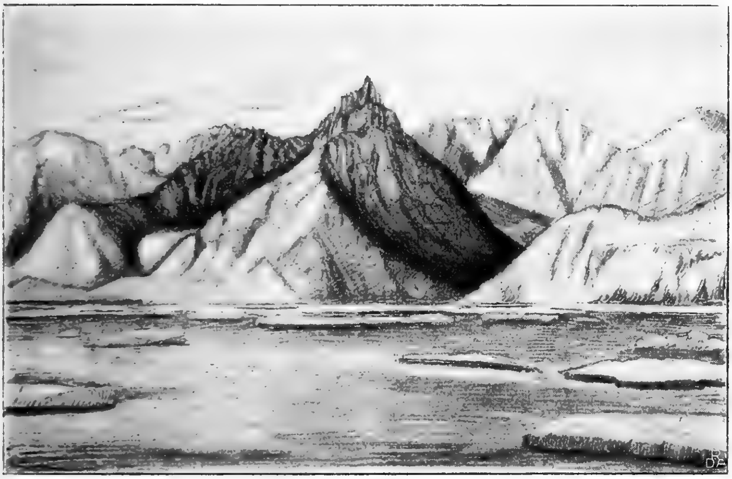

Fig. 6. Liverpool Land, Eastern coast, a little N. of C. Greg. Typical appearance of the steep, pointed, archæan mountains. (From a sketch by E. Ditlevsen.)

only at a short distance from the shore, and rise in strange wildness, often almost perpendicularly, as, for instance, the Church Mountain mentioned by Scoresby. They are separated from one another by deep corries and giddy, bold ridges. The ice-covering is very extensive but not prevalent even inland.

It is plain that we have here a particularly fine example of the type of pointed mountains which, in their contrast to other, usually lowish districts with rounded hills, are described by

[1]) Even C. Greg is situated on a peninsula; Scoresby's map is then correct also in this point.

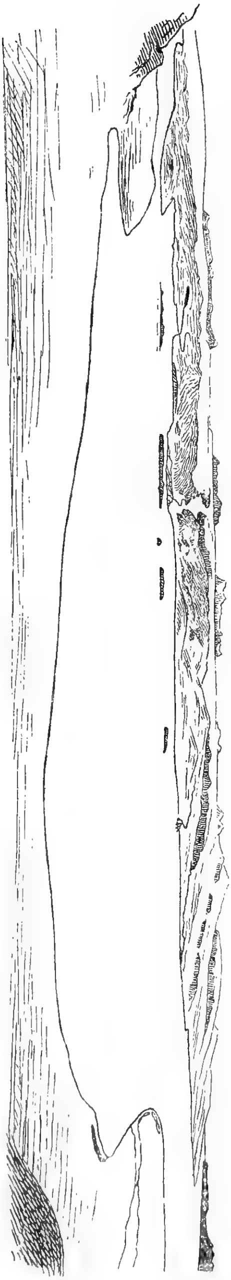

Fig. 7. Hurry Inlet and W. coast of Liverpool Land, seen from Nathorst Mountain. (From a shetch by J. P. Koch.)

Nansen from SE. Greenland, and which are adduced by him as a proof that the parts have never been covered by inland ice. Whether this interpretation is right, or whether we must be content to assume that the period that has passed since a presumable ice-cover retired was sufficiently long for the tops to be chiselled out, is a question to which I may possibly return elsewhere.

In contrast to the parts here described stands the type of landscape which one finds on the S. side of the same Liverpool Peninsula. Here the whole country is lower and at the same time all the hills are rounded, approximating to the other Nansen type, just mentioned. Already on the SE. coast we have an interesting configuration in the contrast between the level, rounded plateau land and a very steep dip towards the sea, quite typically marked, pretty much as is common in the fjord districts of the W. coast of Greenland as described by v. Drygalski[1]). Where any peaks rise above the average level, they are gentle, much as those in the N., in the sandstone territory. A few large, broad corries descend right down to the sea-level, filled

[1]) Grönland-Expedition, I, 45.

with a beautifully stratified, typical névé ice (as seen from the ship); their steep, parabolically curved walls form a contrast to the abrupt, steep dips to the sea, and also to the rounded hillocks of the plateau.

Before returning to the S. coast, I will first describe the W. slope of the land forming the coast of the fjord-like but probably shallow longitudinal valley, Hurry Inlet. That this stretch of coast differs materially from not only the E. coast, but also from most fjord coasts is obvious at once in its utter

Fig. 8. Western slope of the foreland hills of Liverpool Land, seen from the shore of Hurry Inlet. (Nordenskjöld phot.)

lack of harbours, as already Ryder showed. Topographically we may distinguish here three different longitudinal zones, that may be seen on fig. 7, viz. 1) the Nunataks, situated furthest in, steep and often very pointed, surrounded by masses of ice, and presumably all situated rather far E. and mostly identical with the peaks already spoken of as visible from the E. coast; 2) a long sloping foreland, beginning at a height of about 600 metres, quite devoid of all peaks and from a distance giving the impression of a plateau, while in detail the slopes appear with the rounded forms of "roches moutonnées", with typical lee-side to the W., and partly covered with débris formed by disintegration of the rock in place, partly with true, somewhat washed out moraine-débris, whose connection with the ice-masses soon to be met with in the E. is apparent. The "hillocks" themselves attain a height of 50 m or more above the level of the plateau.

The foreland that is shown on fig. 8 and which may also be seen

Fig. 9. The coast of Liverpool Land opposite the Fame I. Young deposits of clay and sand, in the middle of the bluff shell-bearing. (Nordenskjöld phot.)

on the painting Pl. X, passes over gradually to the W. into 3) the true shore-land, a zone of a breadth of up to a few km, where solid rock either does not appear at all or only in the deeper cuttings, while for the rest the ground is chiefly composed of rounded gravel and sand. The latter sometimes forms perpendicular walls facing the sea, rising to 25 m in height; in this sand, at a height of 10 m and right opposite Fame Islands, Hartz found clayey intervening layers with shells of *Mya* and other genera (cfr. fig. 9). Beginning on the precipice we come across an even gravel terrace, 20—40 m above the sea. Above this terrace there rise in many places, especially as one proceeds inland, numerous more or less irregular, often steep ridges or banks, rising to a height of 30—40 m or more above their surroundings. These long banks, which occur especially at the NE. corner of Hurry Inlet, often misleadingly recall moraines; however, they consist of gravel composed of local rocks, and large blocks are lacking. They are presumably a kind of river terraces; at the same time it must be observed that real moraine ridges seem to occur under similar conditions, especially further south. A characteristic view of the surface of this shore-land is given on the picture pl. XIII.

That harbours and bays are lacking on this coast depends exclusively on the presence of this area of deposition, the reverse of the usual denudation areas on such coasts. For the highland itself is interspersed with transverse valleys, whose fjord-type is unmistakable, and which are clearly distinguished from the usual steeply sloping valleys of river erosion, which latter are numerous here also. I have visited two of these valleys, viz. one opposite Fame Islands ("Kalkdalen", or "Limestone Valley", the same valley in which the dikes and masses of monchiquite rocks were found), and the southernmore of the two valleys situated about half way up the fjord, the glacier valleys that are plainly marked on the maps. The former[1]) continues about 5 km in a N. 40° E. direction, the same direction in which one of the here prominent systems of joints runs; broadly speaking, however, it is more or less "S" shaped. At the mouth itself, where it meets the shore terrace, the valley is shut off by a rocky wall, through which the river has made its way in a narrow canyon, over 10 metres in depth. We have here an exceptionally fine example of a barrier of a true rock-basin, now changed into a supra-marine fjord valley,

[1]) Koch's map, which shows the mouth of the river, unfortunately gives us no idea of the topography of this area in detail.

and situated just at the spot of the former mouth of the fjord, where, theoretically, one would expect to find it. Above this rock barrier the valley opens out abruptly, and the river runs in many shallow branches over a broad sandy level plain, probably a deep, now filled-up hollow. Above this again the side walls approach each other, whereupon the real river valley begins, closed farther inland by a not inconsiderable glacier which with a broad tongue shoots down into a hollow between higher mountain masses (cfr. fig. 32). The walls of the valley here are steep, though scarcely insurmountable, and practically free from weathering débris; they show the characteristic form of valleys that have got their shape independent of the activity of running water (cirques, glacier valleys and fjords), and which has been called the U-form, though a better comparison would perhaps be with the parabolic. Especially fine here is the contrast between these valley-walls and the flat rounded table-land on the heights of the hills, and it seems curious that both should have arisen through the same kind of ice-erosion. To explain this we must assume that the valley in its origin is older than the ice-erosion, and the contrast must be ascribed to the great difference in the activity of the ice in a narrow cleft or on an open plateau-land and on the top of the hills.

The southern valley in general shows great resemblance with the one described, but does not offer the same interest[1]).

On the other hand the tops of the lower, western Nunataks, surrounded by glaciers and masses of ice, which I had an opportunity of examining more closely in the heart of these valleys, are quite interesting. As far as I could push forward I found that they still contained traces of a plateau shape, which however when viewed from a height showed itself to be considerably affected by an incipient corrie formation, which has

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[1]) On Koch's map one can see in this valley, as well as in another immediately N. of it, a broad lake-area, corresponding to the wide plain, filtered by the numerous river-branches that I described above.

changed the whole surface of the plateau into rounded crest-walls, alternating with broad deep valleys, which serve as collecting areas for the masses of ice (cfr. the description of the glaciers on p. 269, and also fig. 32).

A specially interesting view of a part of this territory I got from the heights at C. Brewster on the S. side of Scoresby Sund. The S. coast of Liverpool Land is highly cut up by rounded bays, in which respect it is distinguished from both the coasts we considered above. The land rises slowly from the shore, with a shallow inclination. The distant mountains in the E. are quite high and wild, with deep valleys of all the types that are usual in such mountainous districts. Towards the W. this mountainous landscape passes over gradually into the level plateau-like foreland, which from a considerable height slowly sinks towards the W. The slope to the S. is fairly steep; the valleys short, steep and deep, ending in comparatively gentle, deep chasms. Down against the lowland at the coast extend ridges with gentle, rounded crest; between these must lie, or must have lain, glaciers. — Furthest to the SE. the land gets lower, flat and covered by a huge, dome-like mass of ice. The low foreland at the extreme headlands was fairly free of snow at this time of year, and was decked by a mighty cover of weathering débris, almost entirely devoid of vegetation, and lying practically in situ.

Among the most interesting phenomena in this area are the small indentations in the coast line that I came across in the district of C. Tobin. From the wide, rounded bays which alone appear on the older maps, several fjord-like inlets with steep sides penetrate into the low land. One of these I made a special object of study: it is situated to the NW. of C. Tobin, and in the event of a wintering would probably offer a serviceable harbour. It is connected with the outer bay by means of a narrow channel, but opens out suddenly further in to a little, almost circular, bowl-shaped valley, surrounded by steep walls.

On the N. side of the fjord, at a height of 50—80 metres, there is a level terrace with some fine rocky lake-basins; from these the land rises in short, steep terraces. On the S. side there is a low terrace-land, only 15—30 m in height. It is this boundary line, which must represent a fissure, but probably not a fault, that determines the direction of the fjord. The inner basin-wall is about 50 m high and very sheer. Above this there is a narrow terrace; then again a steep wall, and then a more gentle sloping valley, which continues to run in the direction of the fjord, and, like the whole of this inner part, is surrounded by high, steep walls. This valley ended at a large field of snow, which descends from a low depression, probably direct from the great highland ice mentioned above. At its foot there is a small lake, from which a little river runs into the fjord, in a small though evident canyon. As usual, one can see here how the river erosion has had nothing to do with the actual shape of the large valley, whose shape it rather seeks to deface.

2. The Basalt Areas. Essentially unlike the districts described above are the areas where the rock consists of basalt. As has been already mentioned, this is the case in the most northerly part of the coast region visited by the Expedition, and also in all the large territory south of Scoresby Sund. Though the character in each case is very similar, we will describe these territories separately.

Within the northern basalt area I visited practically only Sabine I., while a short landing was also made at C. Borlase Warren. In comparison with the southern area, this one offers a certain interest by reason of the comparatively narrow distribution of the basalt in the direction from E. to W. and of the abundant variation of archaean and later sedimentary rocks in its neighbourhovd. A view from, let us say, Hasenberg on Sabine I., as in the picture fig. 10, clearly shows the varied character of the landscape accompanying each of these rocks.

If, in this place, we only touch on the basalt type itself, it appears to be very fine on Pendulum I., which forms a gently dipping, monotonous plateau. Sabine I., too, is similarly rather monotonous, although the numerous intercalated beds of Tertiary sandstone in the basalt make its contours softer, and in any case it never assumes the appearance of a true plateau. There are various steep walls and ridges, both towards the sea and towards some rather deep valleys, which, however, are not typical

Fig. 10. Scenery from Hasenberg, Sabine I., to the West (Basalt; Archæan and Jurassic Rocks). (Nordenskjöld phot. 12: 7: 1900.)

cirques. On the other hand, pointed peaks are entirely lacking; the highest tops only form gently rounded eminences, which rise from the upper part of the mean level wich is always about the same height, whether it be situated in plateaus or ridges. The coast line is tolerably uniform, and Germania Harbour, known from the German wintering, is only a rounded creek, surrounded by low, steep walls, in a low gravel covered basalt plateau, closely recalling a peneplain resulting from supramarine erosion. The picture on fig. 11, also from a pho-

Fig. 11. View from Hasenberg to the East, across the valley that separates it from Germania Berg. Mostly basalt, with intercalations of tertiary sediments. (Nordenskjöld phot. 12: 7: 1900.)

tograph taken on Hasenberg, gives us a fairly good view of this landscape.

That the whole stretch of the coast is rather cut about and rich in islands, may be attributed to the great variety of rock, rather than to any peculiar qualities in the basalt.

We now pass on to the S. area, which is particularly interesting and typical; here too, I have had a far better opportunity of closely examining its coast-line. We have here, as far as we know, the largest and most uniform basalt area in Greenland — the area can be calculated to more than 40,000 km^2 or somewhat less than the half of Iceland — and it therefore offers a good opportunity for the study of the topographic phenomena of a glaciated region of comparatively recent and uniform rocks. No other rocks than basalt were known, prior to our visit, to exist here; the Danish Expedition certainly came across small intervening layers and enclosed fragments of Tertiary sediments in several places, but with the exception of the occurrence at C. Dalton, which is not very extensive either, they do not affect the topography.

A fine view over this area is obtained from the N. side of Scoresby Sund. (Cf. the description and drawings of Scoresby's, and fig. 12 from Ditlevsen's sketch, also plate V in Ryder's work). As appears from the map, this transversal coast is very uniform, without indentations or islands. The mountains form a fairly connected wall, with very few deep valleys, and those filled with ice. The shape of the mountains is the one characteristic of basalt rocks, i. e., with pyramid shaped peaks and fine stratification, especially prominent when snow covers the otherwise scarcely noticeable terraces. The peaks are often extended into ridges, but extensive plateaus rarely occur here on the coast border. The valleys that divide the ridges are certainly not typical corries, but are evidently due to ice erosion. On a small scale we find, as often in basalt mountains, a very sharp splitting up into small summits and pinnacles.

The extreme peninsula at C. Brewster is comparatively low and plateau-shaped with steep walls towards the sea. The E. coast of Brewster Land (the NE. peninsula of Christian IX Land) shows a great variation in appearance compared with the one described above. However I did not succed in getting a complete survey of the land. Islands are not so numerous as the old maps make out; in the work of the Expedition only Turner I. remains as such; while other large tracts, looked upon as islands, proved to be connected with the mainland, though at times only by very low necks of land. Still, the coast is much cut up by numerous fjords, which, even if they never attain a greater length than 10—15 miles, are in any case very typical examples of fjords in their every character. In both these respects they recall the

Fig. 12. The southern shore of Scoresby Sund, seen from the mouth of Hurry Inlet. Basalt mountains; cirque valleys, filled with glaciers. From a sketch by E. Ditlevsen.

generality of the Icelandic fjords, though they are probably a good deal deeper. Especially fine is Römers Fjord, where we sounded a depth of 128 fathoms, while at the mouth we found 111 fathoms, though neither figure[1]) can claim to be a maximum. The average height of the surrounding mountain walls is about 800 metres, and they vary but slightly; nor is there here any plateau landscape, but rather an interchange of ridges and peaks, separated by valleys, to be described later on. The inclination towards the fjord is almost perpendicular and the banking of the rocks may be well seen in the walls. The Henry Peninsula, too, is bordered by such sheer walls that it can only be scaled with great difficulty at a few spots from the ravines of small rivers.

I obtained a view over the interior of the land mainly during a short tour across the ice on the so-called Bartholins Glacier, which lies in a fjord-like, deeply eroded valley with steep walls; it is a huge glacier, about 3 km broad at its front. At first these mountains are broken up by cleft valleys, and, when viewed in detail, split up into irregular summits and peaks; but further in, everything closes in and seems to pass over into broad plateaus, covered by but small masses of snow (cf. also fig. 30 on p. 268). I received the impression that the land, already at a short distance from the coast, converges into a few similar, level plateaus, as is the case in Iceland (NW. Land), though possibly here, under the protection of the snow and ice, of far greater extent and uniformity than there.

Characteristic of the basalt area, in contrast with the area of Archaean rock, is consequently, in the first place the absence of fjords of any length, and then the wall-like even if somewhat echinate boundary of the mountains, without any large, pointed masses rising above the mean level. In this respect it recalls the sedimentary areas described below, though these,

[1]) Quoted from the corrected figures on Kochs map.

by reason of the variation of the rock, show far greater irregularities and variations in detail, at least in the outer coast land.

Of particular interest within this area are the valleys: in the same kind of rock, under the same natural conditions I have not seen a finer variety, save only in Iceland, where on the other hand the ice-cover is actually more retired. Of least interest are the large valleys ending in glaciers, which end up a number of fjords (for instance, the NW. bay from Turner Sund) and evidently owe their origin to the combined effect of ice and water. Otherwise the fjords end up (for instance, the bay N. of C. Dalton) in true cirque walls where the rock bed, as it was exposed after the retirement of the eroding glacier, is visible everywhere, while a river flowing through in some canyon-like crevice tries to form a lower valley level.

A splendid opportunity of studying these types of valleys occurs in the interior of Turner Sund. Between the very steep, slightly defined, but typically V-shaped river chasms, and the long, often magnificent cirques with their sheer sides and gentle slope outwards, there is a vast difference, and yet the former probably only represent an early stage in the development that results in the latter, and the transition is marked by the insignificant "niche" depressions, which at the top so often end up the valleys of the former class, where snow and ice have begun their work of first forming a corrie with its semicircular, steep border, and then incessantly depressing and elongating the same.

Especially on Turner Island, on the E. side of the sound in question, there are some very fine examples of such cirques, which, divided only by narrow walls, run out at right angles

[1]) In Iceland, in the same kind of basalt rock, one finds similar finely developed fjords, ending in cirques, for instance, in Dyrefjord, in the inner wall of which one can easily see that the fjord is not continued by any fault-line.

to the sound from E. to W. (cf. fig. 13). I had an opportunity of examining a few of them. In all these the bottom at the entrance lies at about the same height, about 200 m, and in front of this level there is a slope towards the sea, which only forms a continuation of the normal fjord wall. Possibly the sea stood at about this level when the main formation of the cirques took place. Through this slope the river from the cirque has cut its way down in a deep chasm, and in front of at least one of

Fig 13. Cirque valley in basalt mountains on the SE. shore of Turner Sund. To the left is seen the river chasm ending another similar cirque valley. (Nordenskjöld phot. July 1900.)

the valleys we find a kind of delta formed by the masses of gravel that the river has carried down and discharged. In all the valleys we find a tendency to turn off from the SE. direction towards the S. Supervening side-valleys, also cirque shaped, only occur subordinately; one of the valleys is split up into two digital arms by a long projecting spur.

The length of the valleys seems to vary between 3 and 8 km; in the valley I examined most closely it was 5 km, while the breadth reached about 1 km. The river gorge, which at the mouth must have had a depth of about 50 m, becomes shallower and shallower at the top and finally the river runs over a couple of not insignificant falls, but the rise is comparatively little until one reaches the inner ice-mass and its terminal moraine, the foot of which lies about 100, and the upper surface about 200 metres above the level of the valley bottom at the opening of the valley. The walls of the valley are very steep, even if not always quite unsurmountable, and have the "parabolic" shape characteristic of these valleys; there is no difference in this respect between the side-walls and the front-wall. The ice-mass, which is now inconsiderable in proportion to the extent of the valley, but which was probably once the cause of its formation, was not examined. Against the front wall itself lie some very steep masses of snow, probably consisting of ice in the interior. To these is attached, at the bottom of the valley, a mass of ice which was now covered by snow that, even at this time of year (July 22), was quite clean and free from gravel, while on the other hand the ice itself, where it appeared, was covered with masses of foreign substance. It is interspersed with fissures in two directions, partly narrow, sharp ones (magnetic E.-W.), partly hook-like ones, corresponding most closely to structure bands ("Blaubänder").

I climbed the front wall in a little river cleft and found there that only a narrow crest, very steep and as sharp as a knife, separated the valley here described from another of similar type, running in the opposite direction. This crest must necessarily break down gradually and then give rise to an "eid", arising exactly in conformity with Hellands well-known explanation. The whole of Turner I. seems in this way to be divided up into similar corries separated by narrow ridges. It is interesting to note that nothing similar occurs on the corresponding mainland, where the mountains are far more closely joined and plateau-shaped.

Since corries of such typical development rarely occur in a rock with such evident alternation of strata as this, I took particular trouble to follow some characteristic basalt banks round the front wall in order to see whether any faults had contributed to the formation of the valley. It turned out that really a few small irregularities occurred, pointing to some minor dislocations such as are common everywhere in these basalts. But it seems to be equally certain that no large faults occur here, and while the first foundation of the valley as usual must have stood in connection with the weakness of the rock along a dislocation line, the possibility of the whole actual valley originating in connection with a depression or a large fault seems to be entirely excluded.

To deduce from this any direct conclusions as to the problem of the formation of the fjords is scarcely justifiable, since no real analogy with the rock barriers at the entrance of the fjords occurs here, but on the other hand it can scarcely be doubted that numerous typical fjords, occurring in the same kind of rock, have assumed an analogous stage during their formation, for which reason every contribution to the history of their origin is of great moment [1].

3. The Region of the Sedimentary Rocks. Between Scoresby Sund (W. of Hurry Inlet) and about 74° N. lat. appears a broad zone of sedimentary rocks of an age, as far as we know, varying between Silurian and Jurassic, and which was made known by Scoresby, Koldewey, Ryder and Nathorst. These

[1] In this paper I can unfortunately not enter further into the question of the formation of fjords and corries, but must content myself with referring to an earlier paper of my own in the Bull. of the Geol. Instit. of Uppsala, Vol. IV (1899), and to Richter, Geomorpholog. Untersuch. in den Hochalpen, Peterm. Mitt., Erg.-Heft 132 (1900). — Sunk below the sea, these cirque-valleys seem to me to correspond to certain typical lateral fjords without entrance barriers (sills). On the other hand most fjords are true basins and must have originated from the direct erosion of moving ice, be it with or without discharge of loose material.

rocks give rise to a particularly interesting and varied topography. In our description we will, for the present, omit Jameson Land with its Jurassic formations covered with Quaternary strata, and proceed to deal with these parts that were visited by the Expedition, viz. Fleming Inlet, Davy Sund and its southernmost fork (Forsblads Fjord). The variation in the age of the rocks is thus reduced; all the rocks may now be classed as Paleozoic or Triassic.

All the interior of this part of Greenland, at and inside the inmost fjords, is made up of a more or less connected plateau. To encounter these plateau types one must retire a long way from the coast line in the Archaean rock areas, while the more pronounced the horizontal stratification or banking of the rock is, the sooner we come across them: thus, in the inmost parts of Fleming Inlet with its Mesozoic strata, and still more plainly in Jameson Land, which already forms a true plateau near Hurry Inlet.

Along the extreme outer strip of coast, however, it is just these loose sedimentary rocks, on a large as on a small scale, that show an exceptionally rich variation and strong splitting up in a topographical respect. To understand the connection between these two extreme types it is best to start from some of the intermediate forms that stamp the character along the main extension of the shores of the fjords.

In this case we can find two types. In Fleming Inlet there is a series of gentle mountains, rising in terrace-like plateaus according to the hardness of the various banks of rock; through the often considerable thickness of these banks the type is well distinguished from the basalt rocks. The peaks that rise above the mean level are, as a rule, flat pyramid shaped. The valleys here are not entirely fjord-like, not even the very considerable Örsted Valley, which however I did not get a chance of examining closely. They are certainly often eroded down deep, but are short and broad, probably emptied glacier valleys, with lateral valleys which end somewhat abruptly, but so that the innermost gorges are more angular and relatively more broad at the top than usual in the corries. If there were really corries here once, their shape has been partly destroyed. The numerous minor valleys are wild and deep, with sheer slopes and end in narrow clefts, of the true mountain river type. A dissimilarity to the fjords in harder rocks arises in territories such as these already by reason of the sides of the valleys not being rounded off, but being either more gently sloping, or, owing to breaking up through erosion and abrasion, angular or even precipitous, which is easily explained by the nature of the rock itself. A very narrow foreland outside the coast-steep is usually present; before every river it widens considerably owing to the masses of gravel carried down.

The gentle impression made by this coast is most closely connected with the uniform nature of the rock, which is without any specially hard or divergent strata. We come across a very different character at Davy Sund. On the S. side rise the high Pictet Mountains; the country in front of them is comparatively low and gentle. In the N., on Trail I. the country is similarly soft, though the shores are steep and somewhat wall-like, and also the smaller crevices are deep, while the larger valleys are broad and end in gently sloping cirques. Not until we approach "Drömbukten" do the valleys become more and more important and at the same time closer to one another; they almost go down to the base-level, and the crest that distinguishes them from their closest matches is often low. What once existed of a plateau-form is now quite destroyed.

In this region four different areas may be distinguished, which we will briefly characterize.

Traill Island consists of isolated rounded masses divided by deep valleys and themselves cut up by numerous small valleys and chasms. Real peaks are generally lacking except perhaps furthest out towards C. Simpson.

Fig. 14. Southern shore of Davy Sund, W. from C. Biot (Strata possibly triassic). (C. Kruuse phot. 24: 8: 1900.)

Fig. 15. C. Brown, seen from N. (Nordenskjöld phot. 24: 8: 1900.)

The exact nature of the rock on this island is unluckily not yet known. Fig. 19, on p. 250, from a sketch by Ditlevsen, gives us an idea of the scenery of the east coast of the island.

The south coast of Davy Sund, towards C. Biot, pictured on fig. 14, is more connected, soft and low, without prominent peaks, but sometimes broken up into crest-shaped hills. Also here it will be necessary to verify the nature of the rock, which is on the map pictured as belonging to the Triassic, though older rocks may occur, especially farthest out towards C. Biot. Here, in fact, the topography reminds one somewhat of the peninsula E. of Fleming Inlet, the region of C. Brown (see fig. 15), forming with its harder rocks (cf. p. 178) a real transition to

Fig. 16. Mountains at the interior of Fleming Inlet (Triassic strata). (Nordenskjöld phot. 25: 8: 1900.).

the Canning Land type mentioned below. What is seen on the picture is evidendly a narrow crest, not gentle in any place, but without any prominent peaks and broken up by the formation of transverse valleys. Connected with the almost horizontal stratification is a partition in narrow terraces, which from a distance almost recalls a basalt coast.

Somewhat different is the scenery around Fleming Inlet. The nature of the generally soft, triassic rock has already been described. On the NW. the fjord is bounded by an almost plateau-shaped wall, the isolated peaks everywhere showing a

Fig. 17. C. Seaforth, on the W. shore of Fleming Inlet. Probably triassic strata. (C. Kruuse phot. 24: 8: 1900.)

strong tendency to assume pyramidal shape, as shown on fig. 16 and also on the typical fig. 17.

Canning Land (formerly "Canning Island") presents in the extreme SE. nearest Liverpool Land a very different appearance and at least in details almost vies with Liverpool Land in its wild and broken topography. The whole peninsula consists of a number of narrow, isolated ridges and cones, not of true peaks, divided by deep and very typical corries, and also by ordinary crevices. The slope towards the sea is very steep, and in detail all the heights are sharply moulded out in peaks and ridges (cfr. also fig. 3). This topography is connected with the rich variety of rocks, in the formation of which huge, almost massive banks of calcareous sandstone enter, as also not inconsiderable quantities of the surface-eruptives that have already been described. The beds dip rather abruptly and the emanating strata-tops of harder beds produce peaked points projecting from the ridges, as is beautifully shown on fig. 18, while fig. 20 gives us a general idea of the aspect of the country, seen from a distance.

The landscape character of the areas just described is

Fig. 18. NW. Peninsula of Canning Land, seen from N.
(C. Kruuse phot. 24: 8: 1900.)

typical of the comparatively low, violently broken up districts nearest the coast-line. Further inland, at some distance from the forks of Kong Oscar Fjord, we find very high mountains, which, however, were seen only at a distance. The character of this mountainous landscape is best seen in the series of good pictures that Nathorst reproduced in his work "Två somrar i norra ishafvet". Where the mountains consist of horizontal sedimentary beds, they have most often a tendency to a plateau-shape. The wildest mountains I had an opportunity of seeing are the so-called "Syltopparne" (reproduced on p. 300 of op.

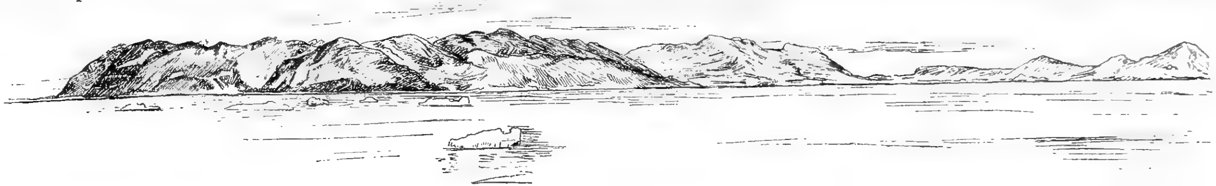

Fig. 19. Traill I., seen from the E.

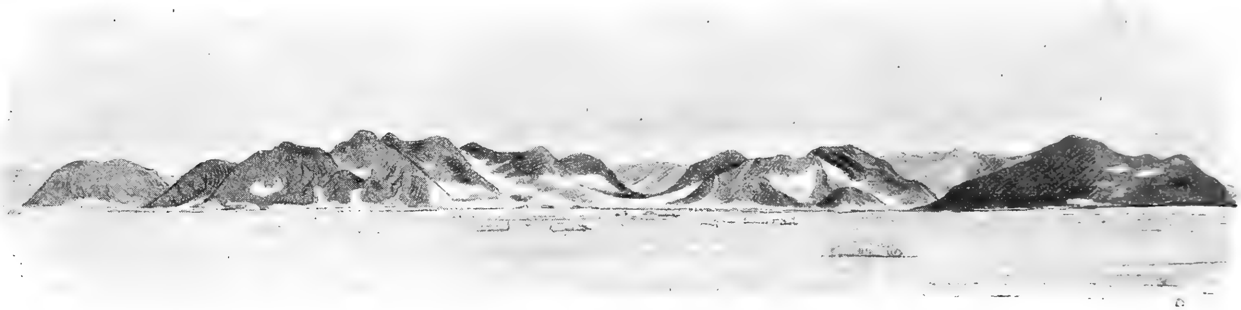

Fig. 20. Canning Land seen from NE., distance 15 miles. To the left, entrance of the Carlsberg Fjord. (From sketches by E. Ditlevsen.)

cit.), whose topography recalls what I described from Canning Land, the sharp, characteristic peaks probably owing their origin to the same phenomena, the resistance to erosion in certain hard banks of the folded sedimentary rocks. Berzelius Mountain, situated right opposite, with an almost horizontal stratification, is pronouncedly plateau-shaped; the same is splendidly reproduced, together with the vivid colours of the rock, on the attached picture Pl. XI, from a painting by Ditlevsen.

Fig. 21. Neill's Cliffs, the E. border of Jameson Land.
(C. Kruuse phot. 12: 8: 1900.)

The large, deep valleys that are met with here probably stand in connection at times with irregularities in the rock, but I noticed no true dislocation valleys; not even has Polhem Valley, which follows so near to the boundary between archaean and sedimentary rocks, originated in that manner.

4. Jameson Land (Jurassic and Quaternary Type). This name indicates the territory to the N. of Scoresby Sund, and situated between Liverpool Land, from which the greater part is separated by Hurry Inlet, and the ice-covered interior N. of Nordvestfjord; in its configuration it differs strongly from

both these areas. It is low, even and free from ice, especially in the southern part. It is known to me partly from a lengthy excursion I made towards the NW. from the inmost part of Hurry Inlet, partly from studies made along the whole of its coast on Hurry Inlet and Scoresby Sund. As far as I could see, all the rocky bed of the territory consists of Jurassic deposits[1]), which in the N. rise to peaks of 1000 metres and

Fig. 22. South coast of Jameson Land, near C. Hooker, with a large stranded iceberg. (C. Kruuse phot. 15: 8: 1900.)

more, and on Hurry Inlet form a steep wall of up to 600 metres in height, (cfr. the typical picture in fig. 21 and the painting Pl. XII), while towards the SW. they grow lower and lower, so that they only exceptionally emerge, the whole country down to the sea-level being formed of Quaternary deposits.

Both from a geological and a topographic point of view the territory may therefore be divided into three main divisions.

[1]) Cfr. also the remark on p. 188.

viz. the N. highland area, the coast land on Hurry Inlet and the lowlands in the S. and W.

The N. highlands consist mainly of isolated rocky mountain-hills, separated by deep valleys with rather steep sides, though not by real canyons. These mountains are also sometimes covered by ice. But already a little further south these elevations close up, so that one can speak of a true plateau, which slowly rises from Ryders Dale from 150 to about 900 metres, and is only interrupted here and there by shallow river-valleys. In these valleys the rocky bed, mostly of light non-fossiliferous quartz sandstone, is often visible. The slope, too, reveals nothing remarkable, but the more interesting are the real plateau-elevations of a mean height of about 800 metres. These are covered everywhere by a large, level, connected cap, usually of some metres in depth, of coarse, very well rounded and washed out gravel, consisting of the greatest variety of rocks: granite, syenite, pegmatite, quartzite, etc. I did not notice any basalt. Already the variation in the blocks shows that they undoubtedly derive from the W. Large blocks, of more than about 2 metres in length, are exceedingly rare. Up here the gravel is evenly distributed; further south, however, one can often observe an arrangement according to the type of shore-gravel, in that the coarser material is gathered up into low hillocks, which are surrounded by a ring of larger blocks, of which one measured as much as 5 metres in length. Here are also huge layers of fine sand, which are lacking in the upper plateau. Sometimes there even occur extensive fields of blocks of well rounded stones, mostly covering lower districts. Finally, we may mention some curious ridges (in several places, though not numerous) of 4—5 m in height and 10—30 m in length, formed of well washed pebbles, up to the size of nuts, with numerous blocks, up to half a metre in length, scattered around, at least on the surface. These formations recall estuary terraces of glacial rivers, or "osar" in the making. A general view of this remarkable country, as seen from the northern hills, is shown on fig. 23.

The same well rounded gravel, though in less quantity, occurs up on the plateau heights right down to Cape Stewart, and exceptionally I found even here on one of the highest points, about 540 metres above the sea, a number of the same, large, exceedingly well rounded and almost smooth polished gravel-stones, so numerous in the N.

Fig. 23. Jameson Land, seen from the northern hills, in the direction facing Scoresby Sund. (Nordenskjöld phot. August 1900.)

How this most peculiar formation, spread over so large an area, came about, is not an easy question to answer. But it shows such a remarkable resemblance to another, well-known formation, the Patagonian gravel-formation, that we can scarcely get away from the idea of an at least similar origin. In another place[1]) I have dealt with the question of this probably quaternary gravel in detail, and proposed the theory that it was deposited by large glacier-rivers. In the present case, it is true,

[1]) Über die posttertiären Ablagerungen der Magellansländer; Svenska Exp. till Magellansländerna Vol. I, no: 2, p. 43.

the facts, and especially the distribution of the gravel itself, seem to speak with far greater emphasis in favour of a submarine formation. But, on the other hand, one hesitates to assume that the sea can so recently have stood nearly 1000 metres higher than now, and in any case it is difficult to explain the absence of correspondingly huge, fossiliferous deep sea formations. As matters now stand, we may very well imagine that there was here a large inland sea basin, though this interpretation scarcely holds good of Patagonia. A few small finds of sand that were examined for micro-organisms proved to be sterile.

The conditions along the coast at Hurry Inlet have partly been touched on above, and it only remains for us to speak of the coast profile itself. The Jurassic beds here usually form a steep, often unsurmountable rocky wall, at the foot of which are terraces and often extensive moraine-like formations deserving of closer study than I could give them. It is most probable that here under the lee of the high, perpendicular wall, huge abruptly dipping drifts of snow and ice have lodged for certain periods of time. Under the influence of wind and thaw water, gravel and dust have been carried out onto their surface, and then, when the snow melted, collected at the foot, where they still lie, like embankments. The same phenomenon can often be observed in full activity in the Polar regions. — The interior of the territory forms part of the large plateau described above, and, just as the beds dip, it gently sinks towards the S.

Of some interest are the river valleys one comes across here, and whose type is common in both the areas described.

[1]) Far in the interior of Jameson Land, at a height of at least 300—400 m above the sea, I made an interesting find, viz. a large piece of driftwood; according to Hartz, probably from a pine-tree. This undoubtedly endorses the opinion that the sea in a late time reached so high, since no other agent, even human, seems possible. — As well known, driftwood has been found at still greater heights, on Ellesmere Land, by the Nares Expedition.

Nearest the shore of Hurry Inlet there is a number of very short and deep, steep chasms, which, as one gets higher up to the verge of the plateau itself, widen out and are continued in gentle, not conspicuous depressions. The large valleys, too, belong to the same type, and in their lower part form wild, often impassable chasms. Up country these suddenly come to an end, like a sack, against a steep wall which is often roofed by a mass of ice, usually in an almost "dead" condition. These are the only occurrences of glaciers to be found in these parts. And should there be any continuation at all of the valley further inland, it only forms a shallow, flat depression in the plateau, usually filled with snow; nothing analogous to the canyon-like chasm valleys of the coastal area is to be found in this part of the interior of the country.

What we see here is evidently a polar type of valley in a plateau area. On a lower level, rivers of thaw water have a very erosive effect in the summer, whereas higher up, where the snow does not melt, but only evaporates, almost every erosive activity somewhat suddenly ceases.

Not less peculiar and interesting than these districts is the SW. lowland territory. A foundation of solid sandstone rock, of the kind already described, is only visible in a few deep river valleys in the S. part of this territory. Here, on the coast in the neighbourhood of C. Hooker we find, as a rule, over this sandstone a clay with numerous stones, which at times forcibly recalls a morainic boulder clay, but undoubtedly consists of a stratified formation, having originated in a water where at the same time blocks of ice had drifted about. I did not come across it on a higher level than about 60 m above the sea. Above the clay one usually finds moderately fine sand, and above this a cover of coarse gravel similar to that just described from the mountain plateau. Further towards the NW., on the other hand, the soil is formed exclusively of sand and fine gravel, only exceptionally with narrow intervening layers of clay, in which are sometimes found marine shells; these, however, have not yet been classed. Along the coast, formations of dune-sand are extensive. Foreign boulders occur here and there, but are rather subordinate. Further inland, 10 km and more from the coast, they seem to be wanting altogether. Noteworthy was a very large boulder lying near the shore, 15 m long, 10 m broad, and 5 m high in the part above the ground (fig. 24, "vandreblok" on the map).

Fig. 24. Big boulder on the W. coast of Jameson Land, probably transported by an iceberg. (C. Kruuse phot. 17: 8: 1900.)

The topography here is as simple as it is interesting. Outside the coast-line lies a broad plateau, which is so shallow and shelving that a landing is only possible at high water. At the shore itself there is usually a 5 to 15 m declination, consisting of sand. This type of coast is very conspicuous on fig. 25. Within this embankment there is now and again a depression, or else a terrace plateau begins at once, rising very slowly, scarcely 100 m in 5 to 10 kilometres. This terrace, save furthest in towards the NE. bay, where the land is lower and more connected, is cut up nearest the coast by innumerable short, deep, sheer river valleys, which — at least at that season of the year (August) — were usually almost empty of water. Several of these valleys are very short, some only a few hundred metres in length; others are widely forked and reach far inland; but all show a strong tendency to come to an abrupt termination against a steep wall. This is the same peculiar type of valleys that has often been described from certain desert regions. Here the explanation I offered just now for the valleys at the E. plateau precipice, does not hold good; it seems to

Fig. 25. The quaternary coast on the W. side of Jameson Land.
(C. Kruuse phot. 17: 8: 1900.)

me most likely that here the streamlets that we now see in the valleys rise from springs which have gradually succeeded in carrying away the masses of earth lying before and over them.

But few watercourses reach the interior of the land. Their valleys are usually broad, not specially marked, and show no unusual characteristics.

Already in Scoresby's time Jameson Land had attracted attention because of its freedom from snow and ice, and nevertheless it lies between the inland ice and Liverpool Land, which — at least in part — is so rich in glaciers and ice. That permanent ice is not altogether wanting has already been pointed out, but it only occurs in the more pronounced mountains in the N., in the highest parts of the land, close upon 1000 m above the sea, and in some deep chasm valleys. The plateau itself is in the summer, even at a height of 800—900 m, almost free from snow. A good picture of this remarkable country is shown in fig. 23. A satisfactory explanation of the absence of snow has not yet been offered. Very probably the plateau character has been unfavourable to the formation of ice, both because it discourages atmospheric precipitation, and because the snow that falls here is easily carried away by the wind; and it is possible that the precipitation at the level that the plateau reaches here within the fjord is, apart from this, less than out by the coast. But this does not seem to be a sufficient explanation. Polar explorations have now shown us that in different regions tracts of land, whose rocky bed consists of horizontally lying, loose sedimentary rocks, are unfavourable to ice formation, even if they lie on an open coast. A short resumé of the observations connected with this has been furnished by J. G. Andersson[1]), who has promised to return to the question. Without, therefore, going into the matter here, I will merely suggest as a possibility — applicable to the present case — that the freedom from snow is directly attributable to the loose nature of the soil, to its porosity. On projecting rocks of sandstone specks of snow can still be found, though not nearly to the same extent as in the areas of primary rock; on a soil of gravel or sand there is not a trace of ice, save a few snow-drifts down in the valleys, which probably melt before the arrival of winter. Why the nature of this soil should have this effect is harder to explain. Perhaps, by letting the thawed water from the snow above sink down, it prevents the formation of a crust of ice on the ground, or in some other way prevents the snow turning into ice, which,

[1]) Bull. Geol. Inst. Upsala, Vol. VII, p. 24.

if allowed to remain some years — the easier as the ice is better able to resist melting than the snow — can form the basis of a general glaciation.

It seems as if the same peculiar state prevailed in Jameson Land even in earlier periods. I had expected, in this territory covered by loose post-tertiary deposits and situated so close to the inland ice, to find what has never yet been met with, a district with a mighty ground-moraine corresponding to that which we find, for instance, in Denmark or other South-Baltic lowland tracts, but in direct connection with formations deposited by recent ice before our eyes. In this, however, I was deceived: I saw no true ground-moraine anywhere in this territory, nor, indeed, any proof that it had ever been covered by land-ice even in conjunction with the widest extension of the ice. Nevertheless, this territory is of considerable interest for the study of the quaternary history of Greenland through its masses — just described — of gravel and, nearer the shore, of sand and clay which, in parts to a thickness of at least 100 m, form its soil. That these loose masses are to some extent marine is certain, and hence they point to a late upheaval of the land, but how great it was is not yet known. Samples of clay from highish levels have, unfortunately, all turned out to be sterile; only up to a height of about 30 m above sea-level did I find indisputable marine shell remains. Neither could typical shore lines be detected in the region on a higher level[1]).

However, strong arguments, above all, the very nature of the deposits, speak in favour of their having been deposited in the sea up to a far greater height. But, as I have just said, I do not venture to extend this hypothesis to the gravel and boulders of the highest plateaus. These are most easily ex-

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[1]) Compare what was said above about the conditions on the west coast of Liverpool Land, where Hartz, as we are informed, has made unexpected and interesting observations which speak in favour of a higher water-level.

plained by discharge from glacier rivers which, like those we know from the south of Iceland, have often changed their bed, and, undoubtedly, large portions of the district were once covered by lagoons, where icebergs laden with blocks of stones floated about. These lagoons must have been shut off partly by the ice itself, partly, perhaps, by the mountain mass of Liverpool Land. Still, it is striking that with the present climate of these altitudes it is impossible to imagine either lagoons or well watered streams. Either the land once lay much lower, which, as we have seen, is probable for other reasons[1]), or we here have traces of some interglacial period with a warmer climate than the present.

A more detailed study of this interesting district and its loose deposits, as well as of its temperature and atmospheric precipitation, is strongly to be recommended to every expedition that finds its way to these parts.

5. The Inner Central Mass of Archaic Rocks. There is, of course, no detailed description of the topography of the surface of the land in the interior of Greenland, since the whole territory is covered with ice. It is, however, probable that the territory forms a mountainous country intersected by valleys, which may be inferred from observations taken at the borders. At the same time, already Nansen has expressed the opinion that it is "indisputable that the topography in the interior of Greenland is at least as cut up and varied as in the Norway of to-day". I can scarcely subscribe to this opinion, and the

[1]) I have also come across deposits at other places at a considerable elevation, which recalled old gravel beaches, as for instance at Cape Borlase Warren in an open position out towards the sea at close upon 300 m in height. The rocky bed here consists of basalt and also some sandstone of presumably Tertiary Age. On the slope there are numerous boulders of chiefly archæan rocks; to assume that these have been transported by the activity of running water is not easy. However, the district is too little known for a definite explanation to be given; one possibility is that these stones derive from conglomerates that might be found in the tertiary sandstone.

observations taken in the interior of the fjords here described point to a different conclusion. For, irrespective of the rocky bed, which may consist either of primary rock, basalt or sedimentary rocks, all the highlands here tend to assume a pronounced plateau shape. This appears already very characteristically in the central parts of Scoresby Sund (Renland and Milne Land, cfr. fig. 26), and still more plainly in the interior of Forsblad Fjord. The same observations can be made at other parts of East Greenland, e. g. on the reproductions in

Fig. 26. Renland and the entrance to Nordvestfjord, filled with icebergs, seen from Jameson Land. (C. Kruuse phot. 15: 8: 1900.)

the already cited work of Nathorst's, "Två somrar i Norra Ishafvet", Vol. II, pp. 257, 264, 268, 326, etc. Some isolated masses of mountains may of course assume bolder outlines, but in the main the phenomenon is striking. Naturally, in the neighbourhood of the fjords it nowhere reaches the development of a continuous plateau; the innermost point of the whole territory known to us is the interior of Franz Joseph Fjord, of the nature of which we can get a conception from the picture on p. 246 of Nathorst's work. The phenomenon appears much less distinctly, without doubt, in landscape pictures from the W. coast, yet indications of it are not wanting even here, though I have not had an opportunity of seeing any pictures from the innermost parts of the fjords in a sufficient number for entering nearer into the question. Now it is true that the same phenomenon is very evident also in the inner parts of the Norwegian fjords, and, broadly speaking, Norway is, as we know, itself a plateau land, whose peaks and mountain masses often show, within the same district, a striking correspondence in their height. So far a comparison between Greenland and Norway may be justified. But Greenland forms a far broader mass than either Norway or the whole Scandinavian peninsula, while again erosion and valley-forming forces, following on the retirement of the land ice, have, at least in the coastal districts of W. Scandinavia, contributed greatly to render the contrast still greater between mountains and valleys. With the impression I received of the topography of Greenland, with respect to the quick transitions from the peaks of the coast strip and the plateau shaped mountain masses of the territory within the fjords, it seems to me most probable that the country still further inland rather forms a fairly continuous high plateau, though it must in any case be imagined as cut up by a number of deep main valleys. For various reasons I think we may assume that this plateau type is here even more widely extended than in other similar stretches of old mountainous country, which were once covered with land ice, as, for instance, Labrador and Scandinavia.

This brings us to the question of the origin of such high plateaus and of the effects of the land ice in the interior of an extensive mountainous district. — If the valley systems were not strongly developed before the advance of the ice, and the ice-cover therefore from the beginning embraced large parts of the land, while only the higher peaks stuck out as nunataks, such land ice should have a great levelling tendency on the topography. A strong erosion can only take place at the districts at the edge, where in this way deep lakes and fjords are formed. On the other hand, frost weathering soon attacks the higher peaks, which are not protected by any ice-cover, and the pieces that break away are carried off with the moraines of the ice. Such a mountain plateau differs entirely from a peneplain resulting from river erosion, in that deep valleys are by no means lacking, and have certainly been

Fig. 27. The inner part of Forsblad's Fjord, seen from the W. slope of Polhem Dale. Gneiss mountains, approaching the table shape. (Nordenskjöld phot. 28: 8: 1900.)

present at every phase. Taking them all round these plateaus form a special type among the land forms, probably limited to areas that are or have been covered with ice. On the other hand, to explain them as a direct result of the erosion of the ice, does not seem to me to be possible. In real mountain-chains, formed by late folding and upheaval, corresponding plateau-areas do not seem to occur.

The pictures fig. 27 and 28, though not very good, will give us an idea about the scenery of those plateau-shaped mountains in the inner fjord-regions.

The present ice and its effects on the nature of the region.

Glaciers and inland ice. I had but little opportunity, during the expedition, of studying the present ice, and have, in consequence, only a few observations to make on this score.

That the central ice reaches the innermost branches of Scoresby Sund, was already known through Ryder's Expedition, but some doubts have been raised as to whether this ice fully

Fig. 28. View towards the interior of Polhem Dale. Mountains of horizontal silurian strata, covered by highland ice. (Nordenskjöld phot. 28: 8: 1900.)

tallies with the inland ice of W. Greenland[1]. Our expedition did not penetrate so far that any decisive observations bearing on this could be taken, but I believe it is indisputable that it is true inland ice that debouches into the interior of the NW. fjord. At the entrance of this fjord, and in the NE. bay our ship was surrounded by hundreds of large icebergs, of which several must have been many hundred metres in length,

[1]) E. v. Drygalski, Grönland-Expedition, Vol. I, 164.

Fig. 29. Hanging glacier coming down from the highland ice on the southern side of Forsblad Fjord. Height of the wall about 1500 m. (C. Kruuse phot. 29: 8: 1900.)

and by their comparatively regular shape (cf. fig. 26) showed that they derived from a large ice-stream. Even if we agree with Drygalski in confining the appelation "inland ice" to such masses of ice as force their way in a mass into a — to them — new district, it can be open to no doubt that that is the case here, such large ice-streams being of necessity derived from a very extensive collecting-area.

On the plateau-shaped mountains at the shore of the fjords, and also on the basalt masses on the peninsula to the S. of Scoresby Sund, we find, as a rule, local caps of highland ice, which are often spread over the mountain plateaus like even and comparatively thin coverlets, as is shown in the photograph fig. 28 from the environs of Polhem Dale, and also on fig. 29. Such highland ice often sends down towards the deep valleys narrow ice-belts which incline so abruptly that it is hard to understand how a glacier under such conditions can retain its continuity. Fine examples of this can be seen, for instance, in Forsblad Fjord, of which the same fig. 29 gives us a picture; the ice cap is here at least 1500 m above the sea.

Of the larger coast glaciers I only visited one, namely Bartholin Glacier, somewhat to the S. of Scoresby Sund (cfr. fig. 30). According to Koch's measurements, the glacier at its front has a breadth of some $3^1/_2$ km and its perpendicular wall rises from 15—20 m above the sea. Its surface is even, almost without fissures, at least on its eastern side, on which I walked; towards the interior of the land it rises very slowly to begin with. Further inland it seems to branch into two arms that appear to rise more steeply in order to converge with the highland ice that covers this district. A dark, central moraine wall, formed by pieces of a scoriaceous basalt, whose cavities are filled by fine zeolite crystals, runs inland as far as the eye can reach. Still larger is the E. side-moraine, which forms a whole broad zone with ridges and valleys and real small ice-lakes (fig. 31), and runs along Henry Land right up to the valley which here debouches

Fig. 30. Bartholin Glacier seen from the northern lateral moraine. (Nordenskjöld phot. 20: 7: 1900.)

from the north. A large block of ice, evidently detached from the glacier and showing a part of its central moraine, lay, probably on the ground, in front of the ice[1], but the movement of the glacier can scarcely be rapid.

The Steno Glacier, which bears an evident resemblance to the one described, and which lies somewhat further north, has been briefly described by Koch[2].

Liverpool Land, as has often been pointed ont, is largely

Fig. 31. Small hole in the ice of the N. lateral moraine, Bartholin glacier. (Nordenskjöld phot. 20: 7: 1900.)

covered with ice, but it is impossible to speak of real highland caps here, as the country is too much intersected by valleys, and the ice may be said to be mainly collected in these and in depressions between the high peaks — not unlike the

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[1]) This piece of ice is also visible on the left of the annexed photograph, which was taken from the outer edge of the N. side-moraine at a place, the situation of which is shown on a photograph specially taken.

[2]) Medd. om Grønland. XXVII, p. 277.

Alpine ice-masses. Here too, again, I only reached the ice in one spot, viz. in the already described (p. 231) valley opposite the Fame Islands ("Limestone Valley" or Kalkdalen). A considerable glacier here descends in a narrow passage from the inner highland district, widening out into a broad, fan-shaped tongue (see fig. 32) from which a river takes its rise. Conspicuous moraine embankments are not to be seen in front of the ice, but the glacier evidently

Fig. 32. Glacier tongue, at the upper end of Kalkdalen, Liverpool Land. (Nordenskjöld phot. Aug. 1900.)

filled the whole valley at an earlier epoch, in any case as far as the remarkable "sill" at its entrance, already described.

The adjoining picture also shows us that plateau-shaped mountains are not lacking either in the interior of Liverpool Land, although they may only appear to the W. of the ice-divide.

The influence of the ice on the configuration of the country. I can curtail the remarks I have to make on this head, and need only refer to the descriptions already given. In this district, as presumably in the whole of Greenland, we can distinguish 3 different types of surface-features of the solid rock, viz., the upper mountain-plateau, the mountainous country with sharp peaks and ridges and, finally, the lower, rounded, and gently rolling stretches of country. A description has just been given of the first-named plateau; its existence, since the withdrawal of the ice, depends on the fact that at this height, where the temperature seldom rises above the freezing point, the erosive power of the water is reduced to a minimum. Between these and the lowland regions round the coast the intermediate type, the Alpine region with its pointed peaks, inserts itself. Here ice and water have combined to excavate deep valleys, and under the influence of frost weathering the tops, which in the ice appeared as nunataks, have assumed bolder shapes, without, however, suffering destruction. However, in other districts, with a very broken topography and with lower summits, this has sometimes been the case, and then we get the regions of the third type — a low rolling country that gently slopes outwards, and from which rounded hillocks rise. If from this level some isolated rocky mass rises to any height, it shows angular, rugged contours of the second type, and consequently appears as an ancient nunatak that has been left undestroyed by the acting forces. Of this the often described and reproduced[1]) Umanak Rock in West Greenland is a fine example.

Within this district a higher plateau-land reaches almost out to the sea in the basalt territory on the S. side of Scoresby Sund. In general the region nearest the sea is a cut-up Alpine country, while the district where the third type appears best in its contrast to it is the S. or S. W. part of Liverpool Land.

In sharp contrast to all these types, cutting through them with steep mountain walls, without very much altering their character at the variations of country, are the fjords and the deep valleys

[1]) Drygalski, Grönland Expedition, I, Pl. 3; also Medd. om Grønland, IV, Pl. 7.

that correspond to them on land. They show here an extraordinary development, and few places on earth, should their origin be made a subject of special investigation, are better suited to the purpose; the opportunities are especially fine for observing to what extent the character of the fjords is changed hand in hand with the variations of the rocky bed. It is only a pity that at present hardly anything is known about their submarine relief. That sills occur at the entrance of several of the fjords seems to be certain; at the inner arms, such as NW. fjord, that is evident from the number of icebergs stranded at their mouth. On the other hand it looks as if the larger fjords, at least Franz Joseph Fjord and Davy Sund, were continued some way into the sea by deepish channels.

Theoretically very interesting are the considerable longitudinal valleys, or "channels" (in the terminology applied to other coasts), connected with the fjords and apparently showing that they are not exclusively indebted for their origin to the erosion of ice. It is at least hard to imagine that this should have moved forward with any force in the inner connecting branches of Scoresby Sund (Rödefjord, Rypefjord, and others) while it is easier to understand why Kong Oscar Fjord, in spite of its direction, should have succeeded in forming the outlet channel for a huge glacier.

That dislocations in the crust of the earth have here played a certain part is beyond doubt. Smallish faults can often be observed along the shores of the fjords, but to what extent these have been of any importance in the formation of the valleys cannot be shown. Both the outer, broad part of Scoresby Sund, and Hurry Inlet owe their shape — which differs, especially in the former case, from that usual to fjords — as well as their position, to the boundary between the loose, Mesozoic rocks within the Jameson territory and the adjacent, hard basalts and archaic rocks.

With reference to the details in the topography of the district, we have already made acquaintance with the imposing formation of corries that sometimes occur, especially within the basalt territory, where a whole district may be so cut up that only narrow ridges remain. Where these corries, as is the case at Turner Sund, all have their mouths at the same level — about 200 m above the sea — one would be inclined to think that they were formed at a period when the sea-level was considerably higher than to-day. To prove this, however, observations would have to be extended to a far wider area than I was able to survey.

"Striate land". Although this phenomenon is not directly caused by the ice, we will, however, speak of it here. Statements[1]) occur in old works to the effect that observations in polar regions have shown that the loose gravel and clay sometimes are arranged in regular hexagons, without this observation having been the object of detailed investigation. On the other hand, a similar but probably not identical phenomenon, "rutmark" or "chequered land", where the surface is broken by hexahedral fissures, has attracted the attention of the botanists.

During his expedition to Beeren Island in 1899 J. G. Andersson observed a phenomenon which he afterwards described under the name "solifluction"[2]) and which seems to be of great importance for the origin of certain details in the topography of such territories. By saturation with thaw-water, large masses of earth on a slope may assume a semi-migrant structure, and, under favourable conditions, start slowly moving down the slope. These "mud-streams" may give the gravel on the hill-sides a band-like arrangement on a large scale; at other times several streams may combine from various directions into a main furrow, like a river and its branches.

In Greenland I made several observations that seem to point

[1]) Th. Fries och C. Nyström: Svenska Polarexpeditionen 1868. Stockholm 1869, p. 30.

[2]) J. G. Andersson: Journ. of Geology, XXIV (1906): 91.

to a combination of the two phenomena just mentioned. In several places, most distinctly in Turner Sund, at the loose layers on some of the slopes I noticed a fine striate arrangement on a small scale: coarse and fine gravel or even clay alternated in long, regular, narrow strips, sometimes covering extensive tracts. The steeper the slope was, the more regular were the strips, and while in general the clayey strips, at least, were

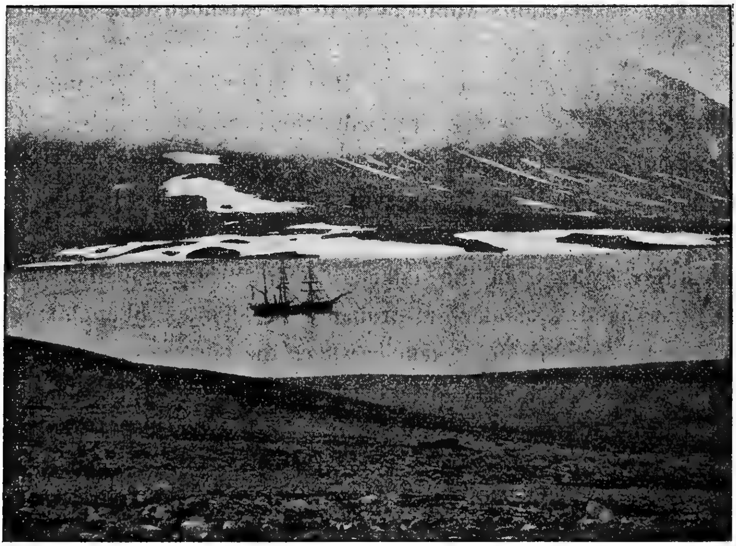

Fig. 33. "Striate earth": sand and gravel arranged by solifluction in regular striæ. Turner Island, in the background Turner Sund and the mainland. (Nordenskjöld phot. 26: 7: 1900.)

moist, the phenomenon was also observed on dry ground. A somewhat indistinct picture of the appearance of this "striate land" is given in fig. 33. There was no further chance during the Greenland Expedition of taking other observations touching its origin, but I have since continued these observations in other places. Here I need only mention that I fully subscribe to Andersson's explanation of solifluction, but for the origin of the narrow regular strips described I consider it necessary for the gliding to take place upon a layer of frozen ground near the surface[1]).

On the nature of the sea-bottom off East Greenland and on the former extension of the ice. One of the most interesting questions to be solved inside the polar circle is to know what particular forces are active here in forming the marine sediments and to what extent, moreover, under different circumstances they differ in the polar regions from those of other regions. In his description of the samples of the sea-floor of our expedition, O. B. Bøggild has given us some extremely valuable contributions to these enquiries[2]). The author shows us how the coarse material in the sea-floor sediment near the shore shows an intimate dependence upon the rocks cropping out in the neighbourhood, which is not the case to the same extent further out to sea. I can only confirm this. When, in dredgings, considerable masses of loose material were often brought up, I examined hundreds of stones and pebbles, though without being able to make exact determinations or calculations. But the general impression is precisely the same as that arrived at by Bøggild after examining smaller but much more numerous samples. Near land at the basalt coast to the S. of Scoresby Sund, the stones consisted almost exclusively of basalt; in the sea off Sabine I. was found a rich alternation of rocks, among which grey gneiss was predominant.

It is unnecessary to refer in detail to the contents of Bøggild's work, and though I should like to touch upon several points, I must content myself with the following general remarks. On the whole the matter is perhaps more complicated than Bøggild supposes. There is no doubt that a large number of icebergs even now drift out from the inner arms of

[1]) A short account of some of the phenomena connected with this appears in my article, "Über die Natur der Polarländer"; Geogr. Zeitschr., 1907, p. 563.

[2]) Medd. om Grønland, XXVIII, 17.

the fjords and carry with them a considerable material of gravel and clay, although in order to pass the fjord-sills they have first to be somewhat reduced in size. But for all that, Bøggild's investigations, as well as earlier observations taken by Bay[1]), seem to show that this material does not, in the main, play an especially great part among the sea-sediment, though this may not hold good for all regions, and it is very hard to form a conception of what the districts are where such ice-berg sediments may be expected. So for instance it seems to me that it by no means follows that when the sea ice in one district, as in the "North Bay", is less compact, melting of *icebergs* cannot take place there on a large scale. Again, Bøggild, in my opinion, undervalues the carrying power of the shore-ice (bay-ice). In the polar regions it is easy to observe that the winter ice nearest the shore — at a distance of a hundred metres and even more — is dark coloured, and covered with a thick layer of fine dust as well as gravel and small stones which have been carried out by wind and streams of thaw water. Here no doubt is possible; though such ice, and especially the pieces on which a coarse gravel is found, is extremely rare out to sea and probably is mostly carried by the coast currents along the shore and soon melts, yet during geological periods it must in favourable places deposit considerable layers. — We may add that it scarcely seems probable that the coast between Gael Hamke Bay and Davy Sund consists of basalt to the same extent as Bøggild's map indicates; it is possible that the sample of bottom-sediment from this region indicates better than he assumes the corresponding rocks of the outer coast-belt.

It seems to follow from Bøggild's investigations, as one of the most important general results, that the sea-bottom off this part of East-Greenland, over extensive tracts and up to a

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[1]) Meddelelser om Grønland, XIX, 186. Especially interesting is sample no. 3 from 69° 41′ N. and 19° 20′ W., in which only basalt occurs.

distance of over 100 km from land, is covered by moraine layers from an older period of much greater ice expansion than now; these moraines are even still in some places said to be determinative for the configuration of the sea-bottom, and the existence of a true terminal moraine is said to have been proved by Ryder and Bay at 74° 17′ N. and 15° 20′ W.[1]), from which it bends "inwards along Hudson's Land", while at Franz Joseph Fjord it again turns further seaward. If this view is correct, the whole district in the ice age must have been covered with a mighty mass of land-ice which, with a continuous front, as we know it to-day only from South Polar regions, forced its way far out to sea. The proof for these far-reaching conclusions is found by Bøggild mainly in the very nature of the bottom samples and in the just mentioned soundings of Ryder and Amdrup off C. Borlase Warren.

It is open to no doubt that during a period of the ice age the fjords were filled up to their mouths with tongues of ice that possibly extended some way out to sea, where they gave rise to icebergs which, as they melted, deposited their moraine material on the sea-bottom to quite a different extent from to-day. It is certainly surprising that this material has not been covered since that time by newer layers, but on this score Bøggild's investigations seem to be conclusive. But from this it is a long step to assume that a land-ice which was rather independent of the local topography of the country should have covered the whole district far out to the sea, a supposition that seems to me highly improbable from other points of view as well.

From reasons I have just mentioned I consider it to be probable that the greater part of Jameson Land was not covered with ice even in the ice age. The topography of Liverpool Land proves that no huge land-ice forced itself across

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[1]) I. e. circa 120 km off C. Borlase Warren. The depth is here 127 Danish fathoms, whereas Amdrup at 74° 18′ N., 15° 25′ W., that is to say only 2½ km farther west, nearer to the land, came upon 162 Danish fathoms.

it from the west. The bulk of its primary rock evidently formed the centre of a particular ice-covering but it has not been overflowed by masses of ice from the west. Again, the surface features of the whole district are rather the reverse of any proof of an ice-covering of so general and comprehensive a nature. I do not, it is true, consider that the old maximum extent of the ice was necessarily determined by the boundary between the peaked outlines and the lower country with its rounded hillocks, but many of the more pointed peaks are of such a kind that one can scarcely doubt that if they were ever covered with ice such a long time has passed since then that the submarine moraine deposits of such a period should now as a matter of course be generally covered with younger layers.

Now it is true that the observations to which I am now chiefly referring were taken in the district south of Franz Joseph Fjord, but it is scarcely imaginable that neighbouring tracts should be markedly dissimilar in this respect. Nor do I hold Bøggild's proofs to be altogether convincing. From the dredgings referred to outside C. Borlase Warren, no sure conclusions can be drawn, since they are derived from various expeditions: a week's journey amid drift-ice is always enough to make the ships position an uncertain quantity to a few nautical miles, and therewith the whole existence of the above-mentioned submarine wall (end-moraine) is uncertain. Nor is it possible to draw any farreaching conclusions if, in a single series of dredgings, at right angles to the coast, the bottom gravel proves to be coarser out to sea than off the coast. That can be explained in several ways, e. g. that once upon a time the ice-bergs within the former coast-belt discharged a more abundant material of coarse gravel somewhat further off the land, or that a covering of moraine gravel was during an ice-period deposited and rather evenly distributed upon the shallow coastal shelf by melting ice-bergs broken off from the glaciers that filled the fjords and which, as a rule, could not get very far away from the place of their origin, but was later covered towards the shore by more recent, finer-grained sediment, which may perhaps derive to a large extent from coast-ice of a more or less local origin.

In these complicated questions a clear result can only be-gained by studying a much more comprehensive material than that brought home by the last expedition, but every definitive elucidation must pay regard to the two factors I have just mentioned, viz. the coast ice, and the ice-bergs; and as for the latter, to their utterly dissimilar natures in different periods. It cannot have been so very long ago, after all, when for instance the Nordvestfjord of Scoresby Sund was filled with an arm of inland ice, and while nowadays only a small number of ice-bergs pass its sill, there is no doubt that during a by-gone period this glacier sent out numerous ice-bergs which in the open sea unloaded masses of moraine material which derived exclusively from primary rocks.

Summary.

The parts of East Greenland that were visited by the Expedition of 1900 are of unique interest by reason of the variations in the formations that present themselves, and because of the excellent opportunities they offer for the study of the effects of the forces that give the polar scenery its characteristic features.

The main part of Greenland — whether we regard it as a continuation of the American continent, or as a territory that is to a certain extent independent — obviously consists of a very old mass, which since the earliest times has bounded the Atlantic depression. It is therefore probable that it is chiefly the coast-belt where we may expect occurrences of younger formations. And accordingly we find there from the

Paleozoic and from the older Triassic time a series of rocks over 2000 m thick, whose characteristic qualities have been described in the foregoing pages. Several formations can be distinguished, but it seems probable that more exact investigations in this respect would take us much further, for though the fossils here are both scarce and badly preserved, experience teaches us that they are not so uncommon as was first assumed and special investigations carried out by an experienced paleontologist should render possible a good exposition of the stratigraphy of the district, especially as the formations in question to a great extent show but comparatively unimportant disturbances and irregularities. For the present, however, it is only possible in the main to distinguish local formations, whose mutual relations cannot be determined with certainty.

The strong analogy that all these rocks show in their appearance, goes to prove that the physical conditions during all these periods were somewhat similar. To what extent already then a shore was present could not be determined. Litoral deposits occur at several levels, but in addition there are formations that must have come into existence in fairly deep water. It is not proved and scarcely likely that any large fault divides the coast-belt from the inner mass, but yet I consider it probable that the occurrence here of these younger formations stands in connection with the appearance of a large fracture line that still marks the coast of E. Greenland. Large disturbances occur, as far as is known, only among the oldest strata, the Silurian formation, and only within certain parts of these. Fresh investigations are required to decide whether we are here in the presence of the traces of an old, folded mountain-chain, or of disturbances in the way of flexures induced by the subsidence of the strata. The sinking, during certain periods, has been accompanied by considerable volcanic eruptions, among the products of which may be noted not only a series of porphyries, but also augite-syenites with appendant dike rocks, among them also alnöite-like eruptives, all forms that have their striking analogies among the eruptives of the Paleozoic epoch on the opposite side of the Atlantic Ocean.

The rocks that date from the Rhaetic age or younger periods until the Eocene, possess quite another character than those just described (cf. p. 185). Throughout it clearly appears that all these rocks are shore formations, with which, too, the occurrence of plant remains at several levels should be connected. From the beginning of the Tertiary period a renewed epoch of volcanic activity entered, which as far as East Greenland is concerned, seems to have been confined to the coast-belt, and there chiefly to the broad mass which at its centre, S. of Scoresby Sund, projects towards the east, an outward bend that seems to owe its existence to just that same cause. Moreover, as is well known, traces of this volcanic activity are found along a broad strip straight across the North Atlantic Ocean. A last trace of the same is afforded in Greenland by the hot spring I came across at Henry Peninsula, in the course of the Expedition.

It was specially interesting to be able, through finds of marine fossils and plant remains occuring together in Eocene beds, to settle not only that this volcanic activity, so important for the North Atlantic areas, was already in full swing at the period mentioned, but that the Tertiary (so-called Miocene) flora, known through numerous finds in different Polar regions, already existed at that time.

It is probable that the land at that or about that period had a far greater extent than at the present time. The country has been subjected to a very extensive valley-formation. Several of the chief valleys can be proved to stand in connection with faults, viz. for instance Hurry Inlet, on the E. side of which friction breccias can be pointed out at several places. That the valleyformation is in part older than the eruption of the basalt sheets is proved by the fact that the latter are not nearly so broken up as the older rocks.

As to the development of the district in other respects during the latter part of the Tertiary age, we know nothing. At its close the ice, as in other areas, pushed forward and gradually covered at least the greater part of the land; along the main valleys it even pushed its way beyond it. During this phase the fjords received their shape, and in the foregoing we have also tried to show to what extent the topography of the country bears traces of the activity of the ice.

Very curious is the area occupied by the southern part of Jameson Land. I have described it in the foregoing (p. 251); it seems as if it had never been covered with connected masses of ice.

During a phase of the post-tertiary period the land was sunk much below the present level. It can be shown that this submergence reached at least 50 to 70 metres[1], but there is reason to believe that it was even considerably greater than this, in any case several hundred metres. But before we can be quite clear upon this point, fresh investigations are required.

On the whole it cannot be doubted that very important geological and geographical results may be obtained in this territory, where we are now beginning to achieve a chartographic basis, and a general knowledge of the district that shows how many interesting questions here await their solution. It is to be hoped that the Danish expedition now sojourning in those parts may return with material contributions to our knowledge of a region surpassed by few in the interest it affords.

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[1]) It was already pointed out by Nathorst that the climate during a period of this submergence was milder than at present, since shells of the *Mytilus edulis*, now extinct in that part, are found at a height of 25 m and above.

Appendix.

For a more detailed examination of the curious minerali-ferous limestones mentioned on pp. 167 and 170, I addressed myself to Dr. O. B. Bøggild, from whose valuable exposition I quote the following[1]):

"Even the purest limestone of which samples were brought back (from the southern valley) contains tremolite and pale mica. As a rule the limestone is very rich in minerals: orthoclase, diopside, chondrodite, titanite, spinel, and possibly quartz, while furthermore biotite, hornblende, and a few minerals that could not be determined, occur. Sometimes the calcite retires and we get large masses consisting of hornblende, pyroxene, biotite and even quantities of scapolite. Pyroxene and hornblende sometimes occur in parallel intergrowths.

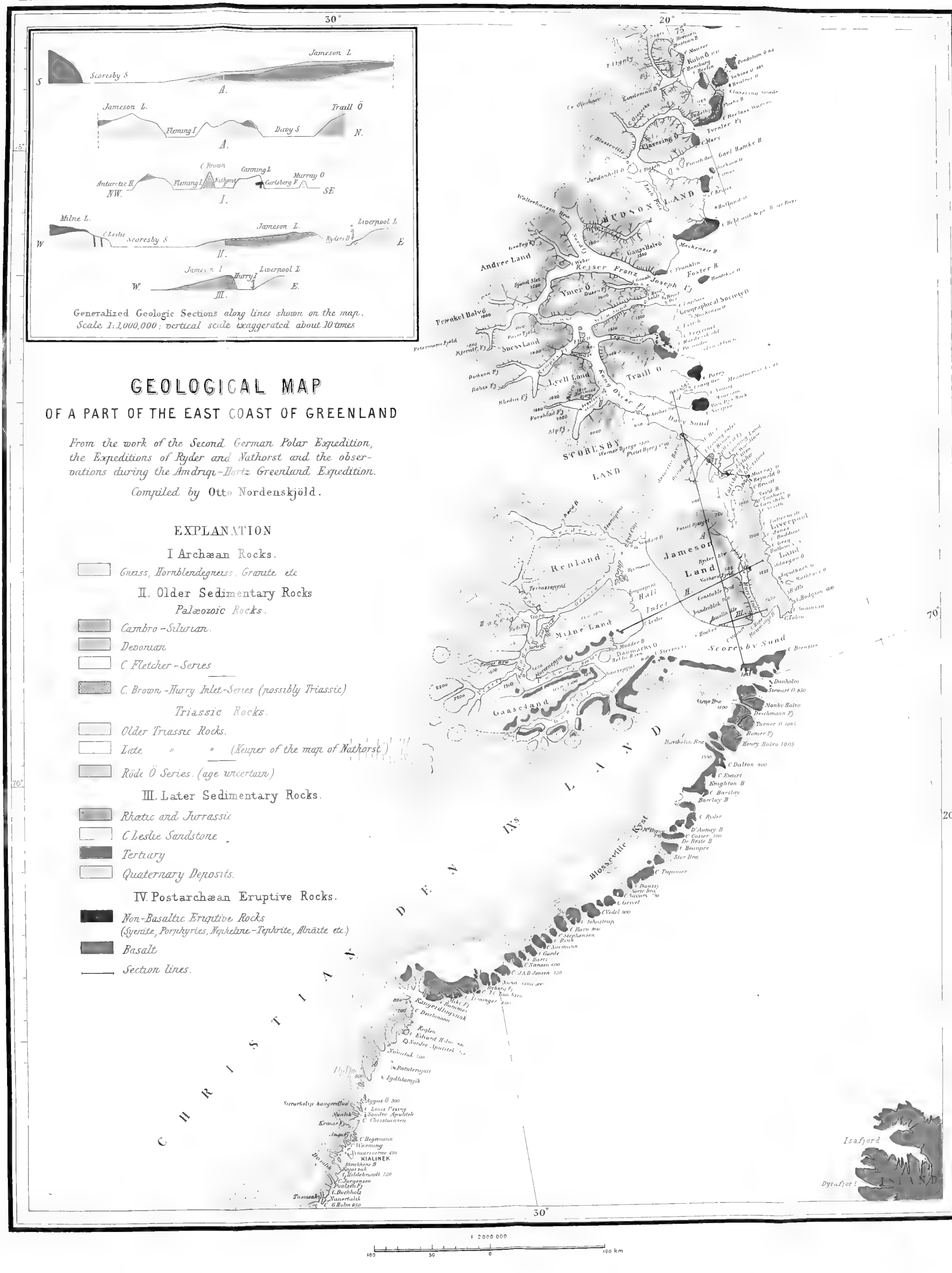
In both occurrences the limestone is traversed by granitic veins which, however, have not given rise to any contact-metamorphosis, though on the other hand the rock-mass is exceedingly varied and peculiar just in the neighbourhood of these. A vein of granite with strongly weathered plagioclase is surrounded on both sides by a narrow belt of similarly strongly disintegrated plagioclase, with its boundary lines well marked against the granite. In this plagioclase there are numerous grains of hornblende, pyroxene, and titanite, and the whole passes over gradually into a mass of predominating pyroxene, though with traces of the other minerals mentioned. Still further out we come across a strip of hornblende, and finally a laminated mass of mica. Peculiar is especially this as it were symmetrically stratified arrangement, which can scarcely be explained by contact-metamorphosis from the granite."

I may add that I am by no means convinced from what I saw that we have to deal here with a young granite. However,

[1]) For this valuable assistance I here express to Dr. Bøggild my sincere thanks.

in one place, in contact with the limestone, I came across what looks like a pyroxeniferous syenite of youngish appearance. Then too there were found veins that may possibly derive from a greatly transformed basic volcanic rock.

Unfortunately I had no opportunity of subjecting to a closer examination those peculiar rocks that I found during an excursion far from the shore, at a place where my attention was greatly struck by the alnöitic dikes and their curious contact phenomena. Still, it may be of interest that attention has been called to these occurrences.



GEOLOGICAL MAP
OF A PART OF THE EAST COAST OF GREENLAND
From the work of the Second German Polar Expedition, the Expeditions of Ryder and Nathorst and the observations during the Amdrup-Hartz Greenland Expedition.
Compiled by Otto Nordenskjöld.
EXPLANATION
I Archæan Rocks.
Gneiss, Hornblendegneiss, Granite etc.
II. Older Sedimentary Rocks
Palæozoic Rocks.
Cambro-Silurian.
Devonian
C Fletcher-Series
C. Brown-Hurry Inlet-Series (possibly Triassic)
Triassic Rocks.
Older Triassic Rocks.
Late " " (Keuper of the map of Nathorst)
Röde Ö Series. (age uncertain)
III. Later Sedimentary Rocks.
Rhætic and Jurrassic
C Leslie Sandstone
Tertiary
Quaternary Deposits.
IV. Postarchæan Eruptive Rocks.
Non-Basaltic Eruptive Rocks
(Syenite, Porphyries, Nepheline-Tephrite, Alnöite etc.)
Basalt
Section lines.
Generalized Geologic Sections along lines shown on the map.
Scale 1:1,000,000; vertical scale exaggerated about 10 times
Scoresby S
Jameson L
Traill Ö
Fleming I
Davy S
Antarctic H.
Carlsberg F.
Murray O
Milne L.
C Leslie
Liverpool L
Hurry I.
Liverpool L
Hudson Land
Andree Land
Kejser Franz Joseph Fj
Ymer Ö
Suess Land
Lyell Land
Traill Ö
Kong Oscar Fj
Davy Sund
Scoresby Land
Jameson Land
Liverpool Land
Renland
Milne Land
Hall Inlet
Scoresby Sund
Gaaseland
Christian den IXs Land
Blosseville Kyst
Kangerdlugsuak
Kialinek
Isafjord
Dyrafjord
Island
30°
20°
70°
1 2 000 000
100 km

VI.

The former Eskimo settlements on the East coast of Greenland

between

Scoresby Sund and the Angmagsalik District.

By

G. Amdrup.

1909.

One of the many interesting tasks that were allotted the «Carlsbergfondets Expedition til Øst-Grønland»[1]) commanded by C. Amdrup and carried out in the years 1898—1900, was that of completing our knowledge of the Eskimo habitation of the East coast of Greenland, and, if possible, gathering ethnological information and making ethnographical collections.

Our knowledge of the Eskimo habitation of the East coast of Greenland is of comparatively recent date. It is true there are allusions in some of the Eskimo tales which might seem to indicate that some of the old Northeners came down to the coast by chance, but no reliable information as to the Eskimo can be obtained through this channel.

The various ship expeditions which were despatched right from the year 1579 (James Allday) down to 1787 (Egede and Rothe) did not add one jot to our knowledge of the East coast of Greenland, inasmuch as none of them reached the coast.

On the other hand the Dane, Peder Olsen Walløe, who went on an expedition in the years 1751—52, succeeded in making his way in an *umiak*[2]) from Godthaab round to the East coast and up along it to 60°56′ latitude[3]).

Here Walløe came across Eskimo in several places, and so he is the first to give us any reliable information about the population of the East coast, just as he is the first white man whom we know for certain to have set foot on the East coast of Greenland.

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1) Meddelelser om Grønland. Vol. XXVII.

2) Eskimo skin boat.

3) Pingel: «Nyere Rejser til Grønland». Grønlands historiske Mindesmærker. Vol. 3. P. 741—749.

Next in order comes the well-known English whaler-captain William Scoresby-jun.[1]).

Almost everywhere where Scoresby landed in 1822 on the stretch between Scoresby Sund (circa 70¹/₄°) and Kap Parry he came across indications that the coast either was, or had formerly been, inhabited by Eskimo. However, he did not come across any living Eskimo.

But when the Englishman Clavering[2]) in 1823 came across Eskimo in Clavering Ö (circa 74¹/₄°), it was but a step to the assumption that the whole coast between Scoresby Sund and Clavering Ö, and probably also the parts to the north, must be inhabited by Eskimo.

The second German North pole expedition[3]) in 1869—70, one of whose vessels, the Germania, overwintered in Germania Hafen (74°30′) in Sabine Ö did not meet any living Eskimo on the stretch between Kaiser Franz Joseph Fjord (73°10′) and Kap Bismarck (77°00′).

Thus when the Danish naval officer C. Ryder in 1891[4]) set out to explore Scoresby Sund the chances were not much in favour of his meeting living Eskimo; and as a matter of fact he met none. But on the other hand in all parts of the vast nexus of fjords he came across numerous indications that these regions had once a fairly large Eskimo population.

And the same holds good of the large nexus of fjords around the Kaiser Franz Joseph Fjord which was carefully explored in 1899 by the Swede Prof. A. G. Nathorst[5]).

As has already been mentioned, the second German North

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[1]) Journal of a voyage to the Northern-Whale-Fishery; including researches and discoveries on the Eastern coast of West-Greenland, made in the summer of 1822 in the ship "Baffin" of Liverpool, by William Scoresby-junior.

[2]) Petermanns Mittheilungen. Vol. XVI. 1870. P. 320.

[3]) Die zweite Deutsche Nordpolarfahrt.

[4]) Meddelelser om Grønland. Vol. XVII.

[5]) A. G. Nathorst. Två Somrar i Norra Ishafvet. Senare Delen.

pole expedition penetrated up to Kap Bismarck (77°00′). But in 1905 Duke Philippe of Orleans[1]) with his ship "Belgica" succeeded in penetrating past Kap Bismarck and landing at Kap Philippe (77° 36′). Here, like the other explorers, Duke Philippe found Eskimo house ruins etc. but no living Eskimo.

It remains only to mention Mylius-Erichsen's expedition, called: "The Danmark-Expedition to the north-east coast of Greenland, 1906—1908". Mylius-Erichsen succeeded in reaching the East coast and placing the «Danmark», the ship of the expedition, in winter harbour at 76°46′ Lat. With the winter harbour as a starting-point sledging expeditions were with splendid audacity and indomitable courage undertaken northwards along the entirely unknown north-east coast. Koch's sledging party reached Kap Bridgeman (circa 83° 30′), while Mylius-Erichsen's sledging party entered Independence Bay at circa 81° 58′ Lat. and 32° 30′ W. Long, three or four Danish miles NE. of Kap Glacier, thus forming a connection with Peary's journeys from the west. The last unknown stretch of coast of the whole extensive coast-line of Greenland had thus been explored, and the last stone laid to a work in which Denmark had taken a prominent part for centuries. But Mylius-Erichsen and his two faithful companions won the prize at the cost of their lives, for they perished on the sledging expedition of which we have already spoken. But the results — in part at least — were saved from destruction. And we thus know that Mylius-Erichsen met with remains of former Eskimo settlements right up at Hagens Fjord (circa 82° 08′).

Whereas previous expeditions had thus shown that living Eskimo were no longer to be found along the stretch of coast from Scoresby Sund and northward, quite different and

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[1]) Zeitschrift der Gesellschaft für Erdkunde zu Berlin. 1905. P. 563.

far more favourable results had been reached on the southern part of the East coast.

Following in the wake of Peder Olsen Walløe the Danish naval officer W. A. Graah had in 1828—1831 made an expedition[1]) from Nanortalik at the extreme south point of Greenland along the East coast to Dannebrog Ö (65° 15′). Along the whole coast he found a scattered Eskimo population, as to which he collected a great deal of interesting information.

But the man who has done more than any other to enlarge our knowledge of the East-Greenland Eskimo is the still living Captain G. F. Holm whose well-known expedition was made in the years 1883—1885[2]). — Like Walløe and Graah he made his way in an *umiak* up along the East coast to about 66° latitude, and here in the so-called Angmagsalik District he came across an Eskimo tribe numbering 400 or more souls which had never at any time come into contact with Europeans[3]). Holm wintered amongst these Eskimo and he spent ten months together with them. He returned home with a magnificent ethnographic collection, and his ethnographic and ethnological studies[4]) will always secure him a place in the front rank of Greenland explorers.

It fell to our expedition to form the connecting link between Holm's and Ryder's researches, as the stretch of coast we were to explore, viz. between circa 66° latitude and Scoresby Sund, had never been trod by a white man.

As regards the southern part of this stretch of coast, viz. right up to circa 68° lat. N., a considerable amount of in-

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[1]) W. A. Graah. Undersøgelsesrejse til Østkysten af Grønland.

[2]) Meddelelser om Grønland. Vol. IX P. 53.

[3]) We find mentioned Cranz "Historie von Grønland" p. 342 § 10 that rumours about this tribe had spread as far back as the eighteenth century down the East coast. On the other hand it must be mentioned that no information whatever as to this tribe had been obtained by Graah.

[4]) Meddelelser om Grønland. Vol. X.

formation had been collected by Holm while he wintered at Angmagsalik; for the Eskimo that lived here had in former times gone on hunting expeditions up along the coast.

But the country from the 68th° of latitude to Scoresby Sund was a terra incognita, at least as far as the Eskimo population was concerned. It might be that the conformation of the coast here was such as to offer particularly favourable conditions for Eskimo existence. In this case it was possible that descendants of the Eskimo who had disappeared from the district north of Scoresby Sund were living here. But if, on the other hand, the coast was uninhabited, it was possible that indications might be found that the Eskimo had wandered down the coast until the attractions of the Angmagsalik District, which to an Eskimo must appear a perfect paradise, had caused them to settle here for good.

However, as a matter of fact, we met no living Eskimo on the whole stretch between the Angmagsalik District and Scoresby Sund. But in many places along the coast we met in the form of ruins of houses, tent encampments, graves etc. indications that the Eskimo had been there.

These ruins of houses, tent encampments, graves etc. now formed the objects of our research. We were fortunate enough at Nualik (67° 15′ 32″) to light upon a house the inhabitants of which were extinct, whereby a large collection of Eskimo implements etc. fell into our hands. And in Skærgaards Halvöen (68° 07′ 20″) we discovered some graves which yielded an uncommonly rich collection. Besides this, smaller discoveries were made in other isolated coast places, as e. g. in Dunholm (69° 54′·9). Altogether the collection which we took home with us was, thanks to the piece of good fortune just spoken of, a fairly rich one, when due allowance is made for the short time the Expedition had at its disposal, the many other tasks allotted to it, and the mode of travelling we were obliged by the nature of the country to adopt throughout the greater part of this stretch of coast.

All the investigations from the Angmagsalik District to Kap Dalton (69° 24'·6), which were carried out on the various boat excursions I made along this coast in 1898, 1899 and 1900, were superintended by myself. The investigations from Kap Dalton to Scoresby Sund were undertaken by the ship Expedition, which, during my absence on boat excursions, was conducted by Dr. Hartz.

In the following pages I shall proceed to give a detailed account of these investigations.

Moreover, I shall give some account of a dwelling-place discovered and examined by lieutenant Koch at Kap Tobin (70° 24'·6), as it presents several points of interest, augmenting, as it does, our stock of knowledge as to the settlements on Scoresby Sund with fresh facts, whereas the more northerly settlements at Kap Borlase Warren and in Sabine Ö did not furnish any new data, and therefore shall only receive a passing mention here.

Now that the whole East coast from Kap Farvel to Kap Bridgeman has been examined, it is no longer a matter for wonder that a large Eskimo population is to be found in the Angmagsalik District, whereas it has completely disappeared from the stretch of coast to the north, and only a scattered population is found along the stretch of coast to the south. For the Angmagsalik District is unquestionably that part of the coast which presents the best conditions for the Eskimo in their difficult struggle for existence[1]). Here we find the largest group of islands of the whole

[1]) See «Meddelelser om Grønland». Vol. XXVII. P. 143.

East coast, leading to the formation of numerous straits and sounds, while large fiords cut deep into the land. The "inland-ice" is thereby forced away from the coast, and, though the large islands are pretty high and rocky, there are numerous points and many small islets which almost seem to call for Eskimo habitation. Moreover, the rushing stream which flows between the numerous islands and through the narrow sounds often keeps them open, even when the great ice lies frozen outside the coast. In this way natural air-holes are formed for the seals, thus facilitating hunting in a high degree, while the current which issues from the sounds and straits assists the "great-ice" to scatter outside the Angmagsalik Fjord quicker than either north or south of it.

Hence it is possible to conclude from the orographic nature of a stretch of coast whether or no it is adapted for Eskimo habitation. And, as a matter of fact, we shall see in the following description of the coast from Angmagsalik to Scoresby Sund that wherever along this line of coast we meet districts resembling that of Angmagsalik, we will find numerous proofs of a former Eskimo habitation, the more numerous, the greater the resemblance, while the proofs get scantier and scantier as the resemblance is smaller.

The coast from Sermiligak[1] (the most northerly inhabited place) to Vahls Fjord resembles the Angmagsalik District in a number of ways. Here we have the great fiord Kangerdlugsuatsiak, besides a number of smaller fiords, numerous islands off the coast, and the "inland-ice" does not reach out to sea. And as a matter of fact this stretch of coast has been thickly populated up to quite recent times. Between Vahls Fjord and Poulsens Fjord lies the great Steenstrup Bræ, and the stretch of coast

[1]) For the description of the coast which follows, consult the map in »Meddelelser om Grønland«. Vol. XXVII. Plates IV, VI, VII and VIII.

between Kap G. Holm and Kap Jørgensen, sloping steeply down to the sea. Here we do not find any Eskimo remains. The stretch between Kap Jørgensen and Søndre-Aputitek again presents tolerably favourable conditions for Eskimo existence, and in fact we find here a number of ruins of houses, tent encampments, graves etc., yet by no means so numerous as further south. From Søndre-Aputitek right up to Kangerdlugsuak the «inland-ice» reaches right out to sea and we could conceive of Eskimo living only on the islands of Patuterajuit and Nordre-Aputitek; and we actually found ruins of houses in the latter island. On the other hand it is improbable that Eskimo have ever lived in the interior of the great fiord Kangerdlugsuak. On the 9th Aug. 1900 we made an attempt to penetrate into the fiord, but a little inside the mouth we were prevented from carrying out our enterprise by icebergs, calf ice, ice-floes and "small-ice". At the mouth of the fiord and outside it we found favourable conditions as regards ice; hence we must assume that the fiord is as a rule filled with masses of ice. On the other hand, on the East side of the fiord close by the mouth we lighted upon quite a large Eskimo settlement on the so-called Skærgaards Halvö. On the stretch of coast from Kangerdlugsuak to Kap Dalton the coast as a whole presents very unfavourable conditions for the Eskimo. The fiords here are as a rule not particularly deep. Many of them are filled with calf ice from the mighty glaciers which flow into them, proceeding, no doubt, from the "inland-ice". And along the whole stretch of coast there is only a single little island — and that inaccessible. Nor did we find during our travels along this coast a single vestige of the Eskimo having lived here or travelled along it. It ought, however, to be borne in mind that we had no opportunity of making anything like a thorough investigation of the fiords, many of which looked by no means uninviting, as the short time at our disposal and the circumstances of the case left us no alternative but to follow the outer line of coast. Thus it is by no means unthinkable that a more thorough investigation would have disclosed traces of Eskimo settlements. But, considering the nature of the coast, I am convinced that only very scattered traces, if any, would be discovered. The coast from Kap Dalton to Scoresby Sund presents rather more favourable conditions for Eskimo settlements, as it possesses several straits and islands. And in fact we discovered the isolated ruins of a house in Stewart Ö, and an entire little settlement in the island of Dunholm.

The following table gives an exact conspectus of the house ruins, tent encampments, graves etc., discovered by us (see pag. 296).

Before I now proceed to give a detailed description of the different settlements, I must begin by stating that, at any rate as regards the settlements examined by myself in person, the time seldom permitted of a thorough-going excavation of the houses. As a rule, we had to confine ourselves to excavating round the place where the lamp had stood, this being the most likely spot for small objects to have got lost for good, men and women having been sitting round here at their work. And in houses where the inhabitants had not died out, we could only expect to dig up objects which had accidentally disappeared. This part of the work fell, as a rule, to Søren Nielsen, as I myself was generally occupied in surveying. After the excavation we examined in common the objects that had been found and deliberated upon what to take and what to reject, considerations of space in the boat compelling us to be very particular in our selection. In this regard I received invaluable assistance from Søren Nielsen, who had lived three years among the Eskimo at Angmagsalik before he joined our expedition, and thus had an opportunity of becoming thoroughly acquainted with the life and ways of this tribe.

No.	Place	Approximate		Number of		
		Lat	Long	House ruins	Tent rings	Graves
	Jærnö SE. side	65°57′·2	35°54′·0	″	1	″
	Smalsund SW. point	65°59′·1	35°50′·9	1	″	″
	Smalsund NW. point	65°59′·7	35°50′·6	″	1	″
	Point close north of Smalsund	65°59′·8	35°50′·6	″	1	″
	Grusö NW. side	66°01′·8	35°44′·5	″	3	″
I	Depotö SW. point	66°06′·8	35°31′·7	4	″	several
II	Depotö N. point	66°07′·2	35°31′·0	2	1	9
III	Eskimoö NE. side	66°14′·5	35°15′·3	3	several	″
IV	Storö NW. side	66°15′·0	35°22′·0	7	several	several
V	Kangerdlugsuatsiak, East side of inlet	66°18′·5	35°27′·8	1	2	1
VI	Nord Fjord, West side of inlet	66°18′·6	35°23′·0	3	″	several
VII	Nord Fjord, East side of inlet	66°18′·8	35°19′·3	4	2	8
VIII	Sarkarmiut	66°18′·2	35°17′·1	3	several	several
	Island just opposite Sarkarmiut	66°17′·6	35°18′·1	″	2	″
IX	Nigertusok North side of inlet	66°17′·6	34°52′·0	1	3	7
	Kap Wandel SW. side	66°18′·8	34°47′·0	″	3	″
	Point on the south side of the gulf north of Kap Jørgensen	66°47′·0	33°48′·5	″	3	″
	Kajarsak W. side	66°48′·5	33°42′·5	″	2	″
X	Lilleö	66°57′·8	33°40′·7	1	2 à 3	″
XI	Kap Warming S. point	67°01′·1	33°33′·6	1	3	″
XII	East point of island between Kap Warming and Langöen	67°03′·4	33°26′·4	3	2	several
	Langöen W. point	67°04′·0	33°25′·2	″	2	″
XIII	Nualik	67°15′·5	33°15′·5	4	8	6
XIV	Nordre-Aputitek	67°47′·5	32°06′·0	3	″	″
XV	Skærgaards Halvöen	68°07′·3	31°34′·0	8	6	many
XVI	Dunholm	69°54′·9	22°38′·5	7	2	″
XVII	Stewart Ö	69°57′·2	22°58′·0	several	″	″
XVIII	Kap Tobin	70°24′·6	21°57′·6	7	″	ca. 2

Besides the above, the settlemenis on Kap Borlase Warren and tn Sabine Ö were investigated. See p. 292.

Nor did time permit of an excavation of the kitchen-middens — except in a few instances. On the other hand we opened and examined almost all the graves we came across.

I. The settlement on the SW. point of Depotö was built on a little point jutting out into the sea. Several small rocky islets lay off this point at a distance of about 100 yards, and the point itself was cut off from the rest of the island by a ravine descending with precipitous sides to a depth of from three to six metres. The passage-way from one of the ruined houses came to an abrupt end just where the ravine lay, which shows that the ravine did not exist at the time when the house was inhabited.

This circumstance, however, did not give us any clue to the age of the house, as the ground crumbles away with extraordinary rapidity along this coast[1]).

In the settlement there were four houses with the following dimensions.

House No.	Inner length of		Inner breadth from back wall to passage-way	Length of passage-way	Magnetic direction of	
	Back wall	Front wall			Back wall	Passage-way seen from within
	m	m	m	m		
1	5·3	4·7	3·5	5·3	NNE–SSW	ENE
2	3·1	2·2	3·8	5·3	E—W	S
3	4·7	4·4	3·5	5·6	E—W	SSW
4			2·2	5·0	NW—SE	NE

All the houses wore the appearance of age, especially No. 4, which was so dilapidated that the length of the front and back wall could not be measured.

The house must at any rate have been very small. Amongst the houses we discovered a number of carved pieces of wood, but nothing of particular interest. House No. 1 was excavated, and yielded the following objects: an ellipsoid stone such as the Eskimo use as a hammer, a Dutch bead, a few pieces of a whalebone, and a few carved pieces of wood.

The surrounding graves all consisted of a stone chamber. One of them, which was situated on a little high rock close

[1]) C. Kruuse. »Naturforholdene paa Østgrønlands Kyst mellem 66° og 67° 22′ Br.» Geografisk Tidskrift. 15. Bd. 3—4. Hefte. Pag. 64.

by the point, was particularly neat. It was rectangular, and its dimensions were: 1·6 metres in length and 0·6 metres in breadth. The walls, which were built up of flat stones, had a height of 46 centimetres. The grave was covered over with flat stones, and one of its longitudinal walls was partially formed by a fall in the rock. In the grave there were four skeletons. In one corner there were two carved pieces of wood stuck into the ground. Opposite the end of one of the longitudinal walls and along it, there had been built a little square chamber with sides measuring 0·6 metres and with a height of 31 centimetres. At the bottom of the chamber lay a nondescript remnant of bone.

II. The settlement on the North side of Depotö was situated on the point between Depot Fjord and the sound which separates Depotö from the mainland. We made only a brief landing here. Seal bones in a high state of decomposition and a few carved pieces of wood lay about the houses and in the immediate vicinity of the houses lay the graves.

III. The island, Eskimoö, about 200 metres in height, on the NE. side sloped down towards a strip of low-lying and rather fertile ground, which shot a number of small, gently sloping, smooth points out into the water; better spots for hauling up *umiaks* and *kaiaks* could hardly be conceived. Thus the place was excellent for Eskimo settlements. However there were only three houses; on the other hand, traces of numerous tent-rings indicated that the place must once have been a favourite summer resort. The dimensions of the house were as follows:

House No.	Inner length of		Inner breadth from back wall to passage-way	Length of passage-way	Magnetic direction of	
	Back wall	Front wall			Back wall	Passage-way seen from within
	m	m	m	m		
1	4·7	4·1	3·8	6·0	ESE—WNW	NE
2	7·2	6·3	4·1	4·4	ENE—WSW	N
3	3·8		3·1	4·7	NE—SW	E

All the houses were rather old, No. 3 being in fact of considerable age. An excavation of the houses yielded nothing but some mouldering woodwork. Outside one of them there lay remains of bones of whales.

IV. The settlement on the NW. side of Storö lay at the end of a valley which extends across the island. There were no less than seven houses. Their dimensions were:

House No.	Inner length of		Inner breadth from back wall to passage-way	Length of passage-way	Magnetic direction of	
	Back wall	Front wall			Back wall	Passage-way seen from within
	m	m	m	m		
1	5·6	5·3	3·5	5·6	NNW—SSE	SW
2	2·5	2·5	3·5	5·6	NNW—SSE	SW
3	4·1	4·1	2·8	4·1	N—S	W
4	3·1	2·8	3·5	5·3	E—W	N
5	6·9	6·6	3·5	6·6	ENE—WSW	SSW
6	2·8	2·2	3·5	6·6	ENE—WSW	SSW
7			Impossible to measure			

All the houses looked very old, though No. 5 and 6 did not appear to be so old as the others. House No. 2 was built within No. 1 and house No. 6 within No. 5. The way in which this was done was that two side-walls, almost parallel with the original side-wall, were built within the original house; while the old front and back wall and passage-way were used for the new house. House No. 7 was so old and tumble-down that it could not be measured. It looked as if it had been divided into two rooms; it seems to have been built in two stages, the larger room having been built first, and the smaller one subsequently built within it. Bones and pieces of wood lay scattered about among the houses.

V. The ruined house on the east side of the mouth of the great Kangerdlugsuatsiak Fjord was built on a little rocky point. This house, too, looked to be of a considerable age. Close by it there was a play-ground for children. The dimensions of the house were:

Length of back wall	4·4 m
— - front wall	3·8 -
Breadth from back wall to front wall	3·8 -
Length of passage-way	4·4 -
Direction of back wall	NW—SE
— - passage-way seen from within	SW.

VI. On a narrow strip of ground at the foot of the high rocks on the peninsula between Kangerdlugsuatsiak and Nord Fjord there lay three houses close to the mouth of the fjord. On the hill slopes behind the houses and in the vicinity there was an unusually luxuriant vegetation. The dimensions of the houses were:

House No.	Inner length of		Inner breadth from back wall to passage-way	Length of passage-way	Magnetic direction of	
	Back wall	Front wall			Back wall	Passage-way seen from within
	m	m	m	m		
1	2·8	1·9	2·8	4·1	ESE—WNW	SSW
2	9·7	8·1	4·7	7·2	ESE—WNW	SSW
3	2·8	2·5	2·8	5·3	ESE—WNW	SSW

The excavation of houses No. 1 and 2 brought to light a number of well-preserved pieces of wood and fragments of iron which had almost rusted away. As the soil was extremely damp from the water which poured down from the hill slopes, the presence of these fragments of iron show that the houses cannot be particularly old, as in fact is also indicated by their appearance. On the other hand house No. 3 looked to be of considerable age. In house No. 1, there were remnants of a little toy pot made of a mica-slate and in house No. 2 the remnants of a pot and a few carved utensils of bone, none of them, however of particular interest.

VII. A little inward of the barren rocky point on the East side of the Nord Fjord there lay four ruined houses, the dimensions of which were:

House No.	Inner length of		Inner breadth from back wall to passage-way	Length of passage-way	Magnetic direction of	
	Back wall	Front wall			Back wall	Passage-way seen from within
	m	m	m	m		
1	3·8	3·8	4·1	6·0	ENE—WSW	N
2	5·6	5·6	4·1	5·6	E—W	N
3	3·0	2·8	3·1	3·8	ENE—WSW	N
4	1·9	1·6	1·9	4·1	NE—SW	N

Houses Nos. 1 and 2 looked to be in extraordinarily good preservation, and yet they were undoubtedly of a considerable age, as the stones in the walls were everywhere covered with black lichens. House No. 3 looked to be very old, while No. 4 had a fairly new appearance. Nos. 2 and 4 were of a peculiar construction: The passage-way did not start as usual from the middle of the front wall, but away from the East end of the house.

VIII. The houses at Sarkarmiut were all very large, but were not measured. In one of the numerous surrounding graves was discovered a little wooden box with pieces of bone more or less roughly carved, and in another grave a little stone pot (child's toy).

IX. The ruined house on the north side of Nigertusok close to the mouth of the fjord presented the appearance of considerable antiquity, but was not investigated in detail.

X. In Lilleö there was a house the building of which had evidently been abandoned, for some reason or other, soon after it was commenced. The walls, which were about half a metre in height were constructed entirely of stone. The house was a very small one:

Inner length of the back wall	1·9 m
Breadth from back wall to passage-way	2·2 -
Length of passage-way	2·0 -

Fig. 1. The house at Nualik, where the Eskimo became extinct. (Phot. by G. Amdrup.)

XI. On the southernmost point of Kap Warming there were very well-preserved remains of an Eskimo house of unusually large dimensions:

Inner length of back wall	11 m
— — - front wall	10 -
Breadth from back wall to passage-way	4·1 -
Length of passage-way	5·6 -
Longitudinal direction of back wall	N—S.

The house looked uncommonly new, and about the two blubber-tanks outside the house there were still some not entirely coagulated remains of blubber which had flowed out over the stones.

XII. On the other hand, the three houses on the East point of the island between Kap Warming and Langöen were undoubtedly of some antiquity. One of them was fairly large and the two others pretty small. One of the two tent-rings which we saw here was somewhat peculiar, as it was formed like a stone rampart.

XIII. The settlement at Nualik is of unusual interest, as we here chanced upon an extinct Eskimo colony. Among the four houses which were found here, there was one which was in such a good state of preservation, that with a few slight repairs it might almost immediately have been used to live in (Fig. 1). All the walls were completely preserved, and likewise the passage-way, except the first metre of it. Only the roof had partially fallen in. The house lay in a valley extending across the little narrow peninsula between the Kruuses and Solos Fjords. It was built up along an evenly sloping surface of rock, and the mode of construction was quite the same as that which is used in the Angmagsalik District[1]. The walls were of stone and sods. From one of the side-walls to the other there lay a heavy block of drift-timber resting on wooden supports in the interior of the house. Between this cross-beam and the front and hind walls there lay other beams of drift-timber. Above the whole rafter-work had been laid thick sods covered with skins. In the front walls there were three window openings. The passage-way struck out almost at right angles to the front wall, somewhat nearer to one of the side-walls than to the other.

The entrance to the house lay through the passage-way, which was 7 metres in length and 1 metre in height and the bottom of which lay about half a metre below the floor of the house.

[1] Meddelelser om Grønland. Vol. X. P. 66.

The inner dimensions of the house were:

Length of back wall	8·1 m
— - front wall	6·5 -
Breadth from back wall to passage-way	3·6 -

Along the whole length of the back wall extended the wooden platform, divided into 7 compartments. On each side wall there was a little platform, and outside the window openings there were likewise platforms.

The very appearance of the house struck us at once. But when among the big heap of bones outside the house amid the skulls of narwhals, bears and dogs we found also human skulls, it dawned upon us that this settlement must have been the scene of a terrible tragedy. All the inhabitants must undoubtedly have fallen victims to some awful catastrophe — famine or poisoning. When we entered the house our misgivings received only too true a confirmation (Fig. 2—3).

On the platform along the backwall there lay skeletons or parts of skeletons, and along the outer edge of it there were remains of the long black hair of the Eskimo's heads. There were still in several places so many remnants of skin that we were able to picture to ourselves how the inhabitants had once lain comfortably between two bearskins, the upper one with the hair downwards; for the bones lay between these skins.

On the five lamp platforms stood the lamps and the stone pots. The drying-hatches above them had fallen down, but remains of bear-skin clothes still lay on them. Under the platform there were chip-boxes and square wooden cases, and on the stone-paved floor large urine and water tubs. In front of one of the small side platforms there was a blubber board, and a large well carved meat trough, and scattered about the floor there lay wooden dishes, blood-scoops, water-scoops, and large and small wooden cases. And besides this, there were specimens of practically all the bone and wooden utensils which belong to an Eskimo house.

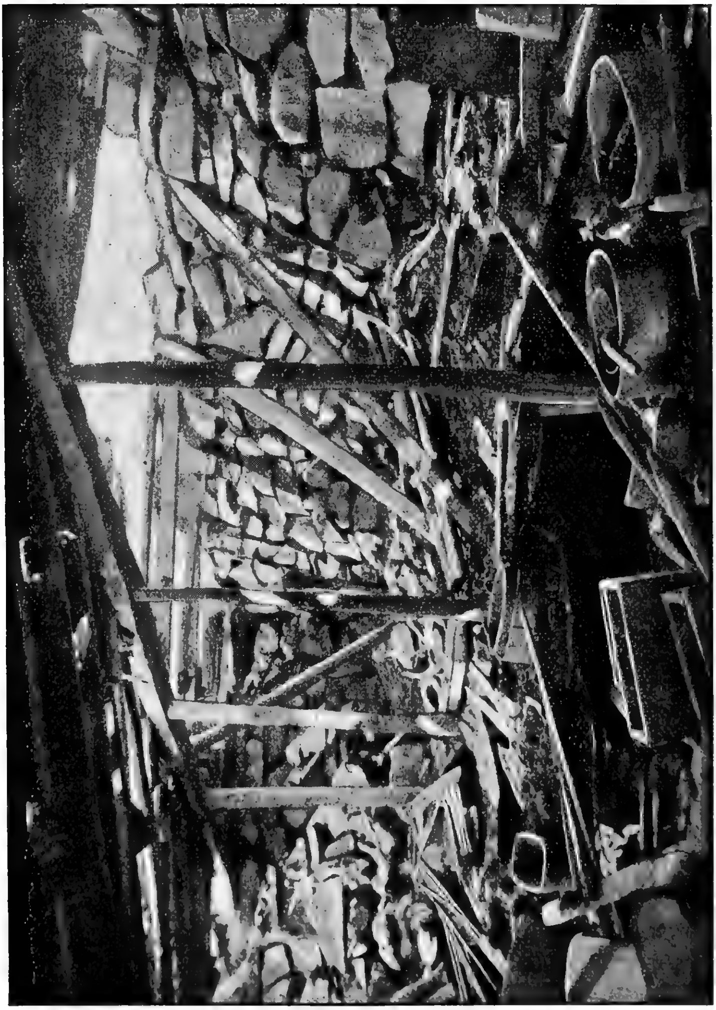

Fig. 2.

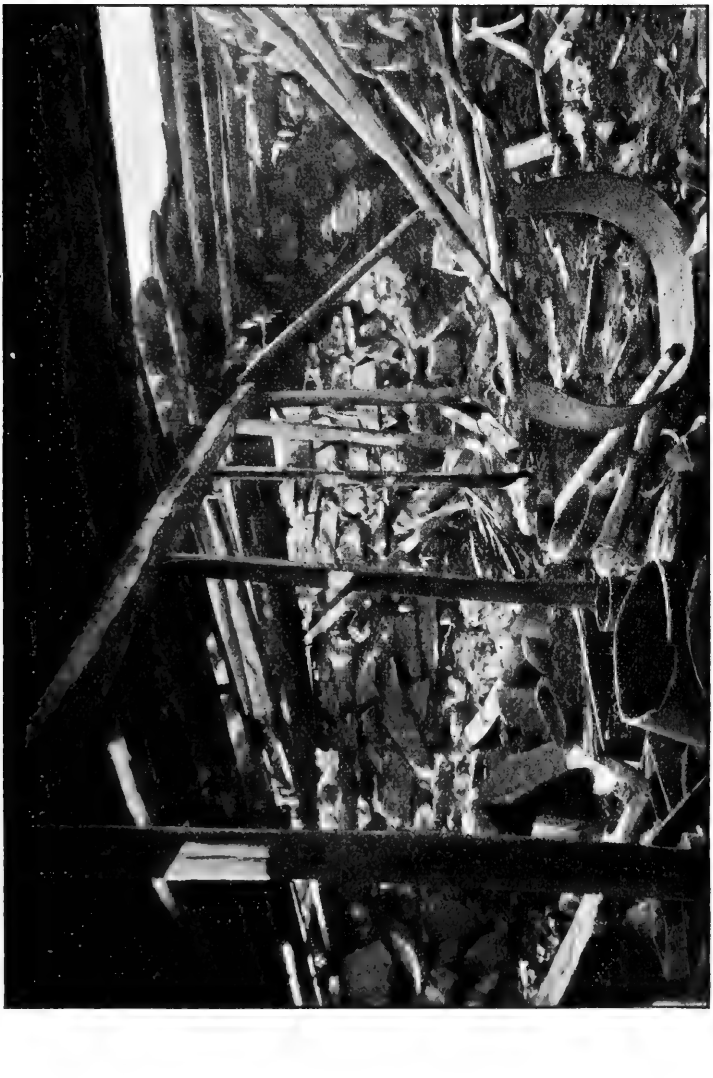

Fig. 2—3. The interior of the house at Nualik, where the Eskimo become extinct. (Phot. by C. Kruuse.)

Near the house, sheltered by an perpendicular wall of rocks, two metres high, there stood four long heavy stones placed edge-wise. It was on top of these stones that the *umiak* had rested. Fragments of the wooden frame still lay round the props. Between these and the rock walls there lay the remains of at least three *kaiak* frames. Scattered among these there were bone mountings for *kaiaks* and for all kinds of hunting implements. Further there lay remains of sledges, parts of tent-frames etc.

Round about, carefully covered up with stones, there lay wooden pieces, more or less carved, which were to have been parts of new *kaiak* frames, hunting implements, or other kinds of implements and utensils.

Now, how many individuals did this colony number? Probably at least thirty, for inside the house there were at least eleven skeletons and outside it we found nine skulls, all of which appeared to belong to adults. And this number seems to agree with the size of the house.

And how did they perish? Doubtless by poisoning. For when we excavated one of the surrounding blubber-tanks we discovered large pieces of still fairly fresh blubber and under one of the stone pots a dried ringed seal flipper. The poisoning may have been brought about by semi-putrid meat, which the Eskimo regard as a delicacy. Instances of such cases of poisoning with a fatal termination are well-known among the Eskimo at Angmagsalik. It is also conceivable that the inhabitants may have eaten poisonous things cast up by the sea. Thus inside the house there was an old conical tin box which had been opened at the narrow end, a proof that this had been done by hands unfamiliar with such objects. But it is by no means out of the question that they may have died of starvation. For famine often weakens and emaciates the people to such an extent that they die even if they still have some blubber left, and we know from G. Holm that in the winter of 1881—82 and again in 1882—83 famine prevailed at the various places along the East coast of Greenland[1]).

Another far more interesting question is: Where does this colony come from? Could they possibly be descendants of the Eskimo from the north who had met their death on their southward journey? In that case the discoveries would be of great interest. But the very appearance and arrangement of the house militated against this supposition. Moreover, all the utensils and implements that were found were exactly like those used in the Angmagsalik District. Far more probably they were the sad remains of the little group of about thirty souls, mentioned by G. Holm, who in 1882 had travelled north from Angmagsalik and had not been heard of since[2]). This supposition received confirmation when we returned to Angmagsalik after completing our boat-trip. For here there were still many surviving who had known the Eskimo who had set forth in 1882. We showed the ethnographic collection with which we had returned to four of them, and they each recognized several of the objects. There was particularly a blood-stopper, with a neatly cut man's head, which they all assigned to a particular person whom they all called by the same name. And yet I had given none of them a chance of conferring together before I cross-examined them.

Although I am thus quite convinced that the extinct colony was identical with the little band of Eskimos that started out from the Angmagsalik District in 1882, I nevertheless consider it right that scientists who are interested in the question shall have a fair chance of judging themselves as to the ethnographic materials brought back from Nualik. The greater part of this collection will therefore be reproduced in illustrations in connection with the general description of

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1) Meddelelser om Grønland. Vol. X. P. 162—164.
2) do. do. Vol. X. P. 56.

the ethnography of the Angmagsalik District. It will then be possible to compare the representations of objects from "the dead house" with the representations of G. Holm's excellent collection from Angmagsalik[1]).

Unfortunately the scanty space at our disposal in the boat did not allow of our returning with the whole rich collection which was to be found at Nualik. We had to confine ourselves to taking with us all the objects carved in bone, most of the smaller, and a few of the larger, objects carved in wood.

XIV. Nordre-Aputitek is, according to G. Holm[2]), the northernmost place which the Angmagsalik Eskimo are known to have inhabited. Holm's informant was an Eskimo of the name of Kunak, who had lived three years in those parts as a boy. When I reached Angmagsalik in 1900 after having visited Nordre-Aputitek, Kunak was still alive. He was then an old man, well over sixty, from which I was able to conclude that the ruined house in Nordre-Aputitek must be between fifty and sixty years old. For on the whole island there was only one ruined house, situated on a little fertile point on the SW. side of the island. Its size precluded the possibility of its having been inhabited after Kunak by Eskimo from the North. The appearance of this settlement has thus served me as a guide in estimating the age of other settlements.

The ruined house itself lay on a site on which two other houses had previously stood, so that the island must have been successively occupied by different sets of inhabitants. A luxuriant coat of verdure mantled the whole ruin. Outside it there were a large number of bones of bears, seals, dogs and narwhals, pieces of wood lay strewn about, and one of the fragments of skin which we found had the hair still adhering to it.

[1]) Meddelelser om Grønland. Vol. X. Tavler. New edition in preparation.
[2]) do. do. Vol. X. P. 222.

XV. The barren Skjærgaards Halvö, which is about 125 metres in height, is connected by a rather narrow low tongue of land with the high mountanous country that lies behind it. Numerous small promontories jut out from the west side of the peninsula. Off it there lie a number of small skerries and islands.

Here there were no less than eight ruined houses, six tent-rings, and numerous graves. The state of the houses showed clearly that they had not all been simultaneously inhabited. Four of them were so dilapidated that they could not even be measured.

The dimensions of the remaining four were:

House No.	Inner length of		Inner breadth from back wall to passage-way	Length of passage-way	Magnetic direction of	
	Back wall	Front wall			Back wall	Passage-way seen from within
	m		m	m		
1	3·1	..	3·8	6·6	..	W
2	2·8	..	3·1	3·1	..	W
3	3·6	..	3·1	5·0	..	W
4	1·9	..	2·8	3·8	..	W

These four houses were constructed throughout of stones which the builders had fitted together as best they could. No. 1 was in an unusually good state of preservation (Fig. 4). Here the platform along the back wall was built up of large flat stones: presumably they did not possess any great abundance of wood. Nos. 2 and 3 were built together, one of the side-walls being common to them both.

The excavation of the houses yielded no result whatever. The graves, on the other hand, gave a rich harvest: we found a good many different implements in four different graves. In two of them the objects lay in a little chamber built outside the grave, but forming part of it, being joined to the side of the graves where the legs lay. In the third grave the objects lay within the grave itself: at the fourth, which evidently was a child's grave, there lay a child's sledge on the top of the grave under some flat stones. Several of the graves were very neatly constructed. In one of the graves we examined, the corpses seem to have lain fully dressed. We found remains of hairy bear- and seal-skins and of dried

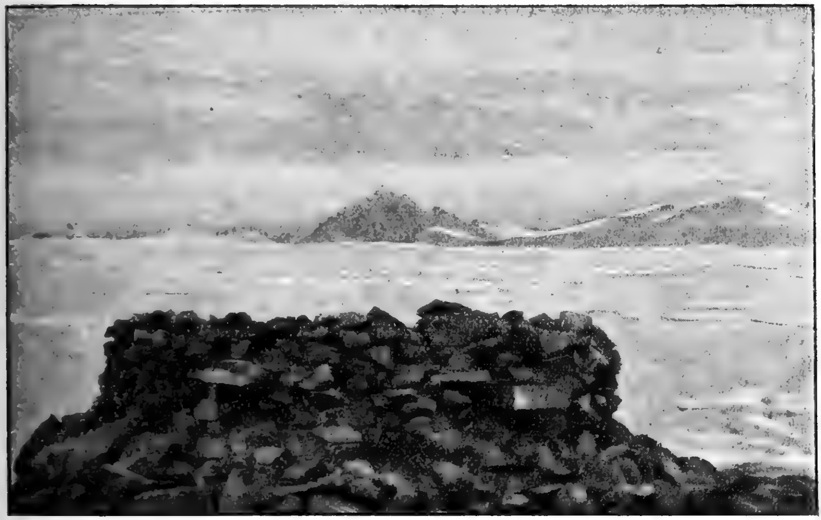

Fig. 4. Ruins of an Eskimo house (No. 1) at Skjærgaards Halvö. (Phot. by G. Amdrup.)

skins. To the heads, which in other respects were mere skeletons, long black hair still adhered.

Round about the houses there lay bones in a high state of putrefaction, and a number of old pieces of wood, all of them of such an appearance as to leave no doubt that it must have been much longer since human beings lived in Skjærgaards Halvö than in Nordre-Aputitek.

XVI. On the little island of Dunholm, which was only about 30 metres high, there were on the top of the island not less than seven ruined houses, grouped in a ring about a little water-wheel. Down by the shore there lay, besides, a couple of tent-rings.

Two of the houses were excavated and yielded, considering the circumstances, a comparatively rich harvest. Measurements, however, were not taken[1].

XVII. At the spot where Stewart Ö pushes a spit of land into the glacier which shoots out from the mainland in the direction of the island, were observed on a little point some ruined houses almost right out by the glacier[2].

XVIII. All the previously mentioned settlements lie on the stretch of coast explored by the expedition and hitherto unknown, while the settlements on Kap Tobin lie in the Scoresby Sund District, which had been visited on several previous occasions. The settlement itself, however, had never been visited before, and as it presents several points of interest which add considerably to our previous knowledge of Scoresby Sund, it shall, as was promised above, receive a particular notice here.

As to this settlement Lieutenant Koch has furnished me with the following information: —

"It had more or less the shape represented below (Fig. 5). About 200 metres north of the settlement there was an extensive burial-ground. The graves were not counted, but there were certainly over twenty of them. The measurements of one of the best preserved graves were: length 1·6 metres, breadth 0·6 metres, depth 0·35 metres (inner measurements). The graves were built up of stones which fitted well together. The roof was formed of flat stones resting on two drift-timber logs. It contained a number of human bones scattered about

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[1]) Meddelelser om Grønland. Vol. XXVII. P. 164.
[2]) do. do. Vol. XXVII. P. 280.

pell-mell, and a few animal bones, among them a bone of a whale. The bottom seems to have been covered with gravel.

Out of the houses II and IV were particularly well preserved, while the two smallest houses V and VII looked to be the oldest. The roofs, however, had sunk in, while the walls remained throughout their whole length above the ground (the foundation granite). The passage-way in IV was completely

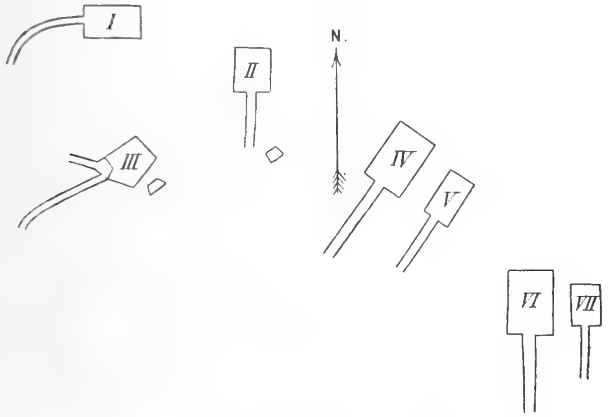

Fig. 5. Sketch of the settlements on Kap Tobin.
(Drawn by J. P. Koch.)

preserved, in II only partially. In I and III the passage-ways curved towards the south (cf. Scoresby's sketch of the settlements at Kap Stewart[1]).

Huts II and III were measured; in the accompanying sketch (Fig. 6) the measurements are given in metres. The broken line *ABC* in III is a well-built wall, which did not seem to give access to the interior of the house. In the corner *D* there was a distinct recess.

[1]) Journal of a voyage to the Northern Whale-fishery by William Scoresby-junior. P. 210.

An excavation of house II brought only a few trifles to light; on the other hand, more considerable discoveries were made in and near three kitchen-middens east of the settlement, viz: 2 human skulls, 2 almost intact three-legged chairs, 1 wooden tub, 1 iron knife with a wooden haft, 1 iron harpoon point in a bone setting, various bone implements and harpoon points, 1 *kaiak* scraper, a number of carved pieces

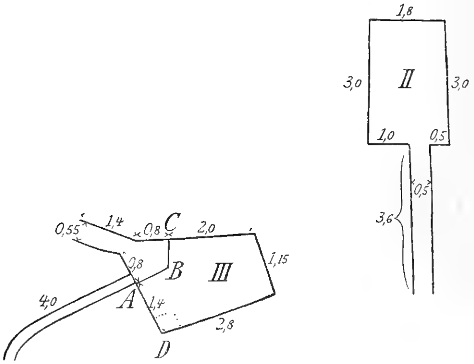

Fig. 6. Sketch of house No. II and III on Kap Tobin. (Drawn by J. P. Koch.)

of wood, and finally a few toys, such as a bear and a bird carved in wood, 1 walrus, 1 duck, seals, and a couple of toy harpoon points in bone. The kitchen-middens were filled with large quantities of reindeer hair; on the other hand the wool of musk-oxen and other remains of these animals were not to be seen.

About 1 kilometer east of the settlement there were two cairn-like stone buildings (bee-hive shaped); (cf. Scoresby's observations at Kap Swainson[1]). In the best preserved of

[1]) Journal of a voyage to the Northern Whale-fishery by William Scoresby-junior. P. 210.

these only the upper stone had fallen down and lay in the interior of the building. The inner dimensions of the whole cairn were:

Diameter at the bottom	1·5 m
— 1 metre over bottom	1·8 -
Height	1·9 -

In the interior of the cairn there lay a few fragments of bone, probably animal bones.

Dr. Nordenskjöld, who also landed at Kap Tobin, believed from Koch's description of the cairns that they were analogous with three others which he had found further north.

In the vicinity of the two cairns close to the settlement there were ten fox-traps, about 1 metre in length and 15 cm in depth and width (inner measurement)." —

It will be seen that house No. III presents the peculiar characteristic that there were two passage-ways, a short and a long one, and that a kind of little front chamber was formed by the wall *ABC*. Koch observes that this wall did not seem to lead to the interior of the house, but that an excavation might possibly have brought such a thoroughfare to light.

My personal opinion, however, is that the house must originally have had only one passage-way, viz. the long one, while the short passage-way and the wall *ABC* must have been constructed after the house had ceased to be lived in. The little chamber that was thus formed was presumably used as a cache, or as a work-shop, and accordingly had no thoroughfare to the interior of the house.

Thus at Nualik I found close to the "dead house" (mentioned above) a small covered chamber built up the side of a perpendicular rocky wall, having about the same dimensions as the above. On the floor there lay a number of comparatively fresh and unbleached shavings of wood, as well as a few newly carved accessories for *umiaks* and *kaiaks*, so that the room probably was used as a kind of work-shop.

Koch observes that the passage-way in houses I and III curved towards the south, and refers us to the settlement at Kap Stewart found and described by Scoresby, where the passage-ways in three of the ten houses discovered curved towards the south, while that in the other seven houses faced south without curving.

Scoresby's idea was that the Eskimo always made the passage-way face south in order to obtain the greatest possible amount of the sun's heat, and at the same time have it facing away from the direction of the prevailing wind.

My experience, however, has been that the direction of the passage-way has nothing to do with the four points of the compass, but that the determining factor is the desire of having the easiest possible access to the sea, while at the same time consideration must be paid to the lie of the plateau on which the house is built.

Thus, when the longitudinal wall in house I is built at right angles to the longitudinal wall in house III, this is probably due to the lie of the plateau, and the passage-way is curved in order to give ready access to the sea.

The recess which Koch found in one of the corners of house III was probably a store-room in which meat and blubber were kept. In two of the houses examined by Ryder store-rooms of this kind were found under the stone pavement[1]).

Another interesting discovery in this settlement were the bee-hive-shaped cairns, quite the same kind as those found by Scoresby at Kap Swainson. They were probably used as store-chambers.

Finally a few there are among the ethnographical objects discovered which had not previously been found in Scoresby Sund.

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[1]) Meddelelser om Grønland. Vol XVII. P. 298.

Thus on the stretch between the Angmagsalik District and Scoresby Sund we found about 60 winter houses. The following general description holds good of them all with a few exceptions.

The houses are rectangular with parallel back and front walls. The front wall is almost always a little shorter than the back wall, which causes the side-walls to converge slightly. All the walls are perpendicular. The passage-way strikes out as a rule from the middle of the front wall, perpendicular or nearly perpendicular to it. The length of the passage-way given above for each house merely indicates that the passage-way must have had at least that length; but in many of the houses we measured it must undoubtedly have heen longer.

The lie of house is never determined according to the four points of the compass; the decisive factor for the inhabitants seems always to have been ready access to the sea. The building materials are stone and turf, in a few places only stones; in the latter case, however, the interstices have perhaps been bunged up with moss or snow.

In the above particulars the construction of the houses is in complete accordance with that employed both at Angmagsalik[1]) and at Scoresby Sund and to the north of it[2]).

But if we consider the dimensions of the houses, we shall find that on the stretch of coast from Angmagsalik to Nordre-Aputitek there are houses of very varying size, ranging from the size employed in the Angmagsalik District to that employed at Scoresby Sund and to the north of it. Out of the fifty houses Ryder found at Scoresby Sund the largest was 2·7 × 3·8 metres, the smallest 1·6 × 2·5 metres, being thus houses only intended for

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1) Meddelelser om Grønland. Vol. X. P. 66—69.

2) Meddelelser om Grønland. Vol. XVII. P. 296. — A. G. Nathorst. Två Somrar i Norra Ishafvet. Senare Delen. P. 342. — Die zweite Deutsche Nordpolarfahrt. Vol. I. P. 520.

one family, while Holm gives the length of the houses occupied in 1884 as ranging between 7·5 and 15·7 metres, and the width between 3·8 and 5·0 metres, several families living in each of these houses. I must observe, however, that during my stay in the Angmagsalik District I have come across ruined houses of smaller dimensions than the above, though none of such small dimensions as in Scoresby Sund.

Ryder believes that the Eskimo are not extinct in Scoresby Sund and the districts to the north of it, and he therefore upholds the theory that the population little by little have journeyed further south, and that these people or their descendants have reached Angmagsalik and the southern part of the East coast. We know from G. Holm that the inhabitants of Angmagsalik have made journeys right up to Nordre-Aputitek, whereby the occurrence of large houses on this stretch of coast receives a ready explanation. But it seems to me that the existence of the small houses right away from Scoresby Sund to the Angmagsalik District to some extent confirms Ryder's hypothesis, although it is possible that small bands of Eskimo may have died out in the district about Scoresby Sund. Thus, in the settlements at Kap Tobin the inhabitants have in all probability died out. In a kitchen-midden east of the settlement Koch found two human skulls and, in spite of the short time at his disposal, made a comparatively rich haul of ethnographic objects.

It is necessary, however, to be very cautious in drawing conclusions from the size of the houses as to the peregrinations of the Eskimo; for the size of the houses is no doubt determined by local circumstances and not by any peculiarity of the different tribes. Everywhere where it is feasible we find several families living in one house. For it is evident to the practically-minded Eskimo that it is in every way best for several families to live together in one house. The individual will not be so much subject to chance in the way of bad hunting luck, as the housemates go share and share alike, while it is also more economic as regards light and warmth. Again from a social point of view life is certainly more pleasant when several families are gathered together in one house.

Thus among the Point Barrow Eskimo as a rule two families, and often more, live together in one house[1]).

Similarly, in the stone houses of the Central Eskimo there live two or three families together. In their snow-houses there always live two families, and two snow-houses have often the same passage-way, so that, properly speaking, four families live together[2]).

Among the Smith Sound Eskimo we frequently find that two stone huts are built so close to one another that by means of a wide opening in the common partition wall they are joined into one[3]). And finally the West Greenlanders used always to live several families in the same house[4]), and the East Greenlanders do so to this very day.

But in order that several families may be able to find room in one stone house, it must be fairly large. But in this case a comparatively large rafterwork will be required for the construction of the roof, whereas for a small house only a few rafters will be necessary; in fact rafters can be dispensed with altogether, and the house can be built entirely of stone. Examples of this latter are the old Eskimo stone houses on Lake Hazen in Grinnell Land[5]), the stone houses in

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[1]) Ethnological results of the Point Barrow Expedition by John Murdoch. P. 72.

[2]) The Central Eskimos by Dr. Franz Boas. P. 539.

[3]) E. Astrup. Blandt Nordpolens Naboer. P. 235.

[4]) H. Egede. Det gamle Grønlands nye Perlustration. P. 63.

[5]) Greely. Three years of Arctic Service. Vol. I. P. 379—380.

Northumberland Island[1]) off the Gulf of Inglefield and in Karnah on the same fjord[1]), as well as several other places on Smith Sound. It is in fact the want of wood which has undoubtedly been the determining reason why the Eskimo in many places have had to resort to stone houses[2]).

That the Eskimo in Scoresby Sund did not possess any great amount of drift-timber will be gathered, amongst other things, from the fact that the rafter-work in most of the houses examined by Ryder was partially composed of whale ribs and large whale bones. Moreover, it is patent that the longer the ice lies frozen in the fjord and along the coast, the less drift-timber will be washed ashore. This circumstance by itself is sufficient to account for the fact that the drift-timber will be found in larger quantities at such places as e. g. Angmagsalik than further north. Another important factor is that the main arm of the stream which flows from the Polar Sea runs in a curve a little west of Spitzbergen down towards Jan Mayen, until just south of that island it is forced closer in to the East coast of Greenland[3]). It is a well-known fact that large quantities of drift-timber are to be found on the island of Jan Mayen, and when in the year 1900, we entered the ice-belt, at circa 74° lat., we came across a great deal of drift-timber in the edge of the pack-ice, while only a small quantity was seen inside the ice-belt.

Thus, if we imagine the present inhabitants of Angmagsalik to have migrated northwards, the houses must by the force of circumstances inevitably get smaller and smaller; but, on the other hand, we should hardly expect to find the quite

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[1]) Robert E. Peary. Northward over the great ice. Vol. I P. 108 and Vol. II P. 269—272, respectively.

[2]) H. Rink. The Eskimo tribes. Meddelelser om Grønland. Vol. XI. P. 11.

[3]) See the author's observations on this head in Meddelelser om Grønland. Vol. XXVII. P. 141.

small houses of the Scoresby Sund pattern right out at Angmagsalik. The occurrence of these houses seems to me, therefore, to furnish a proof, however slender, of the Scoresby Sund Eskimo having migrated south. Further we find an isolated indication that this movement went on little by little, in the fact that in the settlement on the NW side of Storö we find two of the small houses built within the sites of the larger houses.

As to the motives for this movement, Ryder writes: "In spite of the fact that Scoresby Sund, and to some extent, its interior ramifications, during a great part of the year afford the Eskimo good opportunities of acquiring the means of subsistence, there will nevertheless be a long period, viz. from the time the ice gets thick and is covered up with snow till the seals begin to appear upon the ice, that is from December to May, during which it will certainly be difficult for an Eskimo to procure the game necessary for the support of his family; and this circumstance, taken in conjunction with the Eskimo's innate love of travelling, may account for the fact of their having once more moved out to the outer coast and thence further south".

If we add to this that the Angmagsalik District is unquestionably the best district for seal-hunting on the whole East coast, as the hunting can go on there practically the whole year round, and that the drift-timber which is of such vital importance to an Eskimo, is found here in far larger quantities than further north, and further that the climate is far milder here than in the stretch from Scoresby Sund to the north, it seems to me that it is almost a matter of course that a movement of the Eskimo from the north to the south must take place in the course of time, whereas a movement in the opposite direction would be far less conceivable.

It might be added in further proof that the accounts which G. Holm received from the inhabitants of Angmagsalik as to musk-oxen and reindeer having lived in the Angmagsalik District in former times[1]) must certainly be regarded as a tradition which has its origin in the fact that their forefathers had once lived in districts where these animals occurred[2]). It is true that the stone-wall at Kulusuk mentioned by G. Holm as being intended for the purpose of stalking reindeer, and subsequently photographed by W. Thalbitzer, seems to make against this theory. But, for the present, I am inclined to doubt whether this wall was really used for stalking reindeer. For during the fifteen years during which the colony at Angmagsalik has existed, in the course of which time it has been visited by several expeditions, not the slightest trace has been found that might seem to indicate that these animals had lived in the Angmagsalik District, whereas in practically all the kitchen-middens in the Scoresby Sund district, reindeer bones, pieces of reindeer horn etc. were discovered[3]). But if this view is correct, it likewise points to the conclusion that the forefathers of the Angmagsalik Eskimo must once have lived in the district from Scoresby Sund to the north.

In conclusion I shall mention just one factor which may also be supposed to have been at work in the Eskimo's southward migration. As Ryder has pointed out, the musk-ox can hardly have occurred in very large numbers when the Eskimo were living at Scoresby Sund, whereas reindeer must at that time have been found in great multitudes. But as regards the reindeer it has been ascertained by the expeditions sent out during the last ninety years that there has been a considerable fluctuation in their numbers. And there are various

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[1]) G. Holm. Meddelelser om Grønland. Vol. X. P. 53 og 84.

[2]) This possibility has already been broached by Ryder in Meddelelser om Grønland. Vol. XVII P. 304 and later by H. Winge in the same work. Vol XXI P. 474.

[3]) Meddelelser om Grønland. Vol. XVII. P. 324.

circumstances which seem to indicate that the same fact holds good of the musk-oxen[1]).

This fluctuation in the numbers of the reindeer took place at a period where at any rate the great mass of the Eskimo must have left these regions, and is thus not due to human pursuit.

The cause of this fluctuation, as Winge points out, has not been fully elucidated. Nathorst[2]) believes that the decrease in the numbers of reindeer which has taken place in recent times, is due to the appearance in these regions of the polar wolf from the North, who is practically exterminating them. S. Jensen, on the other hand, holds the view that though the decrease is certainly due to the polar wolf, the animals are not being exterminated, but merely driven into the mountain regions in the interior of the fjord. And in fact an actual extermination of them is hardly conceiveable, but we may imagine such a large decrease that the polar wolf gradually passes over to other districts for want of game, in order perhaps to return again when the numbers again begin to increase. An interaction of this nature is by no means unthinkable.

But if we suppose that such an invasion of wolves took place while the Eskimo were living at Scoresby Sund, this fact, in conjunction with the chase, would soon cause the reindeer to become a rarity to the Eskimo, and the migration southwards to the far better sealing grounds would then be still more easily intelligible.

And perhaps we do not need to have recourse to the polar wolf at all to explain the serious decrease in the numbers of the reindeer while the Eskimo were still living in these parts. For the mere hunting of them may perhaps have been

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[1]) S. Jensen. Meddelelser om Grønland. Vol. XXIX. P. 24—27 and 35. — H. Winge. Same work. Vol. XXI. P. 458.

[2]) Två Somrar i Norra Ishafvet. Senare Delen. P. 329.

sufficient to decimate them severely or drive them away, as has happened on the West coast.

But whereas, according to what has been set forth above, everything goes to prove a movement of the East coast Eskimo from north to south, we are compelled to assume that the immigration to the East coast of Greenland must have taken place from the North.

This view was originally tentatively put forth by Rink[1]), but has afterwards been backed up with several weighty proofs by G. Holm, C. Ryder and W. Thalbitzer, all of whom, as is known, have visited both the East coast and the West coast.

Thus Holm pointed out that the East Greenlanders (the Angmagsalik tribe) in artistic skill approach much more nearly to the West Eskimo than to the West Greenlander[2]).

Ryder comes to the conclusion from an examination of the ethnographic objects discovered in 1891—92 that the former inhabitants of Scoresby Sund must have most in common with the north-west Eskimo tribes, the Eskimo of Point Barrow[3]).

Finally W. Thalbitzer has shown by his admirable linguistic studies that the northernmost dialects on both sides of Greenland resemble one another more than they resemble the dialects on the West coast of Greenland between 71° and 60° lat. (or 71°—64° lat.)[4]).

Among the authors who support the theory that the

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1) H. Rink. Om Grønlands Indland og Muligheden at berejse samme. P. 1. — do. Eskimoiske Eventyr og Sagn. P. 44. — do. Eskimoiske Eventyr og Sagn med Supplement. P. 153.

2) Meddelelser om Grønland. Vol. X. P. 153.

3) — — Vol. XVII. P. 343.

4) — — Vol. XXXI. P. 40—43 and 186. — W. Thalbitzer. Eskimo dialects and wanderings. P. 109—10 in XIV. Internationaler Amerikanisten-Kongres 1904.

immigration to the East coast of Greenland took place from the North may be mentioned Schultz Lorentzen[1]), H. Simmons[2]) and A. Hamberg[3]), while Fridtjof Nansen maintains the opposite view[4]).

That neither Lockwood[5]) nor Peary[6]), the only two explorers who have visited the North coast, have found traces of Eskimo habitation proves nothing, as both of them travelled on the sea-ice along the outer coast. For, if a journey was made in a similar manner, e. g. from Sabine-Ö to Scoresby Sund, a stretch which is quite as long as Peary's longest sledge-journey, no traces of Eskimo habitation would be found. And yet we know that in the fjords along this stretch a busy Eskimo life has prevailed.

I shall now conclude with a few words as to the tent-rings and graves which we found on the stretch between Angmagsalik and Scoresby Sund.

The tent-rings did not present any points of interest. On a flat and even site there lay in a circle the stones which had once served as weights to keep down the part of the tent-skin which lay on the ground. Only one of the tent-rings on the East point of the island between Kap Warming and Langö formed an exception, being built in the form of a low rampart of earth and stones. G. Holm mentions that this form of tent-ring is occasionally used in the Angmagsalik District. It will thus be seen that the tent-rings we discovered were of exactly the same nature as those in the Angmagsalik District[7]) and Scoresby Sund[8]), as indeed might have been expected.

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[1]) Meddelelser om Grønland. Vol. XXVI. P. 289.
[2]) Ymer 1905. P. 186.
[3]) Ymer 1907. P. 22.
[4]) F. Nansen. Eskimoliv. P. 12.
[5]) Greely. Three years of arctic service. Vol. I. P. 295—347.
[6]) Bulletin of the geographical society of Philadelphia. January 1904.
[7]) Meddelelser om Grønland. Vol. X. P. 71.
[8]) — — Vol. XVII. P. 302.

The graves invariably lay in the immediate vicinity of the houses, and in no place did we find the graves lying some distance out towards the mountains, as is occasionally found on the West coast[1]).

The graves discovered by Ryder likewise lay hard by the houses. The graves were as a rule quite detached, so that they could easily be perceived. They were sometimes built up along a rock wall, or one of the walls were formed by a terraced ledge in the surface of the rock[2]). As a rule they were constructed with great care.

In most cases several persons had been buried in the same grave. In several places we found utensils buried with the corpse. These lay either within the grave itself, between the stones which formed the covering of the grave, or in a little chamber in one of the sides of the grave.

Finally there remains to be mentioned a highly remarkable stone construction in the Moræneö.

A rectangle, 7·5 metres long, and 4·4 metres broad, had been formed with 27 stones. The interstices between the stones were nearly of the same length. This construction lay in the extinct glacier bed on the NW. side of the island, not far from the coast line, and with its long side parallel to the coast. Could it be some Eskimo or other who had commenced building a house there but afterwards abandoned the project? Not far from it we found a number of putrefied seal bones. The stones were too large for the construction to have been erected by children.

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[1]) Meddelelser om Grønland. Vol. V. P. 21—25.
[2]) — — Vol. XVII. P. 339.

21—5—1909.

VII.

Ethnological description

of

The Amdrup Collection From East Greenland

comprising objects found in
Eskimo house-ruins and graves
north of Angmagsalik between 68° and 75° lat. N.

By

W. Thalbitzer.

1909.

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1. Preface and Introduction.

> The maxim, "Where there's a will there's a way", is quite true among the Eskimo.
> O. T. Mason [1]).

The ethnographical collection which the Carlsberg Fund Expedition to East Greenland which was made in the years 1898—1900 under the command of Lieutenant *G. Amdrup*, brought to Copenhagen, comprises a series of 'finds' of artefacts from the coast between *Ammassalik* (on the map *Angmagsalik* [2])) and Sabine Island, or between $65^1/_2°$ and 74° 30′ lat. N. on the East coast of Greenland.

On those parts of the coast which were visited for the first time by a European expedition, were discovered the ruins of several Eskimo settlements, the inhabitants of which had deserted them long since, or else had died out. These places were subjected to a thorough investigation for archaeological purposes, in accordance with the plan of the Expedition. A number of the settlements were discovered within the Ammassalik district, only some few to the north of it. I reckon the Ammassalik district to extend as far to the north as the coast is known by the sole surviving Eskimo of this coast, the inhabitants of the neighbouring fjords, Ammassalik and Sermilik (at about $65^1/_2°$ lat. N.) — namely to Kangerdlugsuak, 'the great

[1]) Mason III, 242.

[2]) The East Greenland form of this name is *Ammattaling*, but in the West Greenland dialect the name is pronounced thus: *Ammassalik*, in the misleading rendering of Kleinschmidt's orthography *Angmagsalik*.

fjord', at about 68° lat. N., 31° 35′ long. W. (opposite to Iceland). The barrenness of the stretch of coast, which extends 300 miles to the north of this district, between Kangerdlugsuak and Cape Brewster (at the entrance to Scoresby Sund), is illustrated by the fact that only 3 former Eskimo settlements with about 20 houses were discovered here; while further to the north, in the vast fjords of Scoresby Sund and Franz Josephs Fjord and northwards to Shannon Island, which lies 300 miles to the north of Cape Brewster, 25 settlements with over 100 houses are known through the discoveries of earlier expeditions; so that it would seem that the population was in former times larger to the north, where the coast of Greenland (about half-way up it) curves round in a due northerly direction than South of Cape Brewster, where it falls away in a NE/SW direction.

As regards the distribution of the former population south of Cape Brewster, I must refer the reader to the tables given by G. Holm and Amdrup in "Meddelelser om Grønland" vol. X, 183—200, and XXVIII, 296 (this volume); as for Scoresby Sund, detailed information will be found in Ryder's paper (Medd. om Grønl. Vol. XVII, 286). In the table that follows (pag. 333) I have put together the facts which I have been able to glean, on the basis of the reports of previous expeditions, with regard to the distribution of the population north of Cape Brewster.

Geographically, as well as from the point of view of its contents, the Amdrup collection falls into two parts. One part consists of objects found north of the Kangerdlugsuak fjord; the population is considered to have become extinct only a few generations back. The second part consists of objects excavated within the Ammassalik district itself, and for the most part belonging to the same culture which we know from the present inhabitants of this district.

The commander of the Expedition, G. Amdrup, lieutenant (now captain) in the navy, conducted in person the excavations of the house-ruins, graves, and rubbish heaps in which the objects

Ruins and relics of the former population
discovered by earlier expeditions in N. E. Greenland between Cape Brewster (70° lat. N.) and Shannon Island (75° lat. N.).

Locality of settlements and authorities quoted.	North Lat.	Number of winter-huts	Number of tent-places	Graves
Scoresby Sund................	70°			
Ryder: 7 winter settlements[1]...	..	50	many	many
Amdrup: 1 winter settlement, Cape Tobin....................	..	7	several	
Amdrup: Cape Brewster[2]......	..	..	several	
Scoresby: Cape Swainson[3].....	..	..	several	
— : Cape Hope[4].........	..	..	several	
— : Cape Stewart[5] (cf. Ryder)	..	..		
Traill Island...............	72°			
Scoresby: Cape Mewburn[6].....	..	..	2	
— : Cape Simpson[7]......	..	..	over 50	
— : West of Cape Simpson[8]	..	several dozens of old huts and ground-plots of summer-tents		
King Oscar's Fjord and Franz Joseph's Fjord:				
Nathorst[9]...................	..	6	6	
Cape Broer Ruys (Hold-with-Hope)..................	73° 30′			
Koldewey[10]; **Nathorst**[11]........	..	several	several	
Clavering Island.............	74°			
Koldewey: Cape Mary[12]........	..	several	several	several
— : South-western side of Clavering Island[13].........	..	23		
Cape Borlase Warren.........	74° 20′			
Koldewey[14]..................	..	2	several	several
Nathorst: between Borlase Warren and Flache Bay[15].........	..	..	several	
Sabine Island...............	74° 32′			
Koldewey: Southern side[16].....	..	3 or 4	many	
— : South-east of the ruins[17]	..	..	..	10
— : Southern side[18].....	..	..	many	
Klein Pendulum Island.......	74° 40′			
Koldewey[19]..................	..	3		
Shannon Island.............	75°			
Koldewey: Southern side[20].....	..	many	..	many
— : Western side[21]......	..	..	many	
— : Northern side[22].....	..	..	many	

[1]) Ryder 286. [2]) Amdrup, Medd. om Grønl. 27, 175. [3]) Scoresby 185. [4]) Id. 203. [5]) Id. 205, 208 Pl. VI. [6]) Scoresby 247. [7]) Id. 247. [8]) Id. 266. [9]) Nathorst 254, 256—258, 263, 292, 294; the map. [10]) Koldewey 685. [11]) Nathorst 172. [12]) Koldewey 610—615. [13]) Id. 616. [14]) Id. 607. [15]) Nathorst 154. [16]) Koldewey 589—590. [17]) Id. 594. [18]) Id. 606. [19]) Id. 597, cf. 335. [20]) Id. 330. [21]) Id. 330. [22]) Id. 598.

were found. The excavations of the more northerly localities, where Amdrup himself was not present, were conducted by Dr. *Deichmann*, the doctor and entomologist of the Expedition. After the return of the Expedition, *E. Ditlevsen*, painter and draughtsman, supplied a series of designs of the objects found. A detailed report of the Expedition will be found in "Meddelelser om Grønland" XXVII (Copenhagen 1902).

On my return home in 1906 from Ammassalik, where I had wintered for the purpose of collecting linguistic and folkloristic material, I was called upon by the *Commissionen for Ledelsen af de geologiske og geographiske Undersøgelser i Grønland* to prepare not only the results of my own journey, but also a description of the Amdrup collection, for publication in "Meddelelser om Grønland". I hesitated at first to undertake work of a kind which lay outside the special line of study I had hitherto pursued. On the other hand, I was moved by the consideration that the publication of the Amdrup collection had already been sufficiently delayed. This interesting collection surely deserved a better fate than to be forgotten. Further than this, in my capacity of linguist, I was sensible of the advantage of obtaining a better insight into the forms assumed by the material culture of the East Greenlanders; for changes in the implements often run parallel to changes in the language, and the Ammassalimmiut, in fact, have their own particular designations for many of their Eskimo implements and utensils. An exact knowledge of the objects and their modifications will always come in useful in studying a people's linguistic designations of these objects.

During my two journeys to the West and East coast of Greenland, I had had an opportunity of acquiring a first-hand knowledge of the implements and mode of life of the Greenlanders. When I was now shown the highly weathered objects from North East Greenland which lay on two tables in the building of "Det kgl. Danske Videnskabernes Selskab", arranged and docketed by Amdrup according to the localities where they were found, they presented to me a familiar appearance. The lifeless objects seemed to me in their dumb language to call upon me to furnish a solution to the following problem: — In what relation do these objects, which testify to a primitive culture of seemingly great antiquity in the arctic regions of East Greenland, stand to the present Eskimo culture which you know from the southern part of the same coast? Is there in the peculiar forms of implements and the peculiar designations of the Ammassalimmiut any reminiscence of a culture which can be interpreted only in the light of this northern culture?

The Amdrup collection was particularly well adapted for a study conducted with the solution of this problem in view, as it comprises characteristic samples of both cultures, the northern and the southern. The task undeniably appeared easier then than it eventually proved to be, after I had begun to get into the subject and make comparisons in details and in essentials with the implements of the Western Eskimo and the neighbouring tribes. The task grew in magnitude in proportion as I succeeded in extending my knowledge in theory of the ethnology of the Eskimo and Indians, especially by visits to the ethnographical museums at Berlin, Vienna, Stockholm, Christiania and Copenhagen. In all these museums there are considerable collections from Greenland, the largest being in Copenhagen and Stockholm. I have studied the following collections from North East Greenland: that of the "*Second German North Pole Expedition*" (Germania, commanded by *Koldewey*) in the Museum für Völkerkunde in Berlin; that of the *Swedish Expedition* (under *Nathorst*) collected by Dr. *Hammar*, in the Stockholm Riksmuseum; the objects collected by *Norwegian Whalers* in the Ethnographical Museum at Christiania; and *C. Ryder's* collection from Scoresby Sund in the National Museum at Copenhagen. Among the collections of the latter museum is now included that of *Amdrup* from the southern districts of North-East Greenland.

I hope that the following description of the objects found may, in part at least, contribute to elucidate the position of the East Greenland types of implements in the Eskimo ethnology as a whole.

The objects of the Amdrup collection, which are published here for the first time, exhibit the North East Greenlanders as participators in the same extreme Arctic culture as that which we know especially from the most northerly West Greenlanders and from the Point Barrow Eskimo in Alaska.

The particular correspondences between the North East Greenlanders and the Point Barrow Eskimo which Ryder[1]) deemed himself, on the basis of his material from Scoresby Sund, to have detected and proved, turn out partly to be due to error (his fragment of a "throwing-stick" is not a throwing-stick at all; cf. *inv. Amdrup No. 99*) and partly, in my view, to have no signification beyond the fact that the two cultures both have their seat high up in the arctic regions, and have been evolved under the same natural conditions. Thus there are no adequate grounds for assuming any special relationship between these two Eskimo 'tribes', or a direct immigration in olden times of the Point Barrow Eskimo to East Greenland. Furthermore our knowledge of the past culture of the Eskimo races which dwelt between these two remote regions is far too slight to warrant such an assumption.

There exists no connected account of the material culture of the great group of Eskimo dwelling at about the same latitude, around the mouth of the Mackenzie River. Still more meagre is our knowledge of that extinct Eskimo culture of which

[1]) Ryder, Meddelelser om Grønland, Vol. 17, 343.

the sole witness are the numerous ruins in the islands in the North Canadian Archipelago[1]); these islands form the most northerly bridge between the western Eskimo and Greenland. An archaeological investigation in that region might possibly throw light on several obscure points: thus e. g. the remarkable resemblance between the drum-handles (in the Amdrup collection) of the North East Greenlanders and those of the Alaska Eskimo seems to call for an explanation. My own theory is that the North East Greenlanders and their forefathers long after their severance in the remote past from the common Eskimo race, must have numbered families and individuals for many generations who were particularly conservative in their manner of working certain objects.

The conservatism of the North East Greenlanders is not incompatible with their participation in certain innovations (i. e. typological peculiarities which distinguish them from other Eskimo), which are also met with in West Greenland and especially to the north: e. g. the special varieties of woman's knives, ice-scrapers, needle-cases, bodkins, combs, wooden buzzes, harpoon heads used in sealing on the ice (*inv. Amd. 10*), perhaps also the winged harpoons (with a bone weight at the butt end of the wooden shaft, formed like two feathers), a small toy model of which was found by Ryder[2]).

These points of correspondence might seem to indicate that the north-easterly group of Eskimo in Greenland must have belonged to the same mother tribe as that from which the northern West Greenlanders (Upernawik, Oommannaq, Disko Bay) derive their descent. But the time when the groups lived together and could exert an influence on one another must lie very far back in the past; for within the population of the West coast, nay within the three northerly districts on the

[1]) See "Map of the territories occupied by the Eskimo now and in earlier times", in Meddelelser om Grønland, Vol. 31 (1904).

[2]) Ryder, l. c. 314, Fig. 14.

West coast just mentioned, pronounced differences, both liguistically and anthropologically, are observable, particularly between the Upernawik Eskimo and those further south.

On the other hand, we find in North East Greenland certain forms of implements which differ in certain particulars from the West Greenland types, and seem to point further to the west. This is the case with the sledges, the bone foreshafts of the larger weapons, the drum handles made of bone, perhaps also the ornamental teeth used as belts and necklaces. In the remarkable preservation of these types, we see a decided manifestation of conservatism, more so in this part of Greenland than on the West coast, where the immigrated Eskimo probably soon came into contact with Europeans (the Icelanders in the Middle Ages), or for other reasons modified at an early date certain of those implements which were typically common to the whole race.

Side by side with these indications of great antiquity in the culture of East Greenland, there are others which point to independent innovations. We find here a quaint wooden implement (*inv. Amd. 99*) the nature and use of which is unknown, probably some kind of boring or stabbing instrument, which is found only in North East Greenland, though in a sufficient number of specimens to allow of its being set down as a fully developed form of implement invented within this group of Eskimo during the time when they were settled on the East coast. The loose bone points on the shaft of the bird-dart have also a characteristic feature, a lateral barb on the outer side, which is peculiar to the North East Greenland type. The low key-shaped ridge which passes across the under side of the sealing-stools, nay the whole form of this implement, seems to have been characteristic for this region of the Eskimo world. The pattern of the buckle used by the kaiaker for holding the skin skirt round the man-hole in the kaiak tight about his body is found in several places within this stretch of coast, but not elsewhere. These things are characteristic of the material culture of the North East. Let alone such purely individual features as the peculiar form of the large, elegant, ivory comb (*inv. Amd. 86*), the ornamented bone handle of a woman's knife (*inv. Amd. 45*), and several of the carved bone animals. By such manifestations of originality these objects testify that this north-easterly Eskimo group, after having been isolated from the rest of mankind, passed through a vigorous development of its own.

Finally, in the implements from this corner of Greenland we meet with certain features which point to a special continuity between the northern and southern culture of the coast, an ancient connection long since broken off between the Northeners and the inhabitants of the south i. e. the population of the Sermilik and Ammassalik fjords at $65^1/_2°$ lat. N., or the *Ammassalimmiut.* The highly developed culture of this intensely isolated group, which was discovered for the first time 25 years ago, and soon afterwards was made known to the world by its discoverer's, *G. Holm's*, account of "Konebaads-expeditionen" and "Skitse af Angmagsalikerne", occupies a position apart in the Eskimo world. A number of the types of implements, ornaments, and traditions which in their main features they have in common with all other Eskimo, have been individualised and transformed by them in accordance with their own personal taste and requirements, so that their culture has thereby received a stamp of its own which distinguishes it from all others. As it cannot possibly have been influenced from without, it is with all its peculiarity genuinely Eskimo. However, we know that from past times (the Egedes actually mention the Easterners) up to the present day there have been restless spirits among them, individuals of roving temperament, by whose journeys this heart of the East coast has been brought into a remote connection with the most southerly Eskimo of the coast, nay even with the West Greenlanders in South Greenland. Thus the people of Ammassalik have in recent times adopted a modern form of kaiak (with perfectly straight stern) which has superseded their old-fashioned type (with upturned stern); similarly they have modified certain implements used in connection with the kaiak, for instance the receptacle for the harpoon line on the kaiak deck, perhaps also the types of their harpoon heads. It is, at any rate, a matter of certainty that the typical harpoon heads which the people of Ammassalik now use, differ considerably from those which have been found in the ruins and graves in the northerly districts of the East coast; as to this the Amdrup collection gives distinct testimony. The same is true respecting the base end of the loose foreshaft (*inv. Amd. 11* and *12*).

But what is of particular interest to us here, is that, in spite of these and other divergences, certain of the individualising features which characterize the culture of the people of Ammassalik are found recurring in implements from the northernmost part of the coast. A crucial case are the three small specimens of ivory ornaments for attachment, which were found in Sabine Island, 9 degrees of latitude north of Ammassalik. For this kind of ornamentation is otherwise not known at all from any Eskimo district other than Ammassalik[1]). But the 'wing-harpoon' (inv. Ryder), the characteristically jointed woman's knife (*inv. Amd. 45*), the urine tub (*inv. Amd. 52*) the flat bodkin (*inv. Amd. 32*), the round ivory pearls, (*inv. Amd. 111—112*), the wooden toy buzz (*inv. Amd. 113*), perhaps also the drill with its accessories (*inv. Amd. 77—78*), and the thimble-guards (*inv. Amd. 46—48*) all exhibit such surprising similarities to the corresponding implements used at Ammassalik, that the resemblance cannot be accounted for by a mere coincidence.

Comparison seems to show that there is a *continuity* in the material culture along the whole of this coast, though, to

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[1]) G. Holm in «Meddelelser om Grønland» X, 151—153; Pl. XXX sqq.

be sure, but a *partial* one. For most of the features which are peculiar to the northern culture are at present unknown to the people of Ammassalik. Out of the old-fashioned and to some extent characteristic harpoon heads of the Northeners, there is only one, the specimen assumed to be a harpoon head for sealing on the ice, which has a near relation to the south. The mysterious wooden implement with harpoon-shaped head, the club-shaped bone foreshafts for harpoons (*inv. Amd. 73—75*), the needle-cases, the drum handles of bone, the old-fashioned patterns of the ornaments incised in ivory are not known at Ammassalik. Nor indeed, for obvious reasons, are the bows and arrows, which have been found frequently to the north; however, the Ammassalik Eskimo refer to these weapons in their tales. The other implements accentuate a *difference* which exists between the culture of the north and south, and which is presumably due to the circumstance that the two Eskimo groups were separated for a considerable length of time, to some extent owing to the natural obstacles which lay between them. Amdrup was the first European to experience the serious character of these obstacles on his expedition.

The Ammassalik Eskimo have indeed in their traditions only a very dim recollection of other Eskimo north of the northernmost point of the coast which they know by personal experience. If their ancestors once immigrated to their present district from the north, this must have taken place so long ago that their connection with the families they left behind them in the northern fjords, in Scoresby sound, Franz Joseph's fjord, and further to the north, must have long ceased to exist. After that time each of these groups must have gone their own way, and new accessions may have taken place from the west coast to either of the groups south and north of the great island. Archæological investigations in the Ammassalik district itself will perhaps one day reveal whether the inhabitants of this region in older times were more closely in touch with their brethren along the north coast than their present form of culture might lead one to suppose.

The discovery of the above mentioned bone ornaments for attachment high up towards the north on the coast and the other criteria which argue for the continuity, might in themselves be explained by an immigration from the south, i. e. from Ammassalik. I have heard — as G. Holm too did when he was there — old folks tell of families in the previous generation, parties of *umiaks*, who moved northwards 'long ago', never to return. Amdrup lighted at *Nualik*, two degrees of latitude north of Ammassalik, on a very ancient ruin, where over thirty persons had met their death by starvation or poisoning; the implements he picked up in the house were recognised as coming from Ammassalik. Other parties may previously have been more fortunate and slipped past the awkward places up to the great fjords in the north. Here they must have met their unknown kinsmen, and an isolated feature such as the ornaments for attachment may have reached up to these regions in this way. For the present I prefer this explanation, the said find being quite isolated, rather than to assume that this idea of ornamentation should have arisen up there in the high north without striking root, and by chance have been transplanted southwards to Ammassalik.

The Amdrup collection from the regions north of Ammassalik belongs on the whole to a homogeneous culture; the objects found convey the impression that the people who inhabited this part of the coast must have belonged to the same tribe as the West Greenlanders. If some few of the pieces seem to point in a contrary direction, this fact may be explained in the light of a natural conservatism within this isolated group which has made them preserve some implements of high antiquity. For the present, let it remain an open question whether they arrived all at once or in several detachments, and whether the varying use of stone, bone and iron for the blades of the weapon heads and knives indicates different stages of development in their material culture. The numerousness of the house ruins in Scoresby Sund, in Traill Island (72° lat. N.), in Clavering Island (74° lat. N.) and still further to the north render it probable that the history of this population must have extended over many centuries. The old-fashioned types of the harpoon-heads and several of the other implements seem to tell us that this group must have belonged to the oldest stock of the Greenland Eskimo[1]. They may have immigrated into Greenland anterior to, or simultaneously with, the northernmost West Greenlanders. However, the sole historical fact we possess as to these Greenlanders is, after all, only Clavering's account of his meeting with 12 Eskimo on the south-west side of Clavering island, as it would seem, the last surviving Eskimo of North East Greenland. This was in the year 1823. They were seen for three days, then they fled away. No one understood them. No records were made of their language, legends or traditions. We know nothing about them beyond what the traces they have left on the deserted coasts can tell us. —

These 'finds' have recently been added to. From more northerly districts of East Greenland than ever before *Mylius-Erichsen* and his companions on the *Danmark Expedition* brought back a collection of antiquities. I have not yet had an opportunity of seeing this collection, which immediately after its arrival was lodged in the National Museum at Copenhagen. It is to be hoped that it will not be long before we get a description of it by a competent hand.

As I have already mentioned, the following pages will deal

[1]) Ryder's view of the high antiquity of the ruins of North East Greenland (Meddelelser om Grønland XVII, 343) has been opposed by O. Solberg (Beiträge zur Vorgeschichte der Osteskimo, pp. 18—19), but, in my opinion, without convincing grounds. Cf. my review of Solberg's book in Dansk Geografisk Tidskrift 1909 (XX, pp. 11—15).

with that portion of the Amdrup collection which belongs to the ancient culture, north of the Ammassalik district from 68 lat. N. northwards. The publication of the second part (objects found within the Ammassalik district itself, south of Kangerdlugsuak) will ensue later in connection with an English edition of G. Holm's "Sketch of the people of Angmagsalik", and a new reproduction of his ethnographical collection of objects from those parts.

2. Harpoon Heads.

Inv. Amd. 1 (Fig. 1 and Pl. XV) is a beautifully worked and well-preserved harpoon head, made of bone all in one piece (without inserted blade), in form conoidal. The blade part of the head is flat and slender, biconvex in cross section, narrowing and flattening towards the point, with sharp, convexly curved edges. It increases in breadth and thickness towards the centre of the body, whence the thickness continues to increase, till at the base it attains 1·5 cm. The body is a little more broad than thick, being broadest in the middle (2 cm). The sharp edges of the head curve slightly inwards towards the centre of the butt, thus giving the head a graceful slenderness. Both the upper and under side show, particularly towards the point, a marked ridge; but the one on the under side disappears towards the base. The line hole pierces the head from either side of the butt in a plane parallel to the blade, forming a slightly curved channel. The line grooves (side grooves extending backwards from the mouths of the hole and intended for the countersinking of the harpoon line so that it may not hinder the head from penetrating into the animal) are deep and carefully worked, and they

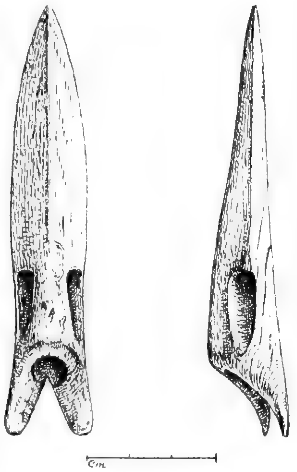

Fig. 1. Harpoon head. Cape Tobin.

extend almost entirely to the edge of the base. The butt end of the head is bevelled concavely in such a way that the two basal barbs formed by a cut in the back taper away into two flat tips with very sharp edges, while at the same time they diverge from each other more and more. The slit between them penetrates a little distance into the distinct edge of the shaft socket. Length 9·6 cm.

This head may be compared with inv. Pfaff No. 52[1]) from the northern part of West Greenland and with Ryder's fig. 13 a, from Scoresby Sund[2]).

Inv. Amd. 2 (Pl. XV, 2) which was found in the same place (Cape Tobin) as *inv. Amd. 1*, has in contradistinction from it an undivided basal barb, but in other respects these heads belong to the same type. The manner in which the inner channel of the line hole is curved (in the horizontal plane of the head), and in which the outer line grooves are formed, the edge lines of the body itself and the ridges of the upper and lower surface, in short all the details of the workmanship in the two heads bear such a close resemblance to each other, that the idea involuntarily suggests itself that they both proceed from one and the same hand. *Inv. Amd. 1* viewed from the side, is a little flatter than *inv. Amd. 2*, the upper and lower surfaces of which bulge over the part which lies nearest to the butt. The side edges of *inv. Amd. 2* are straighter, being without the slight curvature near the rear part of the body which distinguishes *inv. Amd. 1.* The tip of its undivided basal barb is (just as the tips of the barb in No. 1) slightly bevelled from the upper side and tapers to a sharp point.

Like *inv. Amd. 1* this harpoon head is carved out of the hard substance of a marrow-bone, but while the inner softer substance of the bone in the former appears on the upper side, in the latter it is situated on the under side. The bone

[1]) Swenander Pl. 2, No. 52, cf. pag. 40, fig. 5.

[2]) Ryder 314.

has retained its whiteness more perfectly in these two heads than in any other in this little collection.

Inv. Amd. 3 (Fig. 2 and Pl. XV) is a short and dumpy harpoon head, almost rectangular in cross-section, but with rounded angles. The upper side, which is perfectly plane, is a little broader than the belly, which in front is slightly convexed. Both sides taper slightly towards the curved front edge, where in a broad slit an iron blade is still sticking. The openings of the line-hole in the side of the head are large, the line grooves cutting deep into them. Just as in the heads described above, the line grooves extend backward right out to the edge of the basal socket. The butt end is cut off with a short and concave bevel. The edge of the socket for the shaft is sharply defined, on the other hand the outermost edge of the concave basal surface is rounded, running over into the lateral surface and the under side. The basal barbs are separated by a curved slit, whereas in *inv. Amd. 1* they meet at an acute angle.

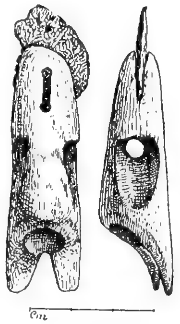

Fig. 2. Harpoon head. Cape Tobin.

The front part of the head is pierced from the upper to the under side by two holes, which lie in the median of the body; in the foremost of these two holes there is still sticking a nail which holds the blade, which latter, as is seems, was also wedged into the slit with small pieces of iron. The two nail-holes both on the upper and on the lower side of the body are united by a fairly deep narrow gutter, as if the intention had been to form a countersink for a lashing through the two holes. And in fact the innermost nail-hole and one of these countersinks are filled with a substance which looks as if it were the remains of a narrow skin thong. The iron blade is in parts corroded by rust, or broken. — This piece resembles very much a West Greenland type of harpoon head [1].

[1]) Swenander 40, fig. 4.

Inv. Amd. 4 (Fig. 3 and Pl. XV), like all the following harpoon heads, was found on the Skærgaardshalvö.

It is a harpoon head, in front flattish, rhomboidal in cross section, with sharp side edges which curve inwards at the middle giving the head a characteristic indenture; rear of the centre it is approximately cylindrical, widening out conically towards the base. The rear part of the upper side exhibits a marked ridge which extends down to the base of the head. There is one barb terminating the back, and slightly bifurcated. The base of the head is bevelled concavely; the shaft-socket, which opens out into it with sharp edges, is about 1·5 cm deep (at the opening about 0·7 cm in diameter).

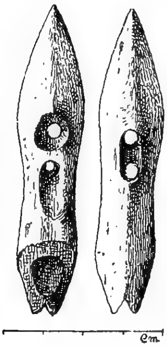

Fig. 3.
Harpoon head.
Skærgaardshalvö.

This harpoon head is distinguished from the types no. 1 and 2 by having, instead of one laterally situated line-hole, two line-holes which pierce it vertically (from the upper to the lower side) and straightly. They lie close to one another in the median of the body. They are bored slantwise and diverge in a downward direction; on the upper side of the head the openings lie scarcely 3 mm from each other, sunk in a common oblong groove (cf. *inv. Amd. 3*), an arrangement whereby the line could run round without forming any hindrance on the surface of the head.

On the under side of the head the openings are about 5 mm distant from each other, sunk like the former, only that in this case each has its own depression, the one in front being formed as a circular countersink, intended for the reception of a knot at the end of the line for fastening it. Thus the line must have run round from this front depression through the hole and back through the other hole, the inner channel of which is of exactly the same width as that of the front hole. In the illustration the latter looks larger on account of its being widened out above. From the inner hole extends on the under side of the head a distinct, but not particularly deep, longish groove, which must have formed a bed for the line with which the head was connected with the bladder.

The principle in accordance with which the line was fastened in the case of this harpoon head must have been different from the usual one. Here the line can not, as in Nos. 1 and 2, have held the head in a noose formed by its being drawn through the line-hole and the end of the line fastened further down on it; but the end of the line must have been twisted into a knot which was sunk in the countersink at the mouth of the hole, and in this way held the head tight. By this device the line ran singly throughout its whole length.

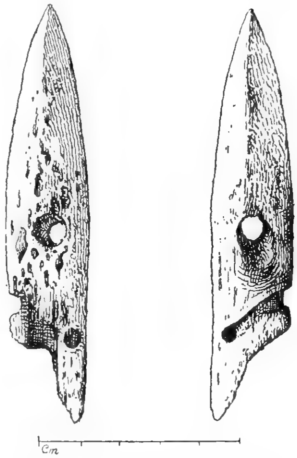

Fig. 4. Harpoon head. Skærgaardshalvö.

I have not found this type of harpoon head anywhere, although a harpoon head from North West Greenland in the Stockholm Riksmuseum (Inv. Pfaff No. 41 [1]) resembles it as regards the position of the line-holes (No. 41, however, has three holes instead of two), and the two heads also resemble one another in having the butt end cut off with an angular bevel, and in the basal barb being median and slightly bifurcated at the end.

Inv. Amd. 5 (Fig. 4 and Pl. XV) is a very high and narrow harpoon head made of bone, all in one piece, the front part nearly rhomboidal in cross section, with four faces, so that the sides meet in an upper and nether acute angle (only at the rear of the body is the nether edge rounded instead of sharp) and in two lateral obtuse angles which appear as oblique

[1]) Swenander, 11.

lateral ridges — thus an entirely different type from the foregoing flat harpoon heads. The upper edge of the harpoon head is slightly concave from the middle towards the butt; whereas the rest of it curves convexly towards the point of the head. The head has one spur for a barb. The line-hole, which is of considerable breadth, is cut straight across the vertical plane of the body; behind the aperture on the right side is seen a very short line groove; on the left side there has also probably been a corresponding groove, but the whole of this side is highly decayed. A large piece of the rear part of the left side is missing, so that one side of the basal socket for the foreshaft is quite open; on the whole of the other side is seen a slanting groove, evidently the bed of a lashing which has been carried through the little perforation at the root of the basal barb to complete the shaft socket. This groove cuts in deeply particularly at the lower edge of the head in order that the wrapping might not hinder the head from penetrating the animal.

This harpoon head in its whole shape, in fact in its very details, resembles inv. Pfaff No. 7[1]), a harpoon head from Disko Bay in West Greenland; Swenander defines the head from North West Greenland in terms which apply perfectly to this head from North East Greenland.

I also find heads which remind one of this type, from more remote Eskimo regions. The Gjöa Expedition (Amundsen) brought back from King William's Land some specimens of harpoon heads of a similar type (Christiania Ethnographic Museum, inventorial Nos. 16038 and 16035), made entirely of bone, one of them 9·3 cm, the other 6·8 cm long; the latter with undivided basal barb, the former with eight small notches in the rounded edge of the basal barb. This latter feature is also found in one of Nathorst's heads from North East Greenland[1]), the basal

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[1]) Swenander, Pl. I, no. 7.

barb of which has three small notches, or is trifurcated. Apart from these ornamentations, the types are sufficiently closely related to one another to suggest the thought of a continuity in tradition.

Inv. Amd. 6 (Fig. 5 and Pl. XV) is noticeable, in the first place, for its inserted bone blade which is still sticking in it. G. Holm also brought back from Ammassalik a harpoon head with a bone blade, but it was lashed tightly with rawhide, whereas this blade was fastened with a rivet of wood or bone. The slit in which it is jammed is unusually deep (3 cm) and the blade is very securely fastened in it, which result has partly been attained by the aid of pieces of whalebone (or wood) wedged in. There was found also a loose harpoon blade of bone (*inv. Amd. 8*) with two nail holes in it; it does not fit any of the harpoon heads with a slit for the blade which have been found. The blade of *inv. Amd. 6* is comparatively large and heavy. In other respects they are of similar shape, ground along the edges on both sides and sharply pointed; only the short basal edge is blunt.

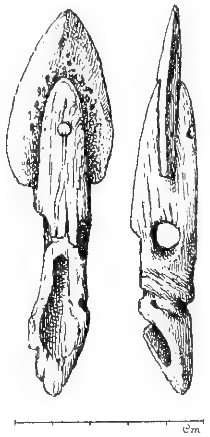

Fig. 5. Harpoon head. Skærgaardshalvö.

The body of this harpoon head is also remarkable, resembling in front *inv. Amd. 5* in being high and laterally flattened, the upper side having a median ridge; at the rear it is unusually slender and narrow (without lateral ridges); in cross section it is oval. The upper side of the body is also, like *inv. Amd. 5*, slightly concave from the middle towards the basal spur. The line-hole lies laterally in the same plane as the blade. There is a short but distinct line groove on the left side. The right side of the harpoon

[1]) Inv. Nathorst (Hammar) in the Stockholm Riksmuseum.

head and the greater part of the lower side is broken off and is missing, so that the shaft socket is completely opened; the bottom of the socket lies only 3 mm apart from the line-hole. — As in *inv. Amd. 5*, the rear part has been lashed round, but the lashing on this head has not been carried through a hole in the upper part of the barb, but merely sunk in a groove which runs the whole way round. The end of the barb is undivided.

Finally, a peculiarity of this harpoon head is its twisted form; its body is bent in its back part sideways to the right, when looked at from above, and the under side somewhat more bent than the upper side.

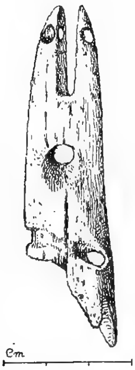

Fig. 6.
Harpoon head.
Skærgaardshalvö.

Inv. Amd. 7 (Fig. 6 and Pl. XV) resembles to some extent the harpoon head just described, but is still narrower, still more flattened laterally. The lateral surfaces are slightly arched; the cross section of the front part of the body is elliptical. The narrow upper side is rounded in front, and is sharper behind. A twist of the back end like that in No. 6 is also observable here, but turning to the left instead of to the right. There is a slit for a blade (of bone, or stone) 2 cm deep, 0·5 cm broad, but the blade is missing. A hole which pierces the head at right angles to the plane of the slit, shows that the blade has been riveted. The basal barb is slightly bifurcated.

This head has suffered severely from frost and damp. At the rear the whole of the right side is missing, so that one of the sides of the shaft socket is open. There has been a lashing on this part of the head to remedy this defect; this lashing lay in a groove, and was carried through a hole in the upper part of the root of the barb.

Inv. Amd. 8 (Pl. XV, 8). Bone blade for a harpoon head, about 4 cm in length, of the same shape as the iron and stone blades that are known (cf. e. g., the iron blade in No. 3, the bone blade in No. 6), with sharp polished edges and two curved bevels which follow the edges. There are two fairly large perforations for rivets close to the base of the blade in its median, one of them near the edge, the other towards the centre.

Inv. Amd. 9 (Pl. XV, 9) is a fragment of a harpoon head, apparently of a similar type to *inv. Amd. 1*, probably with a bifurcated double basal barb, for the stump which has been preserved which forms the centre part of the original body, broadens out behind, and the inner part of the shaft socket is still seen at its base. The line-hole is laterally situated, and distinct line grooves extend from its openings, rearwards. The under side of the body must have been much narrower behind than the upper side, so that the cross section is almost triangular.

The upper side seems to have been almost plane, possibly however with a ridge right behind. Around the line hole the body is a little flattened laterally.

Inv. Amd. 10 (Fig. 7 and Pl. XV, 10) is a peculiar little head, the fore part of which is high and narrow, nearly elliptical in cross section, with a slit of 2 cm in depth in which a loose blade has been fixed with a nail (1 nail-hole).

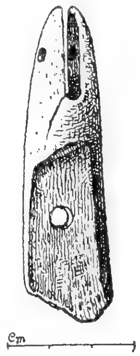

Fig. 7.
Harpoon head.
Skærgaardshalvö.

There is a ridge on the under side from the nail-hole rearwards, while the upper side is slightly rounded. The whole of the hind part from the middle backwards is cut off on both sides by two similar cuts of equal size, which have left lateral oblique shoulders, running parallel to one another on both sides of the head. As a result of this cutting, the hind part has assumed the shape of a flat tang near the centre of which a transverse hole is seen. This part of the harpoon head works as a lever which can be rotated round a horizontal axis in the perforated hole. The longest side-edge must be regarded to be the upper one. The base of the head is cut off aslant, in a direction opposed to that of the shoulders. One of the corners is sharp, the other slightly rounded. The head has no barbs at all.

This harpoon head is of a different type from the others. I presume that it must have been used in the kind of ice-hunting which is called *ituartin.* This method of hunting has been described, as far as West Greenland is concerned, by Rink[1]) and, for Ammassalik, by G. Holm[2]), who was the first to observe and define the particular form of harpoon head used for this kind of sealing.

But the *ituartin* harpoon heads which Holm brought back with him were longer and more slender than this northern type, and were pointed at the back end like a prong and provided with a small barb[3]).

However, the harpoon head which was found by Amdrup in Skærgaardshalvö, 140 miles north of Ammassalik, is similar in principle to the *ituartin* heads. It is movable round an axis which lies horizontally. As the centre of gravity of the body lies a little further forward in the direction of the point than the axis, the head would assume a vertical direction, were it not held in the direction of the harpoon shaft by the aid of a strap which catches its rear end. The head is fitted on to the axis (a bone peg) in a deep slit at the end of the harpoon shaft, and its oblique shoulders rest close up against the corresponding narrow surfaces of the end of the shaft (on either side of the slit), when it is held down on them by the aid of the strap. At the moment when the strap slides off as the head pierces the animal, the head turns crosswise like a toggle. *Inv. Amd. 10* diverges in details from the *ituartin* type of

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[1]) Rink, De danske Handelsdistrikter i Nordgrønland I (1852), p. 115 cf. also D. Cranz I, 206—207.

[2]) Holm, Meddelelser om Grønland X, 78.

[3]) Holm, Plate XVI. Cf. Mason, III, 237—38, and fig. 23 ("Hinged toggle head").

the Ammassalimmiut: its entire length is 7 cm, the narrow end (the tang) being only 3 or 4 cm long; the fore part of it is comparatively dumpy, while the tang is flat and slender, broadening out in the vertical median plane.

The strap which held the head in its recumbent position in the direction of the harpoon shaft, must apparently have held down the projecting corner of the basis of the tang. But there is no trace of a notch for the strap in the upper edge at this corner; nor is there anything of the kind to be found on the corresponding heads from Ammassalik. It is possible that this thin back part of the head may have been somewhat longer, as it seems to be worn away or weathered just around this corner. In the thick part we notice a crack, which extends from the slit right down to the oblique shoulders.

Harpoon heads of this type used for hunting seals have hitherto been known only from East Greenland. Mason mentions in "Aboriginal American harpoons" that the Eskimo of Point Barrow in the northernmost parts of Alaska also use a special kind of harpoon in hunting on the ice: — "In hunting through the ice the Eskimo of Point Barrow used a different shaped harpoon, with a long ivory piece on each end and a smaller head. As the seal comes up to blow they hurl this spear through the hole, then they drown the seal. After the animal is dead they haul it through the ice, picking the ice away until the hole is large enough to get the seal out"[1]. But among the illustrations of American harpoons in Mason's paper the 'hinged toggle head' is only found from East Greenland. On the other hand we have evidence from West Greenland that the hinged toggle head was used there in former times; see Appendix, figs. 78 to 81 (inv. Pfaff).

[1] Mason III, 237; 271.

GENERAL REMARKS ON THE HARPOON HEADS. The eight intact heads which were found turn out to belong to entirely different types. Nos. 1 and 3 were found at Cape Tobin. Nos. 4 to 10 were found on the southernmost of the places, viz., in Skærgaardshalvö. They all diverge from the type most in use at Ammassalik. In most of them the height of the body is greater than the breadth. The interior of the line-holes is in most of them straight and laterally situated (i. e. they debouch on the sides of the head), whereas the harpoon heads which the Ammassalimmiut now employ have curved line-holes, the openings of which lie on the under side of the body.

Inv. Amd. 4 occupies a place by itself, having two line-holes which have been bored vertically in the median line of the head from the upper to the lower side at right angles to the plane of the blade; this arrangement reminds one very much of the *orsseq*, an oblong ivory button with two holes for fastening the dog traces to the sledge (cf. *Inv. Amd. 102*).

It is also worthy of remark that the basal barb in two of these heads is quite undivided, and in two others has only a small notch, whereas the heads which are typical of Ammassalik have two-forked bases, or two barbs flanking the base and shaft socket; *inv. Amd.* 1 and 3 have also forked bases, but the two barbs both lie in the plane of the upper side.

None of the harpoon heads of the Amdrup collection have lateral barbs towards the point.

Most of these types of harpoon heads from North East Greenland are also known from West Greenland. The West Greenland types have been described by Mason and more recently by Swenander. The latter has classified them in the plates and in the text in the manner that the presumably oldest types are placed first, the more recent and more differentiated last. Among the harpoon heads of the Amdrup collection, Nos. 1, 2 and 5 resemble the oldest type in Swenander, in so far as they consist of an entire piece of bone (without inserted blade) and have no lateral barbs; Nos. 2 and 5 as well as No. 6, moreover, approach closely to the old type by having an undivided basal barb lying in the median line, and No. 5 also agrees with it in having the whole shape of the body flattened laterally, so that it is higher than it is broad; the line-hole is bored across the vertical plane of the body. Nos. 1 and 2, on the other hand, approach to a younger type (Swenander, inv. Pfaff Nos. 37—40) in having their breadth greater than their height. The two heads have lateral line-holes, but the inner path of the line-hole is curved, a feature which seems to point to a more recent type. Thus it appears as if older and younger characteristics were blended in these two heads. In No. 3 the transition to a curved pathway is traceable, and its body is more dumpy than any of the others. In this particular it approaches more than any of the others to the Ammassalik type.

Provided that in these differences of type we are justified in seeing different stages of development[1]), we find, as Swenander in fact observes[2]), in the North East Greenland harpoon heads the original type entirely unchanged, and side by side with them types marking the transition to more recent forms. *Inv. Amd. 5* represents the oldest stage in the Greenland harpoon heads; when it is held in such a position that the line-hole lies horizontally, it is seen to have greater height than breadth, and the basal barb, which is undivided, lies in the vertical plane, at right angles to the line-hole; the blade of the head is also placed at right angles to the line-hole. It is made of bone all in one piece, and is without lateral barbs. If we compare it to the general Eskimo types established by Murdoch, without keeping too narrowly to his special representation of the development of sealing harpoon heads (where great stress is laid on the lateral barbs of the heads), we discover the interesting fact that this type in its main features cor-

[1]) Murdoch I, 218—222; Swenander 39—42.
[2]) Swenander 41.

responds to the harpoon heads which are used in Alaska for hunting whales, walruses and the larger kinds of seals. Within this type, too, some variation occurs (note particularly the varying use of blades placed at right angles to the line-hole, and blades which lie in the same plane), but it is just the whale harpoon head, which Murdoch[1]) regards as having preserved certain antique features to a greater extent than any of the others, which has as a general rule a high and narrow body flattened laterally with a basal barb in the median line, at right angles to the line-hole, and without lateral barbs — on the other hand always with an inserted blade, but invariably and obligatorily a stone blade, not a metal blade. The basal barb of the whale harpoon head appears always to be undivided; the walrus harpoon head on the other hand often has its spur bifurcated, but in other respects resembles the larger whaling harpoon. The model of whaling harpoon from Baffins Land given by Boas[2]) combines most of these features with some new ones.

The harpoon heads found in North East Greenland and now in the possession of European museums amount up to date, as far as I know, to 30 in number. In Amdrup's collection there are 9 in all, in Ryder's 3, in Nathorst's 15, in Koldewey's 3. But of these there is only one which has a barb on the fore part of the head (belonging to inv. Ryder[3]), and what is more, this barb is quite unlike the lateral barbs of the heads from West Greenland. All the other North East Greenland heads are without lateral barbs, having only basal barbs, undivided or two-pronged, always placed on the upper side of the head and produced by a concave bevelling in the lower part of the base.

Out of the 30 heads only 10 have a slit for the insertion

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[1]) Murdoch I, 239—240; Mason III, 273.
[2]) Boas I, 500, fig. 436.
[3]) Ryder 314, fig. 13 b.

of a blade, 15 are carved entirely out of a single piece of bone without a slit for a blade, and the remaining 5 are doubtful. In inv. Nathorst (Hammar) 3 heads are quite of the whaling harpoon type. In view of the great number of West Greenland heads which are to be found in the museums with lateral barbs in innumerable variations, it is extremely remarkable to find in North East Greenland exclusively heads of a type without these lateral barbs. Is it conceivable that the development of harpoon heads here has been unaffected by a differentiation of the implement which is otherwise found in all other Eskimo districts, so that the original whaling harpoon (walrus harpoon or great sealing harpoon) here is to be regarded as the local archetype of a quite isolated line of development ? or how is this one-sidedness in the development of this implement in North East Greenland to be explained?

Among the above described objects found by Amdrup there are two harpoon heads of peculiar types, which convey a notion of their function: viz., *Inv. Amd. 4* (without slit for the blade), the line-hole of which points to a peculiar mode of attachment: the line cannot have taken the form of a noose with a double pull from both sides of the head round a transverse axis, but of a single-running pull in the median axis (acting about at the centre of gravity of the head); — and *Inv. Amd. 10* (with a slit for the blade), which is of quite another type than any of the rest, a pure toggle harpoon without either lateral or basal barb. If my conception of it is right, it must have been used in sealing on the ice. Whereas the former head is merely an accidental variation (just as inv. Pfaff 8, West Greenland)[2], the peculiarity of *Inv. Amd. 10* is due to the special function of the head; this confirms what one might naturally have been led to expect, viz., that the inhabitants of these northern coasts must have been acquainted with the same special methods of hunting as

[1]) They are delineated by Stolpe Pl. IV. fig. 114.

[2]) Swenander 16. Pl. II.

are practised by the Eskimo in the other Arctic highlands, in North West Greenland, and at Point Barrow. — As for the other heads of the collection, it is, of course, hazardous to make any categorical assertion as to the function of each singly — beyond the general remark that they must have been used for hunting the different kinds of seals; but the circumstance that some of the North East Greenland heads resemble very closely the whaling and walrusing harpoon heads known from other places, seems to indicate that they must have been used in hunting whales and walruses, or at any rate that they were used in hunting these large marine mammals besides in hunting seals. A similar conclusion must probably be drawn with regard to those of the West Greenland harpoon heads which belong to this type, e. g., the greater part of inv. Pfaff 1—32[1]).

In other words, the typological variation of the heads must not be judged merely from the point of view of form, but also with reference to their function.

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[1]) Swenander Pl. I.

3. Other weapon heads made of bone.

Inv. Amd. 11 (Plate XVI) is the loose bone shaft which belongs to a harpoon (or lance). It is a piece of white bone, part of a narwhal tusk, much corroded and overgrown with sea-weed; it seems to have been carefully carved, but it is broken off at both ends. It is 33·5 cm long, slightly curved, rhomboidical in cross-section, but the upper and lower angles of the section are fairly blunt, towards the basis almost rounded, so that this part of the bone is biconvex. The hole for the strap is double, the bone having at its lower part in two places along the median axis a transverse, direct perforation. The two perforations are alike and parallel to each other. Under (or behind) three of the apertures is seen on the surface of the bone a shallow groove, pointing towards the basis, to receive the strap which attached the bone head to the end of the wooden shaft. This strap must, of course, have been double-running. The edges of the apertures are blunt. The fourth aperture is broken off underneath, a fairly large piece out of the side of the bone having been destroyed. The interior of the line-holes has been widened out, owing to their crossing the interior channel of the tusk. — It is impossible to determine whether the weapon in its fore part had a slit for the insertion of a blade, or whether the bone itself was pointed. Its having a socket at its basis is due to the interior channel of the tusk having been opened by the basal bevelling. In any case we must assume that the butt end was pointed sufficiently for it to fit into the socket of the fore-shaft (the bone head of the wooden shaft).

The German North Pole Expedition of 1869—70 found in Klein Pendulum Island north of Franz Joseph's fjord a partially carved narwhal tusk in the bevelled base of which is seen a narrow hole, but the form of the base militates against the supposition that the piece was used as a detachable bone-shaft. In contradistinction from *Inv. Amd. 11*, the cylindrical form of the tusk has been retained; the front part really seems to have been left quite rough. Stolpe[1]) mentions a similar find made by the Swedish Expedition to North East Greenland in 1899, and the leader of the expedition, Nathorst[2]), has in his book a reproduction of this narwhal tusk; it is only worked at its butt end, where three or four holes are seen in the median line of the side, as well as a bevel at the very bottom, on the surface of which is seen a little hole "as if it (the tusk) was to be fastened to a shaft". These implements seem to have had a somewhat different function from the narwhal-bone shaft discovered by Amdrup, the double line-hole of which relegates it to a place among the well-known detachable forepieces of harpoons or lances. The two previously discovered narwhal tusks must have been firmly attached weapons heads (foreshafts of whale harpoons?).

I might here take occasion to observe that one of the legendary heroes of East Greenland, *Uijarteq*, according to the traditions of the Ammassalik people[3]), is said to have had 'an arrow-head (?) made out of an entire narwhal tusk', just as his companion had one of 'walrus tusk'.

Inv. Amd. 12 (Pl. XVI) is the loose bone shaft of a lance, 31 cm long. It is made of a heavy piece of the hard substance of a bone, probably of the bone of a whale, which is fairly spongy. The shape of the piece is uniform, biconvex, the cross-section almost elliptical, the lower part towards the butt being thicker

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[1]) Stolpe 105.
[2]) Nathorst II, 344.
[3]) Holm 255.

than the middle. The upper (front) end narrows-in slightly from two sides, while on the two other sides it increases, rather than decreases, in thickness; but towards the extreme point it tapers away, the sides being severely rounded off. The butt end of the piece is conically pointed.

In the head there is a slit, 2 or 3 mm in breadth, to receive a blade of stone or bone, which must have been pressed home into it. As the extreme end has been worn away or broken off, it cannot be determined with certainty whether there was a nail-hole or not; probably not. The blade (and the slit) has a horizontal position, at right angles to the two line-holes, which have been bored transversely through the lower part of the shaft. These holes are similarly shaped and parallel; under each of the four openings there is a distinct but short groove, being a continuation of the inner path of the hole. Through these holes must have passed two straps with which this bone-shaft was fastened in the usual way to the wooden shaft of the lance, at the upper end of which there is generally a firmly attached piece of bone (the foreshaft) with a socket into which the conically tapering end of the bone-shaft fits.

It should be noted that the base of this loose shaft is not cut off flatly with a tang-like projection in the middle, as is usually the case in the modern lance and harpoon shafts from Ammasalik and West Greenland[1]), but merely conically pointed. However, we know of several specimens, found in graves from North West Greenland, which have the same basal form as that of the shaft which we have just described[2]); and vice-versa, a loose bone-shaft has also been discovered (by the Nathorst Expedition)[3]) in North East Greenland with the tang-like projection known from Ammassalik and West Greenland.

Inv. Amd. 13 (Pl. XVI) is a flattish weapon head, 35 cm

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[1]) Holm, Pl. XIV. Nansen 31; Fabricius I, 135 and fig. 1.
[2]) Swenander, Pl. V, fig. 168.
[3]) Stolpe, Pl. IV, fig 14.

in length, made of a reindeer horn, broadest just behind the point and in the parts around the strap-hole. The dark-brown upper side is smooth and hard, unevenly convex, the spongy under side is highly weathered. Originally the piece seems to have been thicker and more rounded, as the lower end, which still retains its thickness, attests. The head is not quite straight; the fore end curves slightly upwards, and the same is the case with the middle. Not only the point, but also the foremost part of the side edges, is sharp like a lancet. About the point marks of a cutting tool are perceptible. The pointing seems to have been made with a knife, after which the upper surface has been smoothed.

The strap-hole, which is single, has under one of its mouths what appears to be a faint trace of a groove; perhaps, however, it is merely the mark produced by the rubbing of the strap. The edge of the other mouth of the hole is weathered away.

At the lower end is seen a cross scratched awry on the surface between the hole and the conically pointed base, but it has been so carelessly executed that no importance can be attached to it. If Swenander is right in his assertion that the lances of the Greenlanders usually have a double line-groove (two line-holes), *Inv. Amd. 13* must either be one of the rare lance heads of the old type, with only one hole, of which he has a few reproductions (inv. Pfaff 163, 164, 165), or must have been part of another implement, probably an arrow-head. It deserves to be noted that it has no barb, nor is there any slit for the insertion of a blade in the head. The pointed head of the antler has apparently been used for the point of the weapon. In form and material it bears a slight resemblance to the small arrow heads which figure next to it in plate XVI.

Inv. Amd. 14, 15 and *16* (Plate XVI). The three small flat bone-heads from Dunholm, from 15 to 16 cm. in length, two of which are illustrated here, must have been inserted in the fore-end of wooden arrow shafts. One of them is perhaps of reindeer horn, the two others are carved out of the side of nondescript bones. None of them are quite plane; they have seemingly preserved the original bendings of the material (reindeer antler?).

They have on their upper surface elongated facets, evidently the traces of the tool with which they were cut. Only in one of them is there a faint trace of a ridge on the upper side; the two others are quite flat. The edges of the sides, and indeed even of the points, are blunt in all of them.

Two of them have a little incision in the base — a circumstance which seems to indicate that the bone was driven with some force into the socket at the end of the wooden shaft, in order to drive it home.

Similar arrow-points were discovered by Ryder in Scoresby Sound[1]). Several of them have at the butt-end a conical tenon or tang on the upper surface of which there are distinct traces of screw-threads winding to the left, a feature which is also found in old arrow-heads from West Greenland. In the Riksmuseum at Stockholm there are seven arrows from East Greenland (inv. Nathorst)[2]) with spiral screw-threads of this kind about the tenon; one of these heads, which in other respects closely resembles those discovered by Amdrup, is 22 cm in length. In one of the smaller heads (9 cm long) in the same collection (inv. Nathorst), there is in the place of a tang an incision in the base of the head similar to that in the arrows of the Amdrup collection. Both in the Nationalmuseum at Copenhagen and in the Riksmuseum (inv. Pfaff) at Stockholm, there are bone-arrows from West Greenland with screw-threads on the tenon; and screw-threads are also known to be found in other bone implements from West Greenland (cf. the inventory of Pfaff's collection, sect. 29). Perhaps the uneven-

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[1]) Ryder 309—310, fig. 9.
[2]) Stolpe, Pl. V.

nesses at the rear end of *inv. Amd. 17* are a crude attempt to represent a worm of this kind.

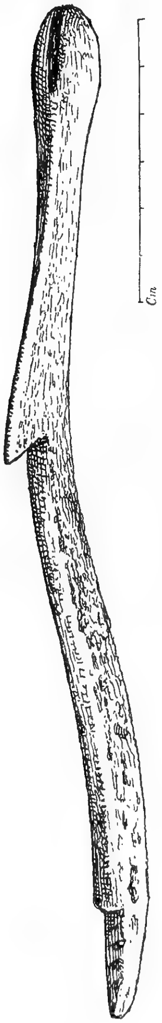

Fig. 8.
Bone head of a spear or arrow (same as in Pl. XVI) Dunholm. $^4/_7$.

Inv. Amd. 17 (Fig. 8 and Pl. XVI) is a weapon head, 21·5 cm in length, worked out of the hard substance of a hollow bone, on one side hard and smooth and on the other somewhat spongy; its form is peculiar. In front, it has a head shaped like the head of a snake, with a slit at the point for the insertion of a blade (without nail-hole). To the rear its body is narrower and more slender, flattened from the upper and under side. One of the edges runs out into a wingshaped lateral barb, found on the left side of the head when what is presumably the upper side is turned upwards; this lateral barb is flat, sharp-edged and pointed. The whole body from the lateral barb to the rear end, on the other hand, is more rounded, being elliptical in cross section. Seen in profile, the central part of the head curves considerably. The lower part of the piece has an incision running half way round and producing a tenon, whittled off towards the point, and 1·5 cm in length; this tenon bears traces of arbitrarily carved figures and roughnesses, as if it had been meant to be lashed or inserted in a socket, the roughnesses serving to give a firmer purchase.

I have not been able to find either in Mason, Murdoch, or Nelson any arrow the head of which resembles this specimen from East Greenland.

In Boas [1]) is seen an arrow-head from

[1]) Boas I, 505, fig. 444.

Boothia with two lateral barbs on the same side and with a pointed butt. Arrow-heads of the Central Eskimo type (Baffin Land etc.) are, according to Boas, always 'slanted and lashed to the shaft', whereas those of the western type (Boothia, Mackenzie River) are 'pointed and inserted in the shaft'. The arrow-heads from King William Land in the collection of the Gjøa expedition in the Ethnographical Museum at Christiania have, one and all, a bone head which at its butt is held in place by a lashing on the cylindrical wooden shaft, presumably inserted in a hole at the end of it (the lashing conceals the junction); these heads are either pointed at the fore end, or have a slit for the insertion of a blade; several of them have lateral barbs. *Inv. Amd. 17* might be regarded as a similar arrow head of the more western type, i. e. 'pointed and inserted in the shaft' (Boothia, King William Land; also Alaska, cf. Nelson[1]), though no exactly corresponding specimen is known to us from the west. However, among the numerous varieties of bone arrows in the National Museum at Copenhagen there are several which resemble that treated of here pretty closely.[2]

It is, however, by no means out of the question that we have to do with the head of a bird-dart. The point of the Eskimo bird-dart was originally made blunt, in order to avoid piercing the skin of the bird, but is found from early times in two varieties, one with a blunt point[3], and the other with a pointed bone head and three barbed lateral points, placed a little behind the middle of the wooden shaft.

Swenander gives reproductions from the Pfaff collection from West Greenland[4] of a series of dart-heads with conically pointed ends and lateral barbs. Most of them are designated as harpoon heads (i. e. bone fore-pieces), or lance heads, though

[1]) Nelson Pl. 61; Mason II, Pl. 52 to 56.
[2]) Solberg 73.
[3]) Mason II, Pl. 54 and 57; Nelson Pl. 61.
[4]) Swenander Pl. 4.

with the qualification that "it cannot be determined with certainty to what use any of them were applied; besides, it is obvious that, with weapons applied to such similar uses as the dart and the lance, transitionary types must necessarily arise"[1]. Practically all of them have in the median of the butt three, two, or one, line-holes pierced through them. These heads are followed by a series of lances without lateral barbs. It is only the last of these in his series, inv. Pfaff no. 169 from the Egedesminde district in West Greenland, which need interest us here. It is somewhat larger (29·7 cm) and more clumsy than *inv. Amd. 17*, from which it differs also by being without a slit for the blade, but it has, like the latter, at the fore end a head-like expansion tapering away in front and thus producing a fairly blunt tip; and it has no line-hole. It has no lateral barb, but resembles *inv. Amd. 17* in having its butt pointed and provided all the way round with irregular indentations to hold it fast in the socket in the shaft into which it is intended to fit. Swenander suggests that it (as well as the foregoing number in Inv. Pfaff, which has a line-hole) either must have been used as a lance-head, fitted in the *kappout* (the small lance), or else as a bird-dart. *Inv. Amd. 17*, as I have already remarked, might be thought to have been used as a bird-dart.

Another, though less probable, supposition is that this bone head may have been used as a salmon spear, for fishing on the ice[2]; cf. Nelson (Alaska)[3]. In the Gjøa collection at Christiania there are some fish-spears (nos. 16002—16006) from King William Land with heads of reindeer horn and shafts of wood. The heads, which have pointed butts and lateral barbs, are detachable, being fastened to the wooden shaft in

[1]) Swenander 27.

[2]) At Ammassalik salmon is cought in the summer in rivers, with a three-pronged pitch-fork, during the winter through holes in the ice with a harpoon (Holm).

[3]) Nelson Pl. 67 and 68.

harpoon fashion by a rawhide-line through a line-hole. A spear of this kind (fore-piece and wooden shaft) is about two metres long. Besides this kind of spear, which according to Amundsen is used for salmon-spearing from a *kaiak*, the Gjøa collection has also some salmon spears of the ordinary well-known type (two-pronged or three-pronged forks on either side of a bone-point at the end of a shaft). However, as *inv. Amd. 17* is not arranged so as to form a detachable fore-piece, it is not quite justifiable to compare it with these western fish-spears; especially, as fish-spears with detachable heads, as far as I know, are not known from any district in Greenland.

A quite similar weapon-head was found in North East Greenland by the Swedish Expedition (Inv. Nathorst in the Riks-museum at Stockholm)[1]. It is 19·5 cm long. The slit for the blade is very narrow and deep, and a transverse hole has been pierced through the head, to receive a nail. The centre of the piece is flatter than its fore part, and just here a lateral barb with a sharp tip is placed. The back part, again, is more or less cylindrical in cross section. At its rear extremity, this head is carved in the shape of a tang with a knob-like extension at the tip. The upper side is smooth, the under side spongy.

There is another quite similar bone head in Vienna (in the k. k. Naturhistorisches Hofmuseum, inv. no. 4905, see Appendix fig. 82); it belongs to a small collection of stone and bone implements which in 1876 was presented to the Museum at Vienna by the late Steinhauer, custodian at the National Museum at Copenhagen. It probably comes from West Greenland. The end of it is partially broken off, being split lengthwise. Viewed from the side, the knob-shaped head is hardly as broad as in *inv. Amd. 17*, and the lateral barb is placed at right angles to the blade slit, whereas in *inv. Amd. 17* it lies

[1] Stolpe Pl. V, fig. 15 ("arrow-head").

in the same plane as the slit; in other respects they resemble each other perfectly.

A bone-head from Scoresby Sund found by Ryder[1]) may perhaps also be placed in the same category as these two specimens, but it should be noted that it has no lateral barb.

Inv. Amd. 18 and *19* (Fig. 9). These two heads of white bone (or narwhal tusk) are of similar shape, 21·5 and 19·5 cm in length respectively, cylindrical, and tapering towards the ends, with a very long bevel at the butt end.

No. 18 (Fig. 9[1]) is a hollow bone; at the upper edge of the bevelling is bored a hole which reaches up to the medullary canal without piercing the bone right through; the medullary canal, moreover, is seen not merely at the lower part of the implement, almost throughout the whole length of the bevel, but also at the thin end, where it emerges along one side of the head as a very narrow elliptical aperture, stopped up with a wedged-in piece of wood.

No. 19 (Fig. 9[2]) is carved out of the hard substance of a bone, the spongy layer of which is seen extending along one side. This bone, too, has a transverse hole in the same place as in the former, but here it runs right thorough, and its mouth on the side opposite to the bevelling is widened out as if to receive a knot.

Both pieces are so well finished that the natnral form of the bone is quite disguised. The upper surface is carefully polished.

At first sight they look like weapon heads, but *what* kind of weapon heads? They cannot have been detachable, loose, harpoon heads belonging to the common sealing harpoons, or *agdligak* harpoons[2]), or to the somewhat heavier walrusing harpoons[3]); against both these possibilities militates the position

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[1]) Ryder 314, fig. 13 d.

[2]) Murdoch I, 212, fig. 197; Boas I, 494, fig. 429 a and b.

[3]) Murdoch I, 224, fig. 214.

of the hole (which runs right through only in one of them), and especially the very long bevelling at the butt end; the bevelling must have been intended for fastening them to another piece of bone, or to a shaft. They have no slits for blades,

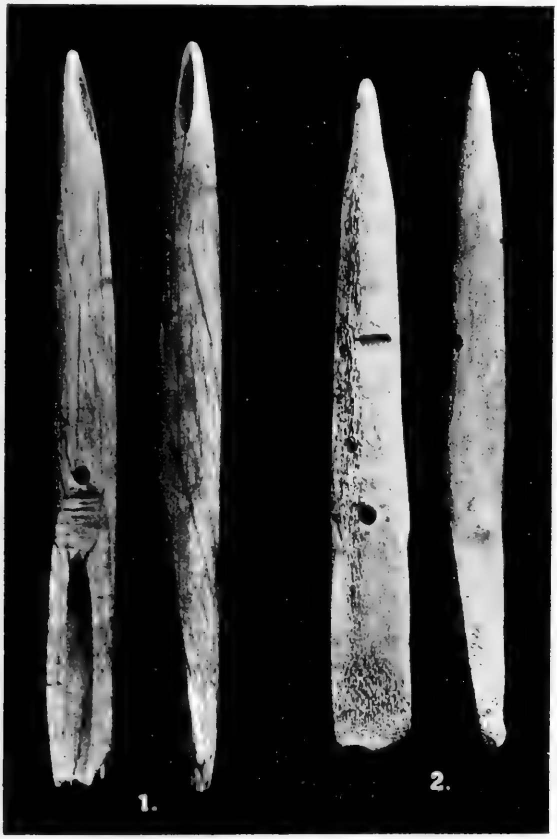

Fig. 9. Miniature bone fore-pieces of whaling harpoons. Cape Tobin. 4/9.

and thus cannot have been the fore-pieces of sealing lances. Nor do they look like the fixed bone heads of bird-darts[1]: a partial resemblance to the head of an arrow from Alaska

[1] Murdoch I, 211, fig. 195; Nelson Pl. 51 and 59.

(illustrated in Mason[1]) which is inserted in the end of the shaft and wrapped round with sinew, must be regarded as a coincidence.

On the other hand, the resemblance of these heads to the firmly secured bone heads at the end of whaling-harpoons of the type known from Alaska and from Baffin Land, is unmistakable. But a remarkable point about them is their small size, which might lead one to suppose that they were only used as toys, or as models for boys to practise with.

Murdoch[2] describes a foreshaft of a whaling harpoon from Alaska in the following terms: "Is of walrus-ivory and 15·8 inches long, with a diameter of 1½ inches at the butt. The oblong slot at the beginning of the chamfer is to receive the end of the lashing which secured this to the shaft." Boas[3] gives the following brief description: "To this wooden shaft a bone point tapering towards the end is firmly attached." The illustration shows it to be cylindrical. It seems to me by no means improbable that the two narwhal tusk heads found by the German Expedition and by Nathorst (Hammar) in North East Greenland and mentioned by me under the heading of *inv. Amd. 11,* must have had the same function, namely of being fore-pieces for whaling harpoons. —

Inv. Amd. 20 is the only one of the three-fold set of bone points fixed back of the centre of the shaft of a bird-dart, each in its plane around it, intended to catch the bird, when the point of the spear has eluded it — an ingenious contrivance which is found, executed in much the same manner, in all Eskimo districts. It is cut out of the side of a nondescript bone, greyish-white and spongy, especially on the flat under side, the upper side being slightly convex. The tip of the point is sharp, and the inner edge of it is cut particularly sharp round the two barbs.

Several quite similar points have been discovered in North

[1] Mason II, Pl. 53, fig. 1.
[2] Murdoch I, 239, fig. 237.
[3] Boas I, 500, fig. 436.

East Greenland by "Die zweite Deutsche Nordpolarexpedition"[1]), by Ryder[2]), and by Nathorst[3]).

Aside from the latter's find, the three other points are characteristic in so far as their barbs are not unilateral (i. e. placed only on the inner edge of the points), but that they have a barb also on the outer edge, and that this barb is — in all alike — situated a little further from the tip than the barb on the inner edge. The lowest of the inner barbs in the point found by Amdrup, as well as in Nathorst's point, are placed unusually far down (about at the middle of the point), and is less sharply marked than the corresponding barb in the two other points from East Greenland. For the rest, all the points which have been discovered are more or less of a pattern; thus e. g., all of them have a little notch on the outer edge just where the edge forms the greatest outward curve; this notch being intended to receive a lashing which held this part of the point in its proper position on the wooden shaft; the butt of the point lies close up against the latter, and is secured with another lashing. Whereas the point discovered by Ryder was broken off at the base, the lower part of *inv. Amd. 20* is well preserved, and the same is true of that found by the German Expedition; both of these latter are marked by the oblique cut in the butt end, characteristic of these implements, which gives the lower edge a slanting shape, adapting it well for resting close up against the wooden shaft, and the equally characteristic reflexed or hooked end, which makes it possible with the aid of a tight lashing to turn the

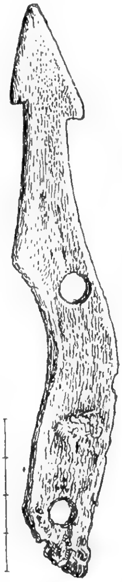

Fig. 16.
Lateral point of a bird-dart.
Cape Tobin.

[1]) Koldewey I, 605, fig. 18.
[2]) Ryder 316.
[3]) Stolpe, Plate 5, fig. 15.

point a little away from the shaft, to which it is secured solely along its basal edge; the lashing nearer to the middle counteracts this tendency of the basal lashing by exerting centripetal force. This manner of attaching these lateral points, which may be safely deduced from their form, seems different from the usual manner, where the two lashings work in the same direction, the position of the point depending solely on its form as soon as the base of it has been secured to the shaft, the lower part bending outwards and the middle part curving inwardly (cf. Appendix Figs. 83 and 84). In the bird-spears of Baffin Land the two separate lashings of the lateral points are placed around the elongated slanting butt[1]; the points of the bird-spears of Alaska[2] have either two separate lashings round the lower part, or a single broader one; the reflexed base is also found in some points from Alaska, but is lacking in others[3]. It is particularly interesting to find the barb on the outer edge of the point, just as in the point from East Greenland, recurring in one of the lateral points of the bird-spears illustrated in Nelson, from St. Lawrence island in the Bering Strait[4]. Finally, it may be mentioned that the Chukchee[5] employ bird-spears with lateral points, of a somewhat different type, it would seem, from those of the Eskimo.

Peculiar to *inv. Amd. 20* are the two comparatively large perforated holes, which were presumably used for securing the lashings.

GENERAL REMARKS. Most of the long weapon heads of the collection come from Dunholm, the little island hardly twenty miles south of the entrance to Scoresby Sund, where an old

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[1]) Boas I, 496, fig. 433.
[2]) Nelson Pl. 59; Murdoch I, 211, 213, figs. 195, 199.
[3]) Nelson 150, fig. 42.
[4]) Nelson fig. 42, no. 6.
[5]) Bogoras, 146.

Eskimo tent-place was discovered out in the open, though always ice-filled, sea. In Skærgaardshalvö, which lies two degrees further to the south, there was only found a very defective fore-piece of a harpoon or lance (*inv. Amd. 11*). The latter has, like the well-preserved loose bone-shaft of a lance which was found in Dunholm (*inv. Amd. 12*), a double line-hole, and must thus have been secured to the wooden shaft by a double-running line.

The longest weapon head of bone (*inv. Amd. 13*) which was found in Dunholm has, on the other hand, only a single line-hole. The flat form of the head and its light weight render it doubtful whether it can have been a part of a lance; and the line-hole and the form of the butt are hardly in favour of its having been attached to a dart; all things considered, there is more to be said for the first possibility; in this case it belongs to a primitive type of the Eskimo lance.

Finally, there was discovered in Dunholm a curious shaped weapon head with a slit for the blade, one lateral barb, and basal tenon, which must, in my view, have been the head of an arrow, or of a bird-dart (*inv. Amd. 17*).

At the north corner of the mouth of Scoresby Sund, at Cape Tobin, was discovered the lateral point of a bird-dart, which in its main features represents the type common to all Eskimo tribes. One feature of this point (*inv. Amd. 20*) — the barb placed on its outer edge — confirms the impression we had formed of two points with lateral barbs previously found in North East Greenland, namely that there must have existed a peculiar form of this bird-dart accessory in this part of the Eskimo world, characterized especially by the barb on the outer edge.

Further *inv. Amd. 18* and *19* were also found in these parts, a fact which seems to indicate that the whaling-harpoons from the more westerly Eskimo districts, with a fixed fore-piece of bone, must have been known in North East Greenland. This find confirms our impression that the former inhabitants engaged in whaling in these parts. — I must also make mention here of the three quite similar foreshafts for harpoons or lances which were found in Dunholm (*inv. Amd. 73, 74, 75*), and which will be described more in detail when I come to describe the other objects found there. These implements, moreover, when compared with the flat, square 'caps of bone'[1] which are otherwise used as foreshafts throughout the whole of Greenland, will be seen to be of a type foreign to that country. They approximate much more closely to the foreshafts of the West Eskimo pattern.

[1]) Murdoch I, 223.

4. Stone Implements.

(Figs. 11 to 16, pag. 381.)

Inv. Amd. 21 (Fig. 11) is a finely polished piece of light-gray clay-slate, triangular, with convex faces, and two slightly curved edges. It was found in a kitchen-midden outside the ruins of a house in Skærgaardshalvö. It is 3·2 cm at its greatest length, but is merely the fragment of a larger, probably elongated blade. The sharp pointed end might lead one to suppose that it is the blade of a weapon head, but the objection to this is that one of the edges is cut sharp, whilc the other is blunt or broad like the back of a womans knife (*ulo*); weapon heads are generally two-edged and are cut alike on both faces. One of the faces of this specimen has traces of an oblique ridge, or what is possibly the edge of a ground facet; the edge line fades away towards the part which has been broken off.

The specimen has no perforated hole, which fact, however, does not militate against the supposition that it might be the end of a woman's knife, as the holes in a knife of this kind, or at any rate one of them, may well be situated 3 cm within the end of the blade (cf. *inv. Amd. 23*). It is also possible that it is to be reckoned as the stone-blade of a 'crooked knife' (Murdoch)[1] a specimen of which was found in Scoresby Sund by Ryder[2]).

Whatever kind of cutting or boring implement this specimen is a part of, it is remarkable to notice the care with

[1]) Murdoch I, 157.
[2]) Ryder 322, fig. 21 d; cf. Solberg 60.

which the polishing has been executed over the whole surface (so far as the latter has been preserved unbroken), rendering it perfectly smooth and bright.

Inv. Amd. 22 is an oblong, flat stone (in linear measurement circa 6·5 cm × 2 cm) of reddish (iron-holding) clay-slate, found in a grave in Skærgaardshalvö. Like the foregoing specimen, it is truncated at one end, and has probably been 2 or 3 cm longer. Its sides are perfectly flat and smoothly polished; one of its edges is shaped like the edge of a knife, but is blunt (worn away?); the other is 4 or 5 mm in thickness. The stone is of the material out of which the Greenland grindstones are usually made; in form it resembles the blade of a woman's knife (*ulo*).

The hole which has been preserved at one end has been perforated from both sides, two conical openings, one of which is bored rather crookedly, having been arranged to meet half way. The German North Pole Expedition[1]) found in North East Greenland a woman's knife of reddish clay-slate. It is probable that *inv. Amd. 22* was the blade of a knife of this kind.

Inv. Amd. 23 is a blade belonging to the bone handle of a woman's knife (*ulo*); the handle will be described in detail under the heading of *inv. Amd. 42.* The blade, which was found firmly stuck in the basal slit of the bone shaft is a short, silicious, fairly soft, stone (clay-slate), 8·5 cm in length, quite flat, or with very slightly convex sides, which have been rather roughly polished, only the two converging surfaces (bevels) on either side of the sharp edge being smoothly polished. The back of the blade is flat and unwrought. One of the ends of the blade has been broken off.

The two holes in the blade have been bored from two sides. In one of them is still sticking part of the twisted sinew

[1]) Koldewey I, 601, fig. 5 a.

thread with which the blade has been secured to the haft through two corresponding holes in its lower part. The upper part of the blade has been driven home into a slit on the lower side of the haft; but even if the blade could go right to the bottom of this slit, its two holes can never have come down far enough to tally with those in the haft, the slit not being deep enough for this. The two holes in the blade must accordingly have lain outside the slit, and been visible under its lower edges, and the sinew cord must have run from the holes in the blade up along both outer sides of the bone haft to the holes in the latter in which it was secured. Traces of the tautening of the lashing can still be seen in two grooves in the upper surface of the bone under one of the holes (cf. fig. 21 a).

The form and appearance of this blade correspond more or less to the blade in one of the *ulos* which Ryder[1]) brought home with him, where it was found fixed in a wooden haft and secured with a sinew lashing in a similar manner to the knife found by Amdrup, namely with exteriorly fastened straps passing from the holes in the blade to the holes in the haft.

Most of the *ulo* blades hitherto found in North East Greenland are of a somewhat different type, having the shape of a section of a circle in which the edge describes the arc and the two blunt side edges form the radii. Both Ryder[2]) and Nathorst[3]) found women's knives of this type, made entirely of stone, without a haft of bone or wood. The curved edge, however, is no doubt a feature which the two types have in common. For the rest, several specimens of the type of a circular section are imperfectly cut, the upper part (i. e. that nearest to the centre) being broken off, and the quadrilateral blade thus formed being perforated and inserted into a haft. As for other details

[1]) Ryder 331, fig. 29c.
[2]) Ryder 331, fig. b.
[3]) Stolpe Pl. VI, fig. 19; Pl. III, fig. 10; the same in Solberg 55, fig. 48.

regarding the types of the *ulo*, the reader may be referred to the excellent papers of O. Mason[1]), and my occasional remarks under the heading of *inv. Amd. 45* and *80*.

Inv. Amd. 24 is a thin flake of gray clay-slate found in Dunholm, 8·5 cm in length and 2 cm in breadth, with a clearly marked, though blunt, median ridge on one of its surfaces, and with sharp edges. The terminal edges, which have been broken off, are on the other hand, not sharp. The specimen shows no trace of polishing or finishing so that it is uncertain whether it is an artefact at all, and whether it has ever been in use.

Inv. Amd. 25 is a more or less globular stone of circa 3·5 cm in diameter, with a segment broken away on one side, and hollowed out. The mouth of the kettle-shaped cavity thus produced is 2 cm in diameter. The interior of the cavity is globular, like the exterior surface of the stone. The specimen does not correspond to any part of any known Eskimo implement, and it is by no means easy to say whether it has been used as toy (a pot), or as an amulet, or as a tool. Perhaps it was only the curious globular form of the natural stone (a form extremely rare in Greenland) which gave occasion to the fabrication of this artefact.

Inv. Amd. 26 is a thin piece of gray clay-slate (circa $2·5 \times 2·5$ cm) with flat, roughly polished sides, and a sharp turned up edge fringing it on two sides. On the two other sides the stone is broken off, in such a manner that one of the two perforated holes which lie close to one another at a distance of 2 cm, has been broken in half. These two holes are bored obliquely and from both sides.

There is a slight vestige of polishing along one part of the curved edge, but only on one side of the blade.

Probably the fragment of a knife-blade (*ulo*).

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[1]) Mason, I and VI, 585.

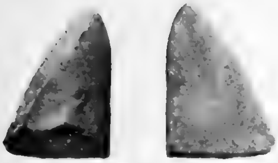

Fig. 11 (*inv. Amd. 21*).

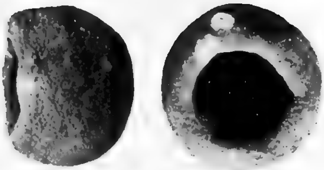

Fig. 15 (*inv. Amd. 25*).

Fig. 13 (*inv. Amd. 23*).

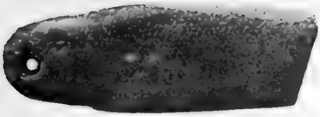

Fig. 12 (*inv. Amd. 22*).

Fig. 16 (*inv. Amd. 26*).

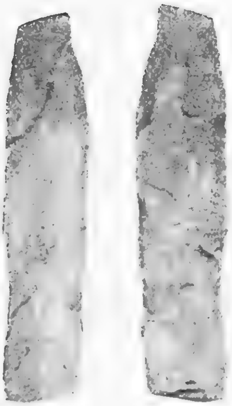

Fig. 14 (*inv. Amd. 24*).

Figs 11—16 (*inv. Amd. 21—26*). Stone implements. 11—13 from Skærgaardshalvö, 14—15 from Dunholm, 16 from Sabine Island. 2/3.

GENERAL REMARKS. Few, and to a great extent fragmentary as these stone implements from North East Greenland are, they nevertheless add their fresh testimony to the stone artefacts previously known from these parts. In the Museum für Völkerkunde in Berlin there are 9 wrought stones brought from East Greenland by "Die zweite deutsche Nordpolarfahrt", among them 2 *ulo* stone blades, 2 arrow-heads, 1 or 2 knives of pronounced Eskimo stone age type (the same type as those from Point Barrow illustrated in Murdoch [1]), as well as some nondescript specimens. Further, Ryder declares himself to have found 3 arrow-heads [2]), and 3 lance stone-heads [3]), all of slate, triangular, pointed and two-edged, one man's knife of stone [4]) and 9 women's knives (*ulos*) of stone [5]), and a scraper of flint [6]) (all of them in the National Museum at Copenhagen). The Swedish Expedition under Nathorst has in its collection at least 2 women's knives [7]) of stone and 4 one-edged knives [8]). In the Ethnographical Museum at Christiania there is a fragment of a woman's knife [9]), and a one-edged stone knife from North East Greenland, 17·5 cm in length.

Taken together, these stone implements from North East Greenland convey the impression that the Eskimo who first arrived on this coast were merely treading in the steps of their forefathers of the stone age. To form any conclusions as to how long this stone-age culture held its own in these regions, would now be premature. It may be a mere coincidence that, comparatively speaking, so little light is shed on this point

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1) Murdoch I 154, fig. 107 a and b.
2) Ryder 309, fig. 8.
3) Id. 316; 315, fig. 15.
4) Id. 322, fig. 21.
5) Id. 330, fig. 29.
6) Id. 333, fig. 31.
7) Stolpe, Pl. 3; Solberg 55, figs. 46 and 48.
8) Solberg Pl. 9, figs. 4 to 8; Stolpe Pl. 4.
9) Solberg Pl. 9, fig. 3.

by the collections hitherto made of stone objects from this part of Greenland. As a rule, it is the largest and best-preserved houses which have been excavated, while the older and much dilapidated houses have not received so much attention. Moreover, the rubbish heaps in front of the houses, particularly the oldest ones, have only here and there been thoroughly ransacked. I am inclined to believe that it is as yet premature to speak — as O. Solberg[1]) does — of the rapid decay and disappearance of the stone-age culture in North East Greenland, and from the temporary scantiness of stone implements discovered there, to draw conclusions as to the short life of the Eskimo culture now extinct in those parts.

I particularly disagree with Solberg's general statement that the one-edged stone knives found in North East Greenland only to a very slight extent resemble Eskimo implements, and can only be explained as the result of European influence. It may possibly hold good of some few knives with iron blades and wooden hafts, which may have had their origin in Clavering's Expedition to the coast in 1823 (see under *inv. Amd. 79*), or have been washed on to the ice from whalers, or have been brought there by immigrants from the south in times past. But Murdoch mentions, as typical of the western Eskimo culture in Alaska, not only stone-knives, both two-edged and one-edged, but also crooked knives with wooden hafts[2]). There is thus nothing remarkable in our finding similar types of implements in North East Greenland (cf. also under *inv. Amd. 69*).

The stone artefacts brought home by Amdrup have therefore a claim on our interest (except perhaps one specimen, the artificiality of which is doubtful). Three of the objects are from Skærgaardshalvö, which for the present I choose to regard as the southern boundary of the North East Greenland culture;

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[1]) Solberg 59—60.
[2]) Murdoch I, 151—161.

I may add that also among the objects found in the Ammassalik district there are some few stone implements. I shall leave it to specialists on Eskimo archæology to determine what the objects found have to teach us as to the stone craftsmanship of the North East Eskimo. Their art as a whole can scarcely be said to be of the most primitive kind. As for the types of the implements, it can hardly be denied that several of the stone implements found in North East Greenland are characteristic samples of the prehistoric Eskimo culture.

5. Finds from Skærgaardshalvö (68° lat. N.), the most southerly part of North East Greenland.

The foregoing sections have treated of three kinds of Eskimo implements which have hitherto been the object of particular attention on the part of ethnographers, and which are all represented in Amdrup's collection from North East Greenland, without taking into account the particular locality on the coast where they were found.

The rest of the collection will be described in the geographical order, the sections beginning from the southernmost place of former habitation and proceeding gradually north. As I have mentioned before, I reckon the southern boundary of North East Greenland to lie where the Ammassalik district begins, namely at *Kangerdlugsuak*, at about 68° lat. N. and 31° 56′ long. W. On the coast just north of this fjord was discovered an extinct Eskimo settlement, where the expedition made a comparatively rich haul of archæological relics and remains.

I shall here quote Lieutenant Amdrup's own description, translated into English. He was coming at that time from the north. On the 29th July 1900 he had left Cape Dalton, the most northerly starting point of the Expedition, in an open boat, whence with three companions he made his way southwards along the coast, following the polar current, towards Ammassalik. On the 8th August they had reached Kangerdlugsuak, where the peninsula of Skærgaardshalvö lies.

"On the south side of *Skærgaardshalvö*, where we landed, Eskimo had previously lived. On the whole stretch of coast from *Cape Dalton* up to here, we had not found a single trace of Eskimo having travelled or lived there. But here we found no less than 8 house ruins, 6 tent places, 11 fox traps, 1 bear trap, and numerous graves. It was quite apparent from the nature of the houses that they had not been inhabited simultaneously. Owing to the lack of turf the houses had been built mainly of stones, fitted together awkwardly. Several of the houses were very old, and some of them had quite tumbled to pieces. One of them was apparently of more recent date, and unusually well preserved. In this house the platform along the back wall was built of flat stones, so that it seems as if the inhabitants did not possess particularly large quantities of wood. But there must be excellent opportunities for hunting in the *Kangerdlugsuak* fjord, for there were plenty of seals, several bears and narwhals were seen, and in *Skærgaardshalvö* itself there were numerous traces of bears.

We set to work at once to excavate and examine the houses and graves. Several of the graves were extraordinarily well constructed. On the Expedition of 1898—99, we had found in *Depotö* Island (66° 07′ lat. N.) a grave which had a feature that marked it off from all others we had seen, viz., that a little chamber was constructed by the side of it. In *Skærgaardshalvö* we discovered several graves of this kind, and at the same time lighted upon the explanation of what the chamber was used for. It was intended as a repository for all the implements etc., which were put in along with the dead, whereas in the graves without a chamber these were placed in the graves themselves.

In one of the graves examined the corpses seem to have lain fully clad upon a bedding of bear-skin, for we found remains both of hairy seal-skin and hairless skin, and on the skulls, which were otherwise complete skeletons, the lanky black hair of the head was still adhering. The excavations of the houses gave no result at all, while the graves, on the other hand, yielded what under the circumstances may be called an unusually rich collection of ethnographical objects, most of which we took with us. We had also room in the boat for three of the best-preserved skulls."

The objects from Skærgaardshalvö are thus, with a single

[1]) Meddelelser om Grønland Vol. XXVII, 240—241.

exception (*inv. Amd. 21*), all grave finds. Besides the objects brought home, there were found in the graves 1 wooden tray, 1 wooden ladle, a number of worked pieces of wood, 1 fragment of a soapstone pot, and two fragments of lamp bowls, one of them of soapstone, the other of a soft kind of gneiss; these objects were not taken in the boat owing to lack of room. In the enumeration of the objects found four graves in all are mentioned, one of which was considered to be a child's grave; above it a toy sledge (*inv. Amd. 27*) was found. Most of the objects were discovered in a little stone chamber built by the side of the three adult's graves. To judge by the nature of the objects, one of these must have been a man's grave and another a woman's. For the finds consist in the one case of man's implements, harpoon heads, a drill, part of a lance, in the other of woman's paraphernalia (woman's knife, bodkins and bead ornaments).

Inv. Amd. 27 (Fig. 17) is a model of a sledge made of wood, found above one of the children's graves under some flat stones. It consists of two runners, 30 cm in length, and 3·5 cm in height (without bone shoes or vestiges of them), and four loose cross-bars, averaging 9 cm in length, 3·5 cm in breadth, which have been secured by a lashing on to the runners. Without doubt, one or more of the cross-bars are missing. There were no traces of the uprights. The upper edges of the two runners are straight, without upturned tips; their basal edges curve upwards towards the fore end, and the curve begins at a distance of 8 or 9 cm from the end of the tip, which practically means that about two-thirds of the runner glides over the firm snow, while the remaining third does not touch it. At the rear, the runner is rectangular. The wood is of uniform thickness behind and in front, so that the under surface of the runners is of the same breadth at either end.

Both the upper and under edge of each runner is chamfered obliquely, which shows that the vertical planes of the

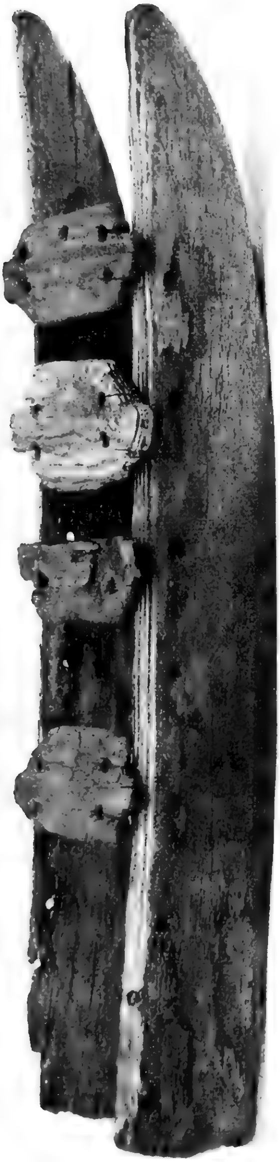

Fig. 17. A child's sledge. Skærgaardshalvö. $^{1}/_{2}$.

runners must have inclined towards each other, the distance between them being less above than below. The distance between them above, to judge by the length and form of the cross-bars, must have been 5·5 cm; if the runners are now placed in such a position that their chamfered under-surfaces rest entirely upon the ground, the distance below will be about 7 cm. When they are placed in this position, the cross-bars will also rest entirely on the chamfered upper surfaces. This, however, would be an exaggerated divergence of the runners, and it can only be explained by the fact that the sledge is merely a toy or an incomplete model.

The cross-bars (which in the accompanying illustration have been placed at a venture in the position they are presumed to have occupied on the runners) must have protruded a little beyond the runners on both sides of the sledge; before they became weathered, they must all have been more or less uniform, notched at both ends so that a kind of neck is produced at either side of the broader body. Each of the cross-bars has towards each end of its body two holes pierced to receive the lashing. As in each runner, a little below the upper edge, there is a row of 7 holes, it is uncertain whether there were one, or two holes in the runner corresponding to each cross-bar; if we suppose there was one for each, there must then have been seven cross-bars on the sledge, and these must have lain close to one another.

One of the cross-bars has an extra hole a little within the centre of one of the edges. In the larger sledges there is generally a hole of this kind in one of the back cross-bars near the uprights where the baggage is placed, to receive the lashing wherewith the latter is tied. But in this toy sledge, where the runners have not the usual hole pierced in front to receive the cross line which holds the dog-traces, this hole may possibly have been bored in the first cross-bar in front, for the reception of a cord wherewith the sledge was drawn.

Particular interest attaches to the two holes pierced right up in the upper edge of the back part of the runners. They are placed higher than the other holes, so much so that in one of the runners the hole has been bored from the inner side of the runners obliquely upwards, so that it debouches on the narrow upper surface of the runner (in the other runner the wood has been partially splintered at this spot). It may be permitted to assume that these two holes must have been used for lashing one of the missing uprights (if the sledge possessed any[1]). If we consider the distance between these holes and the back edge of the runners, we get the impression that the feet of these uprights must have been comparatively long.

Almost all the previous expeditions to North East Greenland speak of having found sledges, or parts of sledges.

Scoresby made a similar find in Traill Island (72° 12′, in the south part of the big Franz Joseph Fjord complex[2]). "One large piece of main-keel was found entire. It was composed of fir-wood (probably drift-timber) and defended by a row of pieces of bone, fastened to it by wooden pegs inserted in holes $^{4}/_{10}{}^{ths}$ of an inch in diameter."

Besides this, in several places a number of sledge keels were found. Whereto Scoresby makes the comment, that this great number of fragments of sledge parts indicates that the population must once not merely have been numerous, but must also have made extensive use of sledges.

Of special interest here is the sledge which was discovered and brought home by "Die zweite deutsche Nordpolarexpedition"[3]), and which now reposes in the Museum für Völkerkunde in Berlin

[1]) Murdoch (I, 355) designates as characteristic of sledges of the Greenland type "two upright posts at each side of the back of the sled, often connected by a cross rail, which serves to guide the sled from behind".

[2]) Scoresby, Journal 267.

[3]) Koldewey 685.

(see Appendix, fig. 85). It was found on the same day that the Expedition was about to leave the country to return home (16th August 1870) near an old Eskimo settlement at Cape Hold-with-hope (Cape Broer Ruys) at 73° 30′, just north of the mouth of Franz Joseph's Fjord[1]). It is both larger (208 cm long), more unwieldy, and more clumsily fashioned than the ordinary Greenland sledges. Clumsy as the sledge is, when we consider the hardness and weight of the logs of drift-wood out of which it was fashioned, and the big holes, most of them rectangular and on an average 7 or 8 cm in length, which they have managed with their primitive tools to pierce in the runners, one cannot refrain from wonder at what they have accomplished.

Doubts might well be entertained as to whether this sledge is of the Eskimo type, for it is widely different from the Greenland sledges with which we are familiar. I believe, however, that along with the picture one will be obliged to form of the North East Greenland sledge, it will be necessary to modify to a certain extent one's conception of the East Eskimo type of sledge. The sledge model found by Amdrup corresponds in all essential details with this complete sledge found by the German Expedition at $5^1/_2$ degrees of latitude further to the north on the same coast; and the sledge runner found in 1899 by the Swedish Expedition (illustrated in the Appendix, fig. 86[2]))

[1]) Die zweite deutsche Nordpolarfahrt, Vol. I (1874), page 685: "The still well-preserved and almost entire pieces of an Eskimo dog-sledge which were found further to the east, by the shore, lying by each other in the right order. They consisted of both of the runners, roughly fashioned out of drift timber, on the lower surface of which the holes and to some extent the wooden nails with which the rails of bone or ivory had been fastened to them, were still in preservation. Besides this, there lay by them some of the connecting cross-pieces, as well as one of the pieces of wood which are fastened on behind as uprights. The circular and square holes through which the dog-traces and the rawhide straps for fastening them were passed were distinctly preserved, but not a vestige of the leather itself was to be seen".

[2]) This sledge is in the Nathorst collection in the Stockholm Riksmuseum.

goes to confirm the picture we have formed, viz. a broad heavy sledge, one meter or more in length, the two runners of which are quite straight along their upper edge, not curving up in front like those of the West Greenland sledges; with irregularly cut cross-pieces, which have at either end two holes through which have passed the straps with which they have been fastened to the runners through large, often rectangular holes; with a keel of flat pieces of bone or ivory, which are nailed to the under surface of the runners by means of wooden pegs. Whether it had uprights or not, is not quite clear. It is true that a pair of uprights have been fathered on the sledge of the German Expedition, but it is by no means certain that the function of the comparatively narrow wooden sticks which were found lying together with the other parts, has been rightly understood[1]).

We find a quite similar sledge among the central Eskimo in King William Land, from which Amundsen brought three large sledges, two of which are now in the Ethnographical Museum at Christiania, and the third in the Ethnographical Museum at Bergen (Appendix fig. 90); these three are entirely without uprights.

In contradistinction to the above, the sledges of the Smith Sund Eskimo (at Cape York) have uprights resembling those of the central West Greenlanders (in Umanak fjord and Disko Bay). The sub-arctic Eskimo in West Greenland between Holstensborg and Cape Farvel, as we know, do not make use of sledges. At Ammassalik, in the central part of the East coast, the sledges are comparatively small and narrow and the uprights are of a peculiar type (Appendix fig. 89), being several times broader at the foot than above, their upper parts being rounded and having an indentation as a rest for the hands in steering them down

[1]) In any case there are reason for supposing that the uprights, if they existed, were fastened to the inner side or on the upper surface of the runners, not to the outer side.

a slope or between the hummocks on the sea ice. The use of uprights made of wood seems to be confined to Greenland.

Among the central Eskimo the use of uprights is only spoken of among the Baffin Land Eskimo[1], and they use as uprights reindeer horns, adhering to the skulls. It is conceivable that it is this latter contrivance which has given rise to the use of the wooden uprights which are characteristic of the East Eskimo sledges in Greenland.

The East Eskimo type of sledge, however great its variations in detail, corresponds only to one of the two types which, according to Murdoch[2], are in use among the West Eskimo, particularly in the north of Alaska. One of these Arctic Alaska types, which is unknown to the eastwards, is common to the Alaska Eskimo and the Chukchee in North East Siberia[3]. The other, smaller type (*unia* = "the one which is dragged") which is low and flat, without rails or uprights, is used mainly for transporting game, or the women's boat (*umiak*) across the land or solid ice. "Both kinds are made without nails, but are fastened together by mortises and lashings and stitches of thong and whalebone; both kinds are made of drift-wood and shod with strips of whale's jaw fastened on with bone treenails." As Murdoch[4] goes on to remark, it is the *unia* type which corresponds to that of Greenland, except in the fact that it is without uprights. It is this type of sledge which must apparently be regarded as typical of the Eskimo, which is found recurring varioulv fashioned, but on a large, and in fact the very largest scale among the Eskimo in King William Land and in North East Greenland. *Inv. Amd. 27*, a little toy sledge, found on a child's grave in the extreme east of the Eskimo lands, is probably an imitation of this type.

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[1]) Boas I, 529.
[2]) Murdoch I, 353.
[3]) Bogoras 105—106.
[4]) Murdoch I, 355.

Inv. Amd. 28, 29 and *30* (illustrations of which are found in figs. 47, a, b, c) are three small bones of similar nature (knuckle-bones or tarsi of a mammiferous animal?) which are used as drill caps (head-pieces) in boring. In the centre of each is seen a fairly deep cavity due to the wearing action of the upper end of the revolving drill-stock. The head-piece is placed lengthwise in the mouth, in such a manner that the teeth tightly grip the elongated crest of the bone, while the knob-shaped thick part of the bone sticks out from between the teeth and forms a support for the upper end of the drill.

At one end of each of them there is a transverse hole, intended for a strap for hanging up.

Ryder[1]) found in Scoresby Sund a similar 'mouthpiece' of a drill made of the tarsus of a reindeer. Quite similar mouthpieces (*kimmiän*), made of the knuckle of a seal's paw, are used at Ammassalik.

Inv. Amd. 31 (Fig. 19) is a slender bodkin, 9 cm in length, in the middle oval in cross section, but flattened towards both ends, gradually tapering towards the point, where both side edges are sharp, just as the point is quite sharp, in contradistinction to the other bodkins in the collection. Through the flat knob of the thick end an eye (to receive a strap for hanging up) has been bored: the part under the knob has a concave indentation.

Several bodkins of a similar nature were found by the Nathorst Expedition in North East Greenland[3]). Some of them (like the bone needles found by Ryder[4]) may be compared with the marline-spikes described by Murdoch[5]), the use of which

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[1]) Ryder 323.

[2]) Nelson 81, and Pl. 37; Hough I, 562 —: "The small wooden and bone mouth-pieces of the Eskimo east of Point Barrow to Cumberland Gulf (Alaska) seem to be copies of the deer knuckle-bone".

[3]) Stolpe, Pl. IV, fig. 13.

[4]) Ryder 319—320 (cf. Boas I, 523, fig. 472).

[5]) Murdoch I, 292: "This implement is used in putting on the backing of

is well known from Alaska. But the nail found by Amdrup is so well adapted for piercing with, that it must, no doubt, have been used as an awl for piercing holes for stitches in skin [1].

It is worth noticing that the Eskimo at Ammassalik use a similar kind of implement (a 'bone plug') for closing up the wound of the seal they have killed [2].

Inv. Amd. 32 (Fig. 20). This needle is remarkable for its short, broad, and flat form; it is only 7·5 cm long and 1 cm broad in the middle. The ring-shaped head, which is now highly weathered, must originally have measured circa 1·8 cm in diameter. The needle from the middle tapers off towards both ends; at the pointed tip, moreover, it is quite thin, so that the edges both at the broad end and some distance up along the sides are sharp.

The implement does not seem to be adapted for piercing hard material or hides. The broad tip renders it more probable that it was used for making folds in skin (e. g. at the edge of the large upward-turned *kamik* soles which are well known further southwards along the East coast), or have been used in some way in women's needlework, though not directly as a needle.

It resembles some of the boot-sole creasers described by Nelson [3].

Inv. Amd. 33 to *44* (Fig. 18). There were found, in all, 12 entire bodkins of this type and 1 fragment in Skærgaards-

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a bow to raise parts of the cord when an end is to be passed under, and in tucking in the ends in finishing off a whipping".

[1]) Nelson Pl. 46, figs. 13—16 (bodkins with knob-like heads without eye). — Two bodkins of a similar kind are found in the Amundsen collection (the Gjöa Expedition) at Christiania, No. 15711, length 12·7 cm, quite pointed, without eye; and No. 15712, length 9·9 cm, with a blunt point and an eye (to receive a cord loop for hanging up).

[2]) Holm Pl. 15.

[3]) Nelson 108 and Pl. 44, fig. 50.

halvö. They have a length of from 8·5 to 13 cm. Ten (eleven) of them resemble each other closely, being cylindrical in cross section, tapering towards the point, which in all of them is blunt, except in the fragment which has a point formed by four short oblique cuts. Around the head end (the thick end, circ. 1 cm broad in cross section) in most of them, has been cut a series of from four to eight independent rings. Three of the bodkins are without these rings.

An eye for a thread is found on the flattened top of 10 of them (in that furthest to the left in the figure it has been broken and replaced by a lateral eye); the eye is carefully perforated through a low projection on the flat top of the head; a very fine and sharp drill must have been used in this perforation, which has been made from two sides, obliquely downwards, so that the perforated holes meet under the foot of the projection. The hole thus curves a little downwards in the middle.

Only one of these bodkins (the next but one on the right in the illustration) is of a somewhat different variety, being flat like a lancet, though without sharp edges, and the eye is produced by a simple lateral perforation through the broad end. Cf. *inv. Amd. 106.*

In North East Greenland, a needle similar to those first mentioned, with a cylindrical body and with six rings in the thick end, was found by Ryder[1]) in a child's grave. The upper part of it is flattened laterally, and the eye produced by a transverse perforation.

In the National Museum at Copenhagen there is a little collection of 10 bodkins found by K. I. V. Steenstrup at Eqaluit, near Ikerasak on the Umanak fjord in West Greenland. These ten bodkins correspond to those from East Greenland both as regards the rings round the thick end and the cacuminally

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[1]) Ryder 333, and fig. 32a (National Museum at Copenhagen, Lc. 1426).

Fig. 18 (*inv. Amd. 33* to *44*).

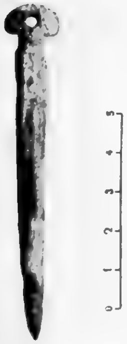

Fig. 19 (*inv. Amd. 31*).

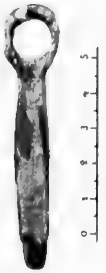

Fig. 20 (*inv. Amd. 32*).

Needles and bodkins. Skærgaardshalvö. $^1/_2$.

placed eye. From the same quarter come 5 bodkins of quite the same type (5 to 9 cm in length), now at the Ethnographical Museum at Christiania (inv. Nos. 5947—5950). — This type seems to be peculiar to Greenland. It is true, we occasionally meet with annular incisions in bodkins or marline-spikes outside Greenland, but there they are more richly ornamented and have knob-shaped heads, which are often representations of animals heads[1]). In Pfaff's collection from West Greenland, in the Riksmuseum at Stockholm, there are two so-called *ajagak* sticks (sticks for the ring-and-pin game) which have these annular incisions round the upper thicker part, and the upper ends of which are cut in the form of human faces (see Appendix figs. 92 and 93).

Inv. Amd. 45 (Fig. 21) is a bone haft belonging to the blade of stone described under the heading of *inv. Amd. 23*; they are the parts of a woman's knife (*ulo*) of a highly differentiated type. The haft consists of four pieces, which are grooved into and partially nailed to one another.

At the bottom is the blade-holder (see fig. 21) or the 'haft proper', an elongated thinly cut bone with two parallel side surfaces and two diverging end surfaces. In the under edge of this haft there is a comparatively broad open slit, into which the stone blade fits. At the bottom of the slit are seen two holes, which might indicate that a blade other than that which is there now was once inserted there, and fastened in a different manner. This perhaps also serves to explain the large aperture (8 mm in diameter) which is seen at one side of the holder, just where one of the legs of the upper

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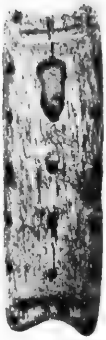
[1]) See e. g. Nelson 193; cf. Pl. 46 and 48 (description pp. 106—107). For simpler types see Murdoch I, 318, fig. 325 (flat, without rings, with lateral eyes). Another type of needle, triangular in cross section, thickest in the middle, where the eye has been pierced, tapering towards the tip at both ends, was found by Die zweite deutsche Nordpolarexpedition (I, 605, fig. 19 b); the same type is known from the Central Eskimo (Iglulik). See Boas, I, 523, fig. 472 and II, 94, fig. 136.

part of the *ulo* has been grooved in, so that its foot is exposed in the opening (there is a break in the haft just underneath in which the lower end of the leg is visible). A little higher up, over the two small holes in the side of the 'haft proper', which are intended to be used in fastening the blade by means of a sinew lashing, are seen the nails in two other holes in the side which hold this bottom piece (the 'haft proper' along with the inserted blade) fixed to the legs of the handle.

The legs are elliptical in cross section (with the broad side in the same plane as the blade), very slightly tapering above to enable them to fit into the holes in the top piece of the *ulo*. The lower ends of the legs are whittled off into two flat, thin tangs, the shoulders of which are chamfered in such a manner, that when they are pressed firmly down, the legs are supported in the position in which they are seen in the illustration, resting against the upper edge of the blade-holder and at the same time fitting exactly into the slots on the under side of the top piece. These slots in the under side of the top piece are very deep, one of them, probably owing to an error in the working, having passed right out to the opposite side of the piece, where the upper end of the leg is seen sticking up in an elongated, irregular opening (cf. fig. 21 b).

The 'top handle', or the upper piece of the *ulo*, is like the 'haft proper', an oblong, slightly curved bone, elliptical in cross section, placed horizontally and with the broad side at right angles to the plane of the blade. The surface of this interesting piece is specially characteristic in view of the three rows of holes (not bored through) which extend along it, and the two slightly concave grooves, which are cut across them at either end, more or less parallel to the concavely cut terminal surfaces of the piece (the concave chamfering of the end surfaces expands infundibularly downwards towards the under side of the bone). These regularly disposed holes in the upper surface of the piece must be considered to have been nail-



a *b*

Fig. 21 (*inv. Amd. 45*). Bone handle of a woman's knife. 7/10. An illustration of the stone blade belonging to this knife is found in fig. 13.

Fig. 22. Three thimble-guards of bone. 1/1. Skærgaardshalvö.

holes for securing attached ornaments of ivory (cf. *inv. Amd. 107—109*), such as we are familiar with in the implements from Ammassalik, or else have been intended for a lashing of whalebone like that mentioned by O. Mason[1]) in *ulo* handles from the mouth of the Mackenzie River (*inv. Amd. 86*, pag. 473).

In this *ulo* two types are blended or joined into one; the *ulo* which consists of a stone blade inserted into a simple bone or wooden haft, and the *ulo* the stone blade of which is attached to a handle formed by two legs united by a cross-piece[2]).

The last of these types no doubt occurs only in Greenland, where perhaps a chance formation of a piece of reindeer horn used for a haft — as in the specimen from West Greenland (inv. Pfaff in the Riksmuseum, Stockholm) illustrated in the Appendix, fig. 94 — may have given rise to its invention. It is extensively used for *ulos* particularly at Ammassalik[3]), whence O. Solberg[4]) holds that it perhaps originally came from East Greenland and was brought thence by traders to the West coast at a later date. At any rate it is interesting that this type has been found so high to the north on this coast as Skærgaardshalvö. (Cf. another *ulo* type in *inv. Amd. 80*).

Inv. Amd. 46, 47, 48 (Fig. 22). These are three thimble-guards of the usual Greenland type, which is also found in Alaska[5]).

Fig. 23. Fork made of bone. Skærgaardshalvö. $^1/_2$.

This type consists of a double hook with barbs back to back, made of a flat piece of bone which by two incisions is formed like two hooks back to back. The upper

[1]) Mason I, Pl. 56 and 57. Cf. Stolpe I.

[2]) Mason (VI. 585) does not give these varieties, as he is chiefly occupied with the differences in the type of handle within the West Eskimo district.

[3]) Holm Pl. 19.

[4]) Solberg 52.

[5]) Nelson 110, and Pl. 44, figs. 16 and 18.

end of the centre part in these pieces has a hole pierced in it so as to enable it to be hung by a loop over the place where the woman works on the platform in the hut. These thimble-guards, which were found on Skærgaardshalvö, are very small (from 3·8 to 4·8 cm in length), when compared with those used by the people of Ammassalik, but the West Greenland specimens in the National Museum at Copenhagen[1]) are, taken all round, not larger than these from North East Greenland.

Fig. 24. Blubber hooks of wood. Skærgaardshalvö. 1/2.

On these double hooks the Eskimo women hang their sewing-rings of skin[2]) which they place on their fingers while sewing. A sewing-ring of this kind was found by Ryder[3]) in the same part of Greenland.

Inv. Amd. 49 (Fig. 23) is a one-pronged fork for meat or blubber. It is a thin piece of bone, 21 cm in length, triangular in cross section, slightly curved. At one end there is a fairly large hole (for hanging up), in the other it is irregularly bevelled or worn away. The best-preserved parts of it have still fairly smooth sides.

Inv. Amd. 50 and *51* (Fig. 24) are two wooden hooks, evidently intended to be hung up, probably over the lamp in the house, or over a fire-place, as they are thickly sooted. One of them has at the pointed end two barbs, like those of an arrow, back to back, with sharp points, whereas the point proper is blunt.

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1) There are many old specimens of this type of thimble-guards from West Greenland in the National Museum in Copenhagen (Nat. Mus. cabinets 84, 91 and 92).

2) Skin thimbles of this kind are found illustrated, for instance, in Boas I, 524, fig. 473.

3) Ryder 334.

The one of these hooks which is entire is 15·5 cm in length; the little fragment has a length of 4·5 cm.

Similar wooden hooks are used at Ammassalik for hanging over the lamp, with a piece of blubber stuck on them so that the train-oil can run down on to the lamp and feed the flame.

Murdoch[1]) speaks of blubber hooks of wood, but with barbs of ivory attached to them, as being very common on the

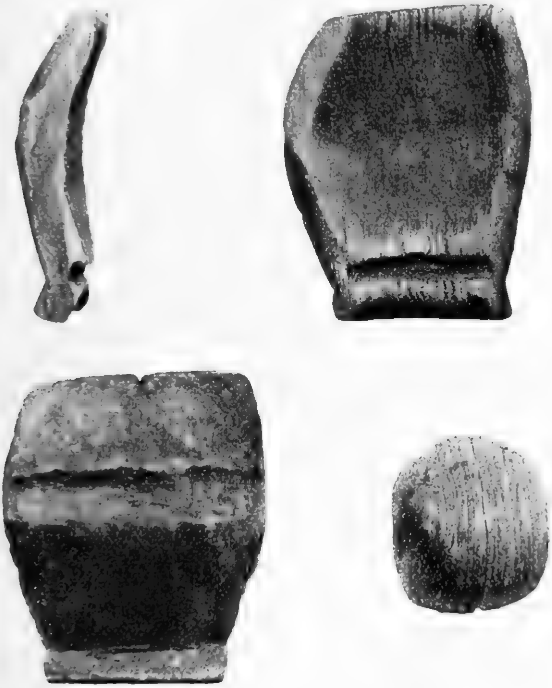


Fig. 25 (*inv. Amd. 52*). Four pieces of a child's urine-tub. Skærgaardshalvö. 1/2.

coast of Alaska, but merely mentions that they are used for moving pieces of blubber from one place to another.

Inv. Amd. 52 (Fig. 25) is a little collection of 9 concave pieces of wood which, when joined together, will be seen to form a little vessel, which in fig. 27 is illustrated in natural

[1]) Murdoch I, 310.

size by E. Ditlevsen, the artist of the Expedition. Two of the pieces form the round bottom of the vessel, the diameters of which are 4·1 and 4·8 cm; the remaining pieces build up the curved sides; the height of the vessel is 8·1 cm. There is one of these side-pieces (staves) in the vessel which is formed in a different way than the other pieces, being more straight, and moreover apparently made of a different kind of wood; perhaps it did not originally belong to the whole, but was fitted in later.

Inside, at the bottom, there runs round the side of the vessel a deep groove into which the edges of the bottom fit, and under which a circular foot has been carved out in the lower part of the staves.

On the side of the vessel, exteriorly, is seen, a little above the middle, a broad shallow groove which passes right round and was apparently intended for a hoop for holding the pieces together. There are no holes, or vestiges of nails having been employed.

This little work of art was probably carved as a model of a urine-tub for the house, to be given as a present to a child.

Inv. Amd. 53 (Fig. 26) is a whalebone-dish of the usual type known from all Eskimo districts (Murdoch[2]), and called by the Greenlanders *pertaq* (cf. Appendix, fig. 95). It consists of a piece of whalebone bent double, and fastened with tree-nails on to a wooden bottom.

The oblong elliptical bottom made of wood of fir or pine, circ. 29 cm long, 12·5 cm wide, is carved out of one piece, and is absolutely flat. In its edge are seen six holes for pegs, and four of these pegs are still sticking in them. All these holes lie on one half of the edge of the bottom; on the other half the whalebone rim has not been pegged on to the bottom, but merely secured by the force of the pressure. The flat surface

[1]) Murdoch I, 88, figs. 18 and 101. Cf. Nelson 71. Boas II, 44 and 73. Holm, Pl. 25.

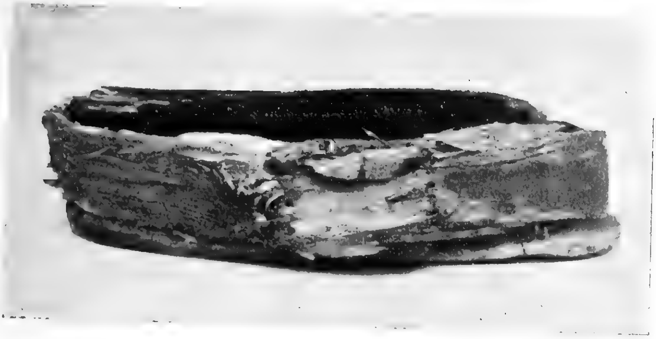


Fig. 26 (*inv. Amd. 53*). Whalebone-dish. 1/4.

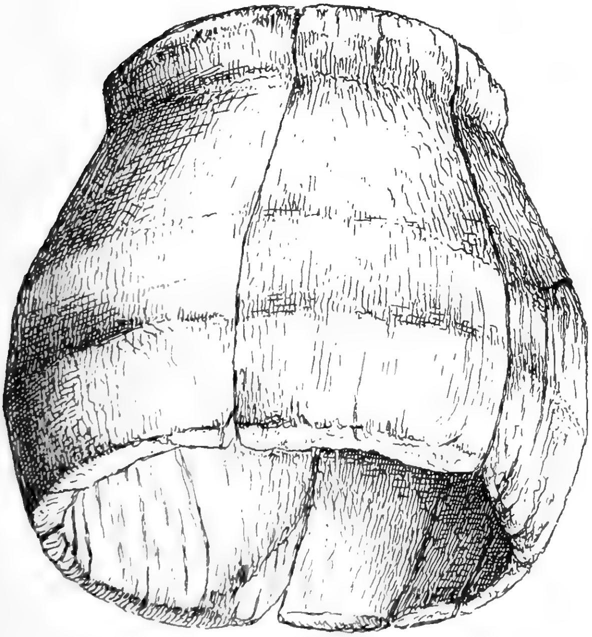


Fig. 27 (*inv. Amd. 52*). Child's urine-tub. 3/4.
E. Ditlevsen del.

of the bottom has also pierced in it eight holes, which must have been made with a very fine drill. They are disposed in two parallel rows. The object of these holes is uncertain. As one side of the bottom bears traces of blubber, the dish may perhaps have been used as a repository for blubber, and the holes in the bottom have been intended for the discharge of the liquid part of the blubber. — Ryder found several bottoms of whalebone-dishes in Scoresby Sund[1]).

The ends of the whalebone piece which form the sides have been made to interlap, and have been sewed together

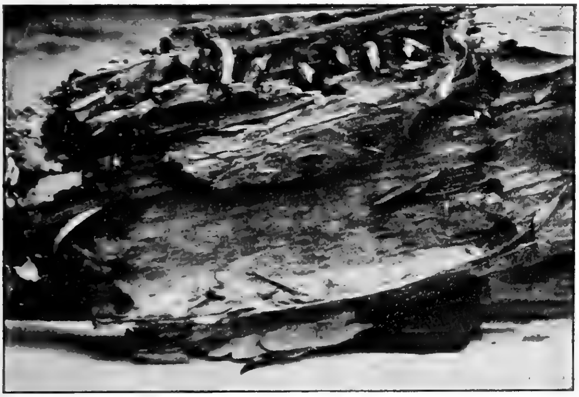


Fig. 28 (*inv. Amd. 53*). The interlapping ends of the whalebone rim. $^{5}/_{7}$.

with whalebone cord (fig. 28). Ryder[2]) also speaks of having found samples of whalebone lashings in Scoresby Sund, plaited or unplaited. Those which were found here are unplaited thin strips. In the piece where the whalebone rim has been doubled over, the holes traverse both its ends, and along the top edge they lie in two rows, eight (or nine) in each. The cord is drawn from each hole in the upper row through the corresponding hole in the lower one, so that it connects one pair

[1]) Ryder, 334.
[2]) Ryder, 326.

of holes with the next only at the inner side of the rim. One of the vertically disposed lines of holes is also double; but here one of the rows of holes lies outside the jointing of the ends of the rim, thus passing through only a single layer of whalebones.

The seam forms a rhomboidal figure (circ. $7 \times 5{\cdot}5$ cm) on the side of the rim. That part of the rim which faces the bottom, as can be seen from a few nail-holes which have been preserved at the nether edge, was no doubt without a seam. Most of the stitches have been broken; at the upper edge a few intact stitches are still to be seen.

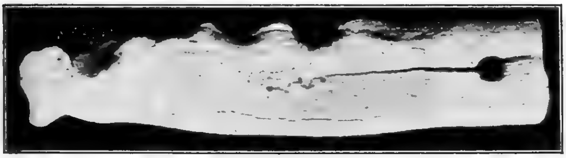
Inv. Amd. 54 (Fig. 30) is an oblong bone button, or toggle, 4·2 cm long, flat on one side, convex on the other, with rounded edges and corners. One of the side edges which run lengthways is straight, the other is slightly curved. Close to the middle of the curved edge has been pierced a hole, with elliptical circumference.

One end of the button has been partially worn or frayed away, forming a sharp edge.

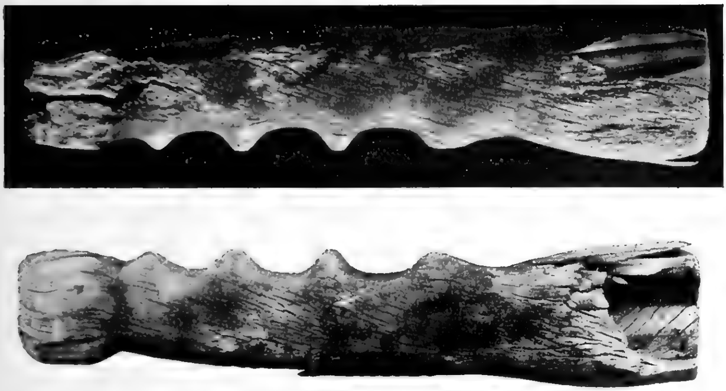
The button may be one of the belt-fasteners described by Nelson[1]. "The belt-buttons are passed through a cord loop on the opposite side of the belt and thus hold it in place". *Inv. Amd. 57*, found in the same spot, is probably part of a belt of this kind.

Inv. Amd. 55 (Fig. 29 b) is a bone handle, 13·5 cm long, made of a yellowish-grey hollow bone (narwhal tusk?), the medullary channel of which is visible at both ends of the handle. The lower part of one of the side surfaces has been broken off. This heavier end of the handle is rhomboidal in section, nearly double as high as broad, whereas the cross section of the handle towards the other end is almost quadratic. The extreme end of this part of the handle is notched off to form

[1]) Nelson 59, Pl. 27.



a (*inv. Amd. 56.*)



b (*inv. Amd. 55.*)

Figs. 29 a and b. Drum-handles(?) made of bone. 2/3.

Fig. 30 (*inv. Amd. 54*). Toggle button of bone. 9/10.

a (*inv. Amd. 59.*)

b (*inv. Amd. 60*).

Figs. 31 a and b. Interlinked beads. 1/1.

Fig. 32 (*inv. Amd. 58*). Bear's tooth.

Figs. 29—32. Bone objects from Skærgaardshalvö.

a round knob. Particularly characteristic are the four notches for finger-rests which lie in a row along the under side of the handle.

On the back of the handle there is a distinctly carved ornament, half of which, however, is weathered or worn away (see Fig. 33 a).

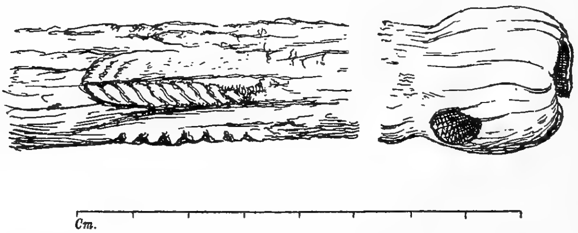
From the underside of the knob-like head a hole has been bored obliquely into the medullary channel, so that its path lies in the longitudinal direction of the handle, one of its mouths looking towards the finger-rests, while the other faces the end of the handle within the medullary channel (see Fig. 33 b).

I am of the opinion that this piece is the old handle of a drum. As far as I know, this is the first time that a drum-handle of this type, and made of bone, has been found in Greenland. In type it approaches very closely to the handles from Alaska described by Murdoch and Nelson. The former[1]) states that the Point Barrow Expedition brought home 8 handles for drums which exhibit but slight variations. The commonest material for the handle is walrus ivory; only two out of twelve were of antler. Their length is from 4·6 to 5·4 inches. Murdoch gives illustrations of several specimens, two of which, like *inv. Amd. 55*, have four notches for the fingers; all of them have at the end a knob carved either as a human or an animal head. Nelson[2]) also speaks of the ornamentation of the drum handles: "One of these handles (number 43807), which was obtained at Shaktolik, is of walrus ivory, and is six inches long by an inch and a half in diameter. It is carved in the form of a walrus, the well-made head being placed at the inner end; on the lower side are four diagonal grooves for finger-rests, and at the rear the animal's flippers are represented. The back is etched with short lines to indicate bristly hairs". This last feature reminds one of the ornament found on the

[1]) Murdoch I, 386—387, figs. 384 and 385. Cf. Wilson II, 561—562.
[2]) Nelson 351.

back of the handle from North East Greenland, and which might possibly be a stereotyped ornament of the same kind.

The question now is to what end of the handle the hoop of the drum, over which the membrane was extended, was secured. If we suppose that it was secured by a lashing to the knob-like head at the narrow end of the handle, where the oblique hole lies, the finger-rests would, if the handle were grasped in the usual manner, with the left hand, be brought to lie transversely to the fingers, as they are cut in a direction obliquely to the longitudinal direction of the handle, and, besides, they would lie too close up to the drum ring. I feel convinced that it is the broad end of the handle which carried the drum, though I am not clear as to the mode in which it

a  b

Cm.

Fig. 33 (*inv. Amd. 55*). Parts of the drum-handle (a) ornaments carved in the surface, (b) the knob-shaped end.
E. Ditlevsen delt.

was secured. It is just at this end that a piece on one side of the handle has been broken off. The mouth of the marrow pipe forms at this end a very large square hole (about 1·5 by 0·8 cm), which may possibly have been used in securing it. Otherwise both in Greenland (e. g. at Ammassalik) and in Alaska there is generally a notch at the back of the handle, in which the drum ring is stuck, and under it one or two transverse holes for the lashing with which it is secured. These features are missing here. But it would be in accordance with the usual practice with regard to drums, that the drum-ring was placed at the broader end of the handle, at a distance of three

Fig. 34. Belt consisting of pierced teeth (fragment). 1/2.

or four centimetres from the nearest finger-rest. — The oblique hole in the narrow end of the handle must then have been intended to receive a strap for hanging up the drum.

Inv. Amd. 56 (Fig. 29 a) is a handle similar to the foregoing, likewise made of a hollow bone (but probably of another animal) somewhat smaller and more slender, scarcely 11·5 cm long, having at the thick end a height of 2·2 cm, and a breadth of 1 cm. It has suffered severely from climatic action, and is almost entirely decayed at the narrow end. The drum-handle type, however, is unmistakable; we see the finger-rests and the remains of the knob-like head; whether a hole was pierced in the latter, cannot be decided. On the other hand, there is, in contradistinction to the foregoing, a transverse hole in the broad end, to which the hoop of the drum was probably secured by a lashing.

Inv. Amd. 57 (Fig. 34) is a collection of 53 teeth of a mammiferous animal, which were found lying loose, all of them pierced in a similar manner at the tip. In the case of some of the holes it can be seen that they have been bored from two sides. — I have strung the teeth on a cord, as is shown in the illustration; the chain, when stretched taut, measures 23 cm in length.

These teeth have, without doubt, been used for some kind of ornaments, as a primitive kind of beads, as part either of a necklace or of a belt. Ryder[1]) also found at 'Hekla Havn' in Scoresby Sund a collection of small carved bone beads, which may have formed a necklace. A necklace consisting of perforated teeth from West Greenland is in the National Museum at Copenhagen[2]).

Whole teeth of this kind used as ornaments are as a rule fastened to and hung from the lower edge of skin girdles which are worn round the women's waists. Nelson[3]) makes mention of belts of this kind among the Alaska Eskimo. "Throughout the Eskimo country from the lower Kuskokwim to the Arctic coast, a favorite waist belt worn by the women is made from the incisors of reindeers . . . . . These rows of teeth are sewed along a strap of rawhide, one overlapping the next in scale-like succession, so that they form a continuous series along its entire length . . . . when worn, the belts are brought loosely round the waist and held in place by a toggle or button".

In the Gjöa collection (Amundsen) in the Ethnographical Museum at Christiania, there are several belts of a similar kind from King William Land and Boothia. Some of them consist of narrow, double strips of skin, others are broader; all of them are richly hung with teeth or other objects, used as ornaments, but always in such a way that the ornaments on each belt are similar in kind: in No. 16153, for instance, 26 teeth of the same kind are strung in the sinew-cord loops at the lower edge of the belt, and all the teeth have their tips pierced. In No. 16167 about 100 teeth (of seal?) have been fastened to a quite narrow girdle, each tooth having been strung on a loop, the ends of which are sewed in at the upper edge of the belt in the intervening space between the double layer of skins; the teeth here are pierced at the roots, and hang in such a manner

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[1]) Ryder 338.
[2]) København Nationalmuseum, Ethnographical section. Vitrine 77, No. 54.
[3]) Nelson 59.

that the tips are turned inwardly towards the body of the person wearing the belt. In other belts in this collection bear's teeth, bodkins, animal bones of one kind, or talons of birds are hung.

Inv. Amd. 58 (Fig. 32) is a bear's tooth (7 cm long) with a hole pierced in the part nearest the root, but otherwise unwrought. As it was found isolated, there is no ground for assuming that it has hung in a chain of bear's teeth.

"Die zweite Deutsche Nordpolarfahrt"[1] mentions a similar find from North East Greenland of a bear's tooth with a hole pierced at the root. — The Fram Expedition likewise found a bear's tooth with a similar hole at Leffert Glacier (Ellesmere land?[2])).

The use to which these isolated teeth were applied is not quite certain. According to Boas, a bear's tooth was used as bait in spearing salmon (just as carved ivory fish are used for the same purpose) among the Baffin Land Eskimo[3]. And with regard to the Eskimo from Southampton Island, he says "knives are carried in seal-skin pouches, provided with a bear's tooth, which may be used for whetting"[4]. There are, however, no grounds for supposing that this is the use to which the tooth we are speaking of was applied.

Occasionally a bear's tooth of this kind is found hanging among the different objects which generally depend in a bunch, attached to the women's needle cases[5]. *Inv. Amd. 58* is perhaps rather to be taken to be a pendent ornament of this kind.

In conclusion, I must remind the reader that the Lapps used to employ bear's teeth pierced at the root as amulets[6].

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1) Koldewey I, 603.
2) Christiania Ethnographical Museum No. 12377.
3) Boas I, 513, and Fig. 454.
4) Boas II, 71, Fig. 94.
5) Nelson 104, Pl. 44, figs. 23 and 25.
6) 8 pieces of this kind are in the Nordiska Museum, Lapp section, at Stockholm.

Inv. Amd. 59 and *60* (Fig. 32 a and b) consist of five 'beads' carved in bone, belonging to different ornaments or implements.

Two of them are elongated, circular in cross-section, attached to each other by the aid of two eye-forming clasps which grip each other. The mode of the attachment seems to have been that one eye was pressed through a slit in the other. There appears to have been a third link, as one of the two has the remains of an eye at the free end.

Inv. Amd. 60, on the other hand, is complete, as neither of the two clumsy beads which are attached by their eyes to the quaintly formed central link, have terminal eyes at their free ends. The body of the central bead has been flattened laterally, and almost has the form of a thick disk the edge of which is cut straight on two opposite sides, which are connected by a bored hole.

Quite similar beads were found by Nathorst (Hammer) at Cape Franklin in North East Greenland, in a grave in which the body of apparently a little girl was buried[1]).

Interlinked bone beads, or short bone chains of this kind have hitherto been known only from Alaska, where they are frequently attached to the thick end of bodkins, as ornamental means for hanging up. At all events, I have not succeeded in finding any objects more closely resembling them[2]).

It is interesting to note that the art of linking together fine bone objects of this kind was known among the Eskimo of the north-east part of Greenland, as well as among those of the Bering Strait.

Inv. Amd. 61 (Fig. 35). This curious object is a shaft-like tube made of bone, with two thick and two thin opposite walls, the implement being oval in cross section, while the cavity of

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1) Stolpe, Pl. 6, Fig. 19.

2) Nelson 107, and Pl. 46; cf. Pl. 43 and 52. — Hoffman Pl. 55, Fig. 1 and especially Pl. 41.

the tube is cylindrical (0·7 cm) in diameter. The implement is made of a single hollow bone (narwhal tusk?), its length 8·5 cm; its cross section at the thickest end 3 cm by 1·5 cm. There are no holes pierced in the walls of the tube, but about at the middle of the body four conic sections have been removed, whereby its upper surface has been divided in the curious manner shown in the figure, bringing to light an inner layer of the bone with convex edges, which appear in the two

Fig. 35. Needle-case of bone. Skærgaardshalvö. 7/8.

bow-shaped incisions between the intact parts of the outer layer, or between the upper and lower ends of the tube; these last are connected on either side by a narrow bridge in the outer layer, narrowest in the middle, expanding uniformly above and below.

It is interesting to find in this part of North East Greenland this extinct type of implement, which has often been found before in graves in the north of West Greenland, but which is otherwise unknown in Greenland, and has never been met with, for instance, at Ammassalik; there are several specimens of it both in the National Museum at Copenhagen and in the Riksmuseum at Stockholm, (the Pfaff collection contains 6 of them) the latter being unusually beautiful and partially ornamented (see Appendix, Figs. 96 and 97). Now to what use can it have been applied? In the records of the above mentioned museums has been embodied an explanation of native Greenlanders to the effect that this implement was part of an old-fashioned ring-and-pin toy (a curious kind of *ajagaq*), a game which, in another form, is to this day very common among the Eskimo of all parts[1]. This, however, is the sort of explanation which a Greenlander might very easily be induced to give when questioned about matters which are no less a puzzle to him than to his questioner. I venture therefore to cast a doubt on the correctness of the explanation, and shall hazard another hypothesis.

From all Eskimo regions outside of Greenland is found as an accessory to the women's sewing-apparatus a needle-case of bone, formed like a tube, from 6 to 10 cm in length, through which a long rawhide thong is drawn. At the ends of this thong, which project out through both the ends of the tube, the women fasten various small implements or knicknacks, such as needles, bodkins of various forms, small carved bone or wood objects, which perhaps are to be collected for a future girdle, pierced bear's teeth etc. The thin sewing-needles are stuck into the thong and can be drawn along with it into the tube in order to protect them[2]. The collection of these objects from Alaska exhibit, as usual, the greatest number of variations and the richest ornamentation[3]. Whereas the types of tubes from the western regions, to judge by the illustrations

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[1]) Culin 544.

[2]) Murdoch I, fig. 328 b.

[3]) Nelson 103, and Pl. 44; Murdoch I, 318—322.

in Nelson and Murdoch, appear to be preponderatingly circular in cross section, the more easterly types, from the coasts of Hudson Bay and Baffin Land, illustrated in Boas[1]) and Turner[2]), are more flattened from both sides.

Exclusively cylindrical needle-cases are found also in the Gjöa Expedition's (Amundsen's) collection at Christiania; the leather thong, which is drawn through the tube, is here secured by one of the ends of the thong being fastened with a knot to a thin bone handle, which toggles towards the end of the tube; at the other end of the thong are stuck needles and bodkins, beads, animals' teeth, etc.

This type of implement is not confined to the Eskimo; an exactly similar implement is also found among the Laplanders; in the Nordiska Museum at Stockholm there are over 30 similar needle-cases, which have belonged to the Laplanders, consisting of ornamented bone tubes through which a rawhide thong is drawn, held in place with the aid of a knot at one end (quite like the thongs in the needle-cases described by Murdoch from Point Barrow in Alaska), while the needles are stuck in the other end of the strap. — The same implement has probably been in use in several places in the north of Siberia; I know it only among the Chukchee[3]).

No proofs have so far been forthcoming that this implement was used in the domestic culture of the Greenland Eskimo, but there are grounds for believing that it must once have existed there. It may, however, easily be imagined that, owing to the introduction of new sewing implements from Europe, it passed out of use at an early date, and was superseded by other kinds of repositories, so that the object of it, when found in graves or ruins, is no longer known. The Greenland specimens which supplement *inv. Amd. 61* with a consider-

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[1]) Boas I, 523 II, 94.
[2]) Turner 254.
[3]) Bogoras 224.

able number both from the east (cf. *inv. Amd. 87*) and the west coast, represent, in my view, the special Greenland type of this otherwise so widely diffused implement. These flattish bone tubes, quaintly carved and often ornamented, are old-fashioned needle-cases, the other accessories which originally went along with them having been lost or destroyed in the earth. *Inv. Amd. 61* from North East Greenland is particularly interesting, as corresponding exactly in type to the form known from West Greenland.

Fig. 36. Wooden handle (object unknown). Skærgaardshalvö. 1/3.

Inv. Amd. 62 (Fig. 36) is a piece of carved wood, in form like a shaft, cylindrical, 11·5 cm in length, cross section 2·5 cm in diameter. At both ends there was originally a rounded knob, a little thicker than the centre part, whittled off all round at the inner side so as to form a well-marked shoulder. Both the knobs are highly weathered, one of them being quite corroded, though the traces of its shoulder are still visible. The object can therefore not have been very much larger than it now appears to be.

The implement bears a resemblance to the cross bars (as a rule made of ivory), mentioned by Nelson[1]) and Murdoch[2]), belonging to large floats, and which serve as a handle for raising them. Nelson also tells us of an isolated cross bar of this kind from St. Lawrence Island in Bering Strait, which is made of wood[3]). This parallel is, of course, extremely dubious. On the other hand there seems to be no grounds for hesitating to compare this object with certain cylindrical pieces of wood from West Greenland in the Riksmuseum at Stockholm (inv. Pfaff, sect. 48). These are a little thicker in the middle

[1]) Nelson 145.

[2]) Murdoch I, 247 (Fig. 249).

[3]) Nelson, Pl. 56a, fig. 31.

than at the ends, where the knob-like heads are shouldered off from the centre parts. The length is 15·5 and 14 cm respectively. The use to which they were applied is unknown.

Fig. 37. Fragments of bone implements. Skærgaardshalvö. 3/5.

Indv. Amd. 63 and *64* (Fig. 37 a and b). Two very thin, triangular pieces of bone, one 5 cm long, sawn off with the aid of drilled holes, whereby jagged edges have been produced; the other 5·8 cm long with smooth edges. The first piece is quite flat; the second curved, spoon-shaped, being, in fact, probably the fragment of a little spoon[1]).

[1]) Holm Pl. 24. Boas II, Fig. 145. Also Kumlien (pag. 21) states that among the Baffin Land Eskimo he found "a little spoon, or rather a miniature scoop, made of ivory, which they used to drink soup with."

6. Finds from Dunholm (69° 54′ lat. N.) and Cape Tobin (70° 24′ lat. N.). The central part of North East Greenland.

The objects described below were found at two settlements about 500 kilometres to the north and east of Skærgaardshalvö, namely right up at the mouth of Scoresby Sund. The section of the Carlsberg Fond Expedition which in the summer of 1900 was sent out to reconnoitre here, was led by the botanist *N. Hartz*, who in his report of the Expedition gives the following description of Dunholm, which lies about 20 English miles south of the entrance of the vast fjord of Scoresby Sund.

"It is quite a little, low basalt holme, the highest top of which lies about 100 feet above the sea-level .... Eider-fowl and black guillemots brooded here in numbers, and up at the top stood no less than 7 Eskimo winter-houses, grouped in a ring about a little water-wheel, which was quite over-mantled with green sea-weed and teemed with swarms of gnat larves. Dr. Deichmann superintended the excavation of a few houses and found various well-preserved objects, a comb, weapon heads etc. Down by the shore, moreover, a few tent-rings were seen[1])."

Only a day's journey to the north lies the other settlement, Cape Tobin, from which the same number of found objects, namely 20, was brought home, as from Dunholm. The territory around Cape Tobin was surveyed by Dr. Nordenskjöld and Lieutenant Koch[2]). This place received its name during

[1]) Meddelelser om Grønland 27, 164.
[2]) Ibid. 175.

Scoresby's Expedition, like Cape Stewart, — which lies a little further in by Hurry Inlet —, where Scoresby in 1822 discovered an extinct Eskimo village of 10 tents[1]. The settlement at Cape Stewart was afterwards more thoroughly investigated by Ryder (in 1891—92)[2], and then again in 1899 by Nathorst. The settlement at Cape Tobin, which lies on the point of land which projects furthest out into the sea at the mouth of the great fjord, in the interior of which, as Ryder has proved, the Eskimo lived in ancient times in many different places, had not been previously investigated, when the Carlsberg Fond Expedition in 1900 made this find there.

The settlements at Dunholm and at Cape Tobin lie so close to each other, and the objects found supplement each other so well, that I have not deemed it needful to keep the descriptions of them apart. Taken together, they give — particularly when we bear in mind the harpoon heads (*inv. Amd. 1, 2*, and *3*, from Cape Tobin) and the longer weapon heads (*inv. Amd. 12, 13, 14, 15* from Dunholm, *inv. Amd. 16, 17, 18* from Cape Tobin) described above — a fairly complete picture of the hunting life of the Eskimo, the men's hunting expeditions on the fjord ice, the work, finery and games of the women and children in the hut or in the tent, by the hearth fire or outdoors.

Inv. Amd. 65 (Fig. 38) and *66* (Fig. 39). It is most characteristic of the manner in which the Eskimo carried on their seal-hunting in this fjord, that two fine specimens of sealing-stools, of the kind the Eskimo use in hunting seals out on the ice, were found at the very mouth of the fjord. We gather from this that the method of sealing adopted during the long and dreary winter season was to repair to the seal's air-hole

[1]) Scoresby, Journal 1822, p. 208.
[2]) Ryder 285—288.

in the fjord ice, and to watch patiently hour by hour for the favourable moment when the animal stuck its nose up through the hole to breathe — for the last time, before the Eskimo buries his harpoon in its head.

The two stools, which are complete, are essentially of a pattern. Each of them has three loose short legs for sticking in the holes in the under side of the seat. The one of the stools is thereby lifted about 10 cm above the ground; the other a little less. As the holes narrow conically upwards, the pointed ends of the legs, when thrust home into them, are caught in a tight grip.

The form of the stool is flat, with a broadly curved outline, like an imperfect half-moon, or a rough triangle with one concave and two convex sides. The measurements are as follows: —

Inv. Amd. 65: 39·5 cm, direct length from corner to corner,
23·5 cm, breadth between the centres of the concave and the convex sides.

Inv. Amd. 66: 42 cm length,
24 cm breadth,
3 cm thickness.

Each of the seats is carved out of a piece of wood (red fir or larch, with the probability in favour of red fir).

They have evidently been made out of a section of the stem of a big tree; the broad log of wood has been cut in two and dressed so as to peel off the bark (the convex side) and remove the marrow (the concave side). It must have been an enormous labour to produce these large objects of carved wood with primitive stone implements; they testify to a highly developed skill in wood-working.

Instead of a handle for carrying the stool there is just inside the middle of the concave edge a semi-circular cutting, the curved side of which is bevelled off conically, so that the section is larger on the under side than on the upper side of

XXVIII.

Fig. 38. Sealing-stool from Cape Tobin. $^{1}/_{5}$.
a. The stool in natural position. *b*. Under side of the stool.
c. One of the legs of the stool.

Fig. 39. Sealing-stool from Cape Tobin. $^{1}/_{5}$.
a. Upper side of the stool. *b*. Under side. *c*. One of the three legs of the stool.

the stool. Through this hole the hand can be stuck in, and the fingers grip the narrow bridge which has been left behind between the edge of the stool and the semi-circular hole, as a handle wherewith to carry the stool on its way to the hunting-ground.

The two stools resemble one another even in such a detail as the following: across the under side of the stool, from the handle-forming section just described to the opposite point on the convex edge of the stool, has been carved in relief on the wood, a low ridge, narrow at the inner end but expanding like the head of a key towards the other end; the expanding end encloses one of the holes intended for the legs of the stool. Presumably this wooden ridge serves to strengthen the bearing strength of the stool. The form of the relief is so characteristic that it can scarcely be a caprice of individual taste, but must be the result of experience which has crystallised into a tradition. The weight of the Eskimo, as he sits or stands on the stool, has its greatest effect on the middle part of its surface. The one of the stools (*inv. Amd. 65*) in fact exhibits at this place one or two fractures and a menacing crack, which it has been endeavoured to counteract by pegging across the cracks some narrow oblong patches of bone, four in all, of which, however, only one has been preserved. These patches of bone have, with the exception of one, not been laid on top of the wood, but have been sunk about 2 mm in grooves of the same size on its surface, and have been riveted with tree-nails which are still sticking in the holes. The large truncated segment in the convex edge goes across through one of the holes which are intended to receive the legs of the stool. Another, lesser segment, which had been broken off on the other part of the convex edge, has been pegged on directly with the aid of tree-nails which pierce the edge transversely and penetrate into the intact part of the wood. While this last segment has been replaced by a piece of a different kind of wood from that of the stool, the part with which the larger fracture has been repaired undoubtedly belongs to the stool[1]); for the ribs in it fit in exactly with those on the other side of the crack.

A stool of the same type, but less beautifully worked, was found a little further up the fjord by the Nathorst Expedition[2]). Considerably higher to the north (at 74° 20′ lat. N.) two legs (about 12 cm in length) of a sealing-stool which are now in the Ethnographical Museum at Christiania (inventorial Nos. 10293 and 10399) were found by whalers.

Not far from Greenland, in Depot point in Heibergs Land (79° 8′ lat. N., 86° 10′ long. W.), the Fram Expedition (Sverdrup) found a sealing-stool of a similar type, but without the above-described relief ridge on the lower side, with three conical holes for the legs, and two smaller holes besides, near the edge on each side of the 'handle'. Between the three holes the under side of the stool has been scooped out. The side edges are bevelled. The greatest length of the stool from corner to corner is 40 cm. This stool also is in the Ethnographical Museum at Christiania.

At Ammassalik towards the southern part of the East coast of Greenland sealing-stools of an almost similar type, but with longer legs are extensively used. They more closely resemble the type used in the northernmost part of Alaska, which is thus described by Murdoch[3]): — "The upper surface is flat and smooth, the lower broadly beveled off on the edges and deeply excavated in the middle, so that there are three straight ridges joining the three legs, each of which stands in the middle of a slight prominence. The three legs are set into holes at each

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[1]) This piece has, to be sure, a different colour than the rest of the stool, but this can be explained by the fact, that after it had been broken off for the second time it lay better shielded from climatic agencies than the rest of the stool, till the Expedition found it.

[2]) Nathorst 347.

[3]) Murdoch I, 255—256.

corner, spreading out so as to stand on a base larger than the top of the stool. They stand on this and thereby escape getting cold feet".

In Hans Egede's "Det gamle Grønlands nye Perlustration" (1741), we find (pag. 35) an illustration of a Greenlander sitting with hunting weapons on a chair which is only provided with one leg, fairly long and pointed at the bottom; his feet rest on a low stool of the usual sealing-stool form with quite short pointed legs. This picture agrees with David Cranz's description[1]) of hunting on the ice in Disco Bay: "A Greenlander sits down by the seal's air-hole on a one-legged stool, and, in order not to catch cold, rests his feet on a three-legged foot-stool". This differentiation of the original single stool into a chair plus a stool, seems to be peculiar to West Greenland. The long-legged stool used at Ammassalik, however, is equally well adapted for sitting on as for standing on.

As compared with these types, we find in the northernmost part of East Greenland a very low-legged stool, adapted for standing on, the features of which, taken in conjunction, bespeak a marked type of development from this part of the Eskimo world.

Inv. Amd. 67 (Fig. 40 a) and *68* (Fig. 40 b) (Dunholm), give evidence of another aspect of hunting-life in the winter-time. They are two pieces of sledge keels made of bone, of about the same size: 30 cm by 5 cm in surface measure.

The nail-holes are all of a pattern, from 5 to 6 mm in diameter, and pierced to the same length. The width of the path of the holes is the same at both mouths, being only in the case of a very few holes slightly larger on the inner side (upper side) of the shoe than on the outer (under) surface; the holes seem thus to have been perforated from the inner side. They are disposed fairly regularly in such a manner that in no part of the keel are there two holes in the

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[1]) Cranz 206. Cf. Mason III, 239 and 210, fig. 8. A foot-stool of this kind from West Greenland is in the National Museum at Copenhagen.

same transverse line; they are placed two and two in lines obliquely to the longitudinal direction of the keel (with one single exception), the advantage of which arrangement is that the friction which the edges of the nail-ends must produce, as the sledge glides over the snow, is evenly distributed, being alternating and in no transverse line produced by more than one nail-end at a time. At the same time the holes form two long rows, which extend almost parallel to each other from one corner of the rhomboidal figure formed by the outline of the keel towards the opposite corner at the other end, whereby is further

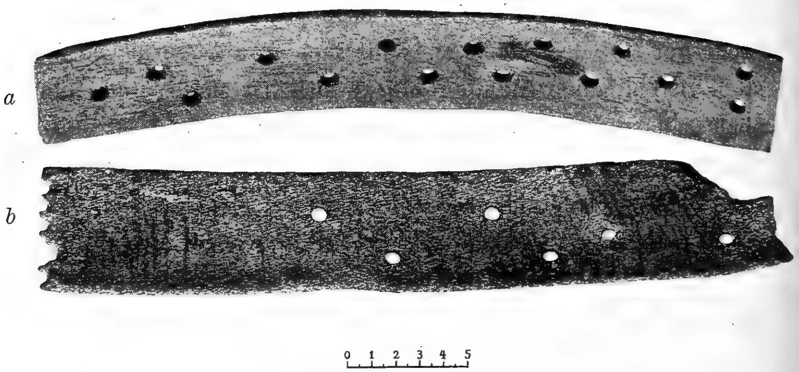

Fig. 40. Pieces of sledge keels made of bone. Dunholm. 1/3.

ensured that the friction under the runner of the sledge is distributed evenly and in an advantageous manner; for otherwise the sledge would receive an uneven side pressure at the bottom of the track formed by the shoe which would tend to make it run off the track. Furthermore, it is of interest to note that not only the placing of the holes but also the boring of them has been made on definite principles, they being bored obliquely to each other (Ryder, too, has observed this)[1] so that the mouths of the two rows on the upper side of the shoe lie a little closer to one another than on the under side[2].

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[1] Ryder 305.

[2] I convinced myself of this by sticking two pencil handles into the holes from above; their upper tips met each other at an acute angle.

Only the isolated unpaired holes at one end of the piece, lying in the median of it, are bored exactly vertically. No doubt, the advantage of giving the nails an obliquely diverging position is that they hold the keels better in place, and that the friction of the snow or of the ground in travelling does not tend so much to loosen them. Only in one of the holes is there still sticking a tree-nail; its bottom has been cut in a plane with the under surface of the keel; its protruding top end has been broken off roughly.

The under side of both these pieces of keels are very smooth, without being much worn. The upper side, on the other hand, is rough, or less carefully smoothed. Both have been warped by the agency of climate, but could presumably be straightened out with the aid of water or heat.

All the previous Expeditions which have landed in North East Greenland have found sledge keels. The first who set his foot in the country, Scoresby[1]), tells us in his journal that he found some in Traill Island (72° 12′ lat. N.): "Our people found the keels of sledges. These consisted of slices of bones of whales, and of the horns of teeth of narwals. One piece of the latter was nearly two feet in length; and another fragment, not quite so long, measured 2½ inches in diameter. These bones were all flat on one side, and convex or semi-cylindrical on the other". He observes that the great number of fragments betoken not only that the population must once have been numerous, but also that they must have made an extensive use of sledges. This impression of Scoresby's derives further support from the German Expedition's find of a sledge (see under heading *inv. Amd. 27*), from Ryder's find in Scoresby Sund of 28 pieces of sledge keels made of the bones of whales and narwhals, and the not much smaller number of these latter which Nathorst and Hammar brought home with

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[1]) Scoresby 266.

them from a locality a little more to the north (now in the Riksmuseum at Stockholm).

Similar sledge keels of bone are also known from the more westerly Eskimo districts. In Baffin Land the Eskimo shoe their sledges with keels consisting of several pieces of flat whalebone, which is fastened under the runners with tree-nails[1]). The same thing is true of the Point Barrow Eskimo in North Alaska, whose sledges in other respects are pretty different in type from the Greenland ones[2]).

Fig. 41. Ice scraper of bone. Fragment. Dunholm. 1/3.

Inv. Amd. 69 (Fig. 41) from Dunholm is a fragment of a kaiak-scraper of bone (cf. the following number). It is a long, flat, thin piece of bone from 16 to 17 cm in length, of a dark-brown colour. One of its edges is bevelled, probably due to wear. The pointed tip is uncommon in this kind of implements.

Inv. Amd. 70 (Fig. 42) from Cape Tobin is a very typical, beautifully worked kaiak-scraper, or bone knife for scraping the

Fig. 42. Ice scraper of bone. Cape Tobin. 1/3.

ice off the kaiak skin, and thus an accessory for the kaiak. It is 31 cm long and 8·5 cm broad at the back end of the blade It is made of a single heavy piece of bone, of a light-grey colour.

1) Boas I, 530; Turner 242.
2) Murdoch I, 353; Nelson 206.

One side of the blade is slightly concave, the other convex; thinner towards the edge than in the middle; none of the edges are sharp.

Two holes have been pierced in it, one of which passes through the back and upper part of the blade; the other, at the extreme end of the handle, is particularly remarkable, as it diverges from the nether edge of the handle in two directions, one branch of the hole leading out on the under side of the projection, right by the point, the other on its upper edge a little further in. Perhaps the craftsman wished on account of the heaviness of the knife thus to obtain a firmer hold for the loops with which the knife was hung up or fastened to the kaiak, than a single hole would afford.

The type of this implement from Cape Tobin corresponds exactly with four kaiak-scrapers from the more northerly parts of the same coast found by Nathorst (Hammar)[1]. One of them even has a hole pierced in the upper corner of the blade, and the end of the handle curves in a downward direction, just as in *inv. Amd. 70.* — From the same region as these there is in the Ethnographical Museum at Christiania (inv. No. 10039), a kaiak-scraper of the same type, a very beautiful specimen, carved out of white (grey) bone, the blade rounded at the tip, broadest at the butt; flat, or slightly bulging, sides, with a slightly concave upper edge and a slightly convex under edge; the handle, rhomboidal in cross section, unevenly cut on the two sides, curving downwards and ending in a downward inclined projection, wherewith the hand obtains a better purchase on the handle. At the rear of the upper edge there is a straight section cut off which has been replaced by a piece of bone or wood (which has been lost) held in place by means of rawhide thongs through three holes under the section; side grooves lead from the holes up towards the empty space.

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[1]) Stolpe Pl. 4, fig. 12.

There is a single hole in the lower corner at the back of the blade, presumably intended for a strap.

It is a striking circumstance that the characteristic handle with the downward bent projection recurs in several of the stone-knives found in North East Greenland[1].

This approximation in type between these two kinds of implements, which are not known from other Eskimo districts, gives us the impression that in North East Greenland the one-edged stone knife, which is otherwise well-known from other districts, has been influenced in this respect by the form of the kaiak ice-scrapers.

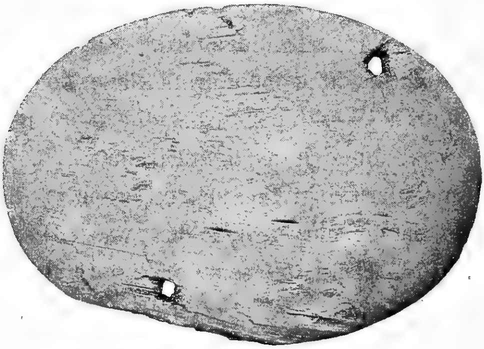

Fig. 43. Wooden bottom? Dunholm. 1/3.

We find in the northern part of West Greenland ice-scrapers of the same type as those in North East Greenland. Here again we come across a special Greenland variety of an implement[2] otherwise common to all the Eskimo tribes.

Inv. Amd. 71 (Fig. 43) from Dunholm. Part of a wooden implement of unknown use. It is a flat piece of wood, oval in circumference, longest diameter 21 cm, shortest 15 cm; the thickness of the wood is about 3 mm. One side of this piece

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1) See the illustrations of both types side by side with each other in Stolpe, pl. 4, figs. 11 and 12.

2) Cf. the snow knives of the more westerly districts, Boas I, 539; II 29 and 95; Nelson pl. 94; Murdoch I, 305.

is slightly convex, the other quite flat. There are two holes pierced near the edge, lying transversely to each other, and there are no traces of holes in the edge itself, which fact might argue that the piece did not form the bottom of a box or a dish, as in that case there would have been nail-holes in it (cf. *inv. Amd. 53*). There are, however, examples of bottoms having been grooved in without nails being used, so that this possibility is not excluded (cf. *inv. Amd. 52*).

Could it be the blade of an *umiak* oar? In one of the ends of the umiak oar, a loose flat piece of wood is generally grooved in as a blade, which at Ammassalik is sometimes ovally rounded in the free part of the edge; only the grooved or nailed part of the blade is formed otherwise, more in the manner of a tongue[1]. The two holes in *inv. Amd. 71* must in this case be thought to have been used in binding the blade to the shaft of the oar, certainly, one would think, a clumsy method, which can hardly have been generally prevalent.

No unimpeachable piece of an *umiak* oar or of an *umiak* (large skin boat) has been found in North East Greenland; but, as Ryder remarks[2], the great number of tent-places betoken that the use of umiaks must have been known.

Inv. Amd. 72 (Fig. 44) from Dunholm is a hammer-like piece of wood, apparently the fragment of a branch, which has grown naturally at right angles.

The length of the legs of the angle is 23 cm, and 13 cm.

The thinner, slightly tapering part of this object is almost circular in cross section; the circumference of the cross section increases continuously towards the corner of the angle, but diminishes where the rounding of the outer line begins. At the same spot there is also a change in the form, the inner

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[1] Oval oar-blades are also found in Baffin Land; see Boas I, 529; cf. Nelson 224, fig. 70; Cranz 149, Pl. 6.

[2] Ryder 306.

surface of both legs near the corner being cut almost flat. This is also eminently the case with the inner side of the thick part of the piece, the cross section of which might almost be said to be triangular. The stump end of it is slightly convex.

The wood, which was intact and solid when it was found, has warped a good deal and has formed deep cracks. It is of

Fig. 44. Hammer-like implement (fragment?) made of a crooked branch. Dunholm. 7/23.

a red fir or larch, 'the probabilities being in favour of its being a larch'.

The only visible traces of workmanship appear in the corner of the inner angle, where the natural rounding of the branch has been cut away, and in the uniform rounding of the rest of the surface. Whether it was part of an implement, and if so, what part, it is hardly possible to decide with certainty.

It bears some slight resemblance to the post[1]) at the bottom of the stern of an *umiak*; but the latter generally consists of two pieces and has holes bored in it. Moreover, the object here would be rather small for this purpose. There is, however, a warrant for the comparison in Turner's description of the *umiak* of the West-Labrador Eskimo[2]): — "The ends are nearly perpendicular . . . . the stem and stern posts are nearly alike, the latter having but little slope, and are cut from curved or crooked stems of trees. A tree may be found which, when hewed, will form the stern-post and keel in one length. Otherwise the fore and aft posts have places cut out for the insertion of the respective ends of the keel, and are fastened firmly by stout thongs of sealskin thrust through holes bored in the wood and ingeniously lashed".

Inv. Amd. 73, 74 and *75* (Figs. 45 a, b and c), found at Dunholm, are three heavy bone foreshafts, for nailing and lashing firmly to the top of the wooden shaft of the harpoon, with sockets in the free end for the insertion of the loose bone shaft which forms the first joint of the harpoon and carries the harpoon head. The biggest of them measures 14 cm in length, its elliptical cross section at the top is about 4·2 cm by 3·4 cm.

In order to permit of their being fastened to the wooden shaft, the lower part of these foreshafts have been given the form of semi-cylindrical wedge-like tangs, rounded on one side, cut to a bevel on the other, so that the bottom edge is sharp. A little above this edge there is a transversely bored hole which seems intended for a nail. Only in the largest of the pieces is there, about in the middle of the plane of the bevel, a transverse, upward-turned shoulder which is meant to rest

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[1]) Boas (I, 527, fig. 479) calls (using the Baffin Land dialect, or erroneously?) a post of this kind *kiglo*. The Greenlandic word *kiʟʟo* (Kleinschmidt *kigdlo*) designates a flat cross-piece resting upon the post, to which the ends of the gunwale are lashed and used as a seat in the stern.

[2]) Turner 235: cf. Murdoch I, 335—336.

against an oppossitely facing shoulder on the main shaft. But in all of them there is at the root of the tang a downward facing shoulder, which runs round it and is only interrupted by the upper part of the tang bevel which narrows here.

The upper part of the pieces is a somewhat flattened cylinder, 4 to 4·5 cm long, with a slightly convex end surface in which there is a deep oval socket (2·5 to 3 cm deep), into

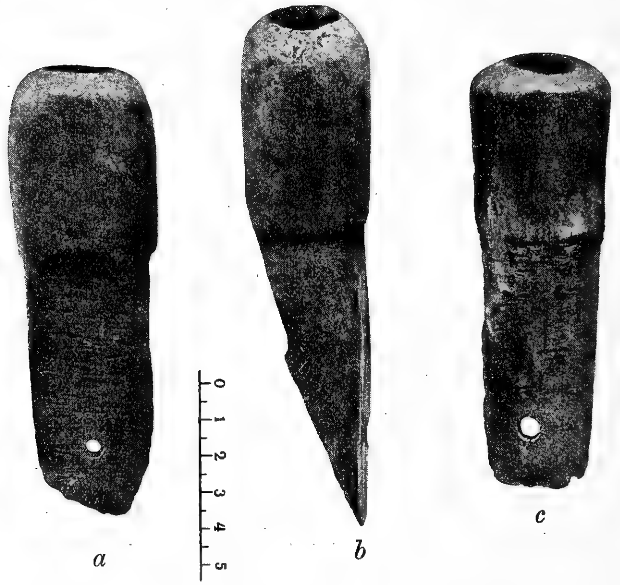

Fig. 45. Bone foreshafts of harpoon. Dunholm. 1/2.

which the loose harpoon shaft fitted. This cylindrical part has in all three pieces, a smooth, almost polished surface. The largest of the pieces is also fairly smooth on the flat surface of the bevel, but its convex back has long facets which are the traces left by a cutting tool; there will be seen, moreover, on the same side of the implement, in the sharp edge of the nail-hole, a cavity which has been cut in half in boring, presumably the result of an error. The two smaller pieces have on both sides of their tangs very evident traces of the knife or chisel with which the rough cutting was made, and only in one of them are there slight vestiges of an attempt at smoothing. These two implements have probably not been quite finished off.

Compare with these implements *inv. Amd. 104* and *105.*

As to the form and use of foreshafts in general, I beg to give a quotation from O. Mason[1]: —

"The foreshaft of a barbed harpoon is a more or less cylindrical or pear-shaped piece of heavy material, bone or ivory, fitted on to the shaft, and having a socket in front to receive the tang of the barbed head . . . . . the attachment of the foreshaft to the shaft is by means of a splice, a wedge-shaped tang and kerf, a socket in the shaft fitting a projection on the foreshaft, or a socket in the loose shaft fitting a projection on the shaft"; after which he refers to two figures of foreshafts in E. W. Nelson's work on "The Eskimo about Bering Strait"[2]), one of which is of a type exactly corresponding to the three from Amdrup's collection which have just been described. Further on he speaks of foreshafts of toggle harpoons[3]): "The foreshaft of a harpoon is the working end of the shaft, and is usually a block of bone or wood neatly fitted on. Foreshafts vary in material . . . . ., in size and shape, from the delicate point of the sea-otter harpoon to the clumsy variety on the Greenland whaling harpoon".

Murdoch's description of the various foreshafts of the point Barrow Eskimo fits in well with the form of *inv. Amd. 73, 74, 75,* except in the feature that the Alaska (Point Barrow) foreshaft 'is kept from slipping out by a little transverse ridge on each side of the tang'[4]), from which it is evident that the tang is bevelled from both sides (not as in those from North East Greenland only from one side), and the transverse ridge which connects the two slanting surfaces of the narrow sides of the tang takes the place of the transverse shoulder I mentioned in the flat surface of the bevel of one of the tangs.

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1) Mason III, 199.
2) Nelson Pl. 57, b, figs. 33, 34.
3) Mason III, 204.
4) Murdoch I, 216, cf. fig. 204; cf, Mason III, 302, fig. 92.

The description is about the same for foreshafts of seal-darts and for foreshafts of walrus harpoons[1]; the latter are of course the largest. The following description is appended to the typical walrus harpoon: "In the tip of the foreshaft is a deep, round socket to receive the loose shaft. The shaft and foreshaft are fastened together by a whipping of broad seal thong, put on wet, one end passing through a hole in the foreshaft one-quarter inch from the shaft, and kept from slipping by a low transverse ridge on each side of the tang"[2]. In this passage Murdoch, as we see, alludes to a hole in the foreshaft, like those in foreshafts from North East Greenland, but with the difference that it lies higher up than the wooden shaft and over the lashing[3], whereas in the Greenland foreshafts, it lies right down on the thin end of the bevel, round which the lashing is wrapped, and seems to have been used for riveting rather than for catching the end of the lashing.

Except for the peculiarities just alluded to in the three foreshafts from North East Greenland, unilateral bevelling and the hole pierced at the bottom of the tang, they bear the most striking resemblance to the West Eskimo foreshafts, as these have been described by American ethnographers[4]. We find in them a type which diverges widely from the small flat square 'cap of bone no larger than the shaft, the tip of which it protects' (Murdoch) of the eastern harpoons, which in Greenland take the place of the foreshaft of the western Eskimo. There is nothing to indicate that they correspond to an older form of the harpoon in Greenland; it still remains a riddle how they came to North East Greenland at all.

Inv. Amd. 76 (Fig. 46), from Dunholm, is the bone head

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[1]) Murdoch figs. 204 and 223.

[2]) Murdoch I, 224.

[3]) Ibid. id. fig. 214.

[4]) Murdoch's general definition of this implement is as follows: "a heavy bone or ivory foreshaft, usually of greater diameter than the shaft and somewhat club-shaped" (Murdoch I, 223).

of an adze with a slot in the lower end for the insertion of a stone blade, or celt. The celt is missing, as also the wooden handle wherewith the centre part of the block of bone was attached.

It is a heavy bone of a dark-brown colour, probably of a whale, 14·5 cm long, the lowest half having the greatest breadth (5 cm) and thickness (2·5 cm), while the centre part, which projects like a shaft up from the bevelled shoulder which runs almost the whole way round is of lesser breadth (3·5 cm) and thickness (2 cm). The upper part of this shaft again is formed like a broad flat head, which expands out on either side in the latitudinal plane of the shaft.

The back of the lower half of the implement (fig. 46 b) is semicylindrical, being rounded on one side edge which thus merges into the front side, while on the other edge (fig. 46 c) it is marked off at the bottom from the front side by a blunt edge which expands upwards into a distinct side surface. The back of the centre part (the shaft) is flat and separated by two sharp edges from the lateral surfaces, thus merging by imperceptible gradations (fig. 46 a) into the front side over a double row of facets, cut in the longitudinal direction of the shaft; the cross section of this part of the implement is a rectangle, in which two of the angles tend rather towards the obtuse. This part of the bone has unfortunately been severely damaged by the elements, so that a large splinter has flaked off.

The upper head-like part of the shaft (one side of which has crumbled away) seems to have had a convex back like the lower piece, but an oblique cut (or the natural form of the bone) has deprived one half of the side of its curvature and made it flat. As the front side, which otherwise keeps uniformly flat over the whole piece, has here also been bevelled, the back and front sides meet at the top in a comparatively thin, slightly curved edge.

The lower part of the front side has an aperture, the irregular form of which is due to its being the result of an accident. Originally, the front side must, of course, have continued right down to the bottom of the implement, and the opening merely debouched in the surface of the base, forming a slot. To judge by the part which remains, the base, must have had a narrow surface of 3·5 cm in length and 0·8 cm in breadth; into this debouched the aperture of the slot, rectangular in cross section, for the insertion of the stone celt of the axe. If this celt filled the opening, it must have penetrated a little over 2·5 cm up into it. The two inner surfaces of the slot converge into one another at the bottom, so that its area is hardly 1·5 cm by 0·6 cm, whereas the mouth of the hole is 2·2 cm by 0·6 cm in cross section.

This implement may be compared with an adze, with stone blade attached, from *Niaqornak* in Umanak fjord in North West Greenland, in the National Museum at Copenhagen (Lc. 780—781), illustrated in Solberg's "Beiträge", Pl. 7, which according to this author is 'one of the most interesting of Greenland antiquities'. The block of bone has been cut out of a reindeer horn, just as is the case of an adze from the lower Yukon in Alaska described by Nelson[1]. There are several finds from West Greenland of adzes belonging to two or three different types, which in the main resemble those known from Alaska; and another adze from West Greenland, which exactly corresponds to *inv. Amd. 76*, of a slightly different type from the foregoing, is likewise illustrated in Solberg[2], who also gives illustrations of a series of stone-blades (celts) for adzes. He does not mention the three bone heads of adzes in Pfaff's collection in the Riksmuseum at Stockholm, of which I give illustrations in the Appendix figs. 100, 101 and 102.

It may be gathered from all these illustrations that the adzes in general use in Greenland had the cutting edge at

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[1]) Nelson 92, and Pl. 39, fig. 1.

[2]) Solberg 48—49, Pl. 7, fig. 2; id. Pl. 8.

Fig. 46. Bone head of an adze. Dunholm. 5/7.

right angles to the handle, and were of three different types as regards the manner of attaching the head to the wooden handle. It is true that the latter is missing in all the adzes found in Greenland, but a comparison with the adze types from the West described, as far as Alaska is concerned, by Murdoch[1]) and Nelson[2]) reveals its original existence. We understand from these descriptions that the groove in the middle part of *inv. Amd. 76* is a bed for the lashing, which passed through holes in the broader end of the handle; in this bed, the thong is held in place, and the handle, moreover, as explained below, is supported by the horizontal shoulder which borders the top of the lower part of the bone in which the celt, or stone-blade, was inserted. — Murdoch sees in this elaborate construction of the adze a substitution for a simpler form which is only known from Alaska, where the stone blade was attached immediately to the handle. *Inv. Amd. 76* thus answers to the first type of the second stage of development and has an exact counterpart in Alaska[3]); the second type within this stage we find in the already mentioned adze from North West Greenland (National Museum, Copenhagen, Lc 714[4]) cf. inv. Pfaff, Stockholm, see Appendix fig. 102), and this type also is well known from Alaska[5]); in place of a groove the bone head has two (or more) transverse perforations from the back to the front side, through which the lashing passed. The third Greenland type (Appendix fig. 101), has a single perforation from the back to the front side, besides a deep round aperture (like a socket) at the top of the head; how it was fastened to the shaft, can not be determined with certainty.

This find of the Carlsberg Fund Expedition at the mouth

[1]) Murdoch I, 165—172.

[2]) Nelson 91—92: as for the West coast of Hudson Bay of Boas II, 88, fig. 128.

[3]) Nelson 88, Pl. 38, fig. 5.

[4]) Solberg Pl. 7, fig. 3.

[5]) Murdoch I, figs. 135 and 136.

of Scoresby Sund thus forms an interesting contribution to our knowledge of this prehistoric implement in Greenland. It is the bone piece of an adze of a true Eskimo type. Only a very few specimens of the same type have been found in Greenland, and none intact or complete. A sharp blade (of stone or iron?) must once have been inserted in the aperture at the bottom, and the whole piece attached to a curved haft (of wood?) in such a manner that, while the bone piece was lashed to the broad end of the haft, the thin end served as a handle, lying cross-wise to the edge of the blade. — Perhaps it is a wooden haft of this kind, for a small adze, which was found in East Greenland by die Zweite Deutsche Nordpolarexpedition (in the Museum für Völkerkunde, IV A, 205, Berlin)[1]; it is made of wood, 14·5 cm long, with four holes in the broad end, and line-grooves from the holes out to the edge[2].

As far as North East Greenland is concerned, *inv. Amd. 76* is an interesting addition to our knowledge of the tools of this primitive population. Ryder[3]) also found in Scoresby Sund five worked whale bones, which he pronounced to be parts of adzes, and one of which (National Museum Lc. 1401) is of a similar type to this one, while the others approach more closely to the other types (the 2nd type: National Museum Lc. 1388 and 1401). But *inv. Amd. 76* is the most beautiful and elaborate specimen we possess.

Inv. Amd. 77 (Fig. 47 d) from Cape Tobin, is a drill consisting of a cylindrical stick of wood (23 cm in length), tapering towards the upper end. An iron point (the remnant of a nail?), 2 cm in length, has been stuck in a crack-like slit in the

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[1]) Koldewey, 603, fig. 14.

[2]) The same kind of hafting of adze-blades also prevails among the Coast Indians south of Alaska; see Niblack Pl. 23.

[3]) Ryder 325—326. Scoresby also believed himself to have found two axes at Cape Stewart: "Two axes made out of bone were picked up". (Journal 214). I do not know where these axes are now.

lower end. A low shoulder-like projection, which passes right round at the lower end close by the slit, indicates that there used to be a wrapping round this part.

The implement is common in all Eskimo districts[1], but has not been previously found in North East Greenland.

Inv. Amd. 78 (Fig. 47 e) from Cape Tobin, is a drill bow of white bone with holes in both ends for fastening the strap with which the drill was set in motion. The length from point to point is 47 cm; the thickness of the bone in the middle of the curve is 1·5 cm. The bow is a little thicker at one end than at the other. It is very carefully worked and smoothly polished. I shall describe it, imagining it lying flat on the ground. At the thin end (pointing up in the illustration) a flat segment has been cut off in the horizontal plane, through which a hole has been bored in a vertical direction; a short oblique groove, probably due to the friction of the taut strap, points towards the inner side of the bow downwards. A little within this groove there is a small hole, probably the commencement of a perforation. At the other end of the bow a concave segment has been cut off in the vertical plane, executed by removing the soft mass of the bone. The two

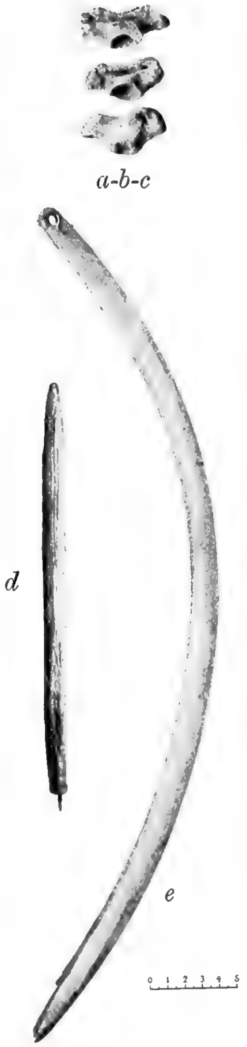

Fig. 47.
Set of a bow drill. 1/4.
a-b-c (*inv.Amd.28,29,30*). Drill caps of bone. Skærgaardshalvö.
d (*inv. Amd. 77*). Wooden drill stick with iron point. C. Tobin.
e (*inv. Amd. 78*). Drill bow of bone. C. Tobin.

[1]) Nelson Pl. 37; Mc. Guire I, 719 ff.; Murdoch I, 176 to 179 and 189.

transverse holes which have been bored here, the outermost of which is broken open at the extreme point of the bow, have thus horizontal paths. The inner hole has been perforated obliquely inwards, so that its path points in the direction of the other end of the bow, this having been done in order to obviate the strap rubbing against the edge of the hole in which it was fastened. At this end also there is a smaller hole within the larger ones, pierced through, but stopped up with a bone plug.

The drill strap was held fast by a knot on the inner side of the outer hole, and was carried from it through a shallow groove in the outer side of the bow, then drawn through the inner hole directly over to the upper end of the bow and fastened in the hole. Every trace of the strap itself has disappeared. It is generally a leather thong, which is so loose that it can be passed once round the drill shaft; the latter is set in revolution alternately to the right and to the left, the drill bow moving to and fro in the manner of a horizontal saw. The drill shaft (fig. 47 d) is held in a vertical position by the upper end resting against a head-piece of bone which the workman holds fast between his teeth, and in which there is a cavity sufficiently deep to prevent the shaft from slipping out[1]. *Inv. Amd. 28, 29,* and *30* are head-pieces (or 'drill caps') of this kind.

Ryder[2] found in Scoresby Sound both a fragment of a drill bow and a head-piece (a bone from a reindeer's foot[3]). — *Inv. Amd. 78* is an intact specimen of a drill bow; and a very fine piece of work too.

Inv. Amd. 79 (Fig. 48), from Cape Tobin, is a knife, 20 cm in length, consisting of a thin wooden haft tapering towards the top, in which has been inserted a still thinner iron blade,

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[1]) Holm Pl. 18, Mc Guire I, 707, 720.

[2]) Ryder 323.

[3]) A mouth-piece of deer's knuckle-bone is also mentioned as belonging to a fire-making set from Point Barrow, Alaska. See Hough I, fig. 31.

Fig. 49.

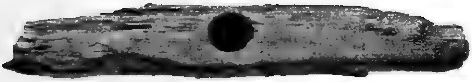

Fig. 50.

Fig. 48.

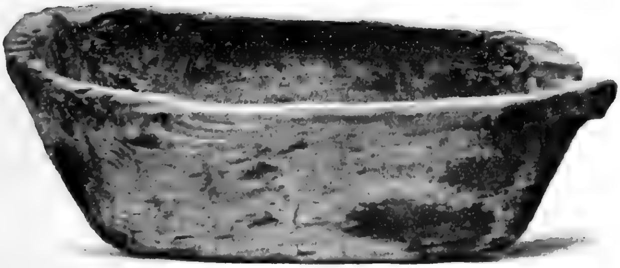

Fig. 51.

Fig. 48. Man's knife with wooden handle and iron blade. Cape Tobin. 1/2.
» 49. Wooden handle of a woman's knife (scraper). Dunholm. 1/2.
» 50. Part of a kindling set with drill-hole. Dunholm. 1/2
» 51. Wooden tray for meat Cape Tobin. 1/4.

which seems to be a piece of a European iron hoop. The blade has been wedged into a slit at the end of the haft and secured with whalebone or sinew cord; for this purpose two holes have been bored in the rear corner of the blade within the edge of the slit in the haft; and the latter has two grooves running right round and forming a bed for the lashing, each covering one of the two holes in the blade.

Doubt might arise as to whether this be a genuine Eskimo knife. The blade is seemingly made of hoop iron, and the form of the handle is, except for the pointed end, about like the wooden haft of an European knife. The mere fact that the haft is of wood seems in itself a suspicious circumstance. On this very ground Solberg[1] cast doubt on the primitiveness of a knife with a stone blade with a wooden haft, found by the Nathorst Expedition in North East Greenland (now in the Riksmuseum at Stockholm), urging that mens' stone knives with wooden handles are never found in West Greenland. Moreover, as has been mentioned before (pag. 384), he sees traces of European influence in the curious form of the stone knife, a view which I endeavoured to combat by referring to the types of knife among the Western Eskimo and the stereotyped ice-knife common to all Eskimo tribes (cf. pag. 438—440).

The western parallels will apply in this case as well. The Eskimo of the West have from olden times used knives both with bone hafts and wooden hafts. Boas[2] gives instances from the isolated Southampton Island in Hudson Bay actually of snow-knives which have bone blades inserted in wooden hafts. He mentions a similar form, but with bone haft, from the West coast of Hudson Bay[3]): — "models of the ancient form of snow-knife, which was similar to that of Southampton Island. In one specimen, figured here, the joint between the

[1]) Solberg 59 (Fig. 6).
[2]) Boas II, 69, fig. 91, b, c.
[3]) id. 94, fig. 138.

ivory handle and the bone handle is slanting, while in another specimen the ivory extends some distance along the bone handle to which it is sewed". It is really a slanting joint of this kind we find here in *inv. Amd. 79*, where the blade is of iron and the handle of wood. The two parts form an angle towards each other. The type is the well-known Eskimo crooked knife[1]), and as for the joining of the two parts, it is, at any rate, just as genuine Eskimo as the knives of the same type known in Alaska[2]), with a handle now of bone and now of wood.

Now as for the iron, both knives and harpoons heads with iron blades have been previously found in North East Greenland (cf. also *inv. Amd. 3* and *77*). So early an explorer as Scoresby[3]) found at 70° 31′ at Cape Swainson (near Cape Lister) 'the head of an arrow or small dart, rather neatly made of bone, armed with a small piece of iron', and adds that "it is difficult to say whether this iron was native, or whether it was carried on shore in the timbers of some wreck". The manufacture was a good deal similar to that of the iron implements of the Arctic Highlanders, discovered by Captain Ross. The state and situation in which it was found, indicated that it had not long been out of use". It was found in a pool of water down by the shore and was hardly at all rusty. Clavering[4]), who in the following year came across the Eskimo themselves in these regions, also observed that several of their weapons had iron points which "seemed to be of meteoric origin." "Die zweite Deutsche Nordpolarexpedition"[5]) found in Klein-Pendulum Island a knife (or chisel) of iron with a wooden handle; the iron blade is inserted in a slit at one end and

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1) Murdoch I, 157-161; Boas II, 87, fig. 126.
2) Murdoch I, fig. 118; Nelson 85—86, Pl. 38, figs. 19 to 31
3) Scoresby 187.
4) Quoted in Petermann's Mitteilungen 1870, p. 326.
5) Koldewey 605, fig. 20; and 623.

secured with a lashing of sinew. The author expressly declares that the iron cannot be derived from iron ore found in the the land itself, but that it is really iron wrought, and the supposition is advanced that it is a piece of the iron which Clavering gave as a present to the natives in 1823, in the form of knives and other objects, as he himself has related. Ryder[1]) found two man's knives with blades of iron, of which, however, only one piece is extant; he also comes to the conclusion that it is not of Greenlandic origin, but has been washed ashore with wreckage or drift timber. Finally Nathorst (Hammar)[2]) also found a knife (length 20 cm) with an iron blade and a haft of ivory, as well as a chisel with an iron point and a haft of reindeer horn. All these implements, however, by no means belong to the same type, and there is no denying that several of them diverge from the types of knives we know from the West Eskimo districts. The divergences, however, at least as far as a number of them are concerned, do not seem to me so great as to preclude our explaining them as varieties within the original type, and to these we must reckon *inv. Amd. 79*, even if the separate parts of this knife, both the blade and the handle, were brought to this coast from Europe[3]).

Inv. Amd. 80 (Fig. 49), from Dunholm, is a flat block of wood, length 6·5 cm, with downwardly diverging side edges and an oval head; the base is about double as broad as the slenderer centre, but only half as thick as the latter, the lower

[1]) Ryder 321—322.

[2]) Nathorst 347, figs. a and b; Stolpe Pl. 4, fig. 11.

[3]) I have no grounds for supposing that the iron in this knife is of telluric (Greenlandic) origin. But in this connection I wish to point out that *K. I. V. Steenstrup* has shown on the basis of objects found in graves from West Greenland that the Eskimo have occasionally used for their implements genuine iron of telluric origin, occuring in the basalt. May not this apply also to some of the implements from North East Greenland, in which iron is found used? Cf. Steenstrup's reports in "Meddelelser om Grønland" 2, 215 and 4, 121.

part of the side surfaces being bevelled, so that the surface of the base is only 0·7 to 1 cm broad, whereas the breadth of the median cross section of the block is 1.7 cm. The form of the cross section all through the implement approaches to the form of an ellipse, which is thus broader in the upper part of the block than in the lower part.

The original form of the implement must have been symmetrical, but the symmetry has been destroyed by the breaking off of one of the bottom corners. On the other hand, the considerable slit which extends from the base up through the whole breadth of the shaft, to the knob-like head, is an integral part of the implement; quite narrow at the top, it expands downwards, until, where it debouches into the basal surface, it attains a breadth of 0·2 cm. It is probable that a blade of some other material (iron?) has been wedged into the mouth of the slit, and that the object before us is really the wooden handle of a woman's knife, or skin-scraper (*ulo*).

An *ulo*, or skin-scraper made of stone, of the same characteristic form was found in North East Greenland by the Swedish Expedition under Nathorst (Hammar)[1]. The form in this, as well as in Amdrup's haft, is perhaps an imitation of a common type of skin-scrapers of bone, the form of which in turn was conditioned by the natural form of the bone. A skin-scraper from Baffin Land made of bone and of the same form is figured in Boas[2], who also figures a series of scrapers the handles of which are of wood, while the blades are of stone, bone, or metal. These handles all have a knob-like expansion at the upper end. Also from Alaska (St. Michael's) an example is extant of this type of wooden handle for a scraper, which is figured in Mason[3], who describes it as follows: "Handle of wood, grip cylindrical, shaft triangular, expanding downward

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[1]) Solberg 55. fig. 47; Stolpe Pl. 3, fig. 10.

[2]) Boas II, 33, fig. 40 b; fig. 41 c and d.

[3]) Mason VI, Pl. 83, fig. 1.

to fit neatly the blade of slate, which lies in a cut on the under side and is held in place by a neat lashing of a fine rawhide string". Except for this last feature (the lashing), the implement is of quite the same type as *inv. Amd. 80.* Finally, we find this type carved in ivory in a handle of a scraper from Cape Darby in Alaska, illustrated in W. J. Hoffman[1]), who in the form sees an imitation of a whale's tail: — 'the front end has a deep incision in which was placed one time a flint scraper.' The form of the handle is quite like the North West Greenland type, only that it is made in ivory instead of in wood. Most of the other skin-scrapers from Alaska which have been described are of a peculiar form, unknown from Greenland[2]), and yet not so different from the type figured here as to disguise the continuity between the forms.

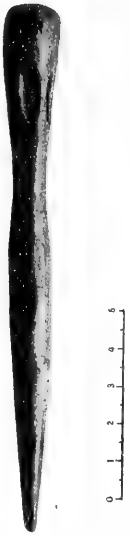

Fig. 52. Bodkin of ivory. Dunholm. 1/2.

Inv. Amd. 81 (Fig. 52), from Dunholm. This is the most notable needle or bodkin in the collection, very beautifully worked in ivory, polished, elegant, and symmetrical, and withal of a peculiar type. It is 14 cm long, cylindrical in cross section, tapering from the middle towards the point (which is much worn or broken off) and having a concave narrowing around the middle of the upper part, so that the top again is thicker, still thicker than the middle of the needle.

The eye is particularly remarkable; it is placed laterally and bored in a curve, or formed by two independent conical borings which meet at their bottom. The mouths of the path are elongated (1 cm high) and placed edgewise, facing almost towards the same side, near each other on either side of a

[1]) Hoffmann, Pl. 35, fig. 8.
[2]) Murdoch I, 294—299.

narrow bridge. The hole seems to have been large enough to permit of a narrow thong being drawn through it. The nail has probably been intended for the sewing of large boat-skins.

Inv. Amd. 82 (Fig. 50) from Dunholm. A block of red pine-wood, 12·5 long, which has been used for making fire. In the middle of the upper flat side there is a conical aperture about 1 cm in depth (the diameter of the mouth is about 7 mm). There are no traces of side-grooves. The interior of the aperture is black with combustion. It is in fact the hole in which the wooden drill rotated, the heat generated by the friction causing sparks. Compare G. Holm's[1]) description of fire-making among the Ammassalik Eskimo.

The only remarkable point about the piece is that the under side of it is so narrow that it has to be gripped firmly when the drill stock is to be moved in the hole, to prevent its overturning; this indicates that the fire-making set when used in conjunction with this block must have been served by two men in drilling.

Inv. Amd. 83 (Fig. 51), from Cape Tobin, is a wooden vessel, made of an elongated wooden block of spruce fir or larch, which has been hollowed out. Its upper edge forms approximately a rectangle (about 30 by 16 cm), while the sharply marked bottom edge (about 21 by 13 cm) approaches more to the form of an ellipse. The side walls, which thus converge downwards towards each other (and the two narrow ones more than the two broad ones), have a thickness of about 1 cm; the bottom is not much thicker, so that it is evident that the hollowing has been very thoroughly carried out. The interior of the vessel is in places very rough, and by its numerous scratches and grooves shows manifest traces of the cutting implement with which the excavation was performed. The long

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[1]) Holm 70—71, Pl. 24; Hough I, 555 ff. II, 396—399; Nelson Pl. 34.

sides are smoother than the two end sides of the vessel, the grain of the wood lying in the longitudinal direction of the vessel. The upper edge has two or three fractures, probably due to rough usage. Along one of the two narrow sides the upper edge projects about 1 cm out over the side surface; this projection, which is somewhat irregularly cut, was perhaps intended as a rest for the hand in carrying the vessel, or else as a lip through which the content might be poured out. In the middle of one of the long sides near the upper edge, there is a minute hole.

The vessel was probably a tray on which meat was served, like the hollowed wooden blocks used by the Ammassalik Eskimo as meat-bowls[1]), although it differs somewhat from them in form. It more closely resembles the vessels, likewise hollowed out of a piece of wood, in the Gjøa collection (Amundsen) from King William Land (in the Ethnographical Museum at Christiania). There are similar trays and dishes from West Greenland also (National Museum at Copenhagen, cabinets 31 and 92). Boas[2]) gives an illustration of a dish made of wood, of a quite similar type, from the west coast of Hudson Bay. 'They are sometimes edged with ivory either all round or only at the ends'. They also occur in Alaska, as we are informed by Murdoch[3]), who gives a figure of a meat bowl with flat bottom and rounded sides, and by Nelson[4]): "cut from a single piece of wood . . . . . to hold meat, fat etc., both raw, and cooked."

Inv. Amd. 84 (Fig. 53), from Cape Tobin, is a bone stick, cylindrical in cross section, 30·5 cm long, curved, tapering towards one end, with a handle irregularly cut at the thick end. The handle is separated from the other part by an annu-

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1) Holm 69.
2) Boas II, 99. fig. 143 b.
3) Murdoch I, 89, fig. 19.
4) Nelson 70.

lar ridge, which, however, is broken through on both sides, on one side by a groove which runs along the lower part of the implement, on the other side by a narrow cut. On either side of this cut and this groove, which lie along the side surfaces of the handle, are seen some irregular facets left by cuts, alternating with hacks and low knobs. In the handle there are two transverse holes converging from the upper side towards each other, and meeting in a common large hole on the under side. Is this curious aperture meant for a looped strap into which the person holding the stick as a fork stuck his hand, thus obtaining a better purchase on it? The end which points upwards in the illustration would easily hold a piece of blubber or meat stuck on it, and the small transverse grooves rifled on the inner side of this end would serve to strengthen the hold.

If it is a fork, it may be compared to *inv. Amd. 49*[1]), which, however, it far surpasses in elegance. However, it is quite possible that it may be intended for a different object ('feather setter', or 'seal indicator', cf. Murdoch)[2]).

Inv. Amd. 85 (Fig. 54), from Cape Tobin. A lyrate buckle of white bone. A thin hexagonal flat piece of bone. The lower part is bounded by five straight sides; the upper part forms a corner, separated from the other part by two fin-shaped wings, and edged by a line which curves round three times. The buckle is 4·3 cm in length, 3·2 cm in breadth, and of

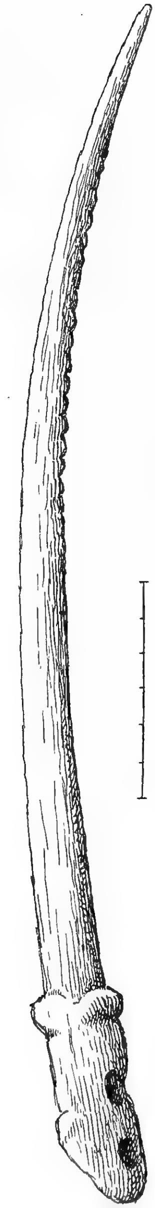

Fig. 53. Blubber fork (?) of bone. C. Tobin. 1/2.

[1]) Also Boas I, 563, fig. 517.
[2]) Murdoch I, 255, fig. 255.

exactly the same thickness (0·5 cm) all over. At the bottom of the buckle there is an elongated narrow horizontal slit, parallel with the basal edge, large enough to permit of a flat thong being drawn through. It was made by first boring two holes in the same line and then cutting away the intervening piece of bone. In the middle of the buckle there is a large hole (filled up with dried clay or mud), the irregular form of which is probably merely due to its having first been bored wrong in the buckle, and the error having been rectified by boring a fresh hole which ran into the edge of the first. Above it there are three smaller holes, the nethermost of which is connected with the main hole by a little groove for the countersinking of the thong which was passed through from hole to hole.

Fig. 54. Buckle of bone. C. Tobin. 1/1.

This buckle is much like those which are attached to the upper edge of the circular kaiak skirt used by the kaiakers both in West Greenland and at Ammassalik[1], and which below is lashed round the ring in the man-hole of the kaiak, while above it reaches about to the height of the man's midriff, when it is drawn tight; for this latter purpose there is either a pair of braces (a chain of bone beads) over the man's shoulders attached at the back to the border of the kaiak skirt and in front carried through one or two buckles in the front of the skirt; or two strings of beads hang down from the man's shoulders, fastened under the neck on his kaiak jacket; in some kaiaks these strings are gathered together in the buckle at the upper edge of the kaiak skirt; in others they are kept apart and attached each to a separate buckle, in which case each of the two buckles is fixed in front of the skirt on either side of the centre.

[1] Holm Pl. 20.

In analogy with the buckles I saw in the National Museum at Copenhagen (Cabines 76 and 66, Nos. 98—99), *inv. Amd. 85* must rather be thought to have belonged to a kaiak skirt which was held up by two buckles, and been attached to its border by a little loop through the elongated horizontal slit at the bottom of the buckle. The single brace string must have passed through the large central hole. The smaller holes are perhaps reserve holes for use in the case the brace got wet before it was attached, and therefore required different degrees of tightening according to the different degrees of contraction and expansion due to the wet.

A bone buckle of exactly the same form was found by Nathorst (Hammar) further to the north; it has the same elongated horizontal slit at the basal edge; on the other hand the larger round hole lies right out at the opposite end, between the fin-like wings, and two small apertures are seen across the middle.

The same Expedition also found in a young girl's grave (at Cape Franklin)[1], a fairly similar buckle which is ornamented with numerous dots (minute holes). As it is hardly likely that an implement belonging to the man's kaiak accessories was laid in a woman's grave, we must cast about for another explanation as to the purpose for which this buckle was used. Boas[2]) describes some buckles of a similar character, serving to carry needle-cases or similar implements at the girdle. This resemblance to a woman's buckle, if it really exists, need not alter our view of *inv. Amd. 85* as a buckle belonging to a man's kaiak dress.

Inv. Amd. 86 (Fig. 54), from Dunholm, is an ornamented comb of yellowish-brown bone (the shoulder-blade of a large mammiferous animal?). Length 12 to 12·5 cm; breadth 3·9 to 4 cm; thickness 4 to 5 cm.

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[1]) Stolpe Pl. 6, fig. 19; Nathorst 364.

[2]) Boas I, 560, fig. 514.

It consists of a flat handle of considerable length (over half of the comb) which by the edge curving well in from both sides is divided into two sections which together form something like an 8 upside down. The larger section is crowned by a flat blade-like projection, at the top of which there is a broken eye, in which a looped thong for hanging the comb may have been fastened. The long teeth of the comb have been cut out from the lower part of the second section; at the root these teeth are flat like the handle itself, but they soon become cylindrical like bodkins, tapering towards the point. There seem originally to have been eight teeth, but the extreme tooth on both sides has been broken off. The teeth are not equally sharp, nor equally long; the shorter ones have been much blunted by wear; a very thin slit in the blunt point of them leads one to imagine that the wear was due to the friction of the hair. Also higher up, on the upper part of the teeth of the comb, where hairs generally collect, is seen a horizontal groove, running from tooth to tooth, and probably due to wear. The spaces between some of the teeth at the root are still filled with dirt from the hair.

What strikes one at once about this comb is the ornamentation, identical on both sides of the comb, which is more luxurious than we should expect to see in Greenland. We see the interlacing ornamentation at the edge, consisting of two parallel lines which follow the border of the handle in all its sinuations, the intervening spaces of which are filled up with small triangular dots placed alternately along the two lines; and the two crosses which are incised each in its section and filled with ornamental straight lines which cross one another and form small squares. The ornaments of the two faces of the comb actually correspond with each other in such minute details as that the two upper crosses are inscribed in rectlinear, very weakly designed figures (perhaps lines to guide the drawing of the cross?) and that the two smaller ones in the lower section are both placed on a sharply marked, continued basal line.

The work as a whole has been carefully and artistically executed; a critical eye will, of course, easily perceive several inaccuracies and crookednesses in the outer lines of the comb as well as in the ornamentation. But, as I shall presently show, the Eskimo craftsman certainly set himself a most unusual task in this little work of art.

For while the construction of the comb, the broad flat handle, and the thick bodkin-like teeth are found in combs from North West Greenland, the size and special form of the handle of this comb are quite unique, as far as I know, not merely among the combs which are found in the collections from Greenland, but among Eskimo combs as a whole. It is so much the more surprising, as no comb has previously been found in the north-east of Greenland.

I know from the collections a number of West Greenland combs, found in graves. The ordinary type is a flat, square handle of bone, expanding a little downwards, where the teeth are cut out of the same piece without much art, being as a rule comparatively short. In Pfaff's collection in the Riksmuseum at Stockholm there are a few varying types, which have a faint resemblance to *inv. Amd. 86.* Two of these combs have a handle with a curving edge, at the top of which projects a circular blade, like a human head. Another has the simple square handle, but longer, cylindrical teeth — curiously enough originally 8 teeth, the two outermost of which on each side have been broken off, just exactly as in this specimen from North East Greenland. (With regard to one or two other combs from West Greenland, it is stated that they were presumably used in plaiting sinew cord, just like those Nelson describes from West Alaska[1]).

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[1]) Nelson 110, Pl. 48 a, figs. 1 to 6.

Fig. 55. Comb made of bone (front and back) Dunholm. $^{11}/_{12}$

The simple square handle and the flat teeth are also found in the types which are described from Baffin Land, from the west coast of Hudson Bay[1]), all of which, however, in contradistinction to those from West Greenland, are ornamented either with indentations along the edges, or with etched designs on the faces. The simple type occurs also in North Alaska, side by side with more elaborate forms, the one where the top of the handle is formed as a ring being apparently the most common. None of the combs figured in Murdoch[2]) are ornamented.

It turns out accordingly that this specimen from the entrance of Scoresby Sound in North East Greenland is cut upon a bolder design than any other known Eskimo comb. The boldly curved outline, the division of the handle into two sections, which is a development of the known type from West Greenland with a circular blade projecting from the top of the comb, are in themselves a new departure. The artisan had a further exercise for his originality and imagination in the ornamentation of the frame. A study of the ornaments shows that he was familiar with Eskimo ornamentation, as he has employed one or two of its typical forms in the execution of his task.

The ornamentation consists of incised figures. The *motif* of the border ornament is two parallel lines each of which is decorated with a regular and unilateral row of small transverse bars, in such a manner that the row of bars in each line faces that of the other line, each bar in the one line pointing towards a space between two bars on the other line. The ornament is thus a combination of two simpled ones, or rather a duplication of the single line, decorated with bars.

Although ornaments on bone work from West Greenland are extremely rare, I have found both these forms of ornamentation on bone implements from that region. The simple

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1) Boas I, 559, fig. 513; II, 107, fig. 156 (cf. 75, fig. 103).
2) Murdoch I, 150.

form, a single line with unilateral transverse bars is found in a needle-case from Karsok (Ikamiut, Disco Bay?) in West Greenland, where two oppositely curved lines on the face along each lateral edge of the needle-case correspond to each other, just as the upper edge is followed by a line of this kind (see Appendix, fig. 96); the combined form is seen in the larger needle-case from Iginiarfik (Egedesminde district), Appendix fig. 97, and on a swivel, likewise from West Greenland, the upper part of which is bordered by the ornament; the narrow convex sides of this little implement are decorated with a second ornament running along them. These three ornamented bone implements, all of which belong to the Inv. Pfaff in the Riksmuseum at Stockholm, are the only ornaments carved in bone which I know from West Greenland. The type of this ornament, both isolated and combined, is very common in bone implements from Alaska[1] (in a skin-dresser, a grass-comb, a buckle, a pipe-stern, a seal drag, bag handles, a comb, mouthpieces, needle-cases, *kantag* handles, drill bows, belt fasteners, buckles etc.) and is designated as 'the fish trap or seal tooth pattern'[2]).

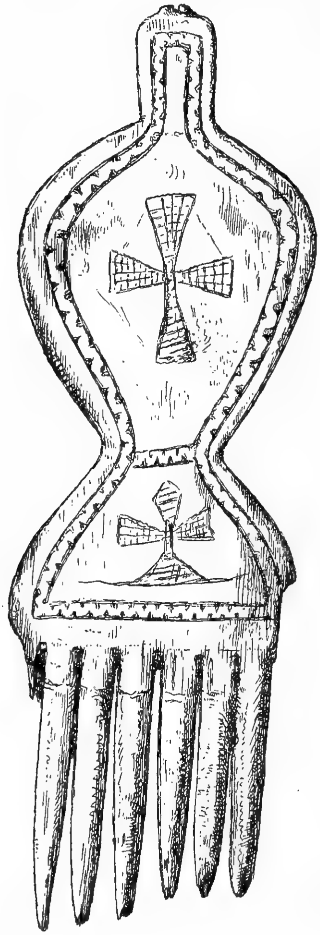

Fig. 56. The comb from Dunholm (same as fig. 55).
Ditlevsen delin.

[1]) Hoffman 805—806; Pl. 18, 23, 32, 52; 20, 26, 31, 32, 35, 36, 37, 50, 51, 52; Nelson Pl. 38, 43, 44; Mason I, Pl. 63.

[2]) Hoffman 806.

H. STOLPE in "Studier öfver amerikansk Ornamentik", discusses these and other Eskimo ornaments at some length; he broaches a hypothesis that this zig-zag pattern, and another, consisting of lines crossing one another, has arisen as an imitation (owing to 'expectancy') of the cross wrapping of whale-bone cord with which the stone blade in the original type of the *ulo* was fastened to the wooden handle, viz. by holes pierced in its upper part. Later on they found it sufficient to join the blade into a slit in the under side of the handle, but retained for some time the whalebone cord lashing on the upper back of the shaft merely as an ornament (cf. *inv. Amd. 45*). The last stage was that this veritable wrapping was abandoned, but that the craftsman cannot help marking it in its old place, thus producing the incised ornament of lines crossing one another. — It is however hardly probable that the very widely diffused zig-zag pattern on bone implements should have this same special origin.

In each of the two fields of *inv. Amd. 86* which are produced by the connection of the inward curving ornamental lines at the point where they approach most closely to each other, the craftsman has incised a cross, thus four crosses in all.

The cross ornament had, as we know, developed in America even before the time of Colombus, and is found in the ornamentation of the Indians in various forms[1]. On the other hand, I find no traces of its naturalization in the ornamentation of the Eskimo. In the illustrations on books I have only found it in a few cases: as far as Alaska is concerned, on a wooden spoon in Murdoch[2], which is designated as new, in a couple of ivory ear pendants, and on a wooden box in Hoffman[3], who, however, expressly states with regard to the latter that the cross on it must be ascribed to Russian

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[1]) See, e. g. Handbook of American Indians, article cross (Bur. Am. Ethnol. Bulletin 30, p. 365—367); Wilson: The Swastika; Stolpe: Amerikansk Ornamentik; Hein: Mäander, Kreuze etc. in Amerika.

[2]) Murdoch I, 104, fig. 42,

[3]) Hoffman 806, Pl. 32 and 34.

influence. Three small crosses are seen on one of the combs from Baffin Land illustrated in Boas [1]. Finally two crosses are found incised in *inv. Amd. 87* from the same place as the comb, but all these crosses are of the simplest possible form, viz. two short lines crossing each other at right angles. The cross in the comb, on the other hand, is of a form which is most striking in an Eskimo district. The type is known as genuine within the Indian districts in North America, as 'the cross formed by the ornamental arrangement of three *tipi* figures' [2]; but the discovery of a cross of this type in the ornamentation of the Eskimo is quite isolated and unexplained.

There is no reason to doubt that *inv. Amd. 86* is a product of Eskimo industry. The details of the border ornamentation are of unmistakable Eskimo origin; the whole form of the comb can easily be explained as an independent variety of an Eskimo comb, with the stamp of individuality; but the cross ornament in its four fields tells another tale, or rather speaks a language which it is more difficult to conceive as pure Eskimo.

But this old Eskimo implement is not the less interesting and valuable for having the riddle of the cross written on its face.

I find in G. Mallery ("Picture Writing of the American Indians" [3]) the following mention of the cross having been adopted as a symbol by some of the Eskimo in the south-western corner of Alaska. "Among the Kiatéxamut [= Kiatagmiut?], an Innuit-tribe, a cross placed on the head, as in Fig. 1231, signifies a shaman's evil spirit or demon. This is an imaginary being nnder control of the shaman to execute the wishes of the latter." The figure shows on a small scale a crudely drawn man, above whose head the Greek cross (an upright cross with limbs of equal length) is placed. Wilson ("The Swastika") [4] cites this passage, but makes

[1]) Boas I, figs. 513 a.

[2]) Handbook of American Indians p. 366 (W. Holmes).

[3]) Mallery 728, fig. 1231.

[4]) Wilson III, 939, fig. 328.

the error of writing: "Among the Kiatéxamut and Innuit tribes, a cross placed on the head signified a shaman's evil spirit or demon etc.", where the simple fact that the cross occurs in a single drawing in southern Alaska has been generalised to hold good of all Eskimo. As a matter of fact the drawing brought to light by Mallery, who does not inform us on what implement or object it was found, is a quite isolated product of an Eskimo's imagination and, of course, does not prove anything as to the cross having been known as a symbol or ornament among this people as a whole.

The cross on the comb brought by Amdrup from East Greenland is of quite another type than the isolated ornamental crosses which, as has been mentioned above, are found here and there on Eskimo objects from different places. It is a pronounced Maltese cross, a type which in Europe is of mediæval origin[1]): in North America it occurs now and then as an ornament. I have only found it in a medicine-case lid[2]), illustrated in Kroeber, from the Arapho Indians (Algonkin family), in a Siouan awl from Nebraska illustrated in Mac Guire[3]), and on a 'mantle of invisibility', illustrated in Mallery[4]) made by Apache Indians (the most southerly group of the Athapascan family); on this mantle it occurs six times as an ornament. Finally, Mallery[5]) referring to Keam's manuscript informs us that this type of cross was used by the Moki Indians (= Moquelumnan?) as an ornament. "The Maltese cross is the emblem of a virgin; still so recognized by the Moki. It is a conventional development of a more common emblem of maidenhood, the form in which the maidens wear their hair arranged as a disk of 3 or 4 inches in diameter upon each side of the head. This discoidal arrangement of their hair is typical of the emblem of fructification worn by the virgin in the Muingwa festival". So among these Indians this peculiar form of cross has been developed as an imitation of the women's head-dress.

Inv. Amd. 87 (Fig 56), from Dunholm, is a flattish tube

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1) Wilson III, 760 and 950 (Fig. 7) "The Maltese Cross was the symbol of the knights of Malta, and has become, in later years, that of the Masonic fraternity.

2) Handbook Amer Ind. I, p. 366.

3) Mac Guire I, 676, fig. 60.

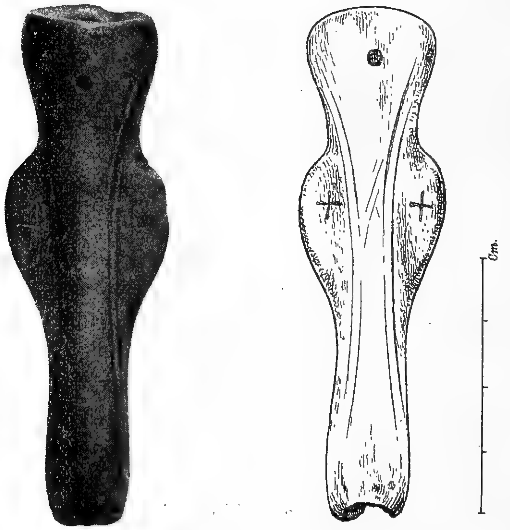
4) Mallery Pl. XXXIII.

5) Mallery 728--729, fig. 1232.

of yellowish-brown ivory (narwhal tusk), length 8·1 cm; greatest breadth 2·5 cm, narrowest in the middle, expanding towards both the mouths of the tube, but most upwards. On both sides of the narrowest part a flat wing has been carved out.

A piece of the edge both of the upper and of the lower mouth has been broken off.

The ornaments are: — a little incised cross on the front of each wing; a little circular aperture on the back of them; four similar apertures (thus not holes bored through) a



a *b*

E. Ditlevsen delt.

Fig. 56. Needle case. Dunholm. 4/5.

quarter turn from each other a little below under the upper edge of the tube; finally both on the front and on the back of the tube are carved two symmetrically curving pairs of lines, which follow the line where the wings join the sides of the tube. The surface of the implement is beautifully polished and carefully worked. The implement must be compared with *inv. Amd. 61*, which I set down as a needle-case. Its form diverges a little from that of the latter, which was seen to be particularly typical of the Greenland fashion of needle-case; but the divergence rather goes to lend support to the view, as this somewhat slenderer form, which in Greenland is only found in the north-east, and only in this one specimen, really constitutes a transition form which fills up the gap between the Greenland and the West Eskimo type of this implement.

Inv. Amd. 88 and *89* (Fig. 57 a and b), from Cape Tobin, are two animals carved in wood, and attesting the usual skill of the Eskimo in characterising animals.

Fig. 57. A bear and a swimming bird, carved in wood. Cape Tobin. 1/1.

(*a*) A polar bear standing in a watchful attitude, or as if ready to pounce on his prey. Though not very carefully worked (the snout and the mouth are not finished, nor are the claws or paws indicated, and there is only a faint indication of ears), it is nevertheless easy to recognize by the broad back, the thick thighs, the short stumpy tail, which lies closely along the flat rump, the low hanging belly, and last but not least, the stooping position of the head (cf. Appendix fig. 106).

(*b*) A large bird, swimming, either a goose or an eiderfowl; its breast and belly right up to the tail are covered with a greyish crust, probably the remains of a piece of bird's skin which has been drawn over it to render it more true to life;

on the breast there are several long hairs adhering to the crest. This idea of covering the carved animal with feathers or hair in imitation of nature is a feature which I have not met with before or seen mentioned as to any Eskimo toy animal.

Carved animals of wood have been previously found in Scoresby Sound: Ryder[1]) found three figures representing seals, two of them lying on their backs, just as when they are dragged home from the ice by the Eskimo. Further to the

Fig. 58. Animals carved in ivory. Cape Tobin. $^1/_1$.

north, at Cape Weber, the Nathorst Expedition (Hammer)[2]) likewise found three figures of animals carved in wood, a polar bear, a seal, and a musk ox, several times larger than the figures found by Amdrup and Ryder; the bear, for instance, measures from snout to tail between 13 and 14 cm. The second German North Pole Expedition[3]) also found in these regions a few wood carvings of this kind: several of the expeditions, moreover, found carved human figures of wood. It is very significant

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[1]) Ryder 337, fig. 38.
[2]) Nathorst 348, figs. b, c, d; Stolpe, Pl. 5, fig. 18.
[3]) Koldewey 601, figs. 2 and 3.

that the Eskimo's representations of themselves, the only race of men they know, appear to us less characteristic than their animal figures.

Inv. Amd. 90—95 (Fig. 58), from Cape Tobin. Six animals carved in ivory. All of them have a hole pierced in them either at one end or in the middle. They were used as hanging ornaments, perhaps attached to needle-cases. They are very small, very finely worked.

The first figure represents a swimming bird (without trace of its legs). To the right is seen a blown-up bladder, a seal-skin float, for which, as we know, a whole sealskin is used, with the skin of the head, the swimmers, and the tail intact and well sewn together, so that the air which is blown in distends the whole skin, making it assume the form of a whole seal.

In the middle row are seen a walrus and a whale.

In the bottom row to the right (under the whale) we see a plump seal of the smallest variety, lying on its belly. The drawing (Fig. 59) gives a better impression of how this little work of art is to be conceived. The animal is evidently to be looked upon as lying on its back, in the position in which after killing it is dragged ashore over the ice by the hunter.

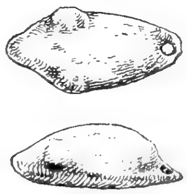

Fig. 59 (*inv. Amd. 94*). Seal carved in ivory.

As all the animals just mentioned are rendered in a very lifelike manner in the carvings, there are no grounds for supposing that the sixth, *inv. Amd. 95*, should not also give a faithful representation of some animal or other. However, it is by no means easy to identify it. It can not be any kind of seal, as it has no swimmers, and the shape of the head with the small pointed ears is very unlike that of a seal. The imagination recoils from conceiving it as a land mammifer. And yet we have no other recourse, and we shall discover, to our surprise, that the realistic sense of the Eskimo has not failed him this time either. The drawing fig. 60, shows how the figure is to be conceived; not with the head in front and the tail behind, but with the head erected: a polar bear walking on its hind legs. The pointed ears are then found to have a significance; the fore paws are pressed closely to the body and are not visible; on the other hand, the hind legs are distinct enough. The upright position is peculiar to the polar bear when it is surrounded by the attacking hounds and stands at bay, ready to defend itself with its teeth and front paws. The little work of art is in its way quite unique; the carver has endeavoured to represent an animal figure which departs from the common stereotyped forms of Eskimo art, like those of the watching bears or swimming seals. That is perhaps why the result has not been very satisfactory from an artistic point of view; but it bears evidence of a personal sense of humour and a liveliness of imagination. It is once again a little manifestation of the same delight in striking out new lines which we have on several occasions observed in useful objects made by one of the most isolated tribes of human beings in the world, which none the less has evidently not lacked the impulse to carry the traditions of their fathers a step further in the new regions to which they have immigrated.

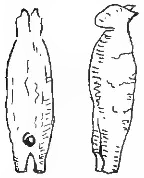

Fig. 60 (*inv. Amd. 95*). Bear carved in ivory.

Fig. 61. Bone split by borings. 1/2.

Inv. Amd. 96 (Fig. 61), from Cape Tobin, is a bone 15·5 cm in length, which has been split by means of drilling from opposite sides. This has resulted in a flat side, where the remains of the spongy soft interior of the bone are clearly seen. A whet-stone or scraper seems to have been used over a small part of this surface, which otherwise is rough. The intention has evidently been to use the piece for some implement or other. In the thick end there is a transverse hole.

The previous expeditions[1] often found similiar half-finished bones, which show that drill-boring has been used instead of a saw to split off the blocks of bone which were to be used for bone implements or utensils. The same procedure was in older times also adopted on the West coast. It must have demanded no little patience.

Fig. 62. Fragment of a wooden implement. Dunholm. $^{1}/_{2}$.

Inv. Amd. 97 (Fig. 62), from Dunholm, is a curiously formed flat piece of wood (about 12 cm long), which looks something like a weapon head. It is split (by the action of frost or as the result of pressure?) into two pieces. Its sides are slightly convex; the edges are rounded, even at the extremity of the blunt end. The resemblance to a weapon-head is due to the two indentations which have been made obliquely opposite to each other. Close behind them is the commencement of a fracture which has perhaps carried off the lower part of the implement.

It is difficult to decide to what kind of implement this fragment can have belonged. A weapon head of wood is otherwise quite an unknown thing, and I do not know any Eskimo implement of this kind, unless it be related to the kind of implement I am going to describe presently, *inv. Amd. 99.*

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[1] Ryder 324; Koldewey 601; Nathorst 258—260.

Inv. Amd. 98 from Dunholm, is a piece of a whale's vertebra, a circular flat piece of spongy bone, circa 23 cm in diameter. In the centre is seen a square hole, which has been cut obliquely through from one side to the other.

According to Ryder[1]), the passage-ways in the settlement he found at Sydkap at the mouth of Nordvestfjord in Scoresby Sund were partially covered with the vertebrae of whales, the rib-bones of whales being likewise used there as rafters.

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[1]) Ryder 289.

7. Finds from Cape Borlase Warren (74° 18′ lat. N.) and Sabine Island (74° 45′ lat. N.), North East Greenland.

Between 4 and 5 degrees of latitude further towards the north, about fifty miles north of the mouth of Franz Joseph's fjord the Expedition landed at two points and made excavations with the object of searching for Eskimo remains. In both these places earlier expeditions had landed previously.

Clavering discovered and gave the name to Cape Borlase Warren, which lies at the extreme point of a peninsula north of Clavering Island. Also in his time (1823) traces of the natives were found; stone chambers built up of stones were found everywhere along the coast, containing blubber, and several old graves were opened. — The members of the second German North Pole Expedition[1]) camped twice at this spot and likewise found numerous traces of the previous Eskimo population. Besides the graves opened by Clavering, they found further to the west an unopened grave, the interior of which was found to have been divided into two chambers by means of a little partition. Among the rocks here there was also found the half of a kaiak paddle. — In this spot Lieutenant Amdrup[2]) made quite a short landing, during which he was fortunate enough to find some few Eskimo objects; a number of these are connected with the Eskimo's dog-sledges.

Only a few miles further to the north lay Sabine Island, where the Expedition made a similar landing after having made

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1) Koldewey 607—608.
2) Amdrup, Meddelelser om Grönland XXVII, 148.

their way through the belt of ice in July 1900[1]). Here Lieutenant Amdrup, together with Søren Nielsen, excavated an old Eskimo winter house and found a few extremely interesting implements, or fragments of them. The place, by the way, is one of the places which have been most visited by Europeans on this part of the coast. Clavering and Sabine had landed here in their time. One of the vessels of the German North Pole Expedition, Germania, wintered afterwards in a little bay off this island. In the report[2]) of this Expedition we find a sketch of the Eskimo settlement, the ruins of which still exist here, and it is mentioned that on the south side of the island east of the ruins 10 graves lie. Half of them at that time had not been tampered with, the stones of the others were scattered all about. "The fact that the graves had been opened and robbed of their contents seemed to us", so the report runs, "to indicate the former presence of civilized men". The English Expedition had presumably already made excavations here. However, the only traces of Europeans which were found was the half of a porter bottle[3]). — Thirty years later, the Swedish Expedition under Nathorst landed on this island, the year before the Danish. It is thus evident that even in the places in East Greenland previously visited by the Expeditions, an archæological investigation would have some prospects of discovering still more Eskimo remains.

Fig. 63. Fragment of a wooden implement. Sabine Island. 1/2.

Inv. Amd. 99 (Fig. 63), from Sabine Island, is a shaft-

[1]) Amdrup, ibid. 146—147.
[2]) Koldewey 589 and 590.
[3]) id. 597.

like fragment of a wooden implement, length 13 cm, greatest breadth 4·5 cm. At the broad end it is flat and thin, over the middle it attains its greatest thickness, at the narrow end it is circular in cross section. All the edges are rounded, and there is no ridge on any of the side surfaces. On the flat upper side is seen a conoid depression, deepening inwardly; its outer edge follows quite closely along the side edge of the shaft, while the opposite border, which is deeply cut and almost hollowed, is slightly curved and has a ridge between the depression and the neighbouring edge of the shaft. The bottom of the depression is flat, but slants evenly up at the bottom corner towards the base of the implement, where a broad ridge between the depression and the basal edge of the implement is likewise produced; this basal ridge forms a rounded angle, less than a right angle, with the lateral ridge just mentioned. This latter is bevelled and rounds off into the under side of the shaft. In the middle of the same edge of the shaft there is a shallow incision, which may be considered to be a finger-rest. The under side of the implement, as far as can be seen in the rather damaged wood, must have been slightly convex, but in the part between the finger-rest and the basal edge its surface has a characteristic slant whereby this corner of the shaft is rendered thinner than the middle.

In this fragment we recognize the same implement which Ryder[1]) found further to the south, in Scoresby Sund, and of which he gives an illustration. It was only natural that he should interpret it to be the handle of a throwing-stick of the type which is employed for bird-darts, especially of the type which is nown from North Alaska, for there is really a resemblance between the fragment found by him and the corresponding part of a throwing-stick (though not the Greenland form of it) and no other Eskimo implement with a handle of this kind was

[1]) Ryder 318, fig. 17 b.

known. Ryder has supplemented his drawing of the fragment with some imaginary dotted lines, which bring out the resemblance to the Alaska form of a throwing-stick.

However, this correspondence is a mere coincidence, as I am now going to prove. The proof, however, was not derived from the specimen found by Amdrup, which is broken at about the same place as that of Ryder's, although this stump, which is longer than Ryder's fragment, did not bear out his hypothesis. In the Museum für Völkerkunde in Berlin my attention was first drawn to an elongated wooden implement from North East Greenland, which I had not seen before from Eskimo districts, but the expanding shaft end of which was formed like the handle of a throwing-stick and like the object found by Amdrup. In the inventories of the museum it is designated as a "Dolch ohne Spitze" (inv. No. IV A 198), brought home by the German North Pole Expedition, but it is not figured among the illustrations of the report of the Expedition. It will be found illustrated here in the Appendix, fig. 103.

As to the use to which it was applied, it must be admitted that as the type is not known from elsewhere, and as we cannot obtain any information from the people itself, which is extinct, we are thrown upon guess-work. The designation of the specimen in the museum as a dagger can only be taken into consideration, if special grounds should be found to argue for it. The implement has a point, in so far as at the narrow end it is bevelled from two sides, and by means of two indentations two small lateral barbs not far from the end have been formed. It is just as long, or longer, than a throwing-stick, but it is not a throwing-stick.

When I found in the ethnographical section of the Riksmuseum at Stockholm among the objects brought home from

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[1]) Stolpe Pl. 5, fig. 17; cf. p. 104 "ein eigentümliches Gerät dessen Bedeutung noch nicht ermittelt ist".

North East Greenland by Nathorst, some wooden implements which must be referred to the same type, I realized at once that the form of this object was no mere accident. Here I came upon a fully intact specimen of exactly the same type as that found by the Germans, which I had seen at Berlin. It is 39 cm long, with an expanding shaft end of about the same form as the handle of a throwing-stick, and with a flat, pointed end, the head of which is marked by two lateral indentations (illustrated in the Appendix fig. 104). There are, besides, several fragments of the same kind of implement in the Nathorst collection.

After this discovery I no longer entertained any doubts that the two similar handles found by Ryder and Amdrup at two different places along this coast, were parts of the same kind of implements as those with which I became acquainted in the museums. The next question then is only what it was used for. It will certainly not be easy to answer this question, as the implement, as far as I know, is not known from any other group of Eskimo than that in North East Greenland. I have never seen it in West Greenland, nor yet at Ammassalik.

I do not know whether the question is brought nearer to its solution by the fact that in the Nathorst collection from North East Greenland there is a wooden implement with a handle of precisely the same form and size as the implements just described, but with a heavy club-shaped head at the other end instead of a point. This implement, too, is otherwise unknown, but it is at any rate possible to form an opinion as to its use (compare my comments on the illustrations of it, Appendix fig. 105). It may have been used as a blubber-beater, or in general as a mallet. The implement with the wooden point might be assigned a similar purpose in domestic life; we must suppose that it was an implement in which it was necessary to have a firm grip of the handle in order to force the flat, blunt wooden point at the other end into the substance or the space in which it is made to work in. It is worth noting that the implement seems to have been very liable to break just above the handle.

Inv. Amd. 100 (Fig. 54), from Sabine Island, is a little cylindrical or conical pipe of bone (length 2·2 cm) with a circular indentation at the top and a deep slit running all the way round at the bottom.

Fig. 64. Nozzle of bone for inflating the sealing float. Sabine Island. 1/1.

It is a pipe-shaped nozzle, or mouth-piece for inflating the sealskin float, of a similar kind to that known from the southerly part of the east coast and from the west coast. They use it in this way. The lower part of the pipe is stuck through a hole in the bladder, which consists of a seal-skin which has been flayed off entire, in which the necessary slits have been sewn up again, so that it can hold the air when it is blown up. The place of the nozzle is in the snout of the seal (or in the genital opening)[1]. The edges of the hole are gathered up with a thin strap in the slit, so that the rest of the pipe sticks outside the bladder; the latter is blown up through the pipe, the mouth of which is stopped up with a plug of wood.

The implement is found everywhere as an accessory of the Eskimo's sealskin floats[2]. The Alaska forms, however, seem to diverge a good deal from the Greenland ones. *Inv. Amd. 100* was possibly meant to go along with the little bladder which is attached to the shaft of a spear.

Fig. 65. Ivory button Cape Borlase Warren. 2/3.

Inv. Amd. 101 (Fig. 65), from Cape Borlase Warren, is a curved cylindrical piece of ivory (length from point to point 3·5 cm), a little thicker in the middle than at the ends, with a transverse hole in the same plane as that of the curve. It is ornamented with three pairs of annular slits.

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1) Murdoch I, 247.

2) Boas I, 492—493; Nelson 142, Pl. 56.

The implement is a toggle belonging to a buckle, or belonging in some other way to a garment. The toggle is perhaps best conceived on the front of a woman's frock (*anoraq*), which is gathered up in front at the breast. Only a few details as to these toggles among the western Eskimo are given in the standard works on them[1].

Fig. 66. Ivory button belonging to a dog-trace. C. Borlase Warren. 2/3.

Inv. Amd. 102 (Fig. 66), from Cape Borlase Warren, is the fragment of a kind of buckle of yellowish ivory (4·2 cm by 2·8 cm); fairly thick, flat on both sides, with rounded edges; the lower edge double as thick as the upper. In both the broken off ends are seen the remains of several holes; those at the broadest end are of the kind produced by sawing off the bone with drills, which indicates that an attempt has been made to modify the original form of the implement. The fragment of the hole at the thinner end, which is connected by shallow grooves on both side surfaces with the well-preserved central aperture, taken in conjunction with the whole form of the implement, shows that the object must be one of the bone holders (*orsseq*) which attach the ends of the dog-traces to the cross-line of the sledge.

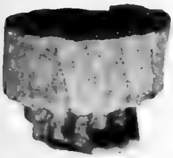

Fig. 67. Ferrule of bone. C. Borlase Warren. 3/4.

Inv. Amd. 103 (Fig. 67), from Cape Borlase Warren. A short ivory ring, or short broad bone pipe (of a hollow bone), 2 cm high; the diameter of the cross section is 1·5 cm to 2 cm. Round the lower part has been made by means of borings a broad slit running all the way round (partially broken off). The upper edge of the pipe also bears traces of the borings whereby the bone has been sawn off. The slit below is produced by two converging rows of holes bored closely above and below each other, the boring

[1]) Perhaps a similar toggle to that figured in Boas II, 20, fig. 16 h.

having been made obliquely towards the axis of the bone; the narrow walls which have been bored out might easily have been cut away. Only the surface of the narrow bottom edge, which projects round the lower mouth of the pipe and runs all the way round forming the bottom side of the groove, is completely rounded.

I conceive it to be a ferrule placed on the lower end of the handle of a whip. The lower part of this wooden handle must have been cut in the form of a tang to fit into the pipe; the shoulder of the tang must have rested up against one of the edge surfaces of the pipe (that which on the figure faces upwards). At the other narrower mouth of the pipe was inserted a loose pike (*tooq*) of bone, which may perhaps have been wedged in a hole at the end of the wooden shaft. In order to strengthen the point of junction the ferrule (*qaateq*) was probably also wrapped round with a thong in the said slit[1]).

The people of Ammassalik still constantly use a bone pike fastened to the bottom end of a whip handle[2]), which is often of great use in cutting away the corner of a hummock which bars the way, or for knocking hard frozen snow from the sledge runners, or to dig hard into the snow in sledging on land, as a kind of brake in coasting down steep slopes.

Inv. Amd. 104 and *105* (Fig. 68 a and b), from Cape Borlase Warren). Two small roughly worked bones, 4·5 and 5·5 cm long respectively, cylindrical at the top, but throughout the greater part of their length bevelled from four sides, with two sides more oblique than the other two, so that they are flattish at the bottom; thus the whole of the lower part is formed like a tang. In the upper circular end surface is seen

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[1]) In a similar manner the ivory head (*qatirn*) at the end of the shaft of the large harpoon is stuck so closely on to it, that it sticks without being either riveted or tied together. (Boas I, 490.)

[2]) Holm Pl. 15.

the mouth of a hole, 2 cm deep. In the lower of the large piece (b) there is a semicircular indentation. The bevelled surfaces (on the sides) bear traces of the cutting tool, just as there are marks of borings in the upper edge of one of the specimens.

I imagine that these specimens are toy miniatures of the same implement as *inv. Amd. 73*, *74* and *75*, thus representing foreshafts of harpoons. It must be observed that the tang here has been cut from opposite sides and is without any

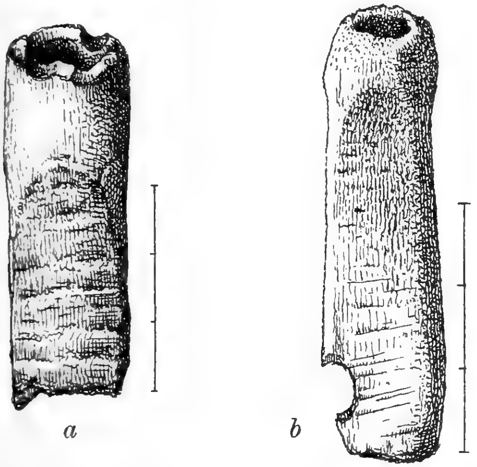

Fig. 68. Miniature foreshafts of harpoons. Cape Borlase Warren. 1/1.

bored holes; it may have been intended to be wedged into the end of the wooden shaft. Perhaps these specimens have never been inserted in any shaft, but are unfinished fragments. —

They should thus correspond in function to the ivory head from Baffin Land described by Boas[1]), which, however, is attached to the shaft in a different manner from these toy objects.

Ryder[2]) discovered a similar specimen in Scoresby Sund, which he pronounced to belong to a walrus harpoon.

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[1]) Boas I, 489, fig. 419—420.
[2]) Ryder 336, fig. 36 b.

Inv. Amd. 106 (Fig. 69), from Cape Borlase Warren), is a sewing-needle of ivory, with a cross section of varying shape, being flat and lancet-shaped at the broad end, just like the single exception (*42*) in the group of bodkins mentioned under the heading of *inv. Amd. 33* to *44*, and circular in cross section at the pointed end. The point itself is rather blunt, in which respect the piece resembles the good-sized plump type of bodkins (or needles) described above.

The eye is placed laterally at the extremity of the broader end.

Fig. 69. Ivory needle. Cape Borlase Warren. 1/2.

Although this is the only specimen of this type which is known to me from Greenland, I am nevertheless inclined to see in it the normal type of a needle, the ordinary bone nail before the time when, with the introduction of iron, modern nails came into use. It corresponds well with the old bone nails from Alaska, described by Murdoch[1]), which were kept in a quill case. Two of these are described as round-pointed, 1·8 to 1·9 inches long, one of them is more slender, flattened and expanded at the butt. (The third is 2·4 inches long and has 'a four-sided point like a glover's needle', cf. *inv. Amd. 44*, fragment.)

This find of Amdrup's, like so many of his other finds, goes to attest the primitiveness of the culture of the North East Greenland Eskimo and its close affinity with the original Eskimo culture between Point Barrow and Greenland.

Inv. Amd. 107, *108* and *109* (Fig. 70), from Sabine Island, are three flat pieces of ivory carved in the form of marine animals (a seal, two whales) each with two holes bored in the median of the piece.

These pieces correspond exactly to those which the Ammassalik Eskimo use (or used till recently) for the ornamenta-

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[1]) Murdoch I, 318, figs. 325 and 326.

tion of their wooden implements, as for instance, throwing-sticks and eye-shades[1].

The discovery of these objects of the same type of ornamental art as at Ammassalik so far to the north on the East coast of Greenland, is extremely interesting as a fresh attestation to the continuity in the material and ideal culture of this coast. At any rate it can be said that as regards this settlement, and thus as regards one or more families who have lived so high up in the north, we find a continuity with the Ammassalik Eskimo.

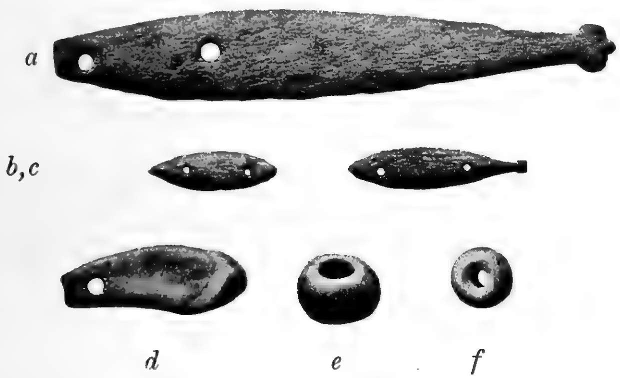

Fig. 70. a, b, c. Bone ornaments for attachment. — d, e, f. Ornamental tooth and beads. Sabine Island. $^1/_1$.

For ornaments for attachment of this kind are otherwise not known in Greenland; not from the west coast, and certainly not from any Eskimo district outside Greenland either[2].

Inv. Amd. 110 (Fig. 70), from Sabine Island, is the tooth of a mammiferous animal, pierced at the root, analogous to those which belonged to the belt or necklace described under the heading of *inv. Amd. 57*.

Inv. Amd. 111 and *112* (Fig. 70 e, f), from Sabine Island, are two round, somewhat flattened beads of white bone, nearly

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[1]) G. Holm 150—153; Pl. XXX to XXXV.

[2]) There is no reference to this form of ornamental art in Hoffman's work on the graphic art of the Eskimo.

cylindrical in form, which without doubt belonged to a chain-like ornament. They are both pierced through. The smaller one particularly is very accurately worked. The mouths of the hole lie somewhat sunk into the concave end surfaces of the bodies, which in form resemble short cylinders. In the larger blade the hole is elliptical in cross section; that of the smaller one is circular.

Ryder[1]) found a number of similar beads, the forms of which were all through more distinctly cylindrical.

Inv. Amd. 113 (Fig. 71), from Sabine Island, is a buzz of the ordinary Greenland type, consisting of an elongated flat piece of wood (length 12 cm), flattest in the middle, with slightly convex sides. The edges curve inwardly towards the centre,

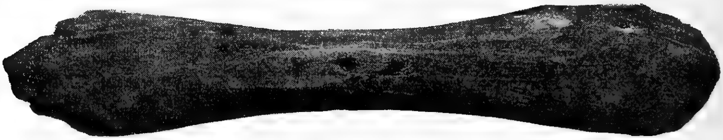

Fig. 71. Buzz made of wood. Cabine Island. 3/4.

where they are rounded off, whereas those at both ends of the buzz are sharp. The workmanship is rather rough and hasty, without any attempt at polishing.

In the middle of the object, in the median line, there are two transverse holes, very fine, so that it can be gathered that they were made with a very thin awl. Through these holes a piece of sinew cord must have been drawn in a loop; its two loose ends were then tied together. A sudden tautening of this double line, which causes the piece of wood to hang vertically between the lifted hands, sets the implement moving with a short rotatory motion, whereby the lines are made to make a whole or a half turn round themselves, especially if the tautening is immediately slackened off; an immediately repeated

[1]) Ryder 338.

tautening of the line sends the buzz swinging back in the opposite direction at an increased speed, and the lines are made to perform one whole turn or two turns round each other, as the tautening is slackened. By a deft continuous movement of the hands, alternately tautening and slackening the lines, the whirling to-and-fro motion of the buzz is rapidly increased, whereby, when it revolves at its greatest speed, a buzzing sound is produced. — At Ammassalik the children to this day still play with buzzes of quite the same type[1].

This toy has often been found in North East Greenland. The second German North Pole Expedition brought home two buzzes of this kind[2]; Ryder likewise found two of them. There is quite a similar one[3], made of ivory, from Cape York at the extreme north of West Greenland; it is illustrated in Culin[4], who has collected a series of tops and buzzes from the western regions[5]. These latter, however, differ from the Greenland type, having a square or circular form. Throughout Greenland, from Cape York to Ammassalik, an independent and marked type of this toy is found.

Fig. 72. Piece of bone mounting. C. Borlase Warren. 1/2.

Inv. Amd. 114 (Fig. 72), from Cape Borlase Warren, is a fragment (length 19 cm) of a small bone mounting, with fine holes for the nails. The holes are placed reciprocally to each other as they are generally placed in sledge shoes (in pairs, obliquely to each other in zig-zag fashion, but with one

[1] Holm, Pl. 27.

[2] These two buzzes are in the Museum für Völkerkunde in Berlin, registered IV, A, 192.

[3] Free Museum of Science and Art, University of Pennsylvania (Cat. no. 18391).

[4] Culin 752, fig. 1013.

[5] Nelson 378; Boas II, 53 and 112.

or two breaches in this regularity (cf. *inv. Amd. 67—68*). Can it be the keel of a miniature sledge for a child (in that case a fairly large toy)? Or may it possibly have been the bone mounting on the edge of a kaiak paddle, or on the edge of a throwing-stick?

Inv. Amd. 115 (Fig. 73), Cape Borlase Warren, seems to be the fragment of a thick ivory mounting, rather finely worked. In its well-preserved, smoothly polished surface a few oblique scratches are visible. A transverse hole for a nail, 8 mm in diameter, shows like an indentation at the edge of the broken piece.

Inv. Amd. 116 and *117* (Figs. 74 and 75), from Cape Borlase Warren, are fragments of sledge shoes with the usual holes bored for nails. Most of the wooden pegs are still sticking in the holes in the larger piece. The holes are, as usual, bored obliquely to each other; the distance between the mouths of each pair of holes is about 3 cm on the under side of the shoe, of the same holes on the upper side (that which faces towards the under surface of the sledge runner) 2 to 2·5 cm.

The larger fragment is highly decayed, and only a small part of the smooth bottom surface has been left undamaged. The ends of the two tree-nails which are stuck in it have been worn smooth, the rest being frayed, as if the bone had been broken with violence. The under side of the smaller fragment is well-preserved, quite smooth, with some slight scratches along it.

Cf. *Amd. 67* and *68*.

Inv. Amd. 118 and *119* (Figs. 76 and 77), from Cape Borlase Warren, are two hollow bones, split by drill-boring, which it was probably intended to use for some implement or other.

One of the bones (of narwhal tusk) shows traces, not very marked, of the boring, and the bored holes lies from $^1/_2$ to 1 cm apart from each other. The boring of this bone must have required more force than that of the other (fig. 76), where

Fig. 73.

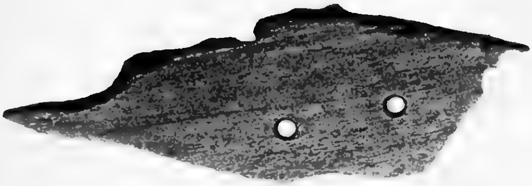

Fig. 74.

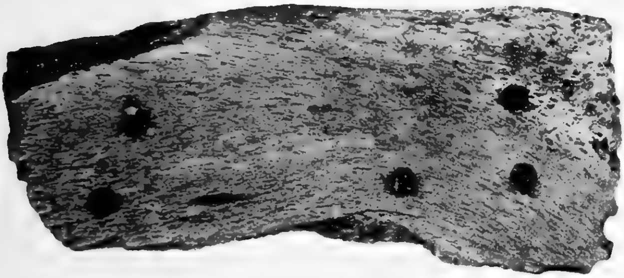

Fig. 75.

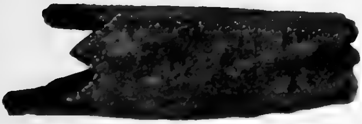

Fig. 76.

Fig. 77.

Figs. 73 to 77. Fragments of worked bone. Cape Borlase Warren. 1/2.

the bored holes are quite close to each other. With regard to this latter piece, it should be observed that the boring must have been performed with two drills of different size, as the diameters of the holes are different. Can it be a mere coincidence that it is the thinnest drill point which has been used for the splitting of the thickest wall of the bone? The longest of these fine drill holes is 1·1 cm in length. The side surfaces produced by the splitting are, of course, more regular where the thin drill-point was used, than where the thick one penetrated.

Cf. *inv. Amd. 96* (and *77—78*).

Appendix.

Fig. 78. Bone head of a harpoon, of unusual type, unfinished. The height of the body greater than its breadth. The back half very thin with flat sides terminating in an undivided tang-like basal barb; no lateral barbs. The point without any slit for blade. The front half oval in cross section, divided from the back half by two steeply inclined shoulders. Probably an unfinished head of an ice-harpoon for sealing on the ice.

North West Greenland.

Inv. Pfaff. Stockholm Riksmuseum, Ethnographical Section.

Figs. 79 and *80.* Two toggle-harpoons without barbs, flexible round a horizontal axis, which lies in a transverse hole through the centre of their bodies. The axis is attached to the end of a loose bone shaft. The body of the heads, which are formed like a conic section with the lower part bevelled, has in the middle of the under side a deep slit, which lies in the longitudinal plane, and the innermost bottom of which opens out on the opposite side of the head. Into this slit the end of the shaft fits, while the head moves round the axis on which it rides. The holes in the lower part of the shafts (three transverse holes through the middle of one, one hole immediately above the base of the other) are intended for the line which connected these bone shafts with the longer wooden shaft of the harpoon.

Intended for sealing or salmon-spearing on the ice.

North West Greenland.

Inv. Pfaff. Stockholm Riksmuseum, Ethnographical Section.

Fig. 78.

Fig. 79.

Fig. 80.

Fig. 81.

Fig. 78—81. Bone toggles from West Greenland. 5/6.
Riksmuseum, Stockholm.

Fig. 82 a.

Fig. 82 b.

Fig. 82. **Head piece of an arrow or bird-dart. West Greenland.** $^{5}/_{7}$.

K. k. Hofmuseum, Vienna.

a *b*

Fig. 83.

a *b*

Fig. 84.

Two pairs of lateral points of bird-darts. West Greenland. $^{3}/_{5}$.

Riksmuseum, Stockholm.

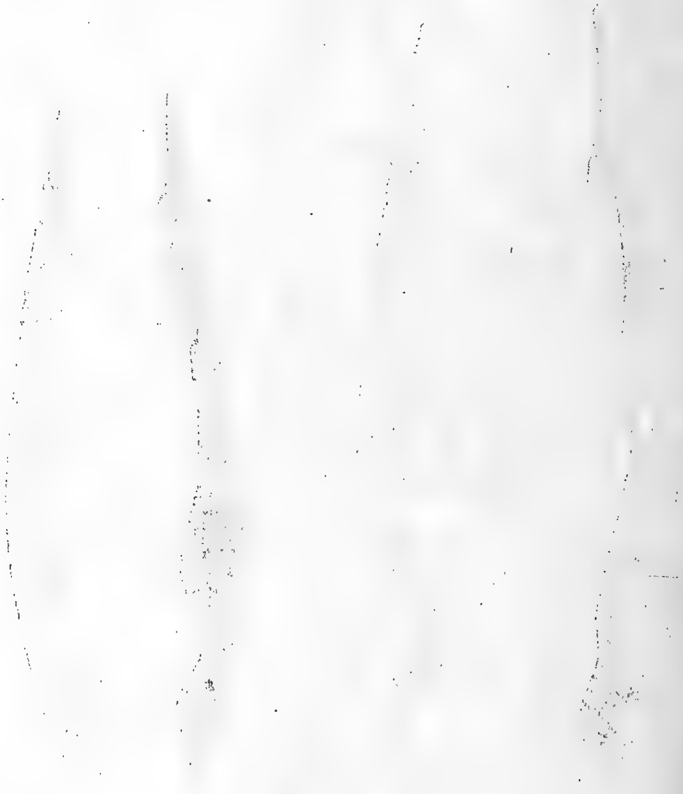

Fig. 81. A little bone-toggle of a similar type to the two previous ones, fixed on a short bone shaft with a key-hole-shaped expansion at the bottom. It can hardly have been used as a harpoon, but must have been employed for holding a seal-skin float in the kaiak. The float (bladder) has at one end a nozzle of bone; in the latter there is a loop, just large enough to allow the toggle (fig. 80), which is attached itself to the kaiak by means of strap, to be passed through it, when turned lengthwise; but, when it is drawn back in the opposite direction it turns crosswise and catches, and in this manner holds the bladder in position.

West Greenland.

Inv. Pfaff. Stockholm Riksmuseum, Ethnographic Section.

Fig. 82. Weapon head of bone, shaped like the head of an arrow or a bird-dart, with expanded head, in which there is a slit for the insertion of a blade. A single lateral barb at right angles to the blade. Cf. *inv. Amd. 17.*

West (?) Greenland.

From a little collection of Greenland stone and bone implements which in 1876 was presented to the ethnographical museum at Vienna by the late Steinhauer, Superintendent of the ethnographical museum at Copenhagen [1]).

K. k. naturhistorisches Hofmuseum, ethnographische Abteilung. (Inv. No. 4905.) Vienna.

Fig. 83 and *84.* Two pairs of lateral bone points for placing on the wooden shafts of bird-darts. They are of the ordinary Greenland type, slightly curved, with unilateral barbs on the inner side, and one or two transverse holes for lashing, and a notch in the outer edge right at the bottom for a basal lashing. — On each bird-dart shaft are fixed three bone heads of this kind, with their bases resting against the shaft, so that the projecting heads form an equilateral triangle.

The sixteen specimens of this implement which are found in Inv. Pfaff (Stockholm) from West Greenland all have unilateral

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[1]) F. Heger 17.

barbs; none of them have the little barb on the outer edge towards the middle which is characteristic of the North East Greenland type. Three of them have two holes quite close to one another in the middle where the body expands; most of them have only one hole here. In one of them the hole lies near the base. Cf. *inv. Amd. 20.*

North West Greenland.

Inv. Pfaff. Stockholm Riksmuseum.

Fig. 85. Sledge from North East Greenland, consisting of two very heavy, crudely worked runners, which are connected with six cross-pieces. It is uncertain in which order these pieces lay on the runners, to which they have only temporarily been fastened with nails. It is likewise uncertain whether the two poles which are erected at the rear of the sledge as uprights are really to be considered as such.

Along the upper part of each runner there are 11 large square holes for the rawhide lashings with which the cross-pieces were secured to them. In one of the holes in the cross-pieces a bit of a hide thong is still sticking. The broadest of the cross-pieces has a hole bored in it in the middle close to one of its side edges; this piece then probably was fixed a little behind the middle of the sledge, or right in the rear, as the said hole was intended to receive one end of the line or lines with which the baggage of the sledge is generally lashed. At the end of each cross-piece there are one or two pairs of holes, connected in pairs with grooves for the lashing. In the side of each runner, towards the front, and a little below the row of square holes, there is a large round hole for fastening the strong common cross-line of raw-hide to which the single traces for each dog are fixed.

Under the right runner there still adheres a little fragment of a bone shoe, riveted to the under side of the runner with tree-nails.

The length of the sledge is 2 m 8 cm. The height of the

Fig. 85. Sledge from North East Greenland. $^{2}/_{25}$.

Museum für Völkerkunde, Berlin.

runner 15 cm, the breadth of the runner at the under surface 5 to 7 cm. The distance between the runners is about 93 cm.

The uprights (?) are 49 cm in length.

Found in the North East Greenland by the second German North Pole Expedition (Germania) in 1870, near Cape Broer Ruys, on the north side of the mouth of Kaiser Franz Joseph's Fjord. Cf. *inv. Amd. 27.*

Museum für Völkerkunde (inv. 4 a 229), Berlin.

Fig. 86. Sledge runner and two cross-pieces from North East Greenland. The length of the runner 1 m 67 cm. Breadth 6 cm.

The length of the cross-pieces about 95 cm.

Found in North East Greenland by the Swedish Expedition under Nathorst in 1899.

Stockholm Riksmuseum.

Fig. 87 and *88.* Sledge and miniature sledge (toy) from Smith Sound.

The runners, the cross-pieces, the uprights are of wood, the keel of bone.

All joints are made by the aid of hide thongs.

The length of *the large sledge* (Fig. 88) 2 m 37 cm.

The height of the runners 18·5 cm. The distance between the runners 54 cm.

The length of the uprights 69 cm.

Museum für Völkerkunde (inv. IV a 7362), Berlin.

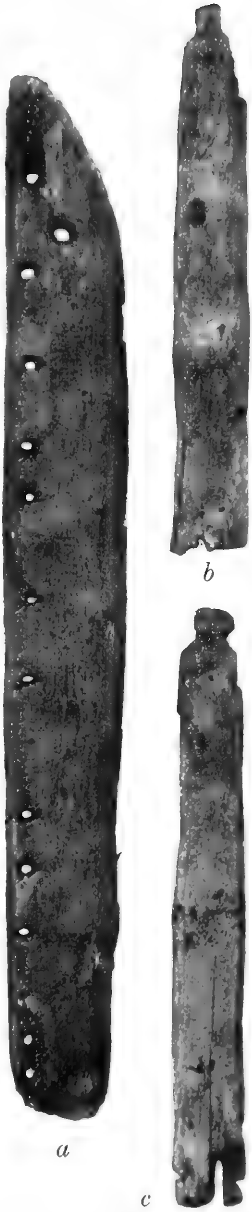

Fig. 86. Fragments of a sledge from North East Greenland. 2/25.
Stockholm Riksmuseum.

The length of *the sledge model* (Fig. 87) 42·5 cm.

The breadth (in front) 12·5 cm; (at the back) 12·8 cm. The length of the uprights 15 cm.

Museum für Völkerkunde (inv. IV a 7363), Berlin.

Fig. 89. Miniature sledge from Ammassalik, typical of the present sledges of the Ammassalik Eskimo, except for the tips of the runners, which as a rule are not bent up as in this toy sledge. The runners diverge from each other downwardly. Both their upper and their lower edges are bevelled, to allow of their lying flat against the cross-pieces of the seat and flat on the ground. The distance between them at their bottom is 6·2 cm in front, 7·7 cm at the back. The cross-pieces are lashed with hide thongs passing through a double row of holes; each cross-tree has at each end four holes. Along the upper part of each runner transverse holes have been bored to receive the lashing of the cross-pieces, two holes for each cross-piece. The corners of the cross-pieces are cut off concavely, so that the narrower end parts with which they rest on the runners are separated from each other by semi-circular notches, which form a bed for the lashings. Like the runners, the uprights also diverge from each other upwards, the distance between them being 7 cm below and 8 cm above. Their characteristic form is peculiar to the Ammassalik sledges. Each of them is lashed firmly to the runner through two holes. The left one has on the outer side three loops, attached to three pairs of holes in which various hunting weapons are stuck while sledging. In front there is a similar loop in the foremost cross-piece to the left side of the sledge, into which the other end of the long weapons (harpoon and lances) are inserted. — The cross stick between the uprights which supports them above has ornamental notches on the under side.

Length of the runners 29·2 cm. Height of the runner behind 3·9 cm (a little lower in front). Distance between the runners 6·2 cm in front, 7·7 cm behind. Breadth of the cross-

Fig. 87.

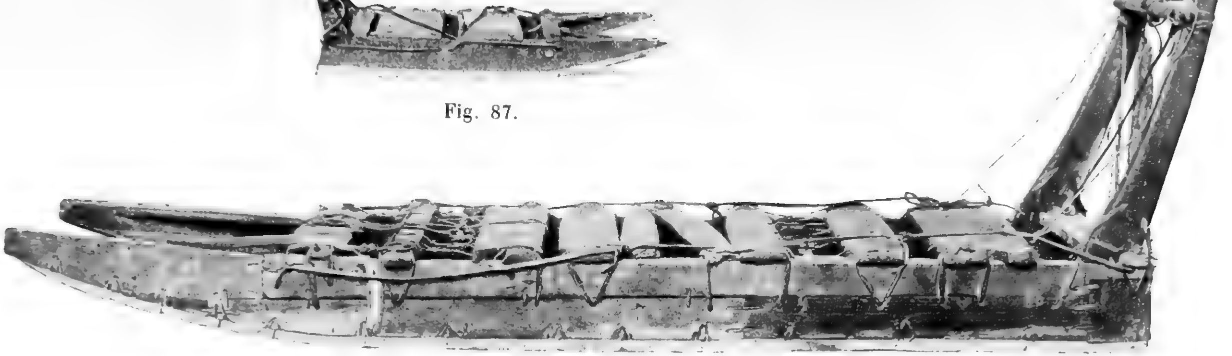

Fig. 88.

Figs. 87 and 88. Sledge ($^1/_{16}$) and model of a sledge (toy) from Cape York, Smith Sound, North West Greenland.

Museum für Völkerkunde, Berlin.

Fig. 89. Toy sledge from Ammassalik, East Greenland. 1/2.

Kgl. Grønlandske Handel, København.

Fig. 90. Sledge from King William Land, North Canadian Archipelago. 1/21.
Etnografisk Museum, Christiania.

pieces 3·5 to 4·5 cm. Breadth of the uprights at the foot 7 cm, at the top, at the broadest part of the grip, 2·2 cm (at the bottom of the curvature 1·8 cm).

The Royal Greenland Trading Department's collection from Ammassalik.

Fig. 90. Sledge from King William Land.

The front ends of the runners curve very slightly up; behind they are cut obliquely downwards. The holes through which the cross-pieces are lashed are square (2 × 2 cm). Only the two holes for the raw-hide cross-shaft in the front of the runners are circular. Most of the cross-pieces are of bone (reindeer?). The foremost cross-piece is of wood, cut in the same fashion as in the Greenland sledges. The lashing is made everywhere with the aid of leather thongs. Only the bone shoes under the runners are riveted with bone nails[1].

Length of the sledge 3·8 m. Height of the runners 22 to 23 cm, thickness of the runners 5·5 to 6 cm. Distance between the runners (in front) 45 cm. They diverge downwards.

The Ethnographical Museum at Christiania. The Gjöa collection (Amundsen).

Fig. 91. A little chest (for keeping tools, clothes etc.) from North East Greenland, found at Ostkap in Jackson Island by the second German North Pole Expedition 1870[2]. On the

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[1]) The sledges which have been discovered farthest to the North on the arctic Archipelago west of Greenland, are mentioned by Feilden in Nares: Narrative of a voyage to the Polar Sea (pag. 188). They found, near Cape Sabine on Ellesmere Island, 'remains of several ancient Eskimo encampments, as well as an old sledge made of walrus bone, with cross-bars of narwhal horn, completely lichen-covered and of such antiquity that the bones were friable, and also fragments of a stone lamp . . .'; furthermore (pag. 190): "Close to Cape Beechy, and about six or seven miles from the 82 parallel of latitude, we came across the most northern traces of man that have yet been found; these consisted of the framework of a large wooden sledge, a stone lamp in good preservation, and a very perfect snow-scraper made out of walrus tusk".

[2]) Koldewey 649. "The removal of the stones led to the discovery of several small boards with many fine holes at the edge; near them was found a well-preserved human skull, as well as several human arm and leg bones. Small leather straps (for keeping the lid closed), doing duty for a lock, were still in existence."

left of the illustration is seen a part of the lid (the rest is missing), by it one of the longer sides of the chest, next to it the bottom piece (fragment, fig. 91 c), and at the extreme right the highly weathered other side. We observe the nail-holes along the bottom edge of the side piece (b), which match exactly with corresponding holes in the edge of the bottom piece. The movable part of the lid (a) has also two single holes near the edge, which correspond to two isolated holes in the upper edge of the side; through these holes must have passed hide thongs for fastening down the lid. The end walls of the chest are missing. Wooden nails have been used for the joints.

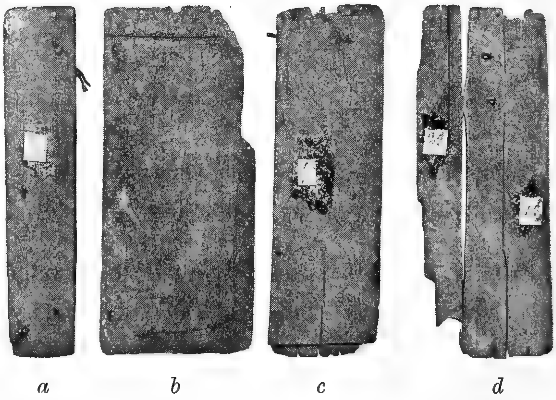


Fig. 91. Part of a wooden chest. North East Greenland. 9/47.
Museum für Völkerkunde, Berlin.

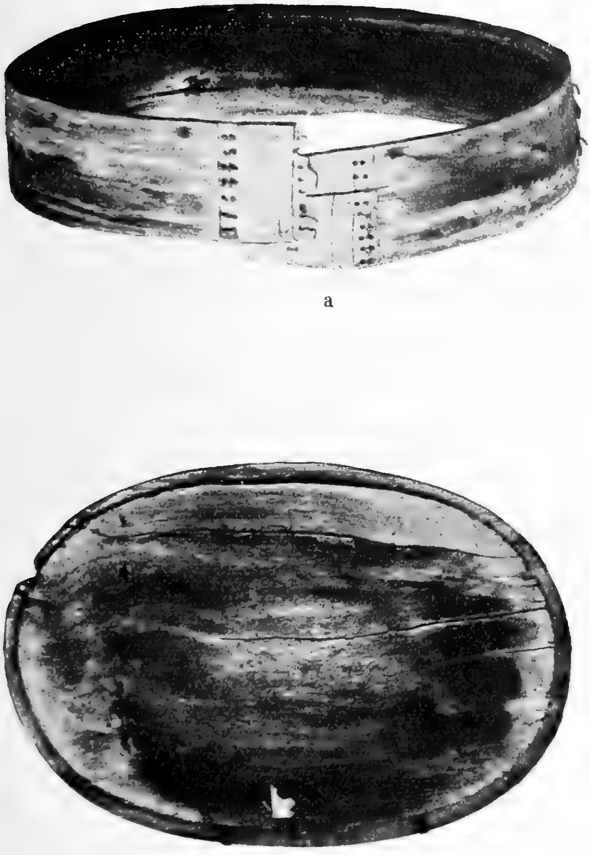
This beautifully worked chest is interesting in the first place as an evidence of the skill with which the Eskimo knew how to work the drift timber washed in from the coast; in the second place as a testimony that these northerly inhabitants of the coast used chests in their houses such as are to this very day in use at Ammassalik, under the name of *tumarqat* [1]). Finally it is worth while to observe the little remnant of a hide thong sticking in a hole in the lid; it has

[1]) Holm Pl. 24.


Fig. 92. Fig. 93.

Two bodkins of bone. West Greenland. 5/8.

Fig. 94. Bone handle of a woman's knife. West Greenland. 5/8.
Riksmuseum, Stockholm.



a

b

Fig. 95. Wooden dish (*pertaq*). West Greenland. 4/10.

Museum für Völkerkunde, Berlin.

been prevented from slipping through the hole by a knot at one end; this knot is made in the true Eskimo fashion by a slit having been cut at the end of the line and the end then doubled back through the slit[1]).

Length of the bottom piece 23·5 cm. Its breadth 7.1 to 7.4 cm (fragment). Height of the side 10 cm[2]).

Museum für Völkerkunde. Berlin.

Figs. 92 and *93.* Two bodkins, or pins for the "ring and pin" game, made of bone. Both have a human face carved out in the thick head. A little further down there are four or five annular cuttings. Cf. *inv. Amd. 33—44.*

Length about 14·5 cm. North West Greenland.

Inv. Pfaff. Stockholm Riksmuseum.

Fig 94. Bone haft of a woman's knife, made of a block of bone, all in one piece. At the bottom of the thin legs holes have been bored to receive the lashing for the stone blade (missing). Cf. *inv. Amd. 45.*

Length of the handle (horizontal measurement) 7 cm; length of the legs 8·5 cm. North West Greenland.

Inv. Pfaff. Stockholm Riksmuseum.

Fig. 95. Wooden dish of the same type as the ordinary whalebone dishes (*pertaq*), consisting of an elliptical bottom bordered with a flange, and a thin strip of wood bent in a corresponding form. The two overlapping ends of the strip have been connected with the aid of two double rows of wooden nails. The bottom has no holes perforated in it, but in the shoulder above the elliptical flange on which the strip which forms the sides of the dish reposes, there are nine holes for the nails which secured the strip to the bottom piece. Cf. *inv. Amd. 53.*

The size of the bottom: 14·4 cm to 18·4 cm. The height of the side: 4 to 4·5 cm.

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[1]) Cf. description in Mason III, 206.

[2]) The measurements given in Koldewey p. 648 are based on a misconception of the way in which the parts found fitted together.

Found in a grave in the island of Umanaitsiaq in the Umanak (Oommannaq) fjord. North West Greenland.

Inv. E. v. Drygalsky. Museum für Völkerkunde (regist. IV. A. 7069 a). Berlin.

Figs. 96 and *97.* Two needle-cases of bone, particularly remarkable for their ornamentation, a border of incised lines running along the curved edges on both sides. In the larger specimen the small cross-lines are placed in the interval between two parallel lines and disposed in two rows vis-à-vis each other, each standing on its own line so that the intervals between them produce a raised zigzag line; in the smaller specimen they are arranged unilaterally on a single line. Cf. *inv. Amd. 61* and *87.*

Size: length 6·5 cm (fig. 96), 10·4 cm (fig. 97).

Fig. 96 from Karsok, Ek. (= Ikamiut?) } North West
Fig. 97 from Iginiarfik south of Egedesminde } Greenland.

Inv. Pfaff. Stockholm Riksmuseum.

Figs. 98 and *99.* Two swivels of bone for preventing the strings or the tether from getting out of order or tangled. Fig. 98, which is a double-swivel, is particularly interesting on account of its ornamentation.

Size: 6 cm (fig. 98) and 3·5 cm (fig. 99). North West Greenland.

Inv. Pfaff. Stockholm Riksmuseum.

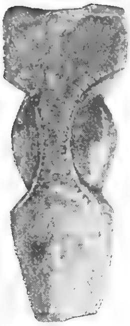
Figs. 100, *101* and *102.* Three bone heads of adzes from West Greenland representing three types, with slits at the bottom ends for stone blades and with different arrangements for fastening onto the wooden hafts. Cf. *inv. Amd. 76.*

Size: 14·5 cm (fig. 100), 14 cm (fig. 101) and 15 cm (fig. 102) in length respectively.

North West Greenland.

Inv. Pfaff. Stockholm Riksmuseum.

Fig. 103. Curious implement of wood from North East Greenland, with a head at one end like the head of an arrow and a handle like that of a throwing-stick at the other end (a finger-rest at the edge).



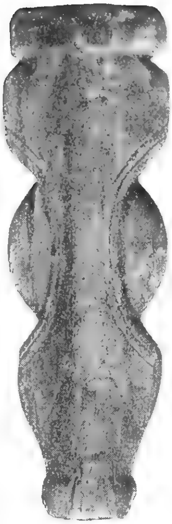


Fig. 96. Fig. 97.

Two ornamented needle cases. North West Greenland. $^3/_5$.

a. b.

Fig. 98.

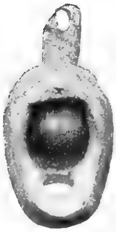


Fig. 99.

Fig. 98. Ornamented swivel. — Fig. 99. Ordinary swivel.
North West Greenland. $^5/_6$.

Riksmuseum, Stockholm.

Fig. 100.

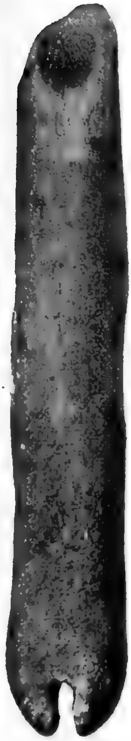


Fig. 101.

Fig. 102.

Three head-pieces of adzes made of bone. North West Greenland. 3/5.

Riksmuseum, Stockholm.

Fig. 103. Fig. 104. Fig. 105.

Museum für Völkerkunde, Berlin. Riksmuseum, Stockholm.

Wooden implements of an unknown type. North East Greenland. 1/3.

Found by the second German North Pole Expedition (Germania) in 1870.

Museum für Völkerkunde (regist IV. A. 198). Berlin.

Fig. 104 is the same kind of implement as the foregoing, likewise from North East Greenland. The use to which these implements were put is unkown. Cf. *inv. Amd 99.*

Length 39 cm.

Inv. Nathorst (Hammar). Stockholm Riksmuseum.

Fig. 105 is an implement of wood, from the same district, which has a similar handle to the two others, while the other end is formed like a mallet. The natural bend or knee of the branch has been turned to account in carving this implement, which is quite unique. The hammering surface of the mallet has deep scars, as if it had been used against something sharp. The handle is narrowest in the middle; in cross section it is circular in front (nearest the head), triangular in the middle, while at the back it flattens out and assumes the form of the handle of a throwing-stick.

Mallets or mauls of bone or wood are spoken of as common among the western Eskimo[1], being used in the preparation of food, or as implements for hammering in wooden nails etc. In the Gjøa collection at Christiania there are several implements of this kind (of horn or bone) which have been used to beat train-oil out of (frozen?) blubber. One of them has a handle with three finger-rests. The West Greenland designation for an instrument of this kind is *kauarsit* (< *kauarpaa* 'beats frozen blubber, to get train-oil from it, when it thaws'). Cf. *inv. Amd. 99* and *72.*

Length, 30 cm. North East Greenland.

Inv. Nathorst (Hammar). Stockholm Riksmuseum.

Fig. 106. There belong to the Amdrup collection some few fragments of bone and wood implements which were discovered in some of the places mentioned in the foregoing

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[1]) Nelson 79; Murdoch 98 (Figs. 31, 32 etc.); Bogoras 188.

pages, north of 68° lat. N., but which were not immediately docketed with the name of the place where they were found. None of them are of any ethnological importance (fragments of sledge keels, split reindeer horns, or other bones, sticks or nondescript parts of wooden implements).

The polar bear figured here, which is carved in wood and is 15 cm in length, is interesting for a trait which is yet another testimony to the continuity between North East Greenland and the Ammassalik district. This trait is the manner in which the legs of the bear are made; the upper parts of the fore legs are carved so as to form two square projections; in the centre of the flatly cut under side there is an aperture in which a thin cylindrical tree-nail has been inserted to a considerable depth, so that a part of it projects thus forming the lower thin part of the animals leg. Similar tree-nails have been stuck in the thigh portions of the hind legs. The body of the bear must thus have rested on four cylindrical pegs, of which, however, only the stumps are seen in the holes. It thus comes to resemble the so-called *angakok* bear from Ammassalik described by G. Holm[1]), a toy which has hitherto been found only in one single specimen. The resemblance, however, is not great enough to warrant us in definitely pronouncing this object to be an *angakok* bear; but the similar manner in which, — at two different places in East Greenland, and doubtless also at different times (Amdrup's bear is highly weathered) — artificial legs have been inserted in a polar bear in order to adapt it better for use as a toy by children, can hardly have been a more coincidence.

Fig. 106. *Inv. Amd. 121.* Polar bear carved in wood. North East Greenland. 1/3.

[1]) Holm, Pl. XXVI.

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[1]) An English translation of Holm's book together with a new illustration of the ethnologic material collected at Angmagsalik is in preparation.

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I wish to thank the following men of science who by so obligingly placing their expert knowledge at my disposal aided me to determine the material of several of the objects found: Dr. phil. *K. I. V. Steenstrup*, at the Mineralogical and Geological Museum (the stone implements), Prof., Dr. phil. *O. G. Petersen*, at the Kongelige Landbohøjskole (several of the wooden implements) and the inspector of the Zoological Museum *H. Winge* (several of the bone implements).

Finally, I desire to express my thanks to the directors of the ethnological museums in which I have studied the ethnology of the Eskimo, for the ready complaisance I have everywhere met with, and for the special facilities which have been accorded to me, to obtain access to the objects I desired to study.

I have mentioned the museums I visited, in the Preface (pag. 335).

8. List of the objects in the Amdrup collection discovered north of the district of Ammassalik.

Objects from Skærgaardshalvø (68° 07′ lat. N., 31° 34′ long. W.)

Objects from Dunholm (69° 54′ lat. N., 22° 38′ long. W.)

Objects from Cape Tobin (70° 24′ lat. N., 21° 59′ long. W.)

Objects from Cape Borlase Warren (74° 18′ lat. N.)

Objects from Sabine Island (74° 45′ lat. N.)

XV. Bidrag til Vest-Grønlands Flora og Vegetation af **N. Hartz** og **L. Kolderup Rosenvinge.** Mosser fra Øst-Grønland af **C. Jensen.** Diatoméer af **E. Østrup.** Forekomst af Cohenit i tellurisk Jern ved Jakobshavn af Dr. **E. Cohen.** Med 2 Tavler. 1898. Kr. 8.

XVI. Undersøgelser i Julianehaabs Distrikt 1893 og 1894. Skjærgaardsopmaaling, Undersøgelse af Indlandsis og Bræer, Misvisning m. m. ved **V. Garde, C. Moltke** og **A. Jessen.** Arkæologiske Undersøgelser af **D. Bruun, F. Petersen** og **V. Boye.** Med 20 Tavler. 1896. Kr. 10.

XVII—XIX. Den østgrønlandske Expedition i Aarene 1891—92 (Scoresby-Sund) ved **C. Ryder, H. Vedel, N. Hartz, E. Bay, H. Deichmann, C. Christiansen, Willaume-Jantzen, Rørdam, S. Hansen, Børgesen, Rostrup, Deichmann Branth, Østrup, Posselt, Lundbeck, H. Hansen, Wesenberg-Lund** og **Lundgren.** Med 40 Tavler. 1895—96. Kr. 25.

XX. Grønlands Alger, Flora og Vegetation af **L. Kolderup Rosenvinge.** Om Steenstrupin af **Joh. Chr. Moberg.** Grønlands gamle Topografi af **Finnur Jónsson.** Brade Ransons Forde af **Frode Petersen.** Med 3 Tavler. 1899. Kr. 6.

XXI, *1ste Afdeling:* Grønlands Fugle af **Herluf Winge.** 1899. Kr. 4,50.
2den Afdeling: Grønlands Pattedyr af **Herluf Winge.** 1902. Kr. 3.

XXII. Under Udarbejdelse.

XXIII, *1ste Afdeling:* Grønlands Brachiopoder og Bløddyr af **Henr. J. Posselt** udgivet efter Forfatterens Død ved Ad. S. Jensen. Med 2 Tavler. 1899. Kr. 4,50.

XXIV. Undersøgelser af Mineraler fra Julianehaab af **G. Flink, N. B. Bøggild** og **Chr. Winther** med indledende Bemærkninger af **N. V. Ussing.** Untersuchungen an den eisenführenden Gesteine der Insel Disko von Dr. **Th. Nicolau.** Beretning om en Undersøgelsesrejse til Øen Disko 1898 af **K. J. V. Steenstrup.** Med 20 Tavler og et særskilt heftet Farvetryk. 1901. Kr. 6,50.

XXV. Om Bestemmelse af Lysstyrke og Lysmængde af **K. J. V. Steenstrup.** Fra en Vaccinationsrejse til Kap Farvel af **G. Meldorf.** On Ilvaite from Siorarsuit by **O. B. Bøggild.** Skildring af Vegetationen paa Disko af **M. Pedersen Porsild.** Med 6 Tavler. 1902. Kr. 6.

XXVI. Undersøgelser og Opmaalinger ved Jakobshavns Isfjord af **M. C. Engell** og **H. Schjørring.** On some Minerals from the Nephelite-Syenite at Julianehaab by **O. B. Bøggild.** Planktonprøver fra Nord-Atlanterhavet (c. 58°—60° N. Br.) af **C. H. Ostenfeld** og **Ove Paulsen.** Tuberkulosens Udbredelse i Grønland af **Gustav Meldorf.** Eskimoernes Indvandring i Grønland af **Schultz-Lorentzen.** On the Tension of Carbonic Acid in Natural Waters; the abnormal CO_2-Percentage in the Air in Greenland, etc., by **August Krogh.** Descriptions de quelques espéces nouvelles de Bryacées de l'île de Disko par **I. Hagen** et **Morten P. Porsild.** Notes on some rare or dubious Danish Greenland plants by **Herman G. Simmons.** Med 15 Tavler. 1904. Kr. 8.

XXVII. Carlsbergfondets Expedition til Øst-Grønland i Aarene 1898—1900, ved **G. Amdrup, N. Hartz, J. P. Koch, Willaume-Jantzen** og **H. Ravn.** Med 8 Tavler. 1902. Kr. 10.

XXVIII, *1ste Afdeling:* Notes on some specimens of rocks collected by C. Kruuse on the East coast of Greenland between lat. 65° 35′ and 67° 22′ N. by Dr. **Otto Nordenskjöld.** Samples of the sea-floor along the coast of East Greenland 74½—70 N. L. by **O. B. Bøggild.** Med 9 Tavler. 1904. Kr. 2,50.
2den Afdeling: The minerals from the Basalt of East-Greenland by **O. B. Bøggild.** Contributions to the Anthropology and Nosology of the East-Greenlanders by **Knud Poulsen.** On the Geology and Physical Geography

of East-Greenland by **Otto Nordenskjöld.** The former Eskimo settlements on the East coast of Greenland between Scoresby Sund and the Angmagsalik District by **G. Amdrup.** Ethnological description of the Amdrup collection from East-Greenland comprising objects found in Eskimo house-ruins and graves north of Angmagsalik between 68° and 75° lat. N. by **W. Thalbitzer.** Med 7 Tavler og 1 Kort. 1909. Kr. 7.25.

XXIX. *1ste Afdeling:* Mammals observed on Amdrup's journeys to East-Greenland 1898—1900 by **Søren Jensen.** Echinoderms from East-Greenland by **Th. Mortensen.** The Tertiary Fauna at Kap Dalton in East-Greenland by **J. P. J. Ravn.** Birds of East-Greenland by **H. Deichmann.** On Jurassic Fossils from East-Greenland by **Victor Madsen.** The Fishes of East-Greenland by **Ad. S. Jensen.** Weitere Beiträge zur Fauna des Jura von Nordost-Groenland von Prof. Dr. **E. Fraas** in Stuttgart. Med 13 Tavler og 1 Kort. 1904. Kr. 5.50.

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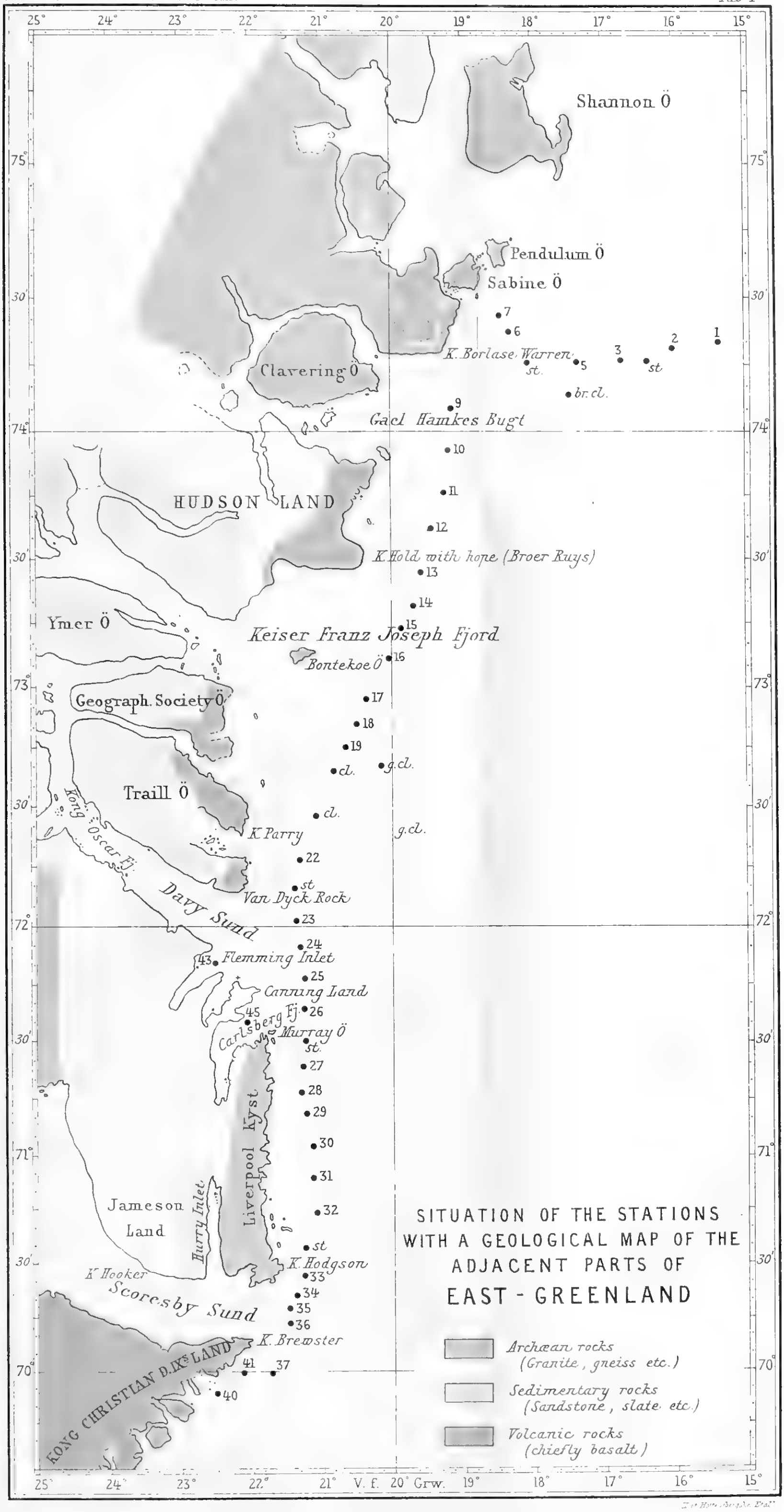
XXX. *1ste Afdeling:* Botanical exploration of the East-Coast of Greenland between 65° 35′—74° 30′ lat. N. By **Chr. Kruuse.** The Marine Algæ of East-Greenland. By **Helgi Jónsson.** The Freshwater Algæ of East-Greenland. By **E. Larsen.** Fungi Groenlandiæ orientalis in expeditionibus G. Amdrup 1898—1902. Determ. **E. Rostrup.** Lichenes expeditionis G. Amdrup (1898—1902). Enumeravit **Edv. A. Wainio.** List of the phanerogams and vascular cryptogams found on the coast 75°—66° 20′ lat. N. of East-Greenland. By **Chr. Kruuse.** List of Phanerogams and Vascular Cryptogams found in the Angmagsalik-District on the East-coast of Greenland between 65° 30′ and 66° 20′ lat. N. By **Chr. Kruuse.** Species nova Marsupellae, muscorum generis. Auctore **C. Jensen.** List of the Hepaticae and Sphagnales found in East-Greenland between 75° and 65° 35′ lat. N. in the years 1898—1902. By **C. Jensen.** 1907. Kr. 4.

XXXI. A phonetical study of the Eskimo Language based on observations made on a journey in North-Greenland 1900—1901 by **William Thalbitzer.** Med 4 Tavler. 1904. Kr. 8.

XXXII. Mineralogia Groenlandica af **O. B. Bøggild.** Med 1 Kort. 1905. Kr. 10.

XXXIII. Kan Tagranden benyttes til Bestemmelse af Forandringer i Vandstanden? Af **K. J. V. Steenstrup.** Contributions to the Study of the Eskimo language in Greenland. By **Poul Vibæk.** A List of Flowerings Plants from Cape York and Melville-Bay (NW.-Greenland), collected by the Rev. Knud Balle and Mr. L. Mylius-Erichsen in 1903—05, determined by **C. H. Ostenfeld.** De i Grønland brugte Fuglenavne og deres Betydning. Af **A. Bertelsen.** On some minerals from Narsarsuk at Julianehaab, Greenland. By **O. B. Böggild.** Om Grønlands Areal. Beregninger, udførte paa det af Kommissionen i 1906 udgivne Kaart i Maalestokken 1:2000000. Af **H. Prytz.** Epidemiske Sygdomme i Grønland: Influenza og epidemiske katarrhalske Affektioner af Luftvejs-Slimhinderne. Ved **Gustav Meldorf.** Ferskvandsalger fra Vest-Grønland. Af **E. Larsen.** Med 8 Tavler. 1907. Kr. 8.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SITUATION OF THE STATIONS WITH A GEOLOGICAL MAP OF THE ADJACENT PARTS OF
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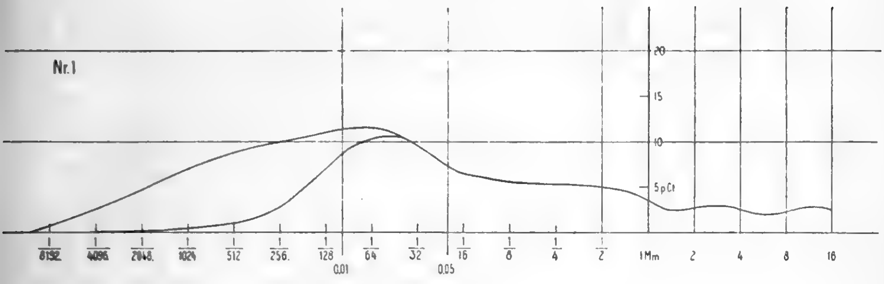

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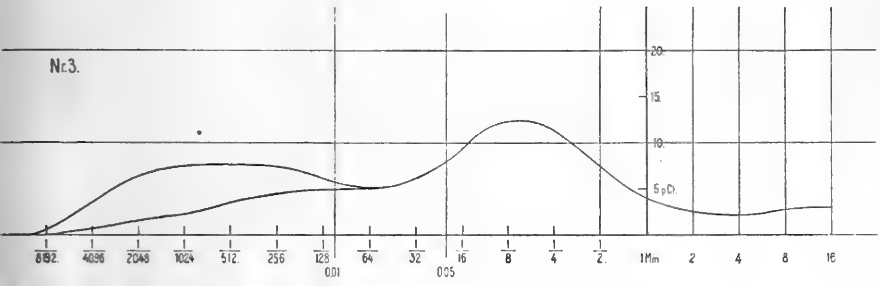

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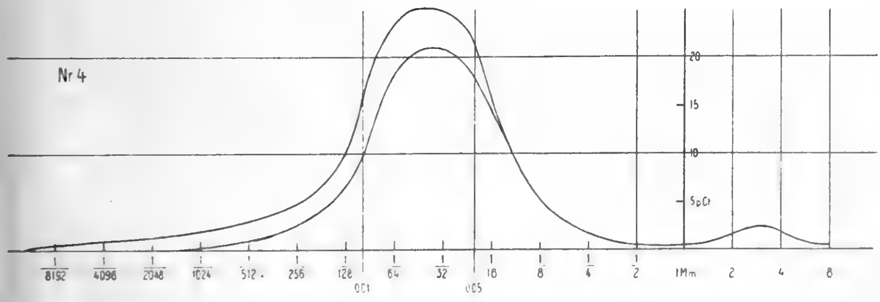

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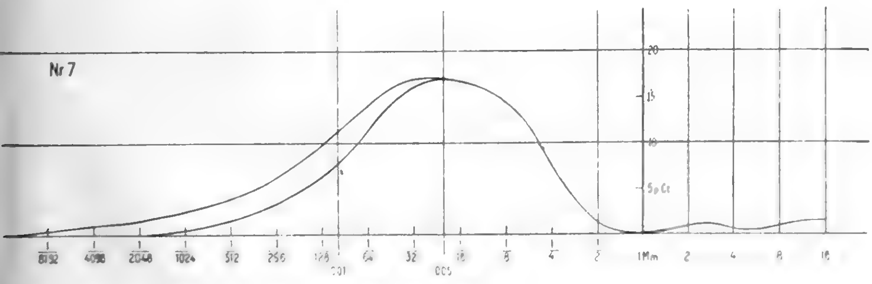

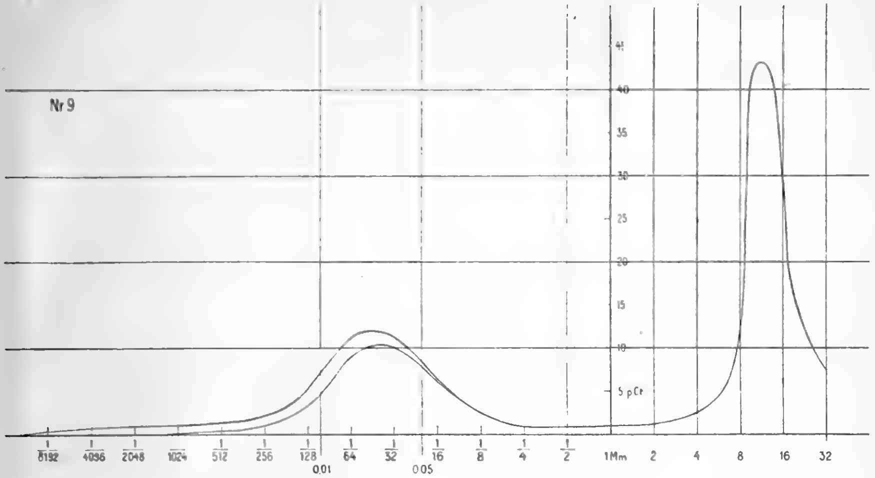
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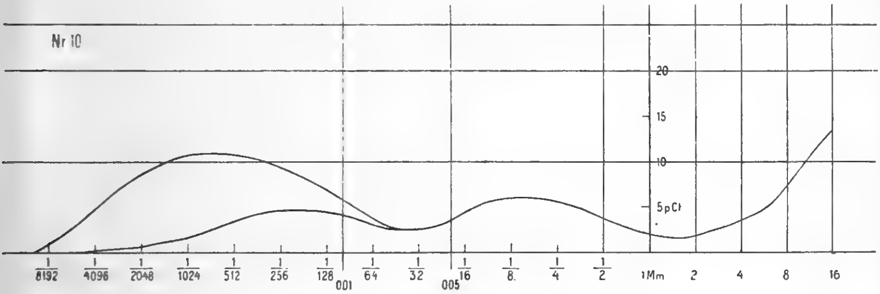
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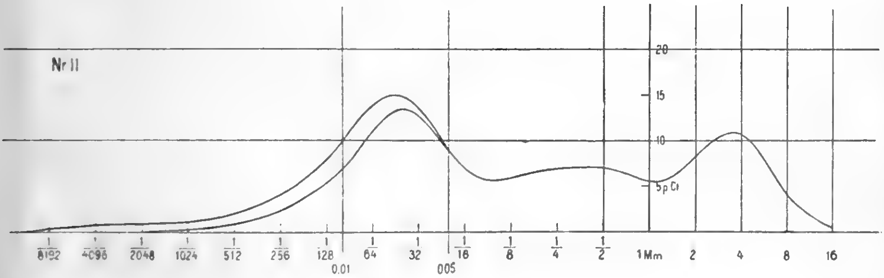
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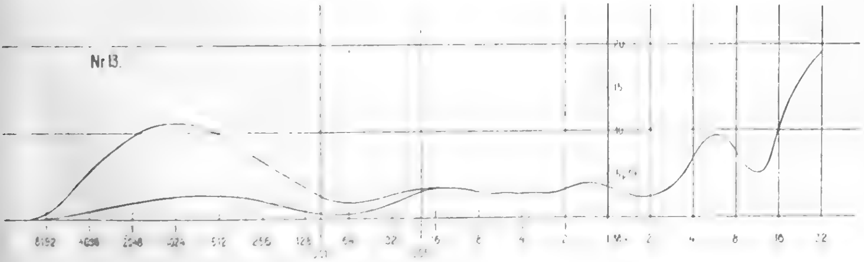
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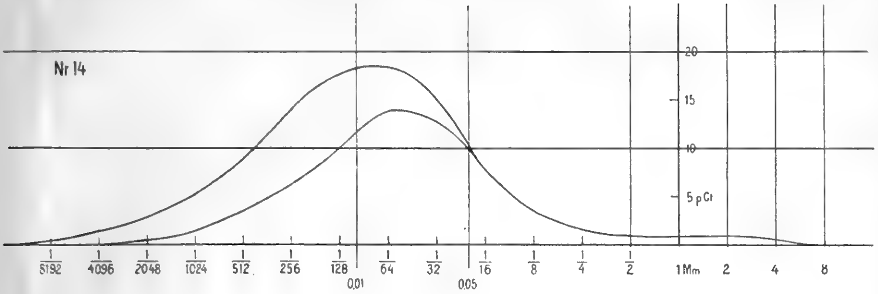
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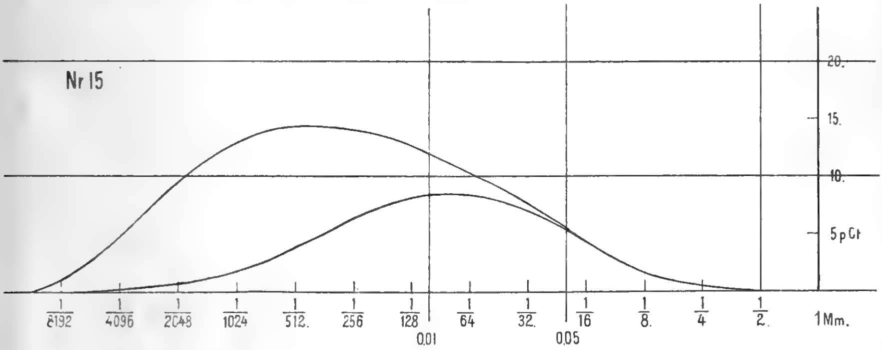
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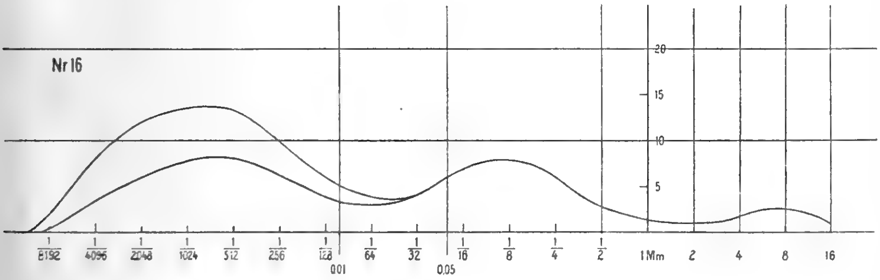
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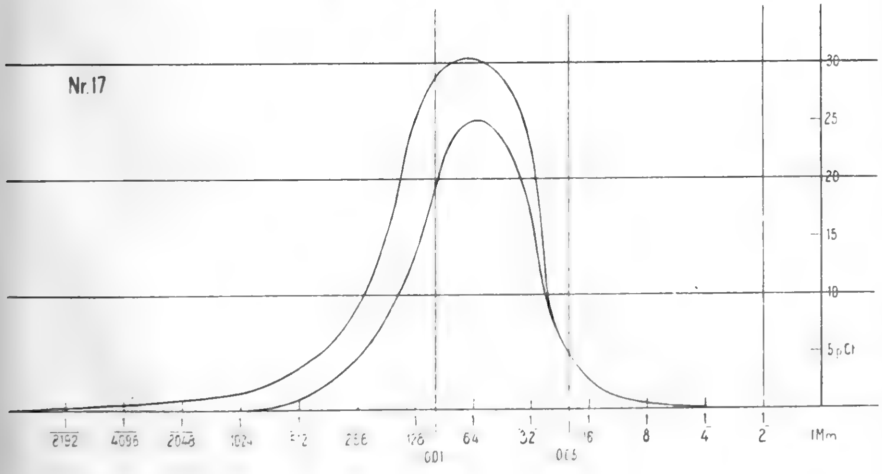
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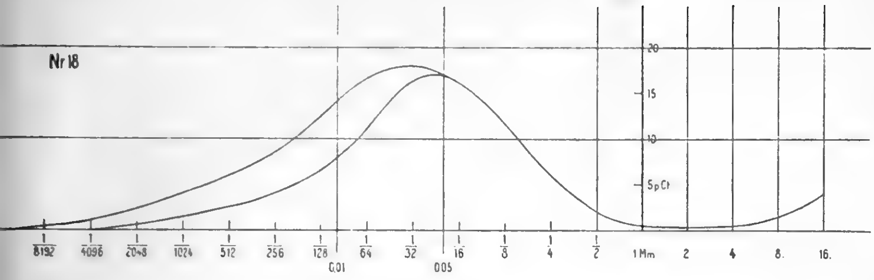
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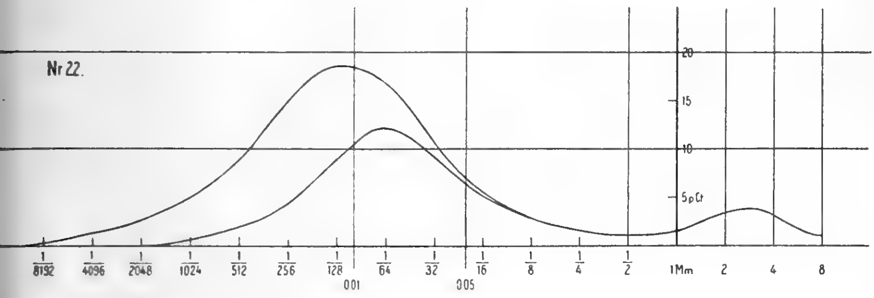
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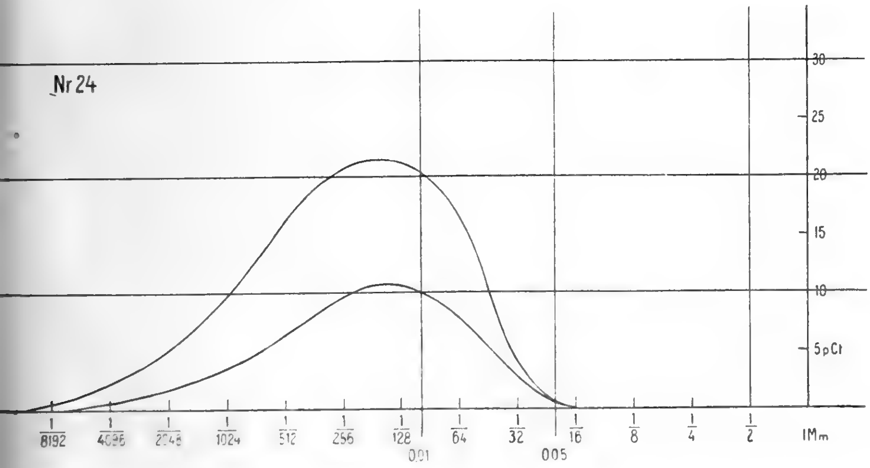
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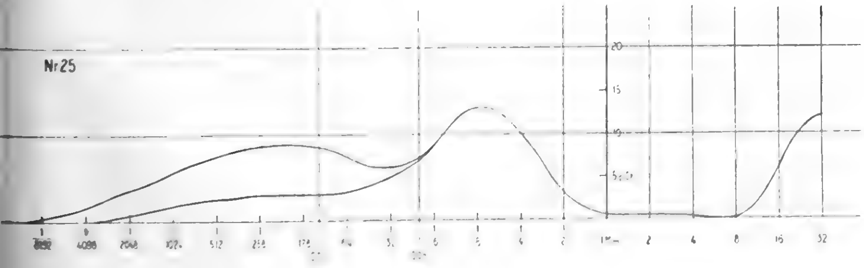
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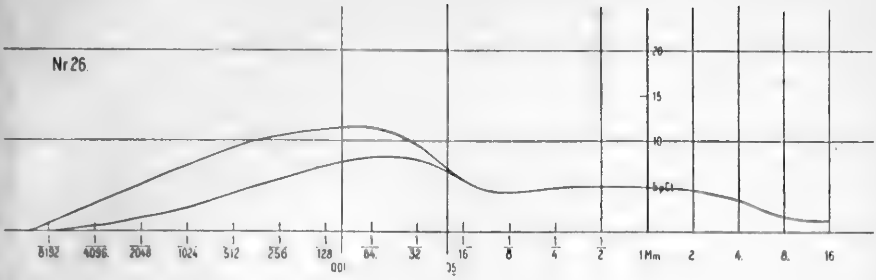
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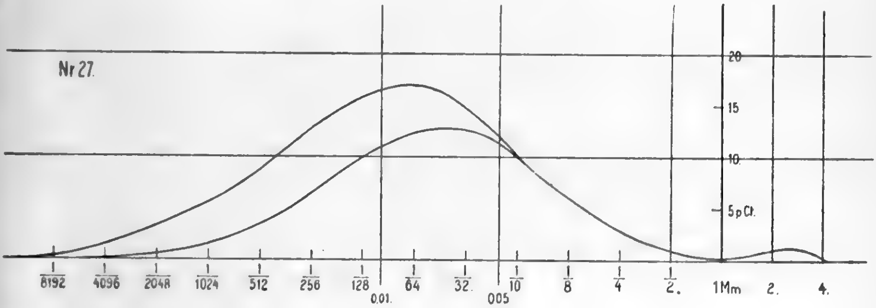
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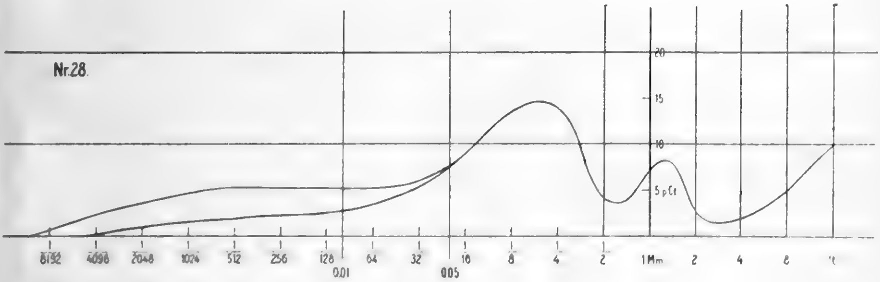
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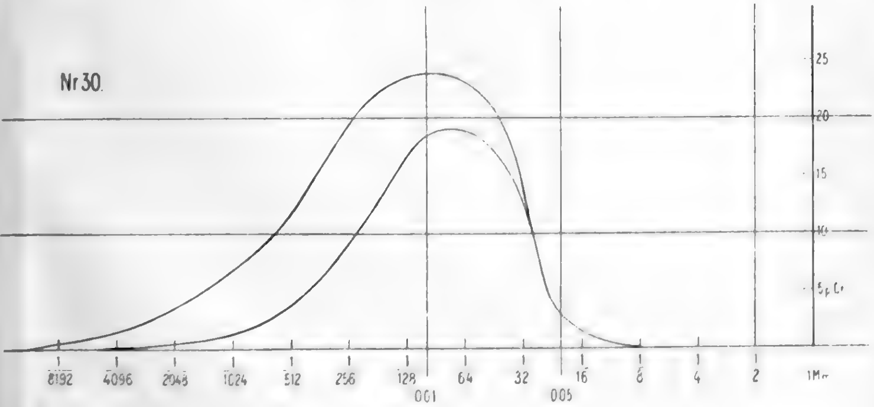
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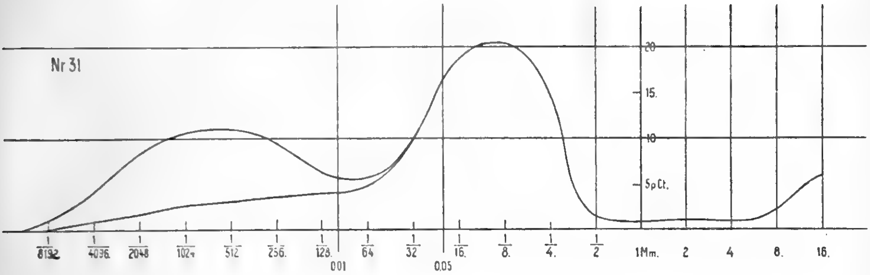
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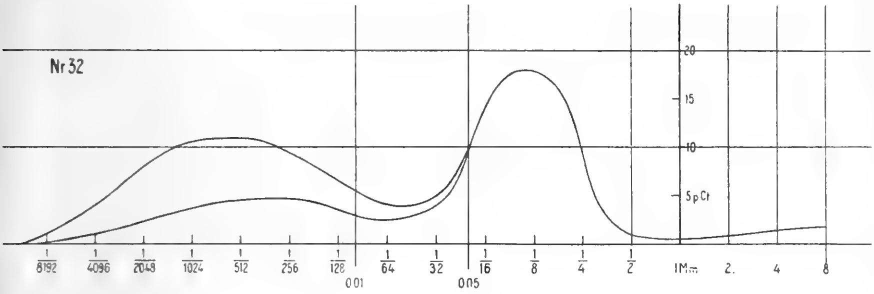
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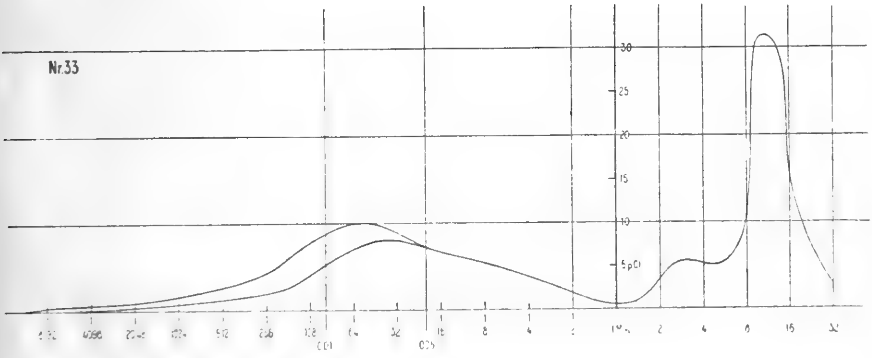
1 Mm 2. 4 8
0.01
0.05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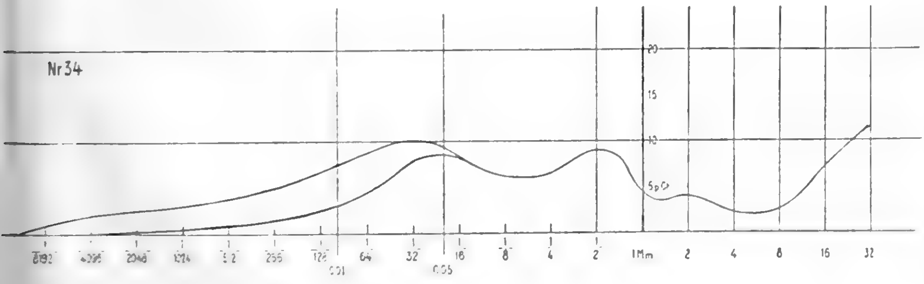
30
25
20
15
10
5 p Ct
1 Mm 2 4 8 16 32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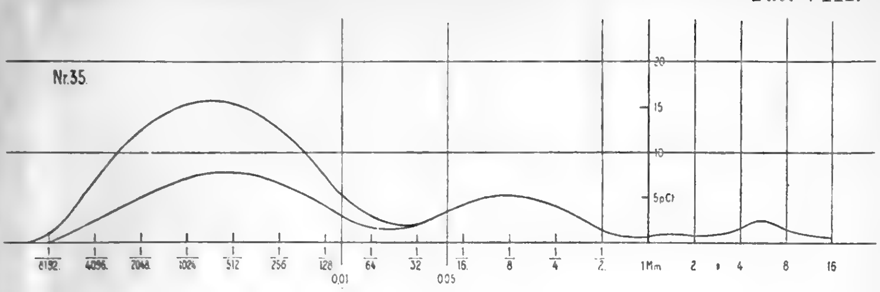
20
15
10
5 p Ct
1 Mm 2 4 8 16 32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15
10
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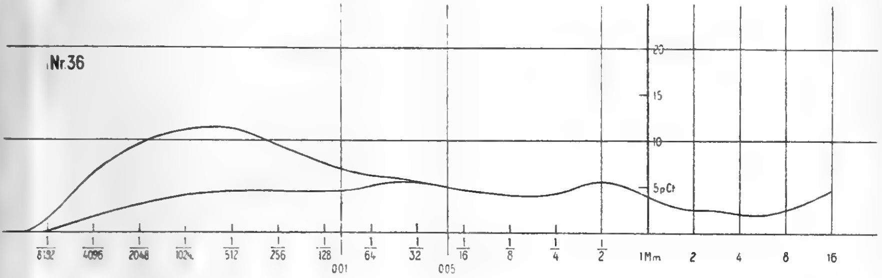
1/2048
1/1024
1/512
1/256
1/128
1/64
1/32
1/16
1/8
1/4
1/2
1Mm
2
4
8
16
0.01
0.05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15
10
5pCt
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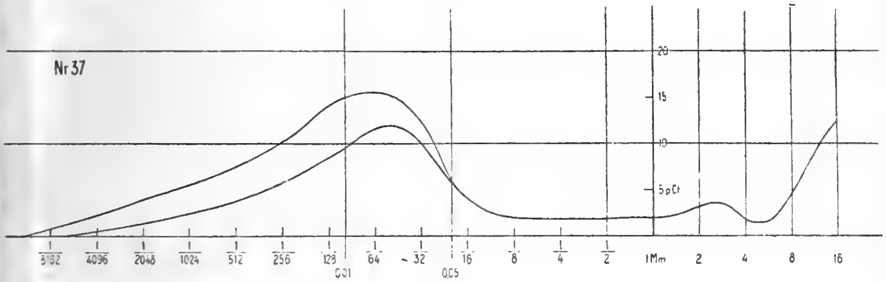
1/4096
1/2048
1/1024
1/512
1/256
1/128
1/64
1/32
1/16
1/8
1/4
1/2
1Mm
2
4
8
16
0.01
0.05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10
5pCt
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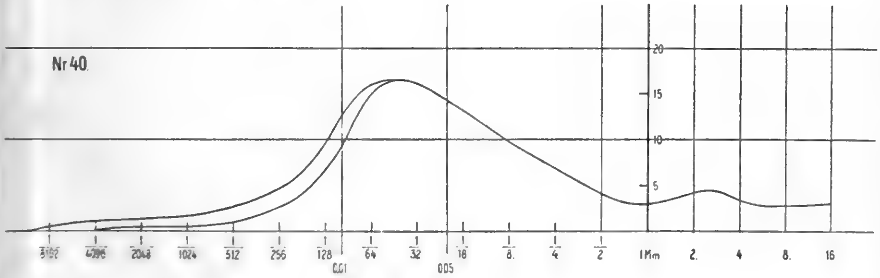
1/2048
1/1024
1/512
1/256
1/128
1/64
1/32
1/16
1/8
1/4
1/2
1Mm
2
4
8
16
0.01
0.05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15
10
5
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1/4096
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1/1024
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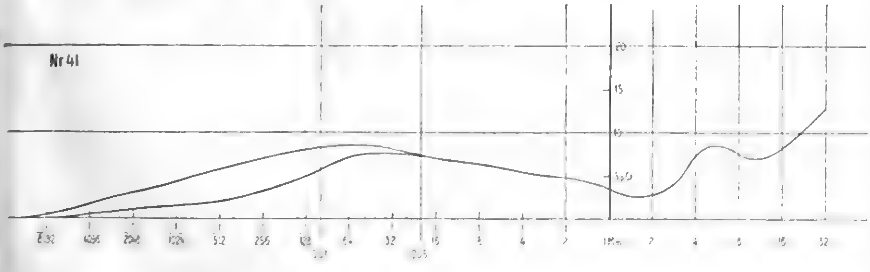
1/64
1/32
1/16
1/8
1/4
1/2
1Mm
2
4
8
16
0.01
0.05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10
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1Mm
2
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8
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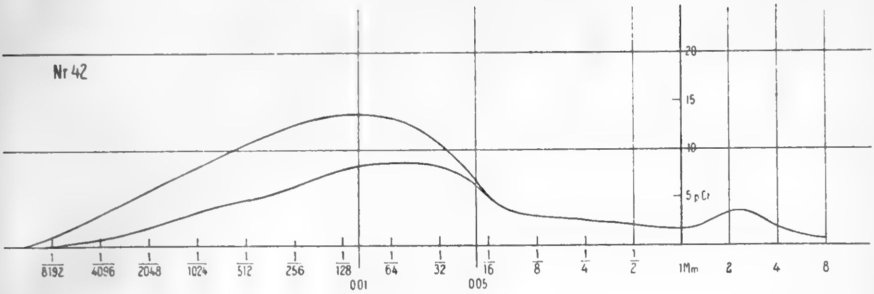
32
0.05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15
10
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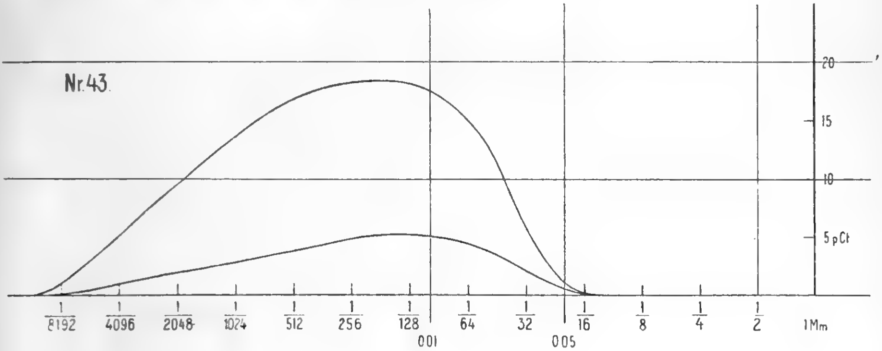
1/8192 1/4096 1/2048 1/1024 1/512 1/256 1/128 1/64 1/32 1/16 1/8 1/4 1/2 1 Mm 2 4 8
0 01
0 05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15
10
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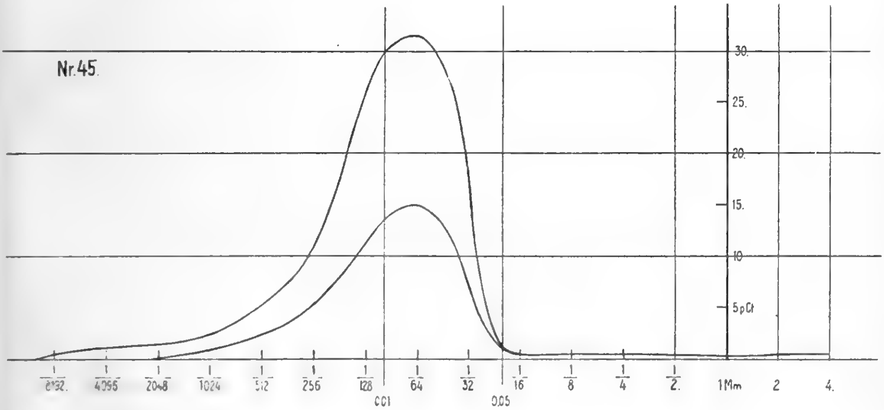
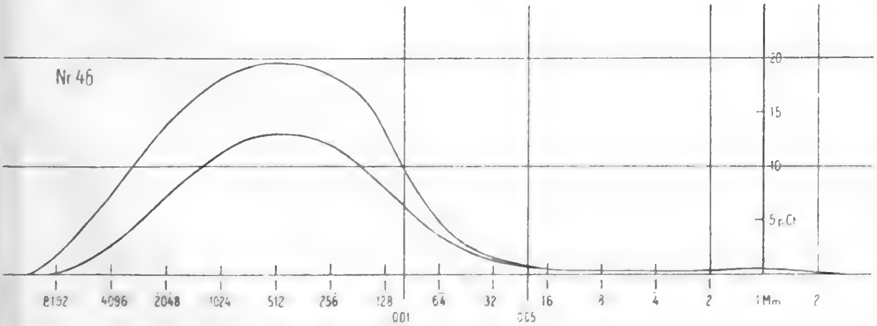
0 01
0 05


Nr. 45.
30.
25.
20.
15.
10
5 p Ct
1/8192. 1/4096 1/2048 1/1024 1/512 1/256 1/128 1/64 1/32 1/16 1/8 1/4 1/2. 1 Mm 2 4.
0 01
0 05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20
15
10
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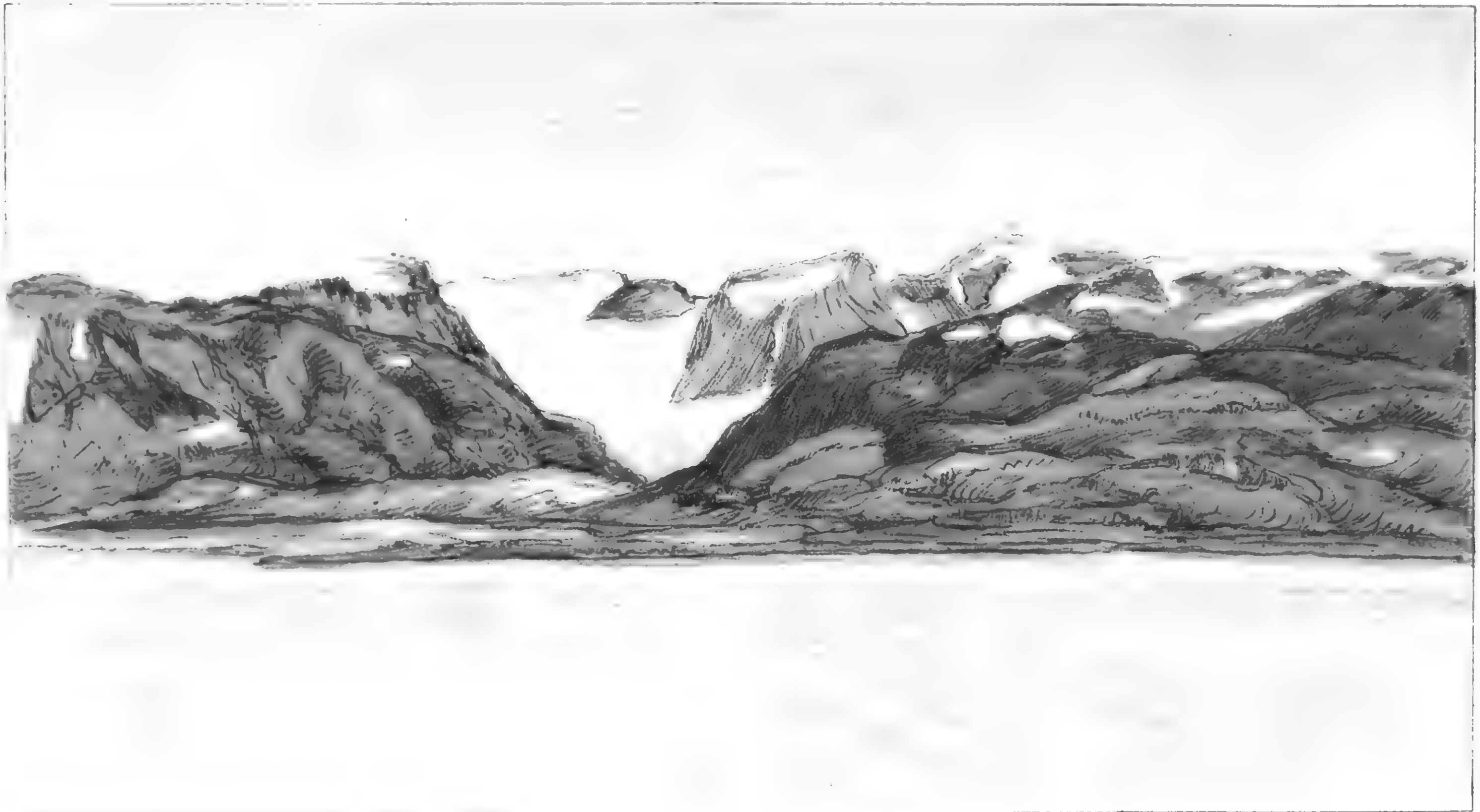
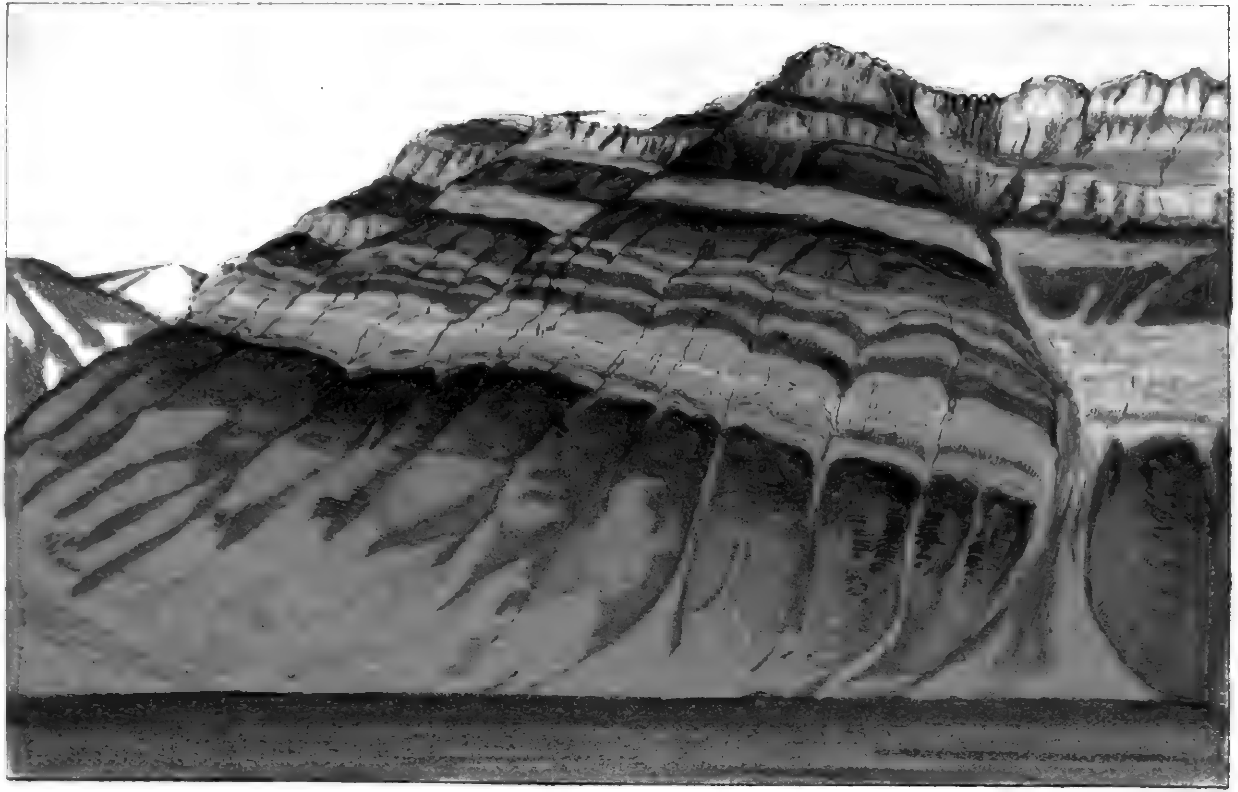
1/8192 1/4096 1/2048 1/1024 1/512 1/256 1/128 1/64 1/32 1/16 1/8 1/4 1/2 1 Mm 2
0 01
0 05

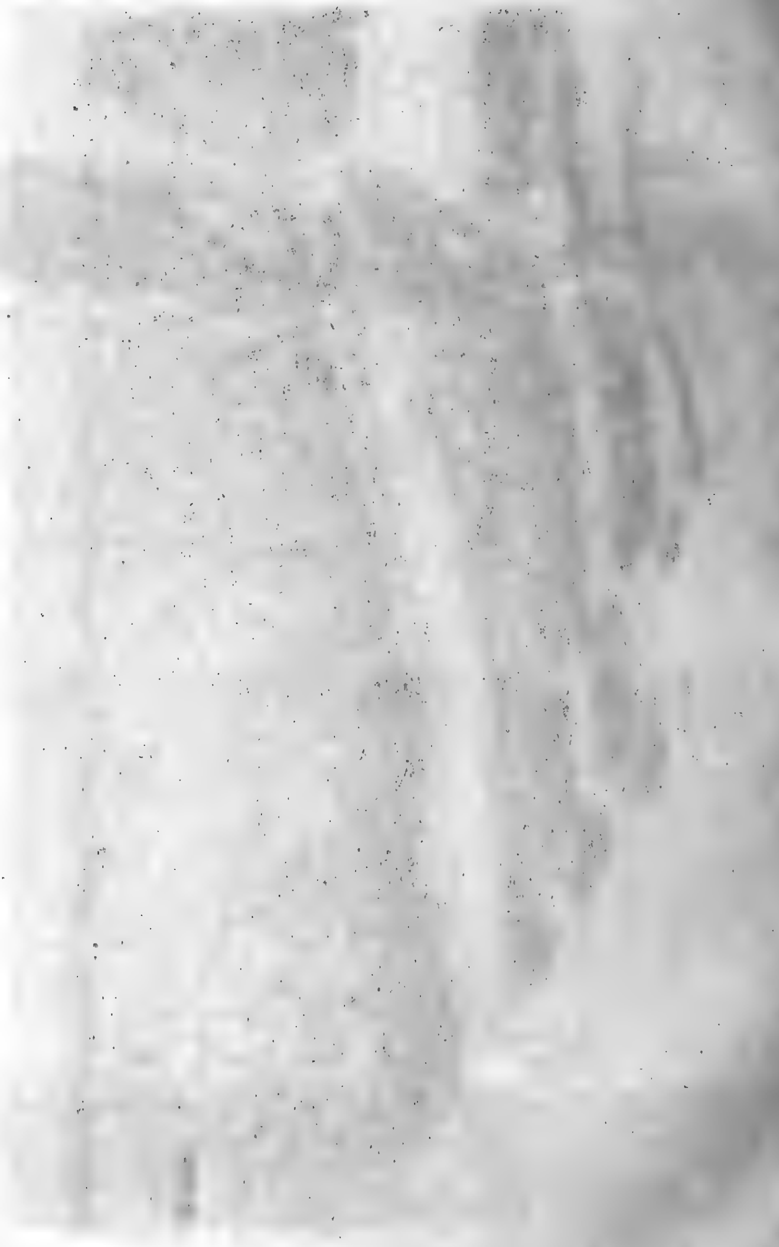


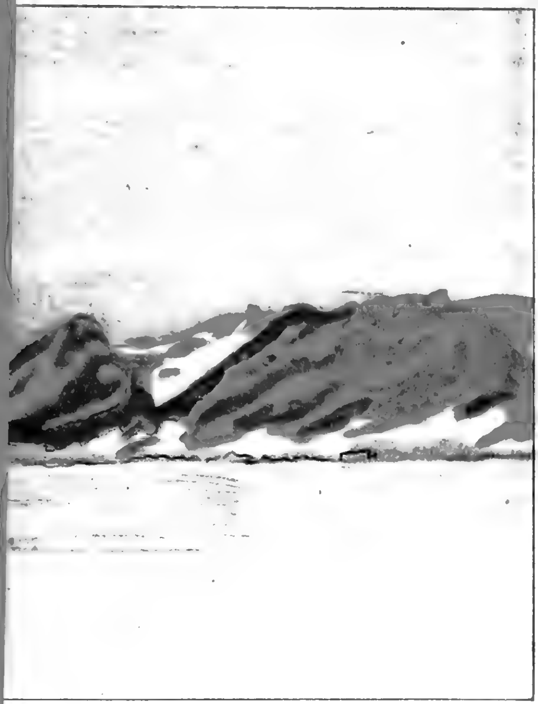
West coast of Liverpool Land seen from Fame I.

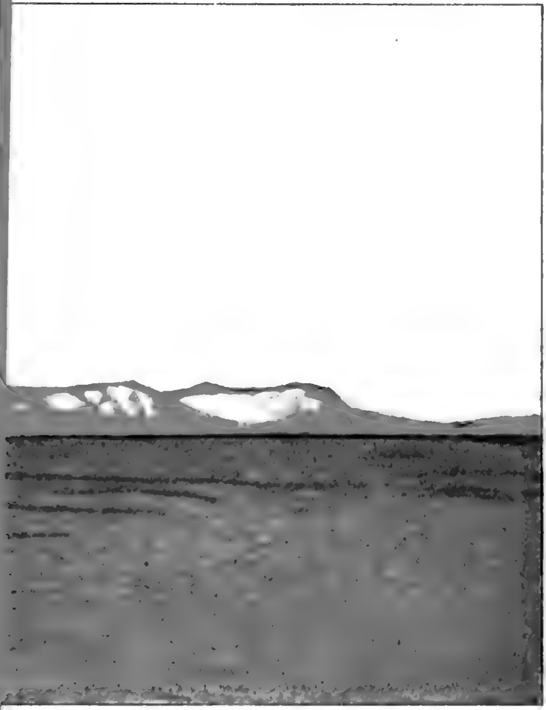
(From a painting by *E. Ditlevsen,* 10 : 8 : 1900).



Berzelius Mountain, on the N. Side of Segelsällskapets Fj. (Silurian rocks).
(From a painting by *E. Ditlevsen*).







Irregular, partly morainic hills, forming the surface of a low foreland, on the Hurry Inlet side of Liverpool Land. In the back Fame I. and Jameson Land. (C. Kruuse phot. 9: 8: 1900.)

"Neill's Cliffs", the steep cliffs of the eastern shore of Jameson Land. In the light sandstone are seen two horizontal, injected basalt banks, crossing over each other to the left in the figure. (C. Kruuse phot. 12: 8: 1900.)

Plate XV.

Harpoon Heads from North East Greenland.

(*Inv. Amd. 1* to *10*, see pp. 345—360).

Place where discovered:

Nos. 1—3. Cape Tobin.
„ 4—10. Skærgaardshalvö.

Materials:

Nos. 1, 2, 4 and 5 entirely bone.
No. 3 bone with inserted iron blade.
„ 6 bone with inserted bone blade.
Nos. 7 and 10 bone with groove for the insertion of a blade (lost).
No. 8 a detached bone-blade.
„ 9 fragment of a harpoon head of bone.

Length:

No.	1	9·6 cm.	
„	2	8·7 „	
„	3	7·2 „	(the body 5·8 cm).
„	4	7·6 „	
„	5	10·4 „	
„	6	9·9 „	(the body 8·1 cm).
„	7	7·8 „	
„	8	4·2 „	
„	9	5·2 „	
„	10	7·3 „	

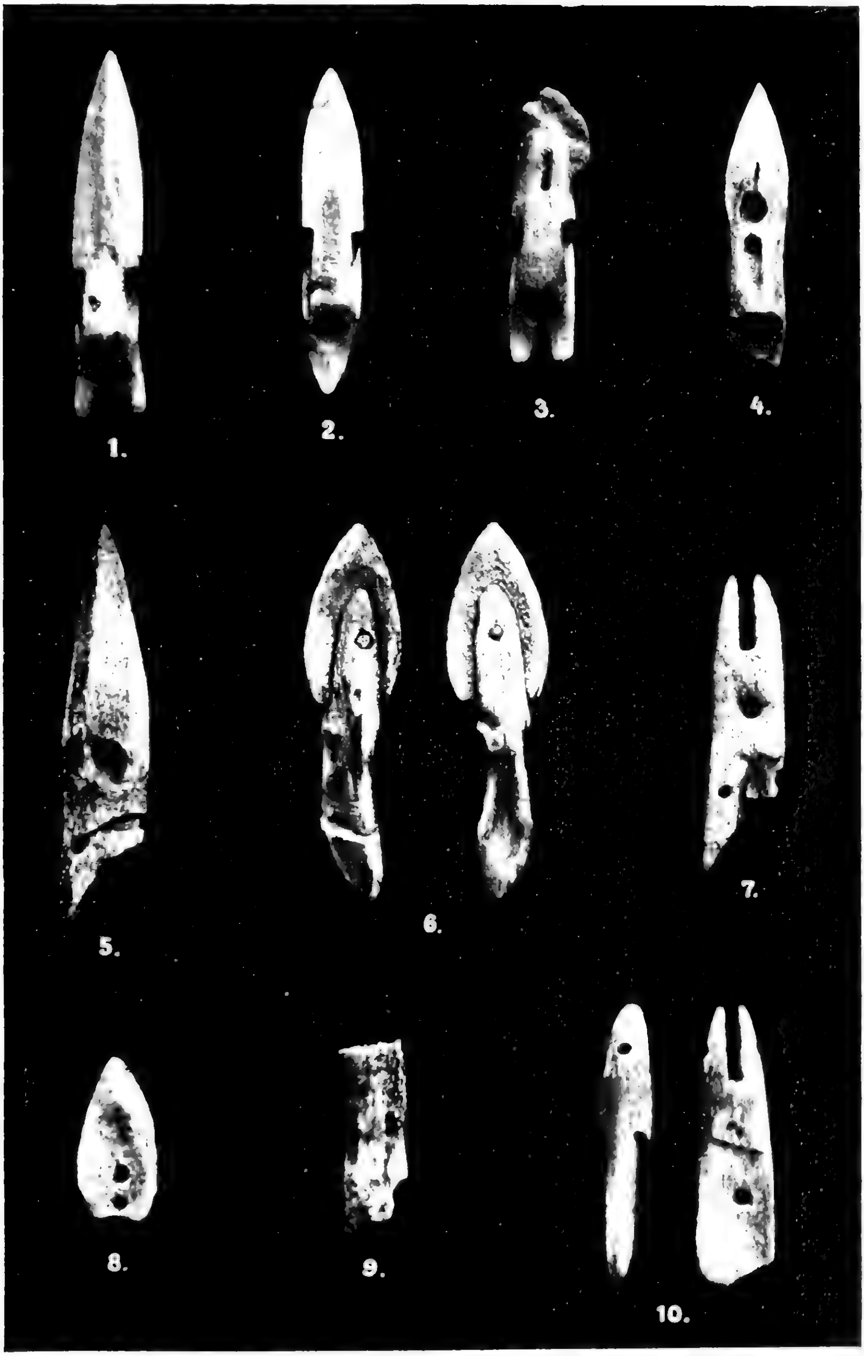

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Plate XVI.

Longer Weapon Heads from North East Greenland.

(*Inv. Amd. 11* to *17*, see pp. 359—376).

Place where discovered:

No. 11 Skærgaardshalvö.
Nos. 12, 13, 14 and 15 Dunholm.

Material: bone.

Length:

No.	11	33·5 cm.
„	12	31 „
„	13	35 „
Nos.	14 and 15	15 to 16 cm.
No.	17	21·5 cm.

17 14—15 13 12 11

Dansk Repr. Anstalt fot.

Date Due