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THE SCORESBY SOUND COMMITTEE'S 2ND EAST GREENLAND EXPEDITION IN 1932 TO KING CHRISTIAN IX's LAND
Leader: Einar Mikkelsen

MAP-MAKING DURING THE EXPEDITION

BY

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WITH 4 FIGURES IN THE TEXT AND 2 PLATES

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I. The Programme.

The cartographic programme of the Expedition corresponded to the general scheme of work which had been formulated by Captain Mikkelsen before our departure from Copenhagen. Although, where so much depends on weather and ice, rigid plans are impracticable, it was at least possible to consider the survey work as comprising two comparatively independant problems. The first corresponded with a rapid passage of the ship from Cape Dalton (Lat. 69°25′ N.) to Kangerdlugsuak (Lat. 68°05′ N.) and the second with a sojourn in the fjord Kangerdlugsuak during which time would be available for a more elaborate investigation.

In the first case therefore, our problem was to do as much new survey of the coast as we could; in the second case we would try to make a large scale special map of high precision. It was furthermore our intention to endeavour to locate the new range of high mountains seen and photographed by Watkins in 1930 and mentioned by Stephenson. (Stephenson (1932) p. 5).

II. Previous work.

The hitherto available map of the coast between Angmagssalik and Scoresby Sound consisted in the greater part of the survey carried out by G. C. Amdrup in the years 1898—99 and 1900 (Amdrup (1902)). Some slight adjustment of the coast-line south and west of Kangerdlugsuak has since then been made by the British Arctic Air-Route Expedition (Watkins (1932) and Stephenson (1932)), but to the north and east the map remained as published in 1902. This map was made during the boat-journey from Cape Dalton to Angmagssalik and is nothing less than a remarkable piece of work. The circumstances during the rowing of a small open boat, deeply laden, through the ice of a savage and unfriendly coast, are not favourable to the continuous observation and concentration required for map-making; the surveyor who comes later with modern equipment and a comfortable ship has frequent occasion to be astonished by the merits of Amdrup's map.

At the time of Amdrup's journey, very little previous information was available. To the north, Scoresby's map, (Scoresby (1823)) which sketched the coast northwards from Cape Barclay and which gave the various English names such as Cape Dalton, Henry's Land etc. to this stretch of coast, had been slightly improved by RYDER in 1892 (Ryder (1895)). The coast south and west of Cape Barclay had been named by Amdrup the DE BLOSSEVILLE coast after the officer who first made a report of it (de Blosseville (1834)). The sketch-map prepared by de Blosseville had been used by WANDEL (Wandel (1883)) in making a somewhat better representation of the coast during the voyage of the schooner "Ingolf" in 1879. But previous to Amdrup's journey the stretch of coast under consideration had in no wise been traversed and was less well known than that lying on either side, to the north as well as to the south.

In Kangerdlugsuak itself the first survey was that carried out by Stephenson and the B. A. A. R. E. in 1930. This survey revealed the curious fact that the description given by the Angmagssalik Eskimoes to Gustav Holm (G. Holm (1889) p. 217) in 1885 gave a better idea of the size of the fjord than Amdrup's sketch made from the mouth of the fjord itself. The English map — a plane-table sketch published on a scale of 1 : 400,000 — although little more than a drawing of the coast-line was of sufficient merit to make it necessary for us to exert ourselves considerably if a new survey was to be worth while.

III. Equipment.

The survey group comprised only Topograf Larsson of the Geodaetisk Institut in Copenhagen and myself. Captain Mikkelsen, however, allowed us as a rule the use of a motor-boat and the services of one member of the ship's company. We are very grateful to Styrmand R. B. Christensen for his assistance.

The method of survey to be used along the de Blosseville coast could hardly be decided before our arrival because we had no adequate information about the conditions likely to be met. The method of extension of a vertical base whose length is measured with an aneroid barometer has recently been popular in East Greenland (Cf. Seidenfaden (1931)). The English have found a small artillery range-finder indispensable. (Watkins (1932): Appendix on survey).

We took with us a Wild Theodolite (the "Universal") and the Wild Plane-Table equipment from the Geodaetisk Institut. The Royal Geographical Society of London lent me an additional plane-table, a chronometer-watch, two precise Survey barometers (Casella and Paulin) and a Casella $3^1/_2$ inch micrometer theodolite. We were thus prepared for most eventualities when, after an amazingly quick passage through

a gap in the pack-ice, we reached Cape Dalton at midday on July 10th.

We had decided to use terrestrial photogrammetry in Kangerdlugsuak. To this end Professor Nørlund supplied us with the small photo-theodolite named the "Kleiner Photogrammeter". This is an instrument exposing a plate 9 × 12 cms, having an objective of 13.5 cms focal-length and weighing 7 kgs in its case. Originally designed by Professor Hugershoff it is now manufactured by the Zeiss concern in Jena, Germany. Our model had been modified so that it could be mounted on the Wild stands. The photographic material was supplied by the Perutz firm in Munich and consisted of the famous "Topographic" emulsion specially prepared on "machine" glass in order to save the weight and expense of plate glass. (Spiegelglas). The photogrammetric equipment remained below hatches as long as we were travelling down the coast.

A "Viking" sounding-machine (a pressure-tube type of sounding-machine) was mounted on M/S "Søkongen". When opportunity allowed, which unfortunately only too seldom happened, soundings were made as part of the survey work. Thus in approaching Cape Dalton it was possible to locate approximately the 100-fathom line.

IV. Procedure.

The ship's movements down the coast were largely influenced by considerations other than cartographical. Coastal survey under such conditions becomes a matter of quick adaptation to the particular circumstances. Nevertheless we used in one form or another the "short-base" technique at every occasion.

If the angle subtended at a distant point by the ends of a base-line of known length be measured, its distance may be calculated. The method had occurred to me while performing the reverse operation in Switzerland, where the length of a photogrammetric base-line is often determined by means of the angle subtended to a point lying at known distance. It was somewhat to my surprise that I found that the method whereby the position of distant points is found from observations at the ends of a short-base had already been developed and put into service a year previously by Colonel Jensen of the Geodaetisk Institut for the Danish surveys in Iceland.

Wherever possible we filled in the topography by plane-table methods between points determined from a short-base. Astronomical sights for latitude, longitude and azimuth gave orientation and position for each unit of the map so prepared; the connection of subsequent sections was also assisted by observing long rays ahead to conspicuous points.

Our experiences confirmed my suspicions that it is inadvisable to carry out a survey even on such a small scale as 1 : 200,000 without

moving about the country with a plane-table sheet. A reason for this is that the position of approximately one in every ten points determined by the short-base method under expedition conditions contains a large error: another is that field-sketching or photographs from a single point can never give a sufficiently plastic impression of mountainous scenery. The distances are so great that the apparent impression of relief is caused only by light and shade and can be very misleading. Photographs taken from the ends of a long base, say 200 m long, can be used in the office later stereoscopically so as to give an impression of relief which is correct. Such stereoscopic pairs can be made with a hand-camera; they should be exposed as frequently as possible and will be found to be of very great value. Fog may dislocate the best laid scheme of work; but photographic pairs may rescue the surveyor from a consequently awkward situation.

V. The Coast and the Weather.

About the Scoresby Sound region slopes are gentle and the coastal mountains comparatively low. At Cape Hammer by Kangerdlugsuak (see Fig. 1) the mountains fall precipitously into the sea and jagged peaks rise abruptly 1000 m from the water. The coast in between presents in general a gradual transition from one type of scenery to the other. To the south and west of Cape Grivel (see Fig. 9. Bd. 104. Nr. 1) the physiography tends to conform to the Cape Hammer type, while to the north and east rather to the less severe type. Thus no great difficulties were experienced in making landings or in finding suitable observation-stations north of Cape Grivel. We had, however, some difficulty by Cape Ravn; and the coast between Cape Ravn and Cape Irminger, which has not yet been newly surveyed, will be found to be unusually difficult since the positions where a landing is possible are rarely good points of vantage.

The weather along the de Blosseville coast in summer is characterised by a pronounced tendency to form fog. Fog sometimes disappears during the forenoon; but if the wind persists in coming in from the sea, fog continues. During fine weather the Föhn type of katabatic wind flowing down from the ice-cap seemed to reach sea-level; but only in Kangerdlugsuak was this "nerrajak" sufficiently strong to impede our work. The fog on the other hand is a continual anxiety since it forms very suddenly. The surveyor is obliged to plan his work so that if the fog should come he can at least make good the time already spent.

VI. The Coastal Survey.

a. Cape Dalton — Cape Ryder.

Cape Dalton is a mountainous peninsular connected to the land by a low isthmus which juts out far enough from the land to command a

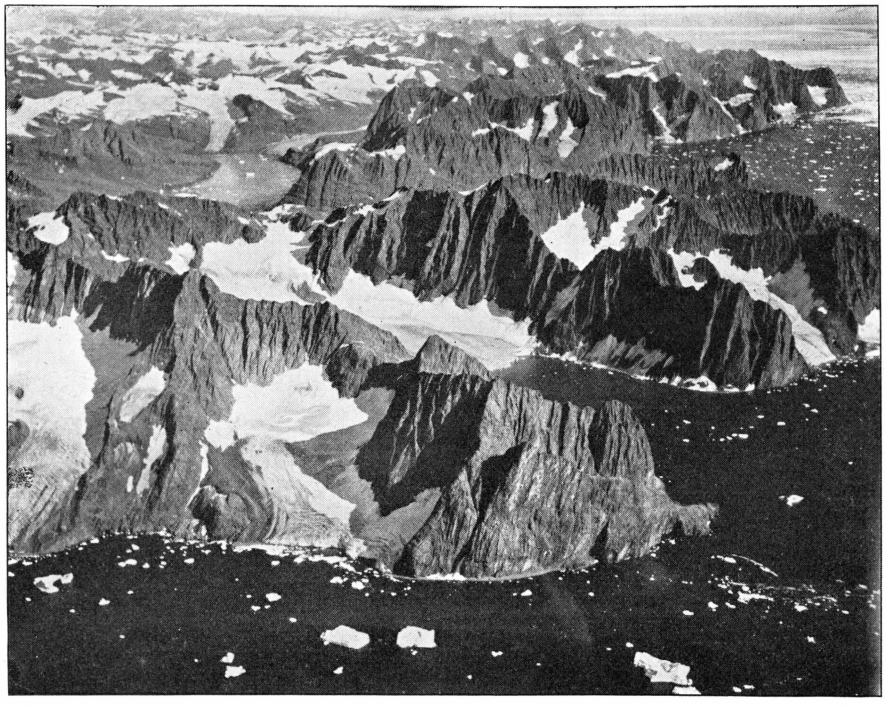

Fig. 1. Cape Hammer and Mikis Fjord. (Photo. H. G. WATKINS).

view along the coast in each direction (see Fig. 2). Early in the morning of July 11th, Larsson set up a base from which could be seen Capes Barclay and Ewart as well as some mountains inland. Morning and noon sights of the sun were taken. While Larsson assisted by Dr. Jensen occupied the station, I made a plane-table triangulation and contoured sketch of the district about Cape Dalton on an open scale of about 1 : 40,000. The orientation and length of my base-line were determined

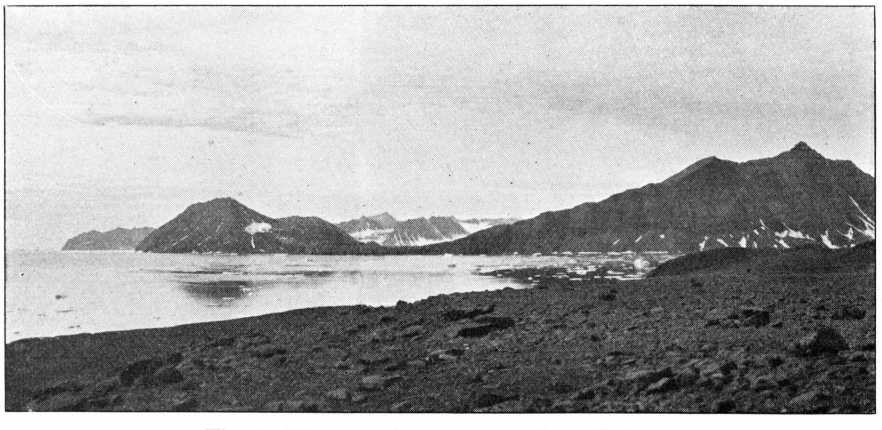

Fig. 2. View southward from Cape Dalton.

by Larsson. A number of points determined independantly by Larsson and myself agreed so well in position and height that I began to have confidence in the short-base method of survey.

We had hoped to be able to fill in the topography between Cape Dalton and Cape Barclay either by plane-tabling from shore-stations or with sextant and station-pointer from the ship during the course of July 12th.

But the morning of the 12th was foggy; by midday it was hardly possible to make out land and ice a ship's length ahead. This was the first of a series of similar exasperating experiences.

The next glimpse we had of the land was at 7.00 p.m. "Søkongen" had been brought fast into some bay-ice in the bight inside of Cape Ewart; since the ship seemed to be lying quite motionless I set up the plane-table and endeavoured to identify detail from the new point of view in order to resect my position. The effort revealed the fact that even bay-ice rotates "en masse"; nevertheless it helped to identify several of the points opserved from Cape Dalton.

At 3.00 a.m. the ship moved to an anchorage under Cape Barclay (see Fig. 3. Bd. 104. Nr. 1). After fitting out the motor-boats we returned independantly to Cape Ewart and began the survey of the inlets into Knighton Bay, which had already been observed by Captain Mikkelsen to be larger than charted. The central inlet proved to be a fjord $4^1/_2$ miles long, at the head of which a large glacier comes down a narrow valley between high mountains. The upper part of the fjord is a steep-sided gorge opening out towards Knighton Bay. On the west side near the mouth is a hot-spring (about 50° C.) which may be detected by a plume of sulphurous steam and a line of bright green vegetation. As soon as we had made a plane-table station here the fog came down, making it impossible to survey the western arm of the bay and obliging us to lay a compass-course for Cape Barclay.

During the same day Larsson had established a station on a rocky spit by Cape Barclay, probably the exact site of Amdrup's observations and 60 metres high. From this station on July 13th points about Barclay Bight were fixed and on July 14th points down the coast as far as Cape Ryder. In this way I could fill in the topography of Barclay Bight on the 14th; the general plan, that Larsson should prepare points one day and that I should use the same points on a plane-table sheet next day was thus carried forward.

Unfortunately on neither day was a latitude sight of the sun at midday possible.

An enormous glacier whose size is not grasped at first sight flows into the north side of Barclay Bight. According to our observations this glacier is 9 km wide and is therefore, in spite of the fact that Wager's

observations would show that it had no connection with the inland-ice, twice as broad as the great glacier at the head of Kangerdlugsuak. So much ice is thrown into Barclay Bight from this glacier that it is impossible to get more than half way up the bay with a boat.

The ship sailed at 6 p.m. on the evening of the 14th. Mapping was carried on from the ship with sextant and station-pointer as far as Cape Ryder.

b. d'Aunay Fjord (see Fig. 4. Bd. 104. Nr. 1).

The motor-boat left "Søkongen" during the forenoon of July 15th. The programme in d'Aunay Fjord was more difficult since we were allowed only until noon of the succeeding day for the survey of the entire fjord, including an awkwardly situated branch inlet near the entrance. Larsson, assisted by the carpenter, occupied a station fairly high up the side of the fjord and made the astronomical observations; in addition he measured in sufficient points to give scale and control to my plane-table sheet, which was made as a plane-table triangulation without any preliminary groundwork. The night was spent in camp at the mouth of the fjord. Fog the next morning provided the usual disappointments and difficulties. Nevertheless we could return to the ship with a fairly well completed map at midday. We immediately prepared a sheet to carry the coastal survey forward, but as soon as we were clear of Cape Coster thick fog put further work out of the question.

c. Cape Beaupré — Cape Grivel.

We arrived on the evening of the 17th in an unnamed bay by Cape Daussy after troublesome navigation through fog and ice. Next morning, the weather being fine, we returned as far as Stor Brae along the coast which we had not previously been able to see. Just south of the glacier there is a headland 180 m high which we climbed; from here points in either direction along the coast, from Cape Beaupré to Cape Tupinier, could be seen and measured. The directions of these points were drawn directly on the plane-table sheet; the same evening the distances were calculated and the points plotted in preparation for next day's work, the whole being completed by 10.30 p.m. The 19th, however, produced an exasperating low-lying fog which suddenly cleared in the afternoon about an hour before it was necessary to rejoin the ship. Somewhat disheartened I sketched in as much as possible before leaving the bay.

The topography of the stretch of coast from Cape Daussy to Cape Grivel was made from the ship. We had made a base, from which longitude and azimuth were determined, under the cape opposite Cape Daussy; from this base, points down the coast as far as Cape Grivel were measured. The valley in which the lake and the Committee's

house lie was quickly sketched on the plane-table a few hours before the ship sailed.

d. Cape Ravn and Wiedemann's Mountains (see Fig. 12. Bd. 104. Nr. 1).

Already before Cape Grivel difficulties had been experienced in coming through the ice. Soon afterwards the ship was beset; three days of beautiful sunshine were spent lying a few miles off Cape Ravn. This gave a not unwelcome opportunity for rest and refreshment; we also began the preliminary compilation of the coastal map on a scale of 1 : 200,000.

On the 25th July the ship succeeded in working a passage through the ice into a fjord to the eastward of Cape Ravn. Ice conditions made it impossible to leave the fjord again for some days, whereby we had adequate time to complete the survey of the fjord and of the neighbouring mountains. Since, however, we had to be in constant readiness to sail, we could not be absent from the ship for any length of time; hence any further exploration of Wiedemann's Mountains (highest point 2473 m above sea-level) was out of the question. Eventually on the 2nd of August the twin impediments, fog and ice, allowed us an unhindered passage out of the fjord; but our preparations to carry the survey farther down the coast were in vain. First mist, then rain and storm forbade all cartography. This very unpleasant weather lasted for three days and is responsible for the long stretch of coast, from Cape Stephensen to Cape Irminger, that still remains to be resurveyed.

e. Results and Compilation.

The field-work was available after our return as follows:

Cape Dalton district	1 : 50,000
Cape Dalton to Cape Ryder (30 miles)	1 : 100,000
d'Aunay Fjord	1 : 50,000
Cape Beaupré to Cape Grivel (38 miles)	1 : 200,000
Cape Ravn district	1 : 200,000

In the assembly of these various sections particular attention had to be paid to the astronomical observations. These were of course all observations of the sun, since the nights until the middle of August were to bright for star observations. Computations followed the method described by Colonel Jensen (P. F. Jensen (1923)) where each observation is corrected for semi-diameter and separately computed. The observations were thus revealed to be good inasmuch as they were self-consistent.

We had had misfortune in the field in that the chronometer-watch lent by the Royal Geographical Society stopped as soon as we reached the Greenland coast, in spite of two previous months of astoundingly

good time-keeping. We had therefore to rely on a Waltham open-face watch belonging to Captain Mikkelsen and originally presented to him by the makers in 1909 for the "Alabama" Expedition. The watch, which we could control frequently at the ship's wireless receiver, kept remarkably good time.

Had the weather permitted, each theodolite station would have been independantly fixed from astronomical observations. Cape Dalton is completely fixed. But Cape Barclay was only determined in longitude. A connection between the two surveys was possible on account of the fact that the mountain 893 was visible from each station.

d'Aunay Fjord hangs on a fully determined station. But at the stations south of Stor Brae and opposite Cape Daussy, longitude and azimuth observations only could be made: hence these stations have latitudes determined indirectly in the following way. Amdrup's latitude for Cape Grivel was adopted; it was then found that two mountains surveyed from the Stor Brae station had also been surveyed from Cape Daussy. The latitude thus derived for the Stor Brae unit gave a position for Cape Beaupré that was in full agreement with the d'Aunay Fjord survey.

In Cape Ravn two fully determined stations were made: these were found to be in good agreement one with the other.

During the working up of the field-sheets considerable use was made of the private photographs made by the other scientific groups of the Expedition in the course of work which often took them to viewpoints unfamiliar to us. The geological party made a special point of assisting the cartography with observations and photographs: in certain cases rounds of angles were made with a prismatic compass whose bearings were controlled by a sun-azimuth or a back-bearing to some known point. The brothers Wager were in this way able to fix the positions of some of the conspicuous mountains lying some distance inshore; their observations were also valuable in securing a more general impression of the physiography of the coast than was possible to us.

Outstanding high mountains standing a little within the de Blosseville coast have appeared on all the maps of the region and indeed on maps of the whole of Greenland. At great distances these mountains appear to stand considerably higher than their neighbours. Their positions have been roughly determined by various expeditions and especially by the "Ingolf" expedition of 1879, (Wandel (1883)). One of these whose approximate position was Lat. 69° N. and Long. 26° W. was identified by Wandel as the Mt. Rigny of de Blosseville.

During Amdrup's boat-journey a high mountain was seen along the line of the glacier in de Reste Bugt; this was taken to be Mt. Rigny, since a slight adjustment of the longitude of the Wandel determination

would bring the mountain into this line of sight. Wandel's determination of the height and of the latitude are therefore retained in Amdrup's map. Our determination of the position of this mountain places it considerably farther inshore and raises a doubt as to whether this mountain was really identical with that intersected by Wandel as Mt. Rigny. However, for the sake of continuity the name Mt. Rigny is retained for the mountain seen from de Reste Bugt. Since we made no theodolite observation to this mountain, Wandel's estimate of the height (which we controlled by a sextant observation from de Reste Bugt) must remain for the present. A mountain 2200 m high lying 25 km ENE we have called "Double Summit".

Quantitative result.

Out of the $25^1/_2$ days from midday July 10th until the evening of August 4th, in all only 11 days were working days. Of the remainder, $9^1/_2$ were foggy, 4 were spent in the ice off Cape Ravn and 1 was spent waiting for improved conditions in the fjord by Cape Ravn. In this period about 120 miles out of the 210 miles from Cape Dalton to Cape Irminger were surveyed on a scale of 1 : 200,000.

VII. The Survey of Kangerdlugsuak.

a. Field-work.

We considered Miki's Fjord as part of the Kangerdlugsuak region and made a careful plane-table survey at 1 : 100,000 on August 5th and 6th. The fjord is too narrow and tortuous to be surveyed photogrammetrically. But the equipment was here tested in preparation for the work in Kangerdlugsuak.

A station was made on the 8th at the summit (420 m) of the snow joch between Kangerdlugsuak and Miki's Fjord. The base commanded a view to the east over the mountains beyond Kangerdlugsuak as well as westwards as far as Irminger Fjord and was thus the means of connecting the Miki's Fjord survey with the work to be carried out later in Kangerdlugsuak. Although this was the first of the photogrammetric bases, its primary function was trigonometric.

During the 9th the ship moved to an anchorage in Kangerdlugsuak and discharged timber for the houses. On the 10th, work was started at the summit of the eastern arm of Kraemer's Island (see panorama Fig. 22. Bd. 104. Nr. 1). We found this apparently low peninsular to be higher — 360 m — and less favourable for the laying out of a base or number of bases than we had expected. After a day's work, fog returned and obstructed work directly for two days and indirectly for a third. Work was completed on August 14th. During the two days of work, we had laid out four bases and taken photographs from three, one of the bases allowing photography in both directions. Full observations

of the sun had also been made, so that this station would be the nucleus for the development of the map.

The next step was to make another "principal" station for the northern part of the fjord. To this end we made a camp on the north side of Notched Mountain (see Fig. 3). Work began at 4 a.m. on August 16th. The conditions were again not favourable to a long base and in order to obtain a base 320 m long we had to work much lower



Fig. 3. Kangerdlugsuak: Notched Mountain and North Sienite Glacier. (Photo. H. G. Watkins).

than had been intended. Before photography was complete the weather became gloomy and overcast and later it rained somewhat. August 17th was fine, but gave us the first taste of the Kangerdlugsuak Föhn wind. A latitude observation and photographs were made nevertheless. The wind in the meanwhile so far from moderating increased to blow with such strength that the next and the day after that were spent in trying to save our camp from being blown away. Not only was it impossible for the motor-boat which should have come, but it was even impossible for "Søkongen" to make headway against this torrent of air. Yet at Uttental Sound there had not been a breath of wind the whole time.

On the morning of the 20th we were much relieved to hear "Søkongen" again. We were soon installed in our motor-boat and in the course of the day completed the northern area of the fjord from the two photogrammetric stations VIII and IX.

August 21—28th was spent away from the ship. An attempt to land near the mouth of Watkins Fjord on the 21st was unsuccessful on account of the quantities of brash-ice. A station on a nunatek south



Fig. 4. Kangerdlugsuak: Inland-ice and Amdrup Fjord. (Photo. H. G. WATKINS).

of Amdrup Point on the 22nd, in spite of a landing made difficult by the heavy swell, was rewarded with as perfect a site for a base as could be imagined. On the 24th, we left our comfortable house with the intention of passing a few days in the main fjord. The wind was blowing smartly down Kangerdlugsuak so that we were somewhat splashed in crossing. But the wind had also cleared so much ice out of Amdrup Fjord that we could get about half-way up and establish a station. We found soon that we must work quickly, the reason for our haste being that the wind had flown round into the opposite direction and was now blowing back all the ice which had left the fjord a few hours previously. However, we came out without much difficulty and found fog blowing up the main fjord from the sea. We had to

wait until 5 p.m. before a station looking towards Kraemer's Island could be made. Towards the end of August the sun was very low in the afternoons; the evenings were beginning to be cold and the nights dark.

Our camp that evening was pitched near the small bight where the Norwegian sealer "Polaris" was erecting a radio-station; as soon as we had made ready we were invited in to the cosy cabin and most warm-heartedly entertained by the scientists of the Expedition. But at midnight it began to drizzle. It rained all next day and all the succeeding night, increasing in the meanwhile to a continuous heavy downpour which was more than our little summer tent could endure. We abandoned the camp in the forenoon of the 26th and returned to the house, soon to be joined by Wager's party, also washed out of their camp. We rejoined the ship on the 28th, the summer's work ended: but the rain continued until the 1st September.

b. Compiling the map.

We left Kangerdlugsuak with nothing but a gross of undeveloped plates and the records of a few rounds of angles. The complete absence of any kind of map was a little disquieting. Nevertheless only by photogrammetric methods could we have attempted a precise survey in so short a time; nor had we forgotten such incidents as the station in Amdrup Fjord, where the entire work had to be completed in half-an-hour, during which time very little of any value could have been brought on to a plane-table.

The astronomical points were three: one in Miki's Fjord, one on Kraemer's Island (in future referred to as Photostation II) and one by Notched Mt. (Photostation VI). Control was available in that at nearly every station rounds of angles had been orientated by sun-azimuth observations. The connection station, Photostation I, is rigidly connected with Miki's Fjord. The three Photostations, I, II and VI were plotted. From each of these rays of known length extend in a known direction to several common points, in this case mountain peaks.

The result of this first plotting showed immediately that the relative positions of the stations were impossible. The only solutions, which were very easy to find with precision graphically, showed that Photostation VI required to be moved in a south-westerly and Photostation I in a north-easterly direction, the displacements being in each case about a kilometre. The position of Photostation II was then the mean value of the three observations and was adopted.

Such a result was somewhat surprising where the astronomical observations showed internal evidence of being considerably more accurate. The discrepancy is probably partly due to an abnormal re-

fraction in Greenland, where zenith distances may be 70° at the time of observation, and partly to local attraction. One hesitates to predict local attraction from local topography; but in Kangerdlugsuak, the deep fjord, the steep mountains and the presence of a geological boundary may well cause sensible deviations of the plumb-line.

The assembly of the principal stations gave a network of points of two kinds. Since the more conspicuous mountains had been observed from two of the principal stations, some of the points were strictly intersected points on the accuracy of whose position much reliance could be placed. The remaining points were those observed from one base only. Using for the most part the intersected stations, the remaining photostations were very easily resected. Each station brought with it new rays which gave, besides the points measured from the station's own base, new intersected points. In any case of difficulty, vertical angles provided a very sensitive control; it was scarcely ever necessary to work out the azimuths observed at subsidiary stations.

In this way a network was constructed which gave all manner of internal proof of accuracy and consistency. The final test to which our network must be submitted, to take points at random from the field of view of any photo-pair and use them as control in the Aerokartograf, is a very severe one. It is in fact practically impossible to continue work in a stereo-plotting machine if the control is inconsistent. Having had some anxiety lest it should be impossible to form a trigonometrical framework accurate enough for this type of survey, I was agreeably surprised at the success of this graphical construction. Dr. Finsterwalder's comment on this matter, while discussing the use of photogrammetry in the circumstances of an expedition, is relevant. (Finsterwalder (1932) p. 6) "Andererseits hat die Photogrammetrie doch sehr grosse Nachteile und bereitet bei ihrer Anwendung viel grössere Schwierigkeiten als die anderen Verfahren. Sie setzt eine wenigstens weitmaschige Vermessung voraus, auf die sie sich stützt und an deren Genauigkeit sie als exakte Aufnahmemethode hohe Anforderungen stellt. Unter den bei Forschungsreisen herrschenden Verhältnissen, z. B. wegen Fehlens jeglicher Signalisierung, ist eine solche Vermessung meist eine sehr schwer lösbare Aufgabe".

Once this network of control had been made, the sequence of the work was simple and normal. Plotting was carried out by Overofficiant H. C. Hansen on the Aerokartograf designed by Professor Hugershoff; the instrument belongs to the Geodaetisk Institut. The only difficulties experienced in the course of the plotting were caused by the collimation-marks (Messmarken) on the plates being obscured either because the plates had been rather liberally exposed or else because a hole, or several of the holes, became blocked with dust. These collimation-marks are

not designed so that some other part of the mark may be used should the small hole become obstructed.

The sheets prepared in the plotting-machine (Auswertungsgerät) comprised contours at 100 m intervals until 600 m, above which contours were drawn with a separation of 200 m. As soon as the contours were finished a few spot-heights and ice-boundaries that might be useful later were plotted. During the working up of these sheets, a mass of new material became available in the form of the air-photographs taken by the late Mr. Watkins in 1930. This is a splendid series of technically perfect photographs taken with an antiquated military plate-camera; they were taken so rapidly one after another that there is no difficulty whatever in viewing the whole field of view stereoscopically when any pair of successive photographs in examined simultaneously. Permission to incorporate this material was given by the Royal Geographical Society. Had these photographs been exposed in a survey-camera, it would have been possible, using our mapping as control, to plot directly from them. Nevertheless the combination of our ground control with these photographs was highly productive. Not only was it possible to fill in as accurately as by any other method "blind-spots" and blanks in the plotting, but, using only the property that three points in alignment on the photographs must also be in alignment in plan, some extension of the map beyond the limits of plotting was often possible by a kind of plane-tabling process with intersecting rays. The difference between the mapping on the east and on the west sides of the fjord is to some extent illustrative of the results obtained respectively with and without the assistance of air-photographs.

It was at the same time interesting to learn how much ground remains blind, even in a series of air-photographs. When a flying-machine is flown parallel to a mountainous coast and oblique photographs are taken directly abeam with the camera axis perpendicular to the aeroplane's course, an area, which is greater than expected, consisting of terrain hidden by the mountains in the foreground, will not be photographed. If it is only possible to fly along the seaward side of coastal mountains, then it would certainly be better if photographs were taken alternately ahead and astern of abeam by such an amount that the two successive photographs had a small overlap.

Kangerdlugsuak was drawn on a scale of 1 : 100,000. In drawing the map the principle followed was that all topography that was as good as good plane-table work should be drawn in continuous lines: this standard implied errors of position smaller than 1 mm. Topography drawn by sketching from photographs about spotheights or points obtained in any other way was represented by pecked-lines.

The special plan on a scale of 1 : 20,000 of the skerry and island

complex north of Skaergaard's Peninsular was made from the foreground of photographs exposed primarily in order to map the west side of the mouth of the fjord from Photostation XIII. The areas of tightly-packed ice which are shown in Amdrup and Watkins fjords represent a state of affairs which is best seen in the air-photographs, but which also corresponded with our own experiences. Generally speaking, navigation will be found impossible some kilometres before these boundaries are reached. Attention is also called to the skerry lying in the west side of the entrance to the main fjord. It is about 9 metres high and, though black, resembles closely in form the numerous ice-bergs in its neighbourhood.

c. Quantitative Results.

The period from August 5th to August 28th should have given us 24 days for work. Actually we had 11 days in the field (or $12^1/_2$ if $1^1/_2$ days spent in travelling are included). Of the remainder, three were foggy, two spent in work connected with the building of the houses in Miki's Fjord and Kangerdlugsuak, two and a half were spent waiting for relief during the spell of Föhn wind in the northern part of the fjord and the final four days were rainy.

Kangerdlugsuak is a fjord about 72 kilometres deep: the area mapped is roughly 2,600 sq. kilometres.

VIII. The New Mountains.

We had hoped to be able to lay out a base on the snow-domed mountain north of Miki's Fjord. Weather unfortunately forbade this. The brothers Wager obtained a round of angles including the New Mountains from a peak south of Watkins Fjord. This showed that a very remote peak which we had measured from our station on the nunatek south of Amdrup Point belonged to the New Mountains. The base at the station was 500 m long: nevertheless the peak was so distant that its position cannot be considered as exact. Assuming normal refraction, the calculated height was 3,370 m. The range is considered to lie in approximately Lat. 68°45′ N. and Long. 29°55′ W.: the height should be a little over 3000 m.

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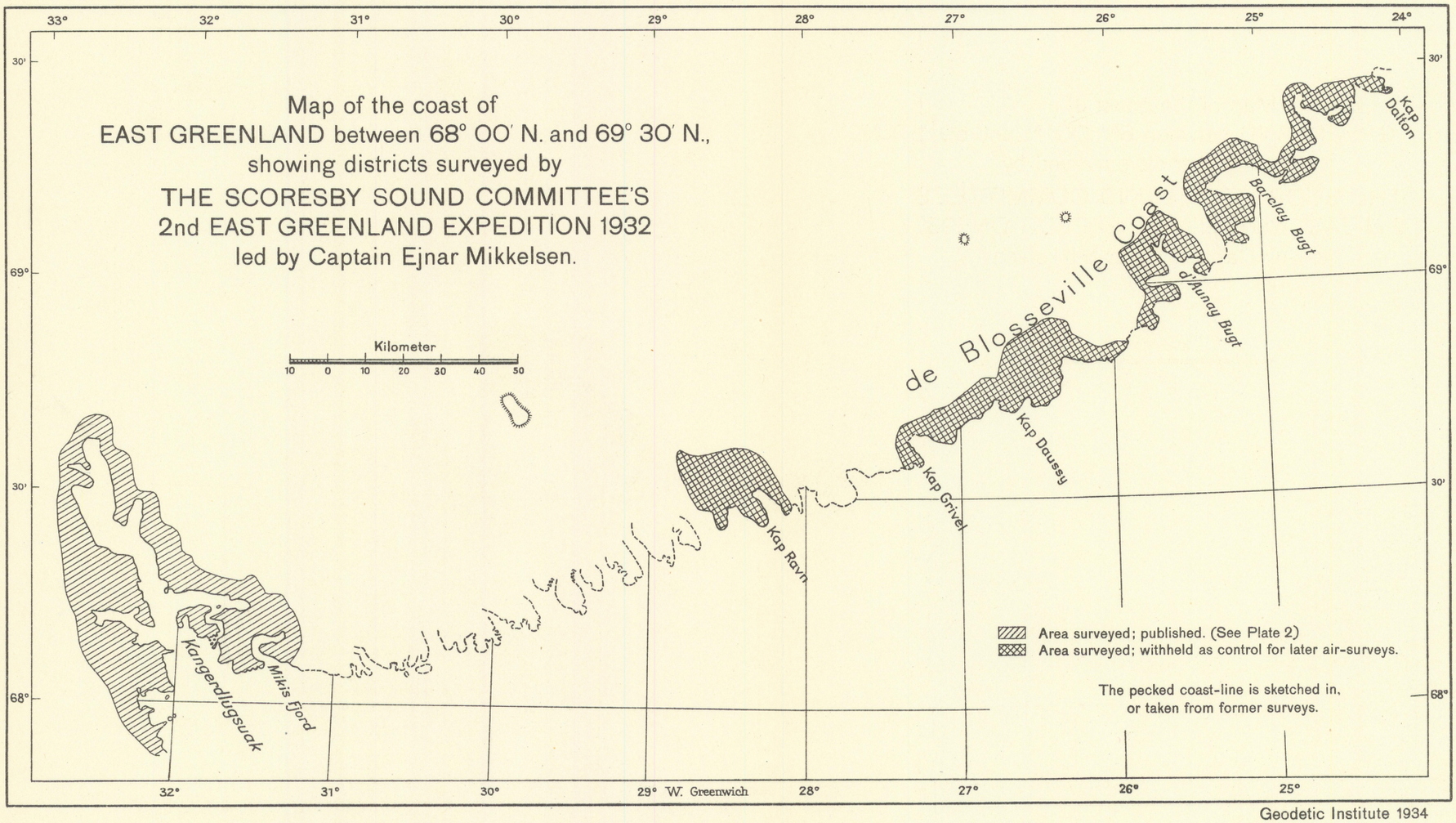
11a. — See 10a.



Geodetic Institute 1934

The Scoresby Sound Committee's
2nd EAST GREENLAND Expedition 1932.

KANGERDLUGSUAK

From a terrestrial photogrammetric survey made by the Expedition under Captain Ejnar Mikkelsen's leadership (Spender and Larsson) and plotted at the Geodetic Institute.

Heights and depths in meters.
Contour interval 100 m.

1. Mikis Fjord
2. Kangerdlugsuak
3. Cape Hammer
4. Skærgaards Halvø
5. House
6. House
7. Amdrup Fjord
8. Norwegian Radiostation (1932—1933).
9. Notched Mt.
10. North Mt.
11. North Fjord
12. Bat Mt.
13. Kangerdlugsuak Glacier
14. Cape Deichmann
15. Rock
16. House
17. Eskimo-Ruins

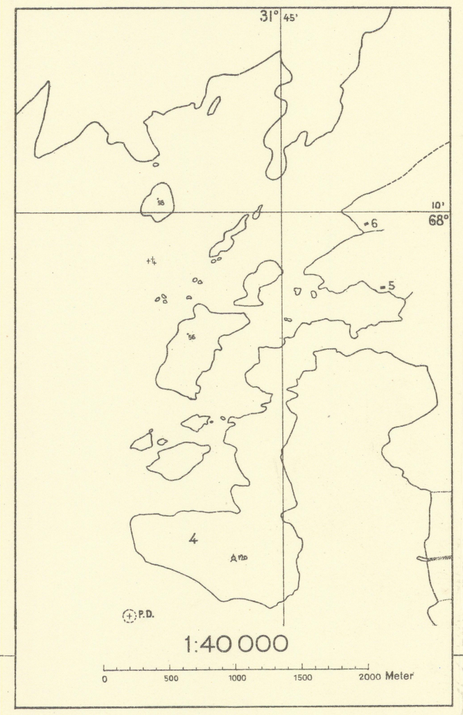
Reference.
- Astronomical Station
- Photogrammetric Station
- Intersected point
- Spot-height
- Shoal-water
- Moraine
- House
- Ruin
- Anchorage
- Lake

St. 2. Latitude: 68° 12′ 44″.
Longitude: 31° 58′ 19″.

1:200 000

0 2 4 6 8 10 12 14 16 18 20 km.

Plan of entrance to the Sound, showing position of the two houses in Kangerdlugsuak.



13 Glacier Tongue

Full of ice

Full of ice

45'
30'
15'
68°
30'
33°
30'
32° W. Greenwich
30'
Geodetic Institute 1934