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DE DANSKE PEARY LAND EKSPEDITIONER
LEADER: EIGIL KNUTH

SURVEYING AND MAPPING IN SOUTHERN PEARY LAND, NORTH GREENLAND

WITH AN APPENDIX:

SOME OBSERVATIONS ON THE HYDROLOGY OF THE JØRGEN BRØNLUND FJORD DISTRICT

BY

THORKILD HØY

WITH 17 FIGURES AND 3 TABLES IN THE TEXT, AND 4 PLATES

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BIANCO LUNOS BOGTRYKKERI A/S
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Abstract

The present paper is first of all of a cartographical character, as the text must be viewed in close connexion with the maps appended and forms the background of the procurement of these under expeditionary conditions as regards the field work. Furthermore, the text is to form the basis of an evaluation of the accuracy and completeness of the graphical information offered by the maps. Finally the work should be viewed as an attempt at improving and sharpening the sense of the map as a scientific implement and at providing an exacter foundation of it as an implement.

Results of a hydrological character are communicated: accumulation/ablation measurements on Chr. Erichsens Iskappe made partly on staffs, partly through levellings made in 1949, 1950, and 1963, and—in an appendix—measurements of run-off in the Kedelkrogelv. The connexion of the run-off with the temperature of the air and the relative independence of the precipitation of the individual years are demonstrated.

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INTRODUCTION AND ACKNOWLEDGMENTS

The present writer in 1949–1950 wintered in Peary Land as a member of the Danish Peary Land Expedition. The duration of my stay was from July 28, 1949, to August 12, 1950. I visited the area again during the period of May 17–August 21, 1963, as a member of the Second Peary Land Expedition. I am highly indebted to Count EIGIL KNUTH, the leader of both expeditions, for the active interest in my work displayed by him. Furthermore, I want to express my indebtedness to the other members of the two expeditions for their good fellowship and helpfulness. In the relevant passages in the text help of special importance for the work has been mentioned. Especially I want to express my thanks to K. ELLITSGAARD-RASMUSSEN, with whom I shared a room for a year, for his friendship and helpfulness.

As regards the principal map Plate 4 I am indebted to the staff of the Geodetic Institute for their services and for good collaboration. Among them I should in this place especially mention the chiefs of the Topographical Department, Colonel J. V. HELK, and his successor, Colonel T. WENZEL-PETERSEN.

I remenber with gratitude guidance and discussions concerning the hydrological measurements with the late Professor J. M. LYSHEDE, Ph. D., who departed too early.

As to comments on the manuscript I am much obliged to Count EIGIL KNUTH and Professor N. KINGO JACOBSEN, Ph. D.

A grant from the Danish State Research Foundation enabled me to have some assistance for calculations and for the making of working drawings.

Copenhagen, December 1967. TH. HØY

I. INTRODUCTORY REMARKS ON THE HISTORICAL CARTOGRAPHY OF THE JØRGEN BRØNLUND FJORD DISTRICT

In his work "Survey of North Greenland", LAUGE KOCH (1940) gave an account of *i. a.* the history of the discovery of Southern Peary Land. As an appendix to the work and inserted in a special portfolio he reproduced a number of the maps which the various expeditions have published, through which the development of the mapping of the country was excellently demonstrated.

When the Danish Peary Land Expedition started its work in the field, it had at its disposal some sheets of LAUGE KOCH's atlas of North Greenland on the 1:300,000 scale. These maps were based on surveys and sketches made by LAUGE KOCH during the Second Thule Expedition in 1917 and the Bicentenary Jubilee Expedition in 1920–23. Furthermore, a map entitled "Physiographical Map of Peary-Land" (on the scale of 1:750,000 at 82° lat. N.) published as Appendix No. 13 of the above-mentioned "Survey of North Greenland". As far as the interior of the country is concerned, the map is based on sketches and photos taken by LAUGE KOCH during two flights from Svalbard (Spitsbergen) by the hydroplane "Perssuak" in 1938. Cartography and printing were performed by the cartographical firm of KÜMMERLY & FREY of Berne. The main features of the topography and hydrography of Peary Land were pictured for the first time on this map. KOCH at the naming of a number of the rivers used the names of Danish historic monasteries and episcopal residences. Examples: the Børglum Elv, the Esrum Elv, the Vitskøl Elv, and the Tvilum Elv.

In May 1947 the whole of Peary Land was covered by oblique photography carried out from American aeroplanes. This was unknown to the Danish Peary Land Expedition, so this invaluable material did not fall into our hands until after we had returned home. By means of these pictures the mapping could be improved enormously, but as no measurements had been made on the ground, it proved necessary at the plotting to rely on LAUGE KOCH's map and the position-fixings which it contained. Before the era of the radio an exact determination

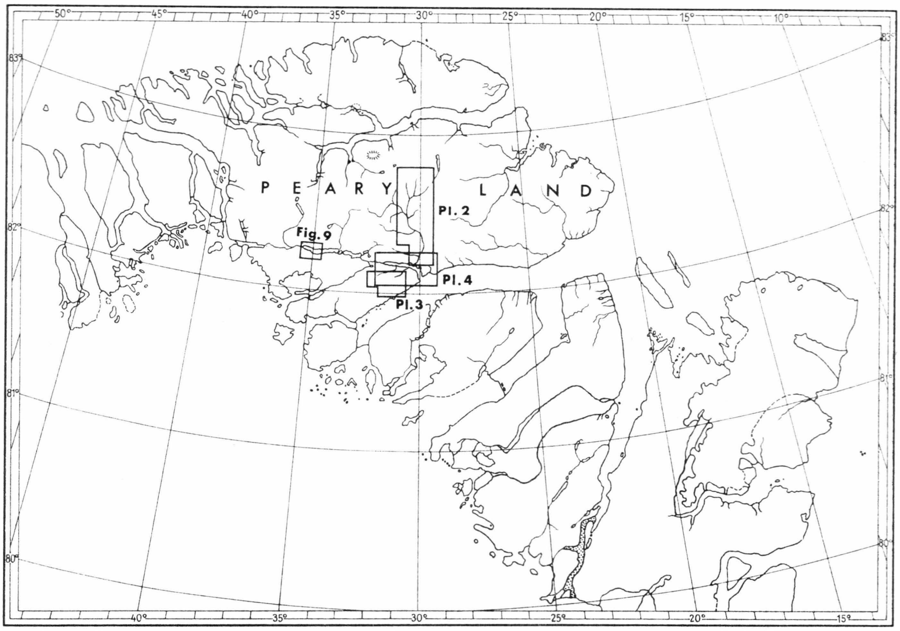

Fig. 1. Map of Peary Land and the areas southeast of it, North Greenland. The framed areas refer to large-scale maps in the text or on plates.

of the longitude offered great problems. On sledge expeditions, on which it was only possible to bring along pocket chronometers, the accuracy must necessarily be modest. According to Lauge Koch's map the longitude of the spot on which *Brønlundhus*, the wintering quarters of the Peary Land Expedition, later came to be situated, was 31°35′W. As taken from the World Aeronautical Chart on the scale of 1:1,000,000, Sheet 8, Robeson Channel, and Sheet 9, Independence Fjord, the longitude is about 31°50′W. According to a determination made by the present writer in July 1950, the geographical coordinates of the place are 30°29′7 long. W. and 82°10′3 lat. N.

The map sheets mentioned and several others of Northern Greenland were published in April 1950 by the Aeronautical Chart Service, U.S. Air Force, Washington, D.C., and for the first time give a detailed picture of the country. Conditions of height are illustrated by means of a range of colours. These maps are based on monochrome plottings on the scale of 1:250,000 from 1948.

In 1952 four monochrome map sheets covering the Jørgen Brønlund Fjord area on the scale of about 1:20,000 were published by the Army Map Service, Washington D.C. As neither horizontal nor vertical reference points were available, the 20 feet contours sketched in should rather be considered form-lines. As mentioned above, the photos were taken in May, at which time the river beds were still dry and frequently veiled by snow, for which reason the indication of the streams is somewhat incomplete.

In 1957 the U.S. Army Map Service published a new series of maps C501 on the scale of 1:250,000. The central part of Peary Land, including Jørgen Brønlund Fjord, is found on the map sheet "Jørgen Brønlunds Fjord". It includes the area between 82° and 83° lat. N., 27° and 36° long. W. The representation is based on the above-mentioned somewhat older maps, and on material from the Peary Land Expedition, especially the preliminary map of the Jørgen Brønlund Fjord on the scale of 1:50,000. Thus the positioning of this area has become correct and some spot heights have been indicated, just as a number of names have been added. The statements of height are now metric, with contours (in brown) for every 200 m, and supplementary spot heights. Coastlines are blue, thus also hydrography and symbols of glaciers. Water-covered areas are indicated by a blue screen tint. The nomenclature is in black or blue. As compared with the present writer's determinations the indications of height are somewhere between 50 and 150 metres too low in the southern part of the map sheet with an apparently slightly increasing tendency towards the north. Nordkronen (on the map named Wistars Bjerg) is indicated to be 1737 m, but in all probability is close to 2000 m high (Lauge Koch has 1950 m). My barometric measurings of altitudes made on top of the highest ice domes in the large ice field east of the Balder Gletscher support this view. On the other hand the lake Øvre Midsommer Sø is shown to be situated above the 200 m contour, whereas checked paulin readings showed the altitude of the water level to be about 90 m. It appears from what precedes, that the indications of height on at any rate the map sheet mentioned must be used with some caution. Apart from this, the map is with its adjoining sheets by far the best map of Peary Land.

In the summers of 1950 and 51 the Danish Geodetic Institute made photo flights over the country and covered it by oblique photography.

Again in the summers of 1960 and 1961 Peary Land was systematically covered by high-altitude vertical aerial photos (on the scale of about 1:60,000) by the Geodetic Institute. Some photo mosaics have been made, but so far no maps, as the ground control is still missing.

II. SURVEYING DURING THE FIRST AND THE SECOND PEARY LAND EXPEDITIONS

The present writer on taking up his duties as a member of the First Peary Land Expedition was i.a. set the task of carrying out some mapping. As mentioned above, the best map available was LAUGE KOCH's map on the scale of 1:300,000, a work which represented a great step forward for its time and which, as being one man's work, was admirable, but which was on too small a scale to be an adequate aid at more detailed investigations.

1. Triangulation

Because of the very limited time that would be at my disposal the work of mapping had to be limited to the fiord and the areas nearest to it. By stretching a triangulation net over the fiord itself it would be possible to obtain a reduction of the reconnaissance work, as in this way it would generally be possible to obtain two or three free sights. There would only be difficulties about the sights to the neighbouring points on the same side of the fiord. It was intended to connect this simple chain of triangles with well-defined objects in the terrain in the hinterland by intersections, *e.g.* points on Buen, Frysefjeld, and Pyramideplateau.

The final appearance of the triangulation net after supplementations in 1963 is seen on Plate 1.

The triangulation points were marked in the field with small cairns built round 2–4 m high canes provided with flags cut from an orange-coloured parachute (fig. 3). The first of these cairns was built in August 1949, when it was still possible to move about by means of a small motor boat.

South of the fiord meltwater deposits have been formed as comparatively even terracelike expanses terminated by steep cliffs towards the coast. The rivers have broken up these expanses into a number of peninsulas, indeed, in a few cases the aquatic erosion has been capable of modelling some almost detached, flat-topped hills, even though the running water is only active for a couple of months of each year.

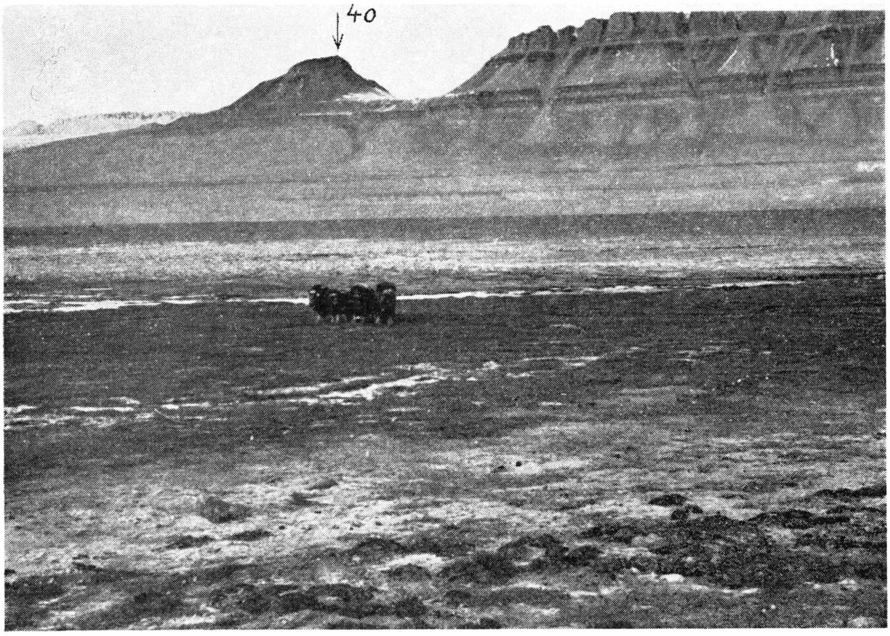

Fig. 2. One of the intersected points (No. 40), the highest point of Bueknoppen as seen from Oksesletten south of the fiord. T. H. phot. September 1, 1949.

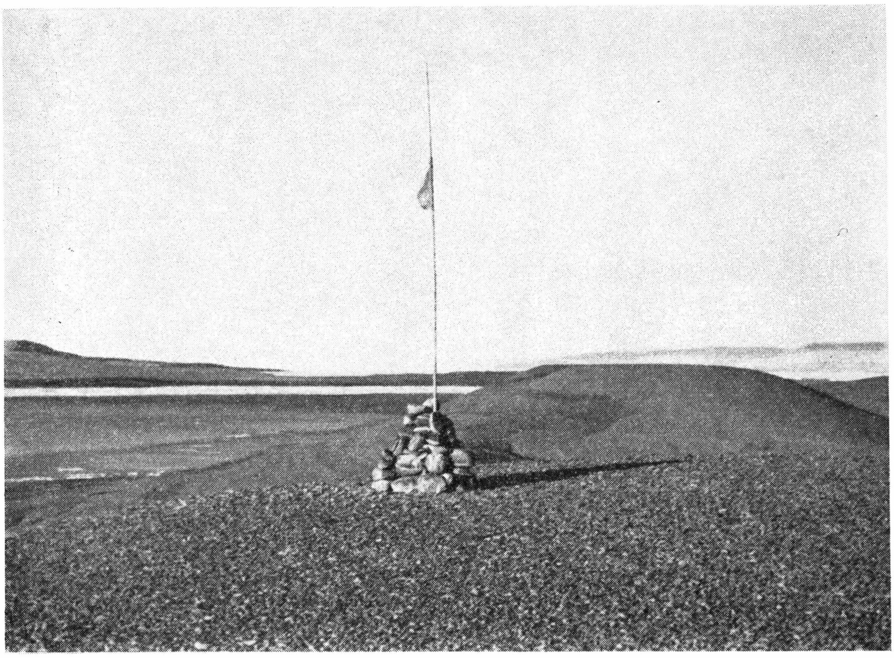

Fig. 3. Cairn III as seen from the west. The bamboo cane is about 3.5 m high. T. H. phot. August 1949.

These projecting rests of terraces are excellent places for the establishment of triangulation points, as there is generally a free sight between them.

To begin with it was intended to map out the main features of the terrain by means of a plane-table, and preparatorily small cairns, which were to serve as plane-table stations, were built here and there on minor elevations. These cairns were to be intersected during the triangulation.

However, it soon became obvious that it would not be possible to finish this work within the time available. The only possibility would be to have the terrain photographed from the air when the expedition was to be fetched. Fortunately this proved to be possible, as mentioned below.

As the triangulation net was now to carry a photogrammetrical plotting, it was a serious drawback not to have any aerial photos handy, as is normally the case, on which it is possible to plot the fixed points. Instead it proved necessary to draw laborious sketches of the environs of each trig point provided with measures to objects which presumably would appear on the photos. Unfortunately I had no experience as to the problem how a terrain like the one in question would look on aerial photos. Furthermore, the time of the photographing would come to play a part, *i.a.* as to the way in which the shadows would appear, and in that respect nothing could be known.

Especially in the terrain south of the lower course of the Midsommer-elv, a rather featureless, desert-like scenery, it was extremely difficult to plot the exact position of the points in relation to objects which could be identified with certainty. Indeed, later on it proved impossible quite accurately to plot the positions of the points.

The measurements of angles started on the 12th June 1950 at Point XIX. The instrument used was a Wild T2, the smallest reading of which is $^1/_{10}$ of a second. For the main net three pairs were read in each direction, the sights in the intersections being taken by a pair and a half. Weather conditions on the whole were comparatively favourable. Sometimes, however, fog banks could prevent observations for a few hours. On the 20th June the work was prevented the whole "day", first by snow, later by rain. Instead the readings were made at "night", it being kept in mind that the observation work could be done throughout all the 24 hours.

In the many bright and sunny days it was difficult to take sights passing close to the ground because of considerable scintillation. This especially applied to the sight between Points VIII and IX. Indeed, it proved that the greatest angular misclosure occurred in the Triangle VIII–IX–XII.

Out of regard for readers of later times, who may find it difficult to imagine the conditions of more primitive times, some information will be given in what follows regarding the normal conditions under which the surveying was done. As a general feature of works of this kind it applies that *e.g.* the possibilities of transport play a very important part for the extent and quality of the work. In my case Shanks's mare was the only means of transport, and as, because of other works, it was not possible to spare other men for the task, I had, besides the instrument with its tripod, to carry tent, camping outfit, provisions, etc. Sometimes it was therefore necessary to move camp in two turns. At that time the fiord was practically impassable because of broad streaks of open water along both banks and large ponds of melt water on the ice.

From a camping site near the delta of the river Geologelven the triangulation net was extended by another five points, XX–XXIV. The terrain below Frysefjeld is an unpleasant place of sojourn because of the high wind. The locality is a veritable flue. On the 26th and 27th June it was blowing so hard that no observations could be made. On the 30th June the stations in the westernmost part of the net were all measured, and the remaining stations closest to the house were left for more occasional treatment.

2. Base Measurement and Investigations of Accuracy

The base was laid out a few hundred metres west of the house. The terminal points are provided with stones having crosses carved into them. Small cairns mark the places. A Wild invar subtense bar was available for the determination of the length of the base. The great advantage of this aid is that no particularly level terrain along the base line is needed. Another advantage is that the table immediately indicates the horizontal distance, as the subtending angle is independent of the difference in height between instrument and bar. Unfortunately the bar at some time had been bent about $2^1/_2°$ 45 centimetres from one of the ends. The base was measured the first time with the bar as it was found. The total length was divided up into 11 pieces of about 27 metres in length, the subtending angles being measured twice on both faces. After the bend had been carefully straightened, the whole procedure was repeated, the number of pieces, however, this time being 10, each of about 30 metres. After the Expedition had returned home, the bar was sent to the Wild factories for being checked. The distance between the two targets was found to be 2000.5 mm instead of 2000 mm, as it ought to have been, the value from which the table has been calculated. In consideration of this discrepancy the baseline of the second measurement was calculated to be 296.10 m. It was found advisable to use only the first measurement as a check against gross errors.

In the instruction for the instrument, an empirical formula is given for the calculation of the standard error based on investigations made by ACKERL (1932). For distances between 10 and 100 metres, d denoting the distance in metres, the standard error μ will be equal to $\pm \frac{d\,(\mathrm{m})}{3}$ mm, provided that the angle is read twice on both faces. If the formula is applied to the distance $d = 29.6$ metres, we obtain $\mu = \pm 7.4$ mm. If this value is multiplied by $\sqrt{10}$, we obtain the standard error of the whole base, ± 23 mm. From a recent work by BABBAGE (1965), who deals with the results of tests made in Canada of the combined use of the bar and a T2, it appears that the condition of the formula mentioned above being correct, viz. that the standard error of the measurement of the angles is 1″, is not present, at any rate not with the instruments now on the market. BABBAGE found that four arcs were necessary to obtain this standard error. Hence it seems reasonable to reckon with a standard error of 3 cm or 1:10,000 at the base measurement. The total length of the whole chain of triangles is about 35 km. Starting from the standard error on the base the error in plotting scale will come to 0.07 mm, *i.e.* it will be without importance in relation to the plotting accuracy. If time had permitted this, another baseline would have been laid out at the western end of the triangulation net.

To throw light on the accuracy of the measurement of the angles in the main net, the standard error of a direction μ has been calculated by means of the usual approximate formula

$$\mu = \sqrt{\frac{[\Delta^2]}{6n}}$$

(the directions being read three times on both faces) to be 3″.6.

As mentioned above, the directions of the intersections were read once on both faces and there was an extra control reading. The standard error on a direction calculated as the mean value of the standard errors in 10 intersections is 5″.

3. Determination of Datum and of Heights

In order to get an idea of the tide and to be able to make an approximate determination of the mean sea level, tidal gauges were stuck into the beach off the house at various times. Unfortunately the periods of measurement were often comparatively short as drift ice broke or overturned the gauges. The longest series of observations dates from the 1st to the 17th September 1949. The material has been worked up by A. LUNDBAK (1962). Applying harmonic analysis he found the following amplitudes (in cm): M_2 10.6, S_2 4.0, N_2 2.0, K_1 6.4, O_1 2.6, K_2 (1.1), P_1 (2.1). The values in parentheses are derived from the S_2 and the K_1 values applying the factors 0.27 and 0.33. Again in 1963 a tidal staff was set up in order that an approximate mean sea level could be re-determined.

On the basis of the whole of the observation material it can in general be stated that on calm days there was a difference between high and low water of 2–3 dm, so that it must be allowable to consider the mean sea level as being determined with an uncertainty of ± 0.5 dm. During periods with a high wind pressure differences have been read of up to 6 dm. From the approximate mean sea level, which was considered the datum, the height of the lower terminal point of the baseline (denoted NB) was determined by spirit levelling. From there towards the east the heights of the points, V, IV, III, and 8, towards the west VI, VII, and VIII were determined by trigonometrical levelling. The value for the terrestrial refraction 0.2 used at the calculations originates from investigations made by J. P. Koch during the Denmark Expedition. In his "Survey of Northeast Greenland", pp. 147–198, he submits a considerable material concerning conditions of refraction. The sum total of his investigations and experiences is found in the following passage on p. 197: "In the course of the survey work performed in Greenland, one has often used the value $K = 0.2$, and generally there will hardly be any reason to choose a different value. In cases in which low sights across water are the principal thing, there may, however, in North Greenland be occasion to use a considerably higher value, according to circumstances as much as 0.6."

4. Astronomical Determinations

As mentioned above, no astronomical determinations had been made in Peary Land apart from very approximate reconnaissance measurements made on sledge expeditions. The present writer found it necessary to improve especially the determination of longitude. For this purpose I had at my disposal the above-mentioned Wild T2 theodolite with various accessories especially intended for astronomical measurements, including artificial lighting. A chronometer was available, too, but no chronograph. A chronometer log was kept during both years of the expedition on the basis of checking against time signals mostly from Washington. At first stellar observations were aimed at, but because of other work the author did not start work until February 1950. At that time the temperature was somewhat below ÷30° C. on calm days with a bright sky. Consequently the oil in the theodolite became so heavy as to make all movements drag. Rime formed immediately on the eye piece when the eye approached to it. The dry cells which supplied current to the artificial lighting on the circle and the cross hairs could not stand the cold either, although various precautions were taken in order to delay the cooling. After a few attempts the measurement was given up and it was decided to make observations of the sun instead later in the year. It is now known that the months of October and November would have been the best for stellar observations with the outfit available, as at that time it is sufficiently dark and the degrees of cold are not yet too bad, generally ÷20–25° C. on calm, bright days.

On the 17th and the 18th July 1950 the observations of the sun for the determinations of latitude, longitude, and azimuth were made on a point WSW of the anemometer on the east gable of the house and at a distance of 49.2 metres from this point. The place is marked with a small cairn, under which a metal disc is kept in position by means of a large spike, a somewhat primitive marking, but nothing better could be brought about with the aids available. Longitude and azimuth were determined by means of altitudes of the sun east and west. Sets of observations were made on both days, the first day three sets, which by calculations gave a longitude of 30°29.6′ long. W. Grw. On the second day five sets of observations were made in the east and the west, resulting in the determination 30°29,7′, which latter value must be considered the best. A stop watch was used as an intermediate link between the instant of observation and the chronometer. From the material obtained on the second day a standard error of the determination of longitude was calculated which amounted to $0^{S}4$ or 6.0″.

Measurements of the altitude of the sun around the meridian were used for determination of the latitude, resulting in the value of 82°10.3′N. With guidance in experiences made elsewhere in Greenland (*e.g.* P. F. JENSEN, 1923) the error in this determination of the latitude was estimated to be of the same order of magnitude as the error in the determination of the longitude.

5. Determination of Magnetic Declination

For the determination of geomagnetic conditions the Expedition had at its disposal instruments constructed by the Danish geophysicist D. LA COUR, for the vertical component "the Magnetometric Zero Balance, the BMZ", and for the horizontal component "the Quartz Horizontal-Force Magnetometer, the QHM". As for description and theory reference is made to LA COUR (1942 and 1936).

In 1948–1949 observations were made by Dr. JOHS. C. TROELSEN, the second year by the present writer. After our return home the material was submitted to the geophysicist ASGER LUNDBAK, M. Sc., for being worked up. In what follows, a brief account of the work will be given as well as a table showing the determinations of declination made by me, this being the aspect of the results which are of the greatest interest from a cartographical point of view.

All the QHM measurements were made at a point marked by Dr. TROELSEN in a locality about 170 metres SW of "Brønlundhus", where the surface consists of a thin layer of stony-gravelly melt-water deposits overlying stratified marine clay, TROELSEN (1949 and 1952). Quartz-dolerite outcrops are abundant in southern Peary Land, although not exactly along the shores of the Jørgen Brønlund Fjord, but many of the blocks and stones scattered in the terrain consist of quartz-dolerite.

JOHS. C. TROELSEN is of opinion (personal information) that a basalt sill to the thickness of 10–20 m and nearly horizontal occurs 50–100 m below the surface in the area measured.

The BMZ measurements were made at three stations, all of them at a distance of 25 m from the QHM point and distributed so that the angles between the directions from QHM to these were the same size (*viz.* 120°). The greatest possible care was taken in order to avoid that anything magnetic came close to the instruments, which in winter *e.g.* precluded the use of electric lighting. An igloo built over the QHM point and another built over one of the BMZ points served as observatories during the polar night.

On a cliff a little more than a hundred metres south of the observation area a signal was placed which was to serve as a starting-point during the QHM measurements. The connecting-line between the QHM point and the signal was by measurements of angles connected with the triangulation net so that the azimuth to this direction could be calculated and hence the declination.

In the polar night a small electric bulb had to be kept on in the centre of the signal, not a small problem, as the intense cold made the current from the dry cells vanish quickly. In order to delay this process a bottle of hot water was wrapped up with the cells in a box with insulating material, and still it was difficult to keep the bulb discernible during the necessary 30–40 minutes. The observation work during the coldest period had many other difficulties to contend with, a fact which influenced the time of observation.

The values for the declination calculated from the observation material appear from the following table.

The declination might vary considerably during a single observation. The values in the table are mean values extracted from the whole observation. As an instance showing the size of the variation which could be obtained for a short period, the measurements made on 18th April are observed. There was at that date a difference of 1°51′ between

Table 1. *Declinations*

Date	GMT	Magnetic Variation (west)
12/11 49	15^{30}–16^{30}	47°56′
28/11 49	14^{50}–16^{10}	47°27′
13/12 49	11^{20}–12^{20}	46°23′
2/1 50	19^{10}–19^{50}	46°13′
14/1 50	14^{40}–15^{20}	46°36′
29/1 50	15^{50}–16^{30}	46°19′
13/2 50	12^{30}–13^{10}	46°19′
21/3 50	10^{50}–11^{20}	45°37′
5/4 50	17^{10}–17^{40}	47°35′
18/4 50	11^{40}–12^{10}	45°32′
—	21^{20}–21^{50}	47°23′
3/7 50	10^{50}–11^{20}	45°42′
22/7 50	15^{40}–16^{10}	47°10′

the determinations made before noon and those made in the late afternoon, not far from the very greatest difference between two measurements, *viz.* 2°24′.

It is not easy on the basis of this material to form an idea of the annual decrease.

The Aeronautical Chart on the scale of 1:1,000,000, Sheet 9, Independence Fjord, indicates an annual decrease of the declination of 14′. If this holds good as an approximate value, the declination should in 1966 be about 42°–44° west. Due to the weak directive force and to magnetic storms the compass can only be used for rough determinations of true directions. Furthermore, the rather short distances between the magnetic meridians in this place should be kept in mind. A final element is the local factors, which may very well make the compass practically unfit for use.

6. The Utilization of the Total Amount of Observations

Fortunately the Catalina hydroplanes that were to carry the expedition home, had prior to this job been engaged in aerial photography farther south in Greenland. The leader of the aerial photography, Colonel J. V. HELK, was very obliging as regards the wish of the expedition to have the Jørgen Brønlund Fjord area covered by large-scale vertical photos. The photographing took place on the 28th July 1950 at a time when the sun was almost in the north. Three series of pictures were taken, which covered the area from Kølen in the east to the confluence of the Midsommerelv and the Itukussuk Elv in the west, on a photo scale of about 1:19.000.

On this scale some of the cairns were just visible through a magnifying glass. In other places it was extremely difficult to identify the spot on which the cairn ought to be. Still greater difficulties were offered by some of the natural points determined by intersections.

In 1951–1952 the trigonometrical net was calculated in a local, plain co-ordinate system. The point ØB (upper terminal point of the baseline) had the following values attributed to it, *viz.* y = 10.000,00 m, x = 15.000,00 m. At the calculation of the base net as well as the main net besides, a rigorous adjustment was used. Thus also in the case of the intersections to the points Anemometer, GII, 8, A, 12, 28, and 40. The other intersections were calculated by means of approximate adjustment. In 1952 the Geodetic Institute (in Copenhagen) by multiplex methods plotted some map sheets on the scale of 1:10.000 with 10 m contours. Later these sheets were combined into one map on the scale of 1:50,000. This map was fairly good in so far as the area southeast of the station right to the delta of the river Botanikerelven is concerned, in other areas, however, less satisfactory for reasons which have already been mentioned and also due to the fact that the number of Z co-ordinates was too small, especially in the hinterland. The author did not find the map good enough to justify publication. In order to meet the great need for a map I constructed the trigonometrical net graphically during the months after our return, and then by means of the aerial photos filled in coastlines, streams, lakes, and, by means of form lines, the main morphological features. Later 10-m contours were sketched in in the middle and outer parts of the fiord on the basis of soundings made with line and lead in six profiles. The zoologist of the Expedition 1949–1950, Palle Johnsen, had taken soundings in a few profiles and kindly placed this material at my disposal. However scattered, these soundings showed, amongst other things, that the inner part of the fiord was an overdeepened trough. The preliminary map on the scale of 1:50.000 described above was published on a reduced scale by various authors: Eigil Knuth (1950), J. C. Troelsen (1952), Dan Laursen (1954), and A. Lundbak (1962).

7. Work in 1963

My participation in the Second Peary Land Expedition in the summer of 1963 was amongst other things based on the fact that I wanted to improve the material of measurements of 1949–1950 and enlarge it so much that it yielded an even coverage of the terrain the mapping of which was desired. This time we had at our disposal not only the aerial photographs of 1950, but also copies of the vertical pictures of 1960–1961. During the visits to the cairns in order to restore the marking, it was now possible to prick in their exact position in the pictures. Most of the stakes were erect, but the flags had, of course, been torn away. The bamboo canes were visibly worn on the west sides, a consequence of a bombardment with sand grains and, perhaps to a still higher degree, snow crystals during the gales. On the mountain slope south of the fiord two new points Ka (Kajakelv) and Zo (Zoologelv) were established, being marked with cairns and poles. On the 26th June the author climbed Buen at the western end accompanied by the geologist PER KIRKEBY, who gave very valuable assistance to me. At the top the station Bu was established (marked with cairn and flag), and there horizontal and vertical angles were read to the Points VII, IX, and X along the south side of the fiord, and to two points at the edge of Chr. Erichsens Iskappe: the tent which was permanently pitched in the same place, and the cairn V3, which during my stay in the camp on the glacier I had wrapped in an orange coloured parachute.

In spite of the considerable distances (15–16 km) these points were seen clearly and sharply in the telescope, a condition which must be ascribed to the fact that the lines of sight in the main part of their courses passed very high above the ground. From the point Bu—only a few metres removed from a vertical drop of more than a hundred metres—there was a magnificent view of the mesa-like plateaus of southern Peary Land. Besides yielding a Z co-ordinate of comparatively high value, the purpose of this point and another on Frysefjeld (Fy), which was established and measured the following day, was to provide a tie between the net at the fiord and the surveys on the glacier, so that it was possible to calculate e.g. the absolute height of the point V3. V3 is the starting-point of a levelling profile up to the top of the eastern ice dome of Chr. Erichsens Iskappe.

As early as 1949–1950 resections were measured from the cairns along the margin of the icecap to mountain peaks and the like on the faces of Buen and Frysefjeld. These natural fixes had been connected with the triangulation net by means of intersections. This early connexion could be used for a graphical construction of the interrelation, but was not sufficiently accurate for a calculation of distance and height.

The whole observation programme resulted in a connexion of the points Bu and Fy with the main triangulation net through triangles with all angles read. I did not succeed in establishing the desirable free sight between the two points because of shortage of time for further climbing.

Measurements were made at a total of 15 of the old stations with a view to extension of the trigonometrical determinations of height, and to tie in new points. To intensify the control of the determinations of height, spirit levelling was carried out to the foot of Cairns IX, XV, and XVI.

In SCHNEIDER and THORKIL-JENSEN's textbook (1940–1941), Vol. II, p. 88 there are some reflections on the standard error in trigonometrical levelling. Guided by these we might expect differences between 1 and 3 dm between the determinations calculated in different ways, a view which is in excellent agreement with the actual results. Thus the height of Point 23, the top of a salient mountain peak at the corner of the Pyramideplateau, was determined from XVI to be 536.49 m, from II to be 536.75 m, the height of XVI, as stated above, having been determined by quite a short levelling, whereas the level of II was calculated from NB by way of V, IV, and III. The height of the terrain at Bu has from IX been calculated to be 723.05 m, from VIII to be 722.88 m, from XIII to be 722.90, and from X to be 723.17 m. For Point Fy the figures were 474.54 m, 474.19 m, 474.06 m, and 474.10 m as calculated from XXIII, X, IX, and VIII, respectively.

The present writer has met with nothing like such differences as were noticed by the Jacobsen-McGill Arctic Research Expedition to Axel Heiberg Island under much the same climatic conditions and with the same instrument type, a Wild T2, in a case as that adduced by D. HAUMANN (1963) 4 m in a distance of 5 km. It should perhaps furthermore be stated that HAUMANN indicates that we may be certain that there have been no gross errors. At the calculation of the heights of points along the margin of the icecap we might fear the presence of considerable deviations, partly because of the long lines of sight, partly because of accumulation of errors. The result, however, was better than was expected. The determination to the tent by way of Bu was 864.50 m, by way of Fy 864.96 m, and to terrain at V3 by way of Bu 855.31 m, by way of Fy 855.75 m.

Point Zo may serve as an instance of extremely fine agreement. By way of VIII the level was calculated at 398.58 m, from IX at 398.56 m, and from X at 398.61 m. To sum up, it may be stated that we are on firm ground if we put the uncertainty of the determinations of height to the points near the fiord at 1–2 dm and to the points farther out at 2–3 dm, considering the uncertainty at the establishment of the 0 level. These calculations and other supplementary work of computation were made by the young Chartered Surveyor HANS STOCKHOLM. This assistance was made possible by a grant from the Danish State Research Foundation. As stated above, the whole net has been calculated in a local, plain co-ordinate system, oriented by the determination of azimuth made during the astronomical observations for the line Astronomical Observation Point (AO)—V at 309°53.2′.

With a view to the purpose of the net, *viz.* to form a basis of a map on the scale of 1:50.000, isolated, for an area of 20 × 40 km, it was not thought to be necessary to transform the co-ordinates into any projection, any more than it was done in the case of a map of an area of the same size, that of the Thomson Glacier Region, Axel Heiberg Island, published by HAUMANN (1963).

The list below shows the co-ordinates to the points used at the preparation of the map.

Table 2. *List of Co-ordinates*

Point	y *m*	x *m*	z*) *m*	*Description of point*
AO	10281.94	14654.80	–	Small cairn
I	1300.87	5689.18	7.4	Cairn with stake
II	6618.12	8879.53	73.7	„
III	7794.89	10041.60	68.5	„
IV	8795.01	12579.18	64.4	„
V	9601.04	13840.05	66.7	„
VI	10372.73	15734.82	64.2	„
VII	10340.76	18530.94	64.0	„
VIII	10627.16	21176.26	62.3	„
IX	10947.60	25268.91	36.4	„
X	11775.86	28646.04	57.6	„
XI	13428.46	26603.64	31.5	„
XII	13136.24	22691.86	–	„
XIII	12456.16	19213.04	18.6	„
XIV	12430.14	16988.72	5.2	„
XV	12329.48	14887.52	3.5	„
XVI	11153.97	12086.90	3.9	„
XVII	10498.97	8899.90	64.9	„
XVIII	8821.17	5996.58	49.9	„
XIX	5814.26	4773.47	64.6	„
XX	14184.68	29828.31	16.2	„
XXI	14074.08	33999.00	–	„
XXIII	12270.62	32561.60	110.6	„
XXIV	12893.55	35388.14	58.1	„
GII	7177.04	9136.74	71.3	„
Bu	14408.20	22476.64	723.0	„
Fy	16533.68	30288.63	474.2	„
Ka	7036.14	20126.25	264.8	„
Zo	7188.66	27606.98	398.6	„
Brønlundhus (Anemometer)	10303.38	14610.62	–	„
A	3053.13	6905.10	–	Cairn
8	7169.11	13731.55	216.3	Black boulder
12	9923.07	3628.63	60.1	Cairn with stake
22	11726.84	6248.37	48.9	„
23	13988.58	4225.79	536.6	Peak
25	9008	10023	–	Cairn
26	9342	10877	0.0	Spit

(continued)

Table 2 (cont.)

Point	y *m*	x *m*	z*) *m*	*Description of point*
27	12236	11093	28.6	Cairn with stake
28	13523.43	12423.59	495.0	Top of pinnacle
40	14803.45	24300.26	–	Peak
46	13837	16774.5	–	Upper outer corner of rock pillar
Permanent camp	1192.61	29501.60	864.7	Tentcorner
V3	1649.85	31405.93	855.5	Cairn
V8	1347.46	35169.06		„

*) Terrain at the cairn.

8. Determination of Bottom-Configuration of Jørgen Brønlund Fjord

In the present writer's opinion no map or chart is completely satisfactory without its also picturing the water-covered topography. The small number of sounding lines produced in 1948–1950 were not sufficient to meet this requirement. Therefore an echo-sounder and a folding boat, a Klepper Master, were brought along in 1963. The echo-sounder was of the type Atlas Monograph 658, and it was driven by a 12 volt storage battery. The transducer was mounted on a special rig equipped with movable gripping devices, so that if occasion should arise, it could be adapted to different boats. For a more detailed description of the equipment reference is made to Th. Høy (1965).

As the fiord is narrow in relation to its longitudinal extension, it could most easily be surveyed by means of a number of cross-sections as appears from fig. 4. The terminal points of the profiles were pricked in on aerial photos, such points being chosen as were easily identifiable. Only in the middle of the fiord, especially along the north coast, which it was not possible to approach because of the presence of shallow water, the terminal points had to be fixed by sextant resections. During the traversing of the profiles all possible care was exercised in order to secure a constant speed. The boat was propelled by a 5 h.p. outboard motor.

In 1963 the fiord ice slowly gave way, as compared with conditions in the years 1947–1950 when the inner part was ice-free from the middle of July. The main reason for this was obviously the moderate discharge of the river Børglum Elv and especially the Midsommerelv, which, again, was due to the temperatures which in relation to previous experiences were somewhat lower.

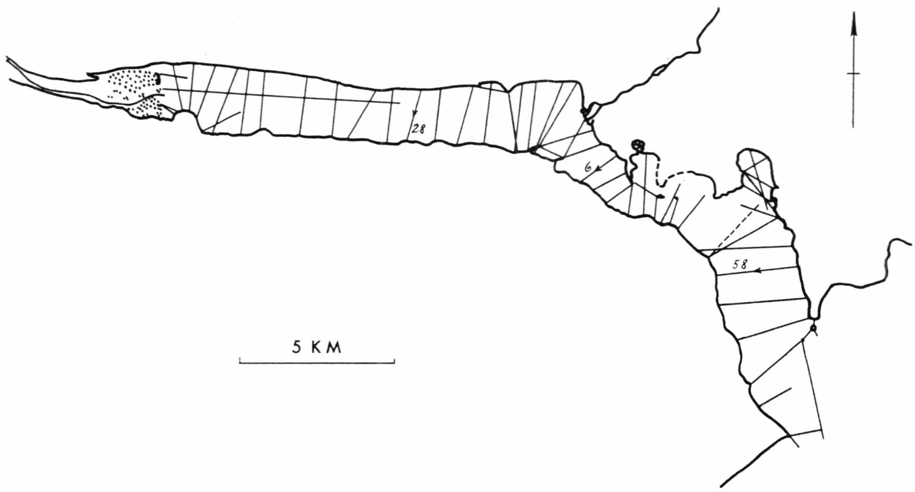

Fig. 4. General plan of the sounded profiles in the Jørgen Brønlund Fjord. The dotted line indicates a profile sounded with a line. All the other profiles were echo-sounded.

On the 3rd August the measurements of the middle part of the fiord were started. Drifting ice-floes, however, hampered the work somewhat. On the 6th August the inner part of the fiord could be said to be fairly ice-free. The work there was often complicated and delayed by the choppy sea, which extremely quickly swelled in the almost fresh top layer when the wind was rising from the east. On the 14th August the activities were shifted to the outer part of the fiord, which had become almost ice-free. It was even possible to penetrate a few kilometres into the basin of the Independence Fjord. The depth increases fast outwards, and at the edge of the unbroken ice the echograph showed the greatest depth measured, a little more than 190 m. The signal received was rather faint, a consequence of the modest size of the transducer (30×33 mm in the case of the active part). A considerably larger transducer was brought along on the off chance that more extensive measurements in the Independence Fjord would have been possible. During the whole work an accumulation of ice remained east of Kap Michael Rottbøll, for which reason there is here a minor gap in the records.

For illustration of the morphology of the bottom of the fiord three echograms are rendered (figs. 5–7). The Jørgen Brønlund Fjord morphologically falls into three widely different parts, an inner overdeepened basin running east–west, an outer part, also glacially initiated, running north–south, and an intermediate narrow and shallow part connecting the two others. The three cross-sections drawn up by the echo-sounder clearly demonstrates the characteristics of the three parts. Fig. 4 localizes

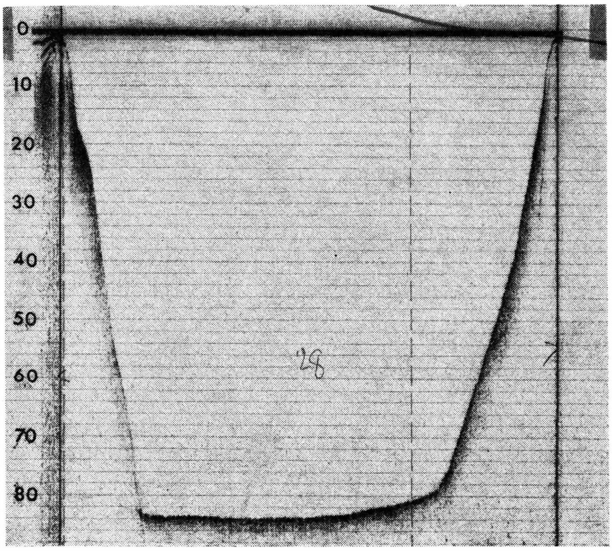

Fig. 5. Profile No. 28 (see fig. 4). Depth indicated in metres.

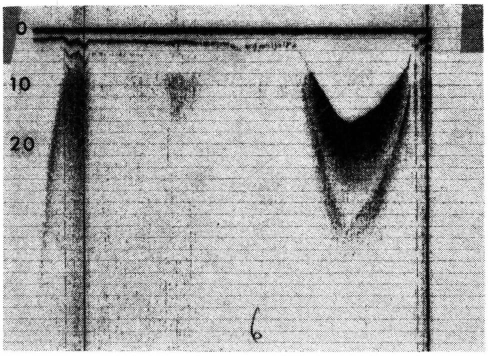

Fig. 6. Profile No. 6 (see fig. 4).

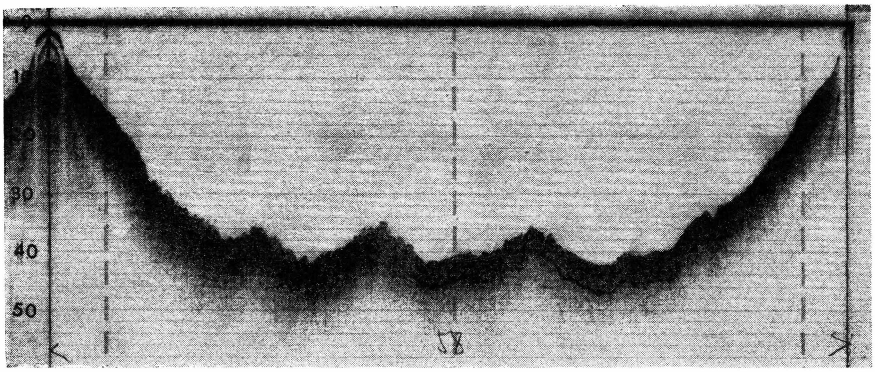

Fig. 7. Profile No. 58 (see fig. 4).

the cross-sections. The silt brought along by the Midsommerelv mainly settles in the inner basin, a fact which has produced the extremely even bottom face. Much less depositing takes place in the outer part, where the original furrows and ridges are not, as in the inner part, concealed under a levelling cover.

In many places along the coast there is a terrace-like flat at a depth of two or three metres. This is seen especially clearly in fig. 6. The 300–400 m broad channel found along the southern shore in the middle part of the fiord slopes evenly outwards. The present cross section—unsymmetrical in curves—has obviously been shaped by the rather strong current passing through it. The present writer must leave it undecided whether this constriction in the middle of the fiord is due to meltwater deposits from the Børglum Elv area or it is an older phenomenon.

III. PREPARATION OF THE FINAL MAP

(Plate 4)

1. Plotting

By mutual agreement between the Danish Geodetic Institute and the Peary Land Expeditions the plotting and the other cartographical processes were entrusted to the Institute.

For the plotting the vertical photos of 1960 were used in a stereoplanigraph C8. A print of the draft was sent to me for revision. Especially the complicated systems of watercourses, which are difficult to unravel according to the photos, had to be subjected to careful adaptation. Without an intimate knowledge of conditions in the field it would not have been possible to unravel the slender threads. The same applies to a distinction between the clayey pans and depressions and the boulder- and gravel-strewn alluvial fans.

The plotting on the basis of the echograms was made by me on a scale of 1:25.000. A contour plan was made from this, and photographically reduced to the same scale as the master plan it was submitted to the Institute for copying in. A later planimetrical extension of the whole map towards the north so that the lower course of the Krengerup Elv could be shown, was made in order to give it a more balanced cut-off.

2. Place Names

On the revision draft the author indicated the place names and their geographical value and definition. During the First Peary Land Expedition a good number of names were given, usually after a discussion by the members of the expedition, due to the long stay at the place. In a duplicated manuscript entitled "Peary Land områdets og Nordøstgrønlands navneformer efter revision i Stednavneudvalget 9. juni 1954" Eigil Knuth has stated the background of many of the names. During the Third Peary Land Expedition the following names were given: Paralleldal (valley parallel to the Jørgen Brønlund Fjord), Krengerup Elv (from the name of a manor in Funen), Brillesø (from the lake's looking like a pair of spectacles), Nynæs (a promontory in formation), Bagsværd Sø (the name of a lake near Copenhagen), and Dødebugt (name of a bay with shores of a desolate character).

IV. SURVEYS AND MAPPING OUTSIDE THE JØRGEN BRØNLUND FJORD REGION

1. Chr. Erichsens Iskappe

The following remarks refer to the map, Plate 3.

In 1948 B. Fristrup (1948–49, 1951 and 1952) started glaciological and meteorological measurements at the eastern end of Chr. Erichsens Iskappe. Fristrup *i.a.* erected two rows of stakes from north to south over the eastern dome of the glacier and built a number of cairns along the edge of the glacier, the first two (ØB and VB) off the permanent camp, the following ones along the eastern and the southern offshoots. Some of them are shown on the map as black triangles.

The present writer was to continue these measurements from the summer af 1949 to the summer af 1950. Some of the stakes in Fristrup's two rows across the dome of the glacier had been detached as the ice melted and had toppled over, but in the case of the stakes still standing, the bore hole was deepened so that they might serve for another season. Another row of stakes was established over the dome of the glacier in the longitudinal direction of the dome. For further elaboration of future control of the displacements of the edge of the glacier nine cairns were erected westwards from the camp towards the small snowdrift tongue. The last one was erected at the root of the tongue mentioned, on the west side. Cairns No. 3 (V 3) and No. 8 (V 8), as mentioned above and as also appears from the map Plate 1, have been included in the triangulation net around the Jørgen Brønlund Fjord. The other cairns were coordinated from these and from the northeastern tent corner of the permanent camp, which was also included in the triangulation. The measurement of distances from cairn to cairn was mainly undertaken indirectly by means of a pair of secondary points on the glacier, taping being extremely difficult due to the felsenmeer which covers the the ice-free area out to the edge of the plateau.

V 3 was built on a fairly large boulder with rather a plane surface. The highest bump on the surface of the boulder is the starting-point of the levellings towards the top of the dome of the glacier. The angle formed by the direction V 3–V 2 with the levelling line is 92°21′5. At the marking out of the line in 1949 a stake was bored into the ice at each 500 m measured out with a steel tape along the surface of the glacier—up to Station 2500. Then a stake was placed at Station 2620, at which point a break in the line was introduced, in order that it might end at Stake XX, which was already established.

In 1963 these stakes were re-established by marking the angle and by measuring as previously. When Station 2500 was reached, it appeared that one of the old stakes still stuck in the ice. A broken-off piece was found beside it, on the western side highly worn by the drifting snow. The new line passed only 53 cm east of the old stake, it thus being proved that the new line was completely identical with the old one, considering the regularity of the dome of the glacier. At the points 2620 and XX (the terminal point) new stakes were bored into the ice. No traces of the old stakes were found. The angle of the long stretch down towards V 3 with the short leg 2620—XX was 133°27′0. The neighbouring stake towards the east and four neighbouring stakes towards the west, on the other hand, had survived 13 years on the glacier (see the map Plate 3).

In June 1963 a profile line was established on the south side of the dome of the glacier marked by six stakes and a terminal cairn on a large boulder at the southern edge of the glacier as a continuation of the line on the north side. For lack of time I had to confine myself to a trigonometrical determination of height of the surface of the ice at each stake. The figures arrived at appear from Table 3. The distance between the five first stakes were measured with a steel tape. At the fifth stake an auxiliary base was established by means of which the distances to the sixth stake and the terminal cairn as well as the positions of six early cairns along the south edge were determined. The stakes erected in 1949 were surveyed in 1950, starting from the terminal point XX of the levelling line, mainly by pacing off the distances and rapid measurement by theodolite of the angles between the various sections. The stakes closest to the camp and closest to the snowdrift tongue, however, were measured by intersections from the cairns along the north side.

All stakes as well as the cairns on the south side shown on the map Plate 3 have been plotted graphically.

The spirit levelling from Cairn 3 to Stake XX was made the first time in the middle of September 1949. The backward levelling was mainly made in the beginning of October. The levelling was repeated in August 1950. After the repeated marking the profile was double-levelled about June 1, 1963.

The results appear from Table 3.

Table 3

Marking No.	Distance along the surface m	Distance horizontal m	Relative height Sep. 1949 m	Relative height Aug. 1950 m	Relative height Ult. May 1963 m
Cairn 3	0	0	0	0	0
	180	179.55	12.5	12.0	7.7
	260	259.30	18.8	18.3	13.5
	340	339.09	24.6	24.1	19.8
	420	418.91	30.0	29.6	26.1
Stake 1	500	498.73	35.3	34.9	31.6
– 2	1000	997.67	68.0	67.7	65.2
– 3	1500	1496.08	107.7	107.4	105.4
	1580	1575.72	115.3	115.0	113.2
	1760	1754.81	133.4	133.2	131.6
– 4	2000	1993.60	157.6	157.4	156.2
– 5	2500	2492.25	194.1	193.9	193.4
– 6	2620	2612.19	197.9	–	197.1
– 7 = XX	2696.9	2689.06	198.5	198.4	197.9
	Distance from stake to stake				
Stake 7 = XX					197.9
–	200.73	200.70			
– 8					194.6
	161.48	161.27			
– 9					186.3
	302.96	302.27			
– 10					165.7
	399.48	398.24			
– 11					134.4
	554.45	552.21			
– 12					84.5
		1079.8			
– 13					16.6
		2183.4			
Terminal cairn.			At the foot of cairn		÷ 6.2

As to my experiences with use of levelling instrument and theodolite on glacier ice it may summarily be stated that the most favourable measuring conditions are found in connexion with slight frost. As soon as the temperature rises above freezing point, the level will soon be spoilt by the fact that the legs of the instruments will sink into the melting ice. The situation may be improved somewhat by cutting small holes for the legs of the tripod and covering the ferrules with snow. Elsewhere wooden plates mounted on the legs of the tripods have been used, which undoubtedly is an excellent solution. The backward levelling in October 1949 was made at temperatures about $-18°$C., under which circumstances the measuring work was greatly hampered by the eyepiece being frosted over.

By measuring along the stakes still standing on the top of the dome the total melting away of ice since 1950, was found to be 13–14 cm, thus appreciably less than substantiated by the levelling, the difference between the heights at the top being 50 cm. The deviation is higher than the uncertainty of measurement, for which reason at any rate part of it must be due to a slight change in the shape of the icedome.

In 1949–50 accumulation/ablation was measured on an average ten times at each stake, the first time August 9–11, 1949, the last time August 5–7, 1950. At the first reading the ablation period was not yet finished, and at the measurement towards the end of August the ice surface proved to have sunk another 7–8 cm in the marginal areas, decreasing to 0 at the top. At that time an average of 10 cm new snow had settled on the ice surface. In September and October the further depositing of snow was modest, generally a few centimetres only, on the south side, however, somewhat more (up to 28 cm). The last reading before the full polar night was made on October 30–31.

At the first round after the polar night, March 30–31, 1950, it proved that during the intervening five months only some few more centimetres of snow were deposited, in the marginal areas generally 7–8 centimetres, decreasing towards the top, increasing down the tongues. During the following months right to the end of June, when a long period started with positive temperatures throughout the 24 hours (see fig. 15), very little depositing appeared. Beside many stakes the maximum was reached already about April 1. However, during the following months almost constant readings were made.

From the end of April (see p. 43) the evaporation from the surface of the snow begins to play a part. It is not, however, known exactly how great a part, as sufficient detailed measurements are missing.

The total deposit of snow at the beginning of June on an average for all stakes on the dome of the glacier constituted 25 cm, in the marginal areas mostly 25–35 cm, decreasing to 12–15 cm in the case of many of the stakes in the top region. Towards the tips of the offshoots the depositing of snow increased greatly, obviously as a consequence of the effect of shelter. At the extreme tip of the southeastern tongue and at the extreme tip of the small tongue towards the north 1.5 m snow was measured. At a large number of weighings of samples of snow evenly distributed on the glacier, the value of water was determined at 0.4 as the average figure. Apart from the loss by evaporation the accumulation thus constitutes about 10 cm water; if the values from the tongues are included, about 12 cm.

The extraordinarily long period with positive temperatures (see fig. 15) consumed not only the whole snow cover, but also a considerable part of the bared solid ice, so that the icecap in all gave off very considerable quantities of water. In the marginal areas towards the north 25–50 cm ice melted. The melting decreased to a few cm at the top, and increased again to 10–15 cm down along the south slope. The much greater melting along the north margin must be a consequence of frequent foehn winds in the Wandel Dal system. The readings on the east and west slopes showed a decrease in ice of 30 cm on the east slope, but only 10–20 cm on the west slope.

The summer of 1963 showed quite a different picture. On our arrival at the glacier on May 24, the snow cover proved to be extremely thin. In many places the ice was bared. During the following weeks we saw numerous falls of snow, which resulted in a total depositing of snow of 8–9 cm, a percentage of well over 50 per cent. of the total quantity of snow. Sastrugi were conspicuous by their absence, whereas they were frequent in 1948–50.

On our last visit in the beginning af August the snow cover had melted completely only in a small area near the northern margin. The remaining quantities of snow, however, rested on solid ice so that nowhere on the dome of the glacier there had been a surplus in the immediately preceding years. The results from the levelling profile also suggest that the ablation period in 1963 was extremely unfavourable, the melting in 1950–1963 on an average corresponding to ten times the melting in 1949–1950, the extreme values being eight and thirteen times. From this it may be deduced that in the total period of 1949–1963 the first year indeed was somewhat above the average, but not so much that extrapolation would not be in tolerable good agreement with actual conditions.

Because of the quite even flattening out of the icecap (see fig. 8) a vertical melting of a few metres gives rise to quite a considerable withdrawal of the edge of the glacier. In the case of the period 1950–1963: at ØB (see Plate 1) 150 m, at V 1 141 m, at V 2 149 m, at V 3 148 m, at V 4 113 m, at V 6 73 m, at V 7 95 m, at V 8 104 m, and at V 9 in the direction of V 8 about 80 m. On July 29, 1963, the distances from the cairns to the edge of the glacier from ØB were about 240 m, V 1 185 m, V 2 162 m, V 3 188 m, V 4 145 m, V 6 89 m, V 7 132 m, V 8 132 m, and V 9 in the direction of V 8 about 140 m.

At the cairns along the southern edge the withdrawal was slight.

The two tongues down towards the Independence Fjord end in steep walls. Comparative studies of photographs show no change in situation and otherwise very small changes between 1949 and 1963.

The other climatological measurements as well as other investigations on the icecap will not be discussed in detail. It should, however, be mentioned that thermo-electrical measurements of temperature in the ice showed that at a depth of nearly 10 m the temperature was constantly $-18°$C. all the year round.

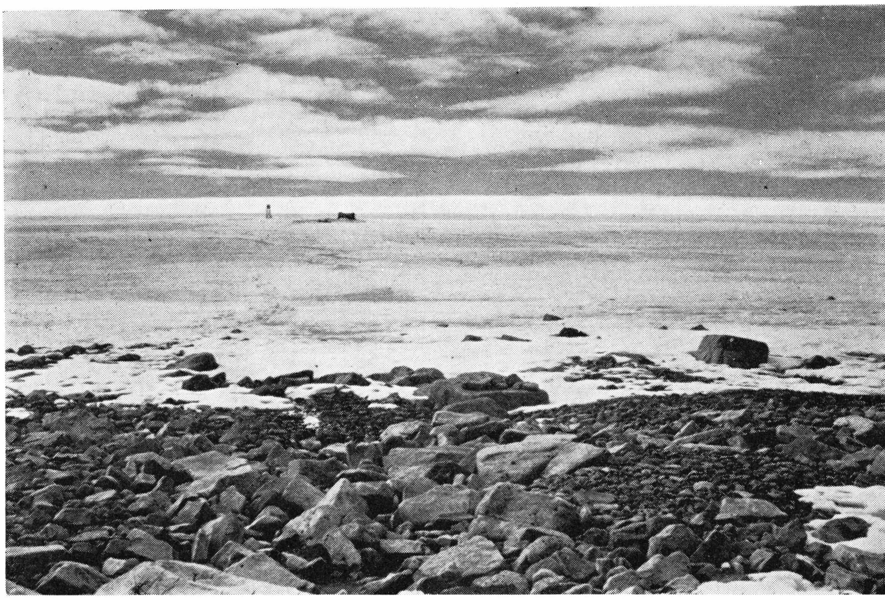

Fig. 8. Chr. Erichsens Iskappe, the eastern dome of the glacier as seen from the north. In the foreground felsenmeer, in the middle distance the permanent camp. T. H. phot. July 1950.

Apart from the northwestern dome on the top of which there is firn, and from which area two tongues flow down into the valley Itukussuk Dal, Chr. Erichsens Iskappe clearly stands out as characterized by relict conditions. The study of reports from glaciological investigations in the northern part of Ellesmere Island and Axel Heiberg Island shows that there are many points of resemblance with conditions there, so that Chr. Erichsens Iskappe fits well into the glacial picture of this arid area along the Arctic Ocean, although the glaciations in central (see pp. 36–37) and southern Peary Land undoubtedly are found at the most arid end of the scale, the end most characterized by relicts.

2. Midsommer Søerne

From the 8th to the 19th October 1949 the author participated in a dog-sledge journey up the Midsommerelv and Midsommer Søerne with the turning point and depot laying in the Sydpas about 15 km below Aftenstjerne Sø.

While passing the lakes barometrical determinations of the altitude of their water surface were made with a paulin aneroid. These determinations may be considered comparatively reliable due to the fact that the climatological station at Brønlundhus could serve as a control station.

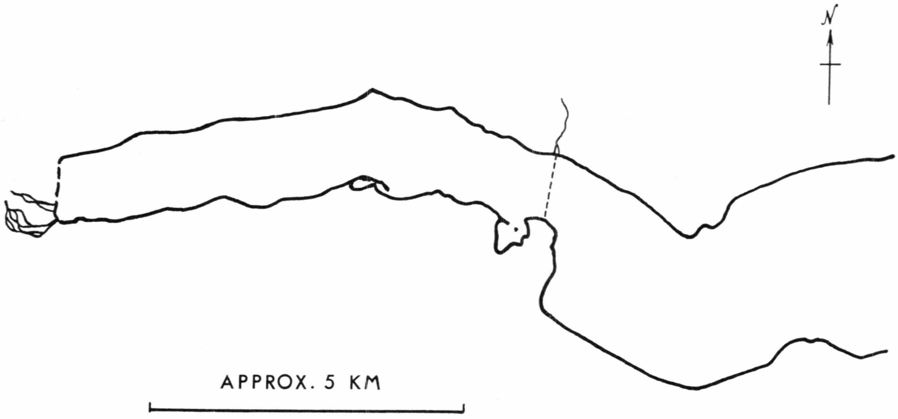

Fig. 9. Sketch-map showing the western end of the lake Øvre Midsommersø with the sounding-line indicated.

The readings during the sledge ride over the Nedre Midsommersø on the 8th October gave, when corrected, the height 87 m. Corrected readings on the return journey on the 19th October resulted in 89 m—mean 88 m. The water surface in the Øvre Midsommersø is 1–2 m higher.

I brought along a lead line, but time only permitted measuring of one profile across the Øvre Midsommersø (see fig. 9). The results of the measurements appear from the following table. The starting point was at the southern end.

Distance m	Depth m
About 50	25.0
– 100	32.1
– 200	41.0
– 400	37.9
– 600	33.2
– 800	36.8
– 1000	25.5
– 1100	Shore

3. The Børglum Elv and the Central Icecap

Accompanied by TOBIAS SAMUELSEN the present writer during the days 20th May to 30th May 1950 made a reconnaissance on foot through the Børglum Elv valley. Our main purpose was that of ascending the icecap on the mountains immediately south of Frederick E. Hyde Fjord in order to get an idea of its character as compared with the material collected regarding the Chr. Erichsens Iskappe. During our march up through the valley angles were measured at a number of points by

Fig. 10. The Børglum Elv valley off the mouth of the canyon Domkirken (v. Map Plate 2). T. H. phot. May 1950.

means of a compass with mirror and notch combined with drawing of sketch maps and panoramas. As regards distances we had to content ourselves with pacing off the distances between some of the compass stations. Immediately after our return to Brønlundhus the material was combined into a map on the scale of about 1:100.000. In Plate 2 this map is shown in a slightly reduced size. Due to the rough methods used, the scale cannot be assumed to be quite constant for the whole length of the map, but its merit is that it shows the morphology of the valley better than any other map available. Furthermore, it shows the correct position of the names given en route. A short description of the valley is given in connexion with the map.

In the lowermost and southernmost part, where the valley is 2–3 km broad, between the foot of the talus, the bottom of the valley consists of melt water terraces in which the river has eroded and created series of terraces of a more recent date. Between 10 and 15 km up the river the valley turns north and northwest, while the slopes of the valley approach each other, only leaving the bottom of a valley about one kilometre broad between the enormous talus slopes. The height of the slopes increases, and here and there 200–300 m high steep walls have developed above the screes. Now and then major and minor tributaries come from side valleys with steep walls. The tributaries form flat delta cones consisting of sand and gravel. In certain cases the cones are strong enough to dam the main stream to some degree. One of the tributaries to the right beach comes from a canyon unparalleled in magnificent beauty (fig. 10). Domkirken (the Cathedral) seemed to be the name corresponding best to the impression made. A large tributary river from the west was named Vestervig Elv, with reference to Danish church history like Børglum.

Thirty odd kilometres up river, slopes of the valley are flattened materially, the valley opening up. The mesa-like plateaus are replaced by flat domes, which must have been modelled from the stratified, slightly slanting sedimentary rock by glacial erosion. Differences in hardness have resulted in the formation of series of steep and flat slopes on the sides of the flat domes. From the foot of the steep part of these broad steps streaks of humidity radiate along the flat part of the step farther down, streaks which clearly stand out by means of the dark lichens that thrive there. The whole forms a most peculiar picture which is especially distinct in the aerial photos and makes some of these look like abstract paintings.

The contributory stream which most direct led to the icecap, flows through a broad and open valley which was named Ugledal, this name being inspired by some pellets of snowy owls found at a camping site.

Our supplies permitted two days' stay there on the margin of the central glaciation of Peary Land. Our tent was pitched close to the ice front opposite a nunatak with a melt-water lake at the foot of it. In order to mark the point from where a photo was taken, a smallish cairn was erected, from which the distance to the ice front was also measured. In the direction towards the southeastern corner of the nunatak the distance proved to be about 85 metres. In a note left in a cigarette tin in the cairn, *i.a.* this figure was left for the benefit of later visitors.

The pits dug on the lower part of the nearest domes of the glacier showed the snow of the preceding winter deposited direct on solid ice just as on Chr. Erichsens Iskappe, the deposit even being of the same magnitude, *i.a.* 15–25 cm on free wind-swept parts. On the Stormkuppel we found profiles with a stratification evidently showing that years with a surplus of accumulation of snow occur without it being possible to state with certainty that these years are those immediately preceding. It is quite conceivable that on the contrary some years show a deficit so that there is a drain on the layer representing the immediately preceding year with a surplus. Thus a shaft in the top flat had first 17 cm loose snow, then from 17 to 28 cm under the surface a layer of coarser snow and ice grains with two faint layers of dirt at 21 and 24 cm. From 28 to 54 cm there was a layer in which a considerable degree of cementing together of the ice grains had taken place. Below 54 cm we penetrated into layers which approached to being solid ice. We could not penetrate very far into these layers with the tools available.

Judging from the data collected and from a general impression conditions were very much like the corresponding ones on Chr. Erichsens Iskappe. The thickness of the central glaciation did not seem to be very great, the subglacial topography is clearly apparent. Here and there nunataks break through the ice of the glacier.

In memory of the ingenious constructor of the modern theodolite, which has been of invaluable service to mapping during the last few decades, the icecap was named Heinrich Wild Iskappe.

APPENDIX

Observations on the Hydrology of the Jørgen Brønlund Fjord Area

Besides the work of mapping the author made observations on the drainage pattern in the area mapped and measurements of the discharge in the Kedelkrogelv in 1949–1950. I hope that the results, in spite of shortcomings, will give some idea of the hydrology of the area.

The river Kedelkrogelv rises on the plateau south of the Jørgen Brønlund Fjord and from there flows in a northeasterly direction to fall into the fiord. Its length is some 15 km. It flows down into the lowlands through a V-shaped valley and, when reaching the plain Oksesletten, forms inland deltas. The first delta has formed a small lake along a low rock wall. This type of lake—due to a barrage—is fairly common, especially in the narrow valleys parallel to the margin of the plateau.

Until the summer 1950 the river ran parallel to the coast for nearly half a kilometre. Beach ridges ending in the marine foreland Vestmolen barred the river so that it fell into a small lagoon behind Vestmolen. By a somewhat accidental human interference the beach ridges were broken through and the river obtained direct access to the fiord. Although certain steps were taken in order to restore the original state of things, we found in 1963 the old course given up completely, but wave action and currents had already effected a notable deflection of the new outfall towards the east (fig. 11).

For practical reasons the Kedelkrogelv was the only possibility of securing daily readings. This aspect of the matter was excellently taken care of by the wireless operators Kristen Sørensen and Børge Haagensen when the present writer was away.

It must be considered an advantage that the river does not have its source in the icecap, as a much more accurate determination of the catchment area in this way becomes possible. A river with a somewhat greater discharge might have been better in so far as the accuracy in the measurement of the flow-off is concerned. On the other hand, the moderate depth, 20–30 cm, and the modest width, 2.5–3 m permitted a detailed survey of the cross-section at the locality. Such a survey

Fig. 11. Mouth of the Kedelkrogelv, July 21, 1963. T. H. phot.

Fig. 12. The Kedelkrogelv at the measuring locality August 21, 1949. T. H. phot.

was made twice, *viz.* 14th August 1949 and 10th August 1950. The cross-sections were plotted on squared paper so that the areas of the profiles corresponding to the various water levels could easily be calculated.

In its lowest course the river splits up into many channels, but about one kilometre up the course as reckoned from the coast, however, we succeeded in finding a place where all the water passed through one channel. The profile there was even fairly trapezoidal and the gradient rather even. A ranging pole provided with a division into centimetres was placed in the middle of the profile. Figs. 12–14 show the locality and its surroundings.

Unfortunately hydrometric wings were not available, for which reason the velocity of the current had to be determined as well as possible by means of floats. In four places floats were put out, evenly distributed over the width of the profile. The time used by them to pass a given distance was measured by a stop-watch. Three determinations were made in all: One at fairly low discharge (24th August 1949), and two in the maximum period (2nd and 19th July 1950).

From the various data a certain mean velocity was derived, although including a certain rough estimate based on observations of the movements of the water through the distance measured. By means of a curve plotted on the basis of these data, the other velocities were interpolated. After the discharge in l/sec was calculated in this way, the results were checked by means of another method. The gradient in the stretch of the river in question was determined by means of the on p. 19 mentioned plottings on the scale of 1:10.000 at 37 per thousand. With the area of the profile, the width at the bottom, and the gradient as arguments the discharge was calculated from tables produced by the late Professor C. L. FEILBERG (1940) on the basis of STRICKLER's formula. The values found in this way were in very good agreement with those first calculated at mean and high water level, whereas at low water level there was some difference, those first calculated being somewhat smaller than the others. These lower values have been used at the construction of the graph fig. 15, as at observations on the spot it was noted that only part of the profile is active in the case of slight discharge. The staff was set up on the 14th August 1949. The last reading was made on the 26th August, at which time the flow had practically stopped. On the 28th August ice had formed round the staff, and on the 8th September the profile was completely frozen over. Till then small quantities of water had trickled through.

In the middle of May 1950 positive temperatures were recorded which produced small streams of water from the snow drifts and streaks of humidity in the riverbed, but not until the 10th June (fig. 13) the flow was estimated to be great enough to be measurable. At the peak

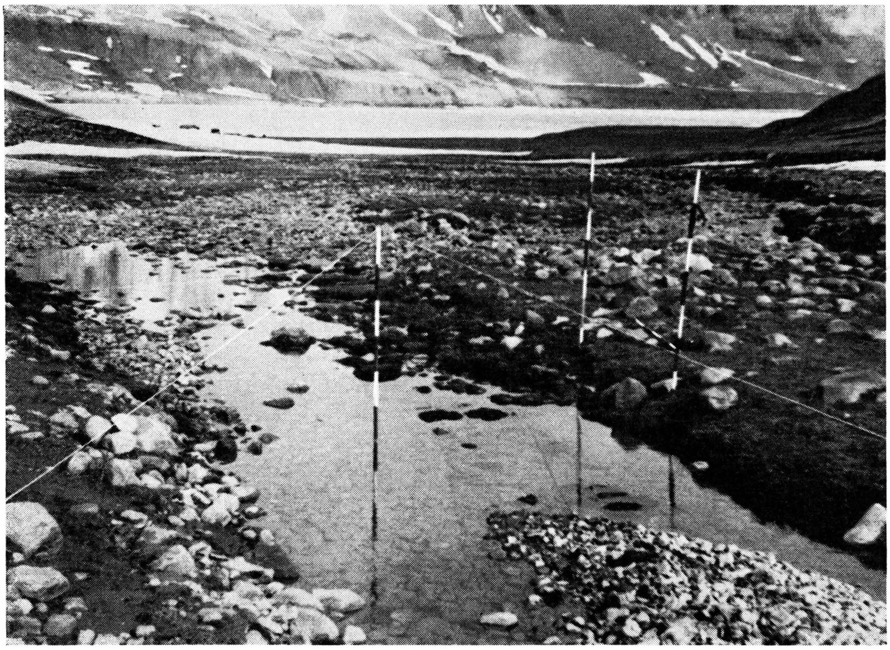

Fig. 13. The Kedelkrogelv at the measuring locality June 10, 1950. T. H. phot.

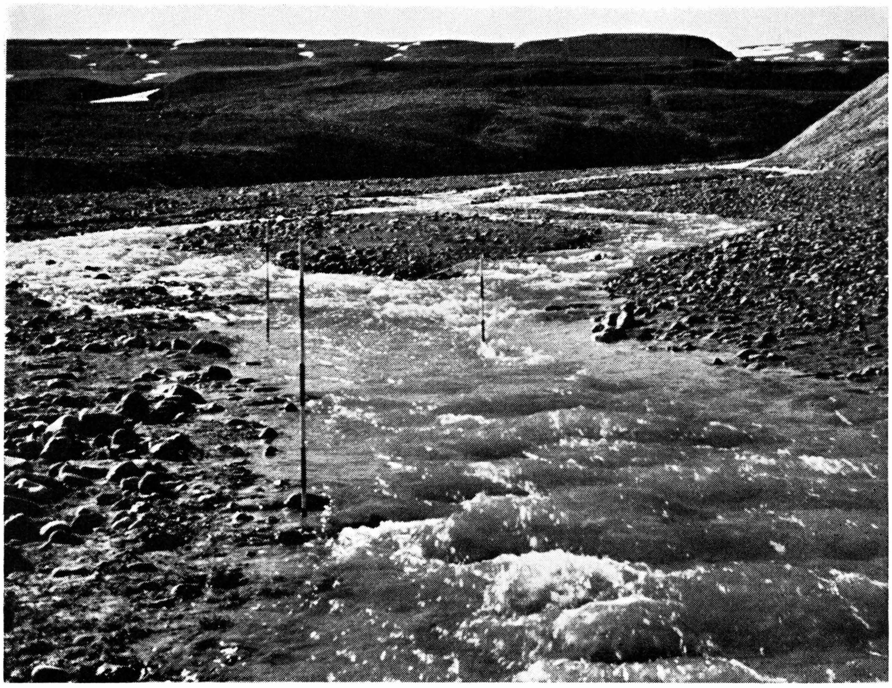

Fig. 14. The Kedelkrogelv at the measuring locality July 3, 1950. T. H. phot.

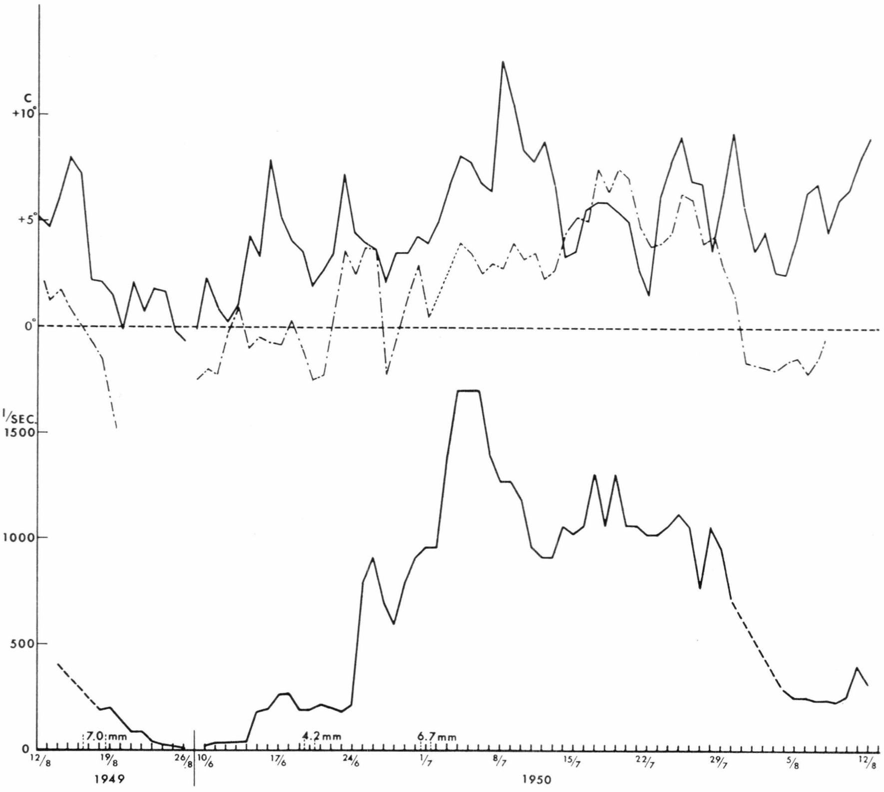

Fig. 15. Simultaneous graphs showing: above, the diurnal mean temperature at Brønlundhus (solid line) and the permanent camp on Chr. Erichsens Iskappe (broken line); below, the run-off of the Kedelkrogelv in l/sec. For further explanation see text.

flow on the 4th to the 6th July the discharge was calculated to be 1700 l/sec, and then kept at about 1000 l/sec for the rest of the month, while August showed greatly decreasing values. The last reading was made on the 12th August a few hours before we left the area.

If the figures of 1949 are included, the material covers a whole season of run-off. It was soon made evident that the air temperature played the greatest part by far as regards the variations in discharge. Radiation was also taken into consideration, but nothing like a correlation with its variations could be established. Fig. 15 shows graphs indicating the mean temperatures for Brønlundhus and the climatological station at the permanent camp on the margin of the icecap;[1]) the catchment area of the river stretches between these two stations. Precipitation falling as rain is indicated at the bottom of the diagram. 17.9 mm in all fell during three periods with rain. As appears, the effect on the

[1]) Mean temperatures calculated on the basis of thermograms.

discharge is only just discernible. Ground water in a general sense does not exist. In loose soil a few decimetres thaw every summer. Movements of water through this thin layer play only a small part. Practically all the water of the river is melt-water from the perennial or non-perennial snow drifts developing on the slopes of valleys and ravines and at the bottom of canyons. As snowfall is practically always connected with strong westerly winds, the snow is most easily caught in narrow valleys running north–south, and in this respect the Kedelkrogelv is "well off", just as the other rivers making for the Jørgen Brønlund Fjord from the south. In this way morphological factors come to play a considerable part. Consequently a discharge was to be expected which is comparatively too great in relation to the precipitation.

The precipitation at Brønlundhus constituted a total of 72 mm water for the period with snow 1948–1949, and the extremely low value of 10.5 mm for the winter of 1949–1950. No validity can be attributed to these figures, as the snowfall is practically always connected with strong westerly winds, which makes a rain gauge most unsuitable as a meter of precipitation. Likewise a sufficiently representative setting-up of stakes simply is not possible. The measurements on the icecap, on the other hand, must be considered appreciably more reliable, as there is there a very large uniform expanse. Measured by means of rows of stakes as related on pp. 31–32 the accumulation in 1948–1949 constituted about 12 cm water (FRISTRUP 1951), in 1949–1950 10–12 cm.

Evaporation was also the object of certain investigations. The author does not, however, from the data available offer any numerical statements. By regular weighing of Petri dishes with ice I found that an evaporation worth mentioning from surfaces of ice started in the last week of March and increased very much towards the end of April. A conspicuous result of the intense evaporation in the late spring is that the whole of the general snow-cover, which, however, is thin, was gone before any melting could take place. A considerable layer, of course, also disappears from the surface of the snow drifts.

Perennial snow drifts are found here and there in the upper parts of the valleys in protected places. During warm summers they contribute to the run-off from the stored mass of ice. In cold summers the result may be an addition to the snow drifts. The diagram fig. 15 may give an idea of the time when the stores are broken into. As to the first part of the season of run-off, there is a clear connexion between air temperature and volume of water. The maximum at the locality measured is delayed 30–50 hours. As mentioned above, there are no reservoirs in the river system, apart from a single small lake. When the two temperature graphs are "working together", the connexion is more distinct than if they do not. About the 6th July the volume of water decreases, without a preceding fall in temperature. On the contrary the temperature graph for Brønlundhus just reaches its maximum at that time. The explanation must be that the larger and smaller snow drifts from the preceding winter are just then spent. The water must come from a few mainly elevated perennial snow drifts situated in shadowy places, where the local climate is somewhat different. The discharge is stabilized at a lower level, after which a correlation with the temperature graphs is again demonstrable, especially with the graph for the permanent camp, which is in good agreement with the fact that now it is the elevated supplies which have to give off water. Perhaps the whole picture is not representative of a prolonged period, as later measurement (meteorological observations 1963 and 1964) suggest that the summer of 1950 was somewhat above the average warm, a fact which explains the early falling back on the reserves. The catchment area above the hydrological station has been calculated at 27.8 sq. km by a planimeter on the map in 1:50.000. The total volume of water for the whole summer is calculated at 4.142.000 cu. m, the author having taken the liberty of filling in what is missing from 1950 by the figures from the same period in 1949. The total run-off thus becomes 15 cm. The result is of course subject to considerable uncertainty, yet the uncertainty hardly exceeds 20 per cent.

If we consider the figures of precipitation from the icecap as representative of the whole area, the result will be the paradoxical one that the run-off exceeds the precipitation, including precipitation in the shape of rain. The explanation has already been touched on: because of its orientation and topography the catchment area catches more precipitation than expressed by the figures from the icecap, and furthermore there is consumption in warm summers from the supplies collected in the masses of ice in the perennial snow drifts.

Measurements in rivers with a catchment area in another kind of terrain and differently oriented as regards drifting snow and insolation must give essentially different results in the case of minor streams. In the case of major streams with a complicated net of tributaries an equalization will take place. Rivers rising in glaciers have a somewhat deviating discharge graph. The maximum will be more marked, of shorter duration and comparatively higher, conditioned, as it highly is, by the short period of melting on the glacier. The Glaciologelv is a good instance of a river of that type. No measurements have been made, but its habits are well-known from a large number of visits in 1949–1950 and 1963. In the last-mentioned year the channels in the delta during the melting period on the glacier, although this was short and faint, were changed from easily fordable water-courses to swelling torrents. The development of this delta has taken place on the abovementioned submarine terrace. The silting now takes place in deep water, and the submarine slope of deposits is extremely steep.

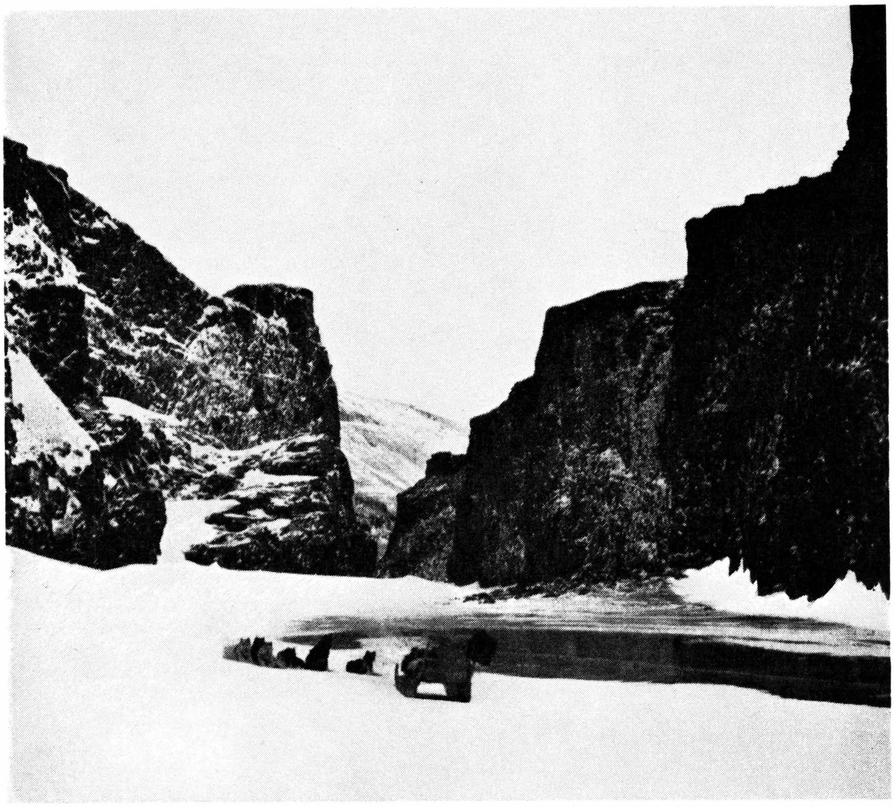

Fig. 16. The canyon of the Itukussuk Elv. K. SØRENSEN phot. March 1950.

The huge river Midsommerelv, which drains off most of southern Peary Land and a considerable part of the great icecap falls into the bottom of the fiord. The drainage area is estimated at 20–25.000 sq. km. Its source is the lake Aftenstjernesøen about 100 km west of the delta. It flows through the two large lakes Øvre and Nedre Midsommersø, which clarify its water. Farther down the clear water of the Midsommerelv encounters the milky white water from the large tributary from the south, the Itukussuk Elv, and the two streams are seen to flow together without being mixed. The Itukussuk Elv comes from the lake Inuiteq Sø in front of Hobbs Gletcher. Soon after leaving the lake it receives a long tributary, which drains off the long valley, Himmerland Dal, north of Storm Iskappe. The meltwater which flows from the two tongues of Chr. Erichsens Iskappe, adds to the amount of sediments. Having passed the other tongue, the river flows through a 10–12 km long picturesque canyon eroded some tens of metres into basalts. Beautiful columns are seen in many places in the walls. The author in the early spring of 1950 passed through the whole canyon by dog sledge accompanied by KRISTEN SØRENSEN (fig. 16).

In the northern side of the delta of the Midsommer Elv the Geologelv has formed a huge alluvial cone consisting of sand, gravel, and pebbles. The river comes down torrentially through a deep and narrow ravine, its main catchment area being the plateau of the Frysefjeld. A small tributary comes from the peculiarly situated lake between Buen and Bueknoppen.

The hanging valley between Buen and Frysefjeld is drained off towards the north to the Krengerup Elv. The valley floor is strewn with small lakes often surrounded by small pieces of meadow land, where musk oxen are very frequently met with.

The plateau of Buen dips slightly to the north and is therefore almost exclusively drained off in that direction. Through two gaps in the escarpment, however, two mountain torrents carry water to the fiord. A third, somewhat longer mountain brook drains off the southeastern corner down to the lagoon flats north of the mouth of the Børglum Elv. The latter river, which, indeed, is a considerable stream, can by no means match the Midsommerelv as regards the discharge. In late summer it almost dries up, and thus does not in winter form a sledge route into the interior as the Midsommerelv system does. Its affluents have their origin in the tongues of ice deriving from the south side of the ice-caps in central Peary Land. A characterization of the main valley has been given in a previous section (pp. 34–37).

The small streams that converge on Slik Bugt, have all a short period of discharge, which is due to the fact that only small quantities of snow accumulate in their valleys. The water in these streams is yellowish from clay silt, for which reason the largest of them has been named the Gulelv (Yellow River).

The formation of gullies which to such a great extent takes place within the areas in which the marine clay occurs, is in most cases, as regards the rate of the development, dependent on the amounts of snow accumulating in the gullies. Consequently the process has a tendency to intensify itself. In order to obtain an idea of the rate of the erosion on this point, the author in 1950 marked out the upper end of a small gully in the coastal cliff below the western flank of Flaghøj (see fig. 17). At the same time some photos were taken. In 1963 the upper end had moved back 16 m, and some branching had taken place. Such a figure, of course, does not say very much, dependent as it is on a large number of factors. It should, however, be added that conditions in the place match very well with those found elsewhere along the fiord.

The magnificent canyons found in so many places in southern Peary Land, mainly seem to have been cut by running water, although crevices and fissures in the sedimentary rocks have prepared the work. In many cases it cannot have been the present streams which

Fig. 17. Gully being formed in slope towards the fiord north of the lake Klaresø. Since 1950 it has cut 16 m farther backwards (forward in the picture). Scale: 2 m. T. H. phot. August 1963.

have been able to manage this. A large part of the process must have taken place in a period when the rivers in question received much larger amounts of glacial melt-water. Thus the Botaniker Elv is now rather a modest brook, which in its lower course passes through a good-sized canyon. The considerable delta, to a great extent built up by very coarse-grained material, is also evidence of a stream much more abounding in water.

The course of the small Arkæologelv is determined by crevices and fissures in the firm rock, as is seen from the aerial photos. Near its mouth it forms a waterfall in the same way as the Kajakelv, the Zoologelv, and the Glaciologelv.

The Kajakelv has in the margin of the plateau modelled a canyon at the upper end of which there is a waterfall. Coming down on to the plain Oksesletten it forms an extensive inland delta consisting of a very coarse-grained material. After the delta it splits up into many branches, which water rich meadows. Still larger meadows are found along the lower course of the Zoologelv, a veritable oasis in the dry and desolate country. This river perhaps receives some melt-water from the ice-cap by seepage through the "felsenmeer" on top of the plateau between the margin of the glacier and the edge of the plateau.

To sum up, it may be said of the pattern of drainage in the area that, as might be expected, it shows all the characteristics found in a young landscape: Faintly developed valleys (especially where glacial erosion has not prepared the work) and many rapids and falls, and where the gradient is small, a splitting up into many channels, sometimes with bifurcations.

As elsewhere with prevalent desert-like conditions the vegetation is greatly dependent on running water, and good-sized areas covered with grasses and the like are almost exclusively found along brooks and small rivers.

Another conspicuous feature connected with running water is the part played by the outflow of relatively warm fresh water for the dissolution and melting of the ice on the Jørgen Brønlund Fjord. The Midsommerelv is seen to produce a large ice-free area and the Børglum Elv contributes to having the fiord ice cut in two pieces, which then may begin to drift and gradually will be broken into smaller and smaller bits.

The picture of the hydrology of the area is not complete without some remarks on the lakes.

According to TROELSEN and other authors the Quaternary formations mainly consist of stratified marine clay overlaid by melt-water formations which mainly consist of coarse-grained sand and gravel.

South of the Jørgen Brønlund Fjord, about a half or whole kilometre inland, there is a row of roundish lakes. Most of them without any doubt fill the bottom of kettle holes arisen solely in the melt-water deposits. The depth of these lakes is moderate. The lake Lersø is very shallow, 0.3–0.4 m. In Klaresø BENT FREDSKILD (personal communication) measured 3.5 m as the maximum, in Grydesø 5.5 m, in Opalsø 2.4 m. "Gadekæret" east of Opalsø, Bagsværd Sø and the lakes immediately east of that are all very shallow.

The kettle holes near the northeastern part of the fiord are of an early date. They cut deep into the stratified clay, perhaps pass through the deposit of clay. Slik Bugt is formed by a complicated system of such holes, which do not fully manifest themselves in the course of the 5 m line of depths on the map. The small cove behind Drivtømmernæs is a hole of the same kind, with very steep sides and a maximum depth of 8 m. A similar, somewhat larger hole, also with a maximum depth of 8 m, is found behind the shallow bay between Kængurunæs and Nynæs. It is connected with the fiord by a short and shallow channel. The two lakes not far from the coast between Drivtømmernæs and Kap Harald Moltke probably also belong to this group of kettle holes, at least in the northern one BENT FREDSKILD has put out 7.6 m line without reaching bottom.

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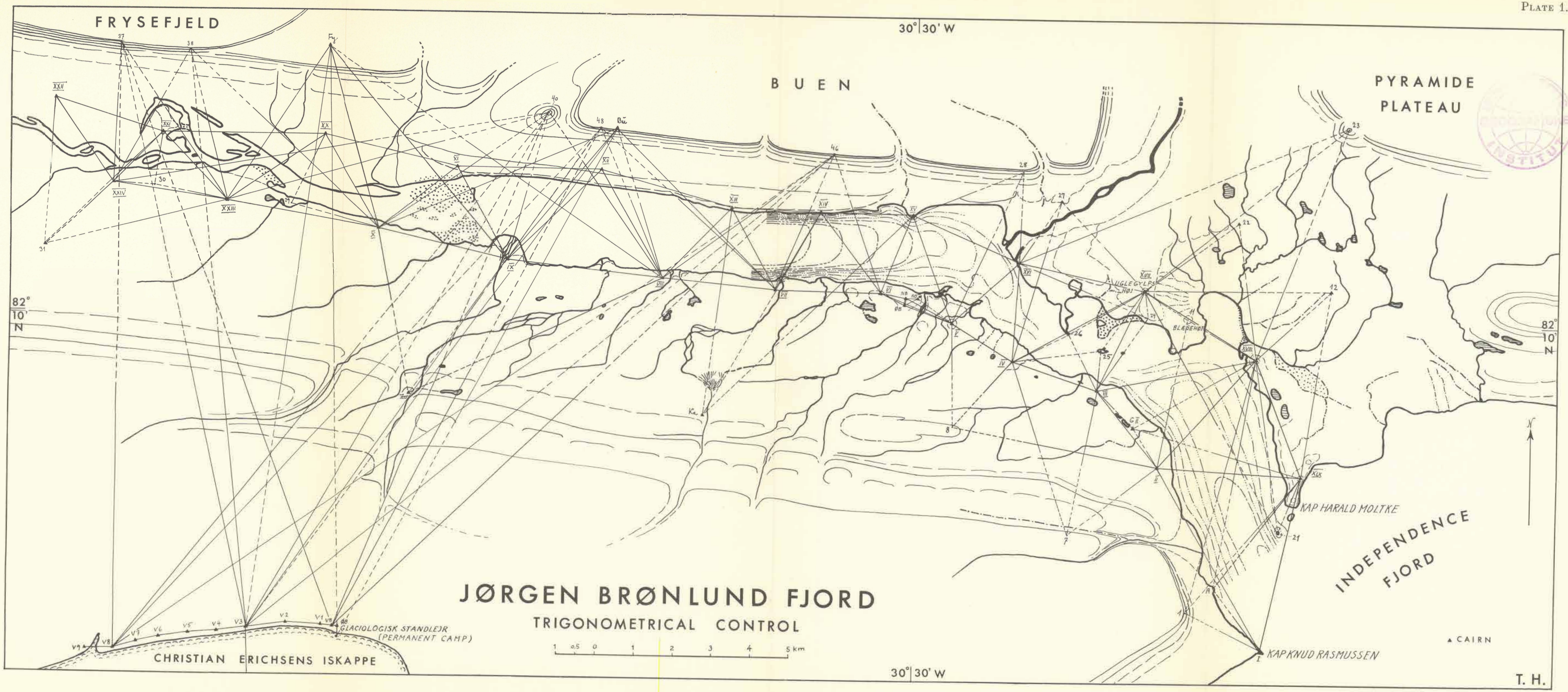
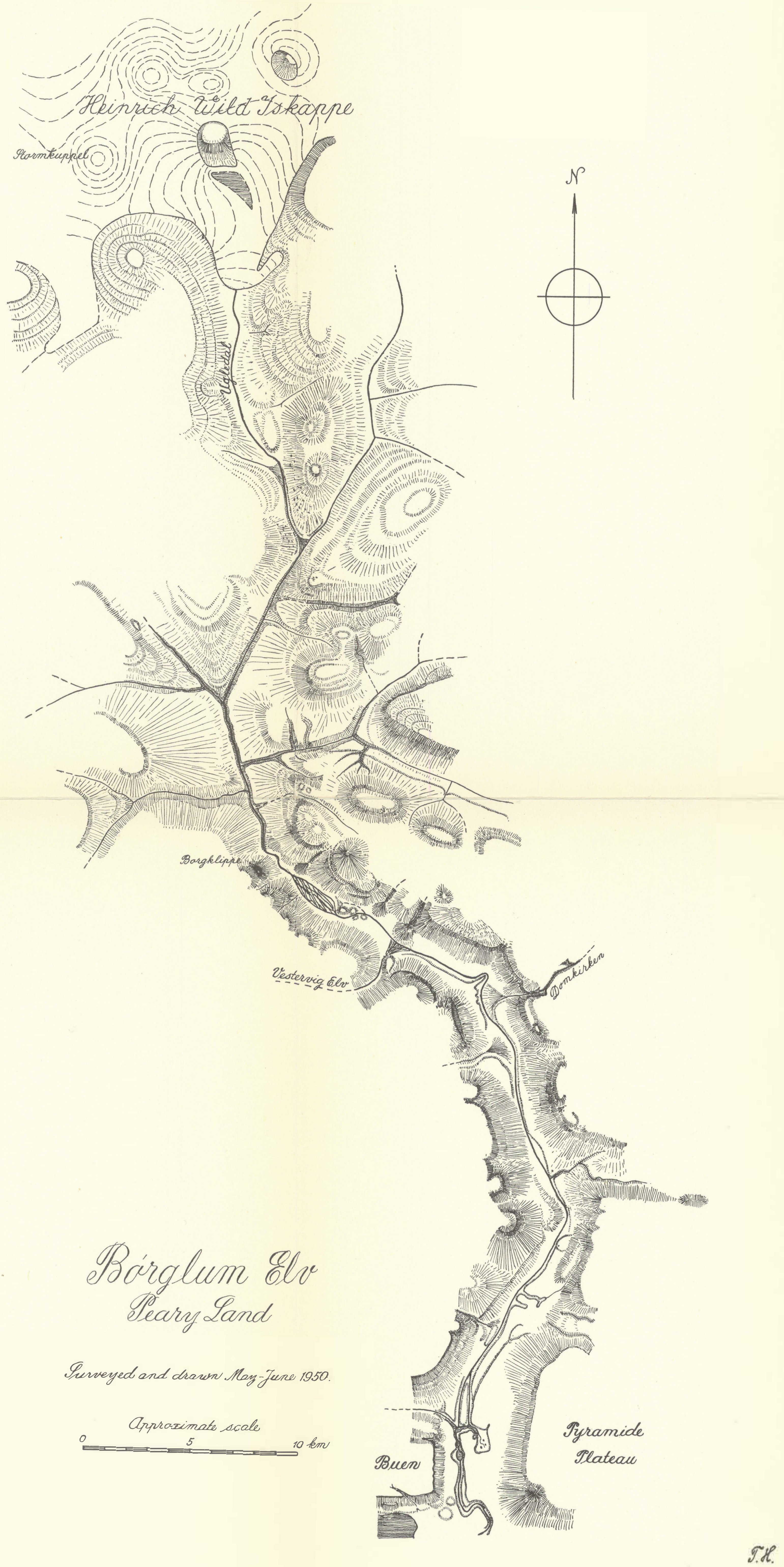
Færdig fra trykkeriet den 16. januar 1970.


FRYSEFJELD
BUEN
PYRAMIDE
PLATEAU
30° 30' W
82° 10' N
UGLEGYLPS HØJ
BLÆSEHØJ
KAP HARALD MOLTKE
INDEPENDENCE FJORD
KAP KNUD RASMUSSEN
GLACIOLOGISK STANDLEJR
(PERMANENT CAMP)
CHRISTIAN ERICHSENS ISKAPPE
JØRGEN BRØNLUND FJORD
TRIGONOMETRICAL CONTROL
1 0.5 0 1 2 3 4 5 km
▲ CAIRN
T. H.


Heinrich Wild Iskappe
Stormkuppel
N
Uglerdal
Borgklippe
Vestervig Elv
Domkirken
Børglum Elv
Peary Land
Surveyed and drawn May-June 1950.
Approximate scale
0
5
10 km
Buen
Pyramide
Plateau
T.H.

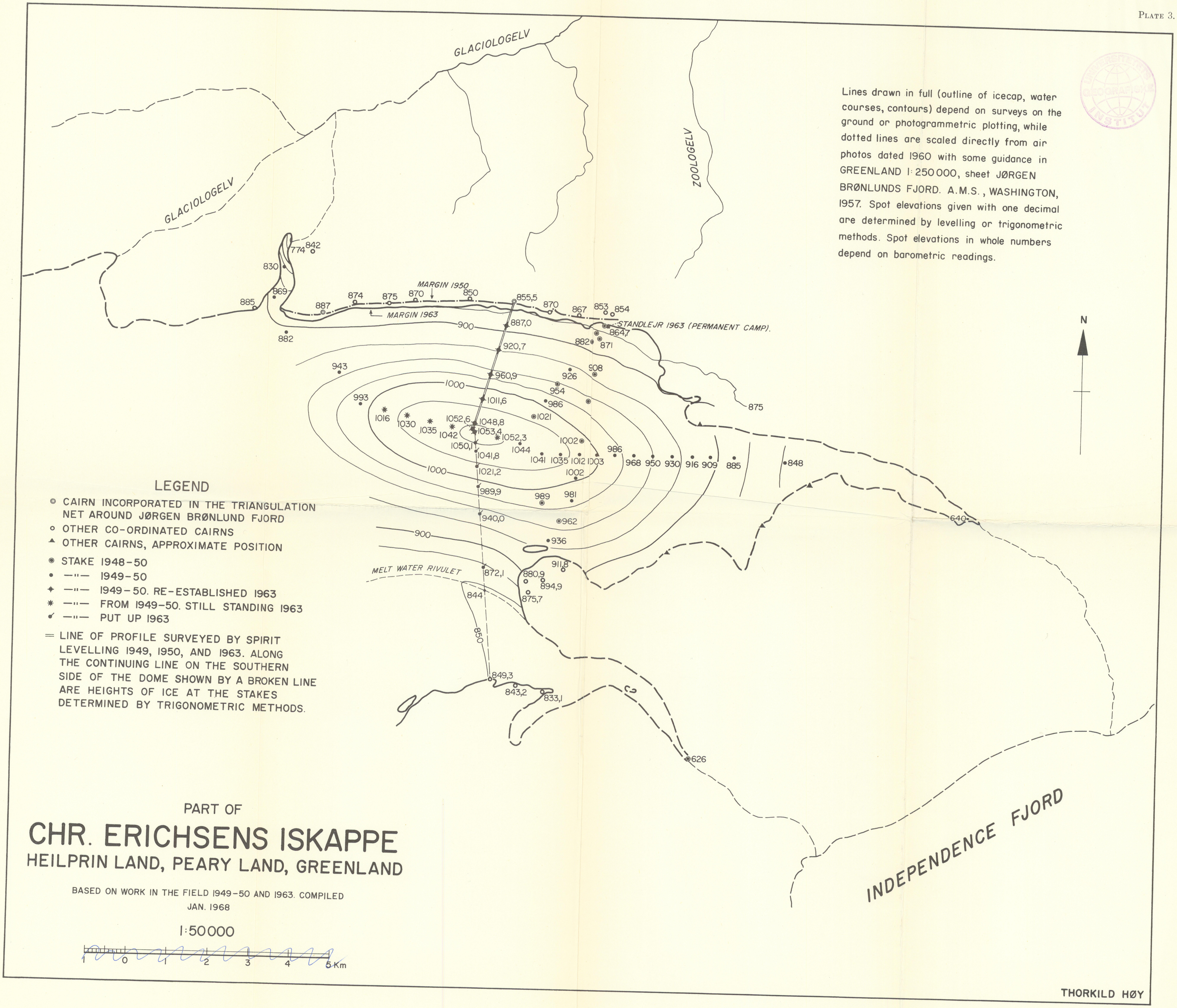

Lines drawn in full (outline of icecap, water courses, contours) depend on surveys on the ground or photogrammetric plotting, while dotted lines are scaled directly from air photos dated 1960 with some guidance in GREENLAND 1:250000, sheet JØRGEN BRØNLUNDS FJORD. A.M.S., WASHINGTON, 1957. Spot elevations given with one decimal are determined by levelling or trigonometric methods. Spot elevations in whole numbers depend on barometric readings.
GLACIOLOGELV
GLACIOLOGELV
ZOOLOGELV
MARGIN 1950
MARGIN 1963
STANDLEJR 1963 (PERMANENT CAMP).
MELT WATER RIVULET
INDEPENDENCE FJORD
N
LEGEND
CAIRN INCORPORATED IN THE TRIANGULATION NET AROUND JØRGEN BRØNLUND FJORD
OTHER CO-ORDINATED CAIRNS
OTHER CAIRNS, APPROXIMATE POSITION
STAKE 1948-50
—"— 1949-50
—"— 1949-50. RE-ESTABLISHED 1963
—"— FROM 1949-50. STILL STANDING 1963
—"— PUT UP 1963
LINE OF PROFILE SURVEYED BY SPIRIT LEVELLING 1949, 1950, AND 1963. ALONG THE CONTINUING LINE ON THE SOUTHERN SIDE OF THE DOME SHOWN BY A BROKEN LINE ARE HEIGHTS OF ICE AT THE STAKES DETERMINED BY TRIGONOMETRIC METHODS.
PART OF
CHR. ERICHSENS ISKAPPE
HEILPRIN LAND, PEARY LAND, GREENLAND
BASED ON WORK IN THE FIELD 1949-50 AND 1963. COMPILED JAN. 1968
1:50000
1 0 1 2 3 4 5 Km
THORKILD HØY

Plate 3.

JØRGEN BRØNLUND FJORD REGION
PEARY LAND, GREENLAND

Field survey including soundings by 1st and 2nd Peary Land Expedition 1949–50 and 1963 (surveyor: Thorkild Høy).
Air photography 1960 by Geodetic Institute.
Stereoplotting and compilation of topography by Geodetic Institute 1965.

Heights and depths in meters.
Contour-interval on land 25 meters.

Geografiske koordinater for Brønlundhus:
30° 30' W og 82° 10' N

1:50000

1 0 1 2 3 4 5 km

Stony and gravelly deltas in a dynamic stage.
Clay pans, clayey tidal flats and diluvial fans.
Ice cap.
Ravine or intermittent stream.

Printed by Geodetic Institute.
Copenhagen 1968.