IMPERIAL COLLEGE

OF SCIENCE & TECHNOLOGY

JAN MAYEN

1959

THE EXPLORATION BOARD.

FINAL REPORT BY THE IMPERIAL
COLLEGE SECTION OF THE 1959 UNIVERSIT
LONDON JAN MAYEN EXPEDITION.

PREFACE

The Imperial College Section of the Expedition would here like to acknowledge their indebtedness to the Birkbeck College Section, in particular to Dr. Dollar. Without his untiring efforts, particularly in as far as fixing up transport and obtaining money, the Expedition would never have left this country.

Differences of opinion sometimes arose between the two Sections of the Expedition, as will be apparent in certain chapters of this report. It should be emphasised, however, that these differences generally reflected a different approach to a particular problem, and in no way do they detract from the integrity of the person concerned. Comments and criticisms contained herein are intended to be merely constructive and are recorded in order to help any other expedition faced with similar difficulties.

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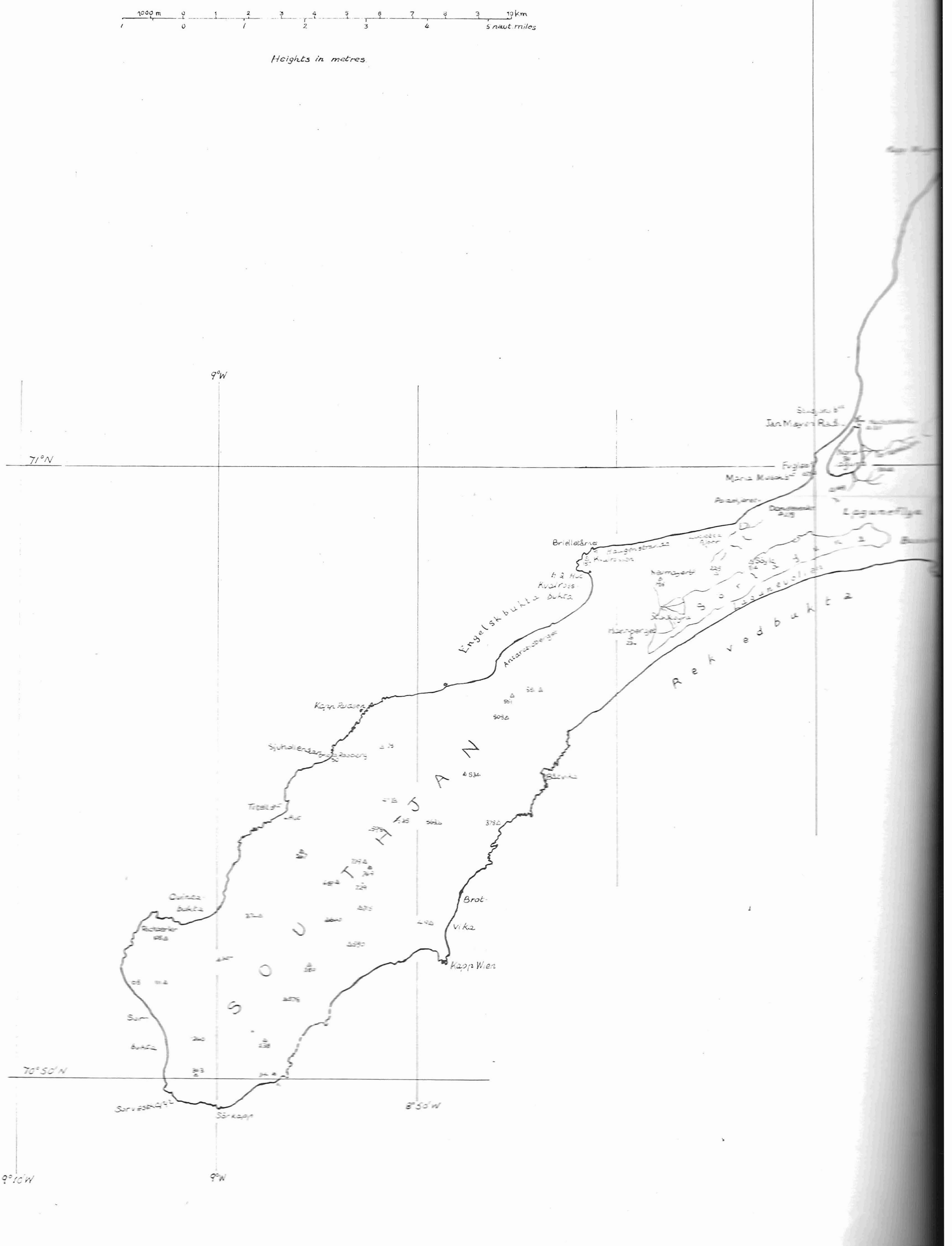
A.I.1. LOCATION.

Jan Mayen is a small island in the Greenland Sea, 300 miles north of N.E. Iceland and about 250 miles east of Scoresbysund, E.Greenland. To be more precise, latitude 71°N and longitude 8°30 W intersect in the middle of the island.

In form, the Island may be divided into three parts: in the north, the great ice-sheathed volcanic cone of the Beerenberg, rising to 7500ft., and about 10 miles in diameter; in the south, a block of mountains and volcanic cones, some 10 miles long and, at a maximum $4\frac{1}{2}$ miles wide; the two are joined by a narrow ishtmus of land, at a minimum, $1\frac{1}{2}$ miles wide. The orientation of the final spoonshaped island is very nearly NE-SW, and its total length is about 35 miles.

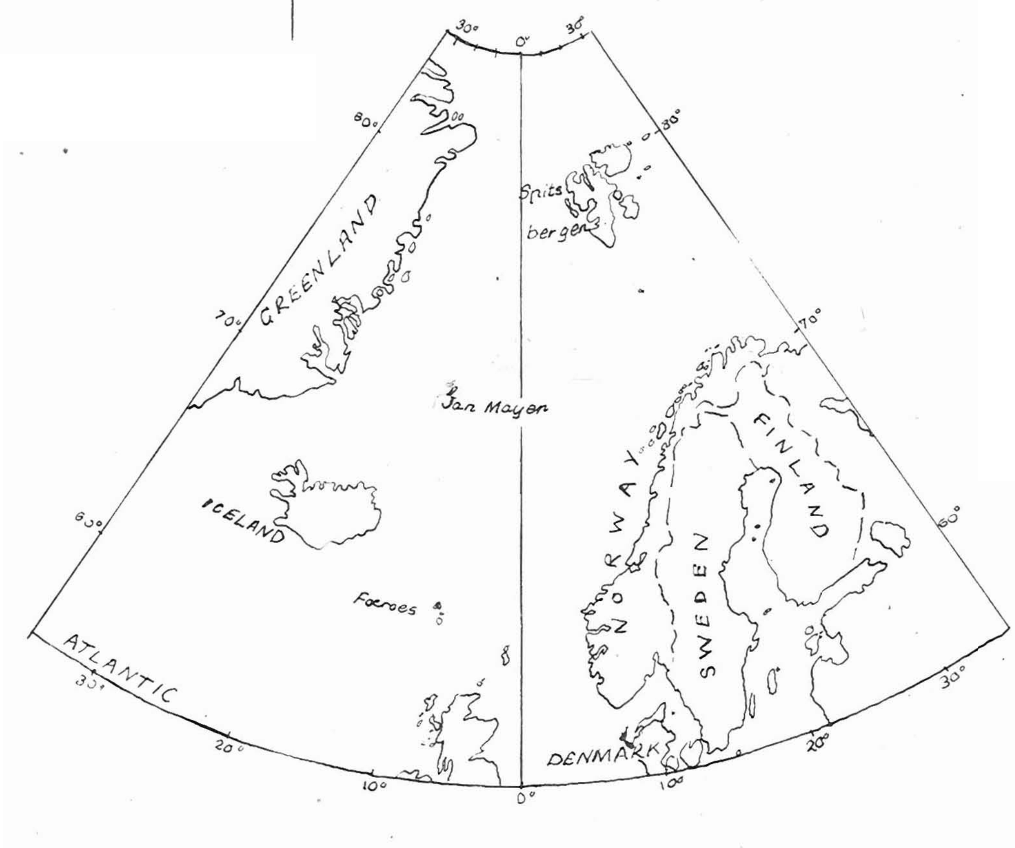
Geologically, the Island lies on the extreme N.E. margin of the Tertiary Thulean Volcanic Province, within which is included N.W. Scotland, N. Ireland, The Faroes, Iceland and E.Greenland.

JAN MAYEN



1000 m 0 1 2 3 4 5 6 7 8 9 10 km
1 0 1 2 3 4 5 naut. miles
Heights in metres
9°W
71°N
70°50'N
8°50'W
9°10'W
9°W
Engelskbukta
Rekvedbukta
Kvalrossbukta
Brielletårne
S O U T H J A N
Brot-
vika
Kapp Wien
Sørkapp
Sur-
bukta
Quinta-
bukta
Jan Mayen Radio

8° W
Nordkapp.
Nordkapp-
hallet
Clandeboyeb^kt
Kronprinsesse
Märthas
Bre
Dufferinbreen
Frielebreen
Prins Haralds Bre
Kjerulfbreen
Kingbreen
Weyprechtbreen
Stigebr.
Hamarbreen
Jorisbreen
Jutulen
Hakluyttoppen
2205
Crater
Haakon VII topp 2277
Charcotbreen
Mercantontoppen
Wordietp
Griegbreen
Beerenberg
Willebreen
Kerckhoffbreen
Kronprins Olavs Bre
Petersenbreen
Kapp Neill
Fotherbybreen
Sorbreen
High Camp
Vulkanlia
Scoresbyb
Vogtfjellet
Grönb
295
Eskkr
Ekerolddalen
Kreklingh
Ullerengsanden
Presidentsteinen
Hamburka
Kapp Håp
Röysflya
Hut
Jamesonb^kt
Eggöya
(Egg Bluff)



GREENLAND
Spitsbergen
Jan Mayen
ICELAND
Faeroes
NORWAY
SWEDEN
FINLAND
DENMARK
ATLANTIC

A.I.2. TOPOGRAPHY.

The first impression the party formed on landi
at Guinea-bukta in South Jan was that of a lunar
landscape, like those of the artist Chesley Boneste
with rust-red and grey rocks contrasting with the g
and vivid, almost luminous, greens of the extensive
blankets of plant life.

The topography of this "eerie little island",
Peter Freuchen, described it, is dominated by the
grandeur of the Beerenberg, a massive central volcan
rising to a height of 2277m. (7500ft). Its upper sl
are sheathed in ice and a series of glaciers pour do
the lower parts. The crater itself forms the ice-
reservoir of the most spectacular of the Beerenberg's
glaciers, the Weyprechtbreen, which tumbles out thro
a great gash blown out of the northern part of the c
rim during a late stage in the Beerenberg's volcanic
history.

The island is composed entirely of volcanic roc
trachytes, basalts, ankaramites and their related ty
these extrusive rocks are interbedded with tuffs and
agglomerates. The Beerenberg appears to be compose
a series of basalt and ankaramite flows, while on it
flanks are numerous parasitic lava and cinder cones.
In Mid and South Jan the geology is dominated by clo
spaced lava and cinder cones with intervening valley
filled with scoria and other volcanic ejectamenta.
Other interesting features of South Jan, are domes o
"whaleback" masses of trachyte. Some of the peaks i
S.W.Jan reach heights of around 2500ft. and though
large permanent snow patches occur no evidence of
glaciation has ever been observed. Thus no morainic

material is found in the South, but on the Beerenberg morainic debris plays an important role topographically. The lateral moraines formed by the South Glacier at the time of its greatest advance, reach a height of about 250ft.; they are being actively eroded by melt-water streams and material from the lateral moraines is being added continuously to the large terminal moraine field of the South Glacier and it is safe to assume that when the ice first began to recede they were quite considerable features.

Apart from the general character of the rocks, e.g. vesicular lavas and loosely packed tuffs and agglomerates, which would normally make them very susceptible to erosion, the erosive activity is intensified by glaciation and frost action. Classic examples of glacial erosion and frost shattering effects were observed. A number of fine sandy beaches, the best example in North Jan being Ullerengsanden, have been developed from the shattered olivine and augite phenocrysts and fragments of black magnetite-rich rock matrix. These sands have a characteristic black-green colour and are quite attractive.

In Jan Mayen surface water supplies are a major problem. Owing to the character of the sand and rock again, the drainage of the island is almost entirely sub-surface and the provision of water was a difficult matter for us. At Jameson Bay our water supply was stagnant [illegible] sand and dust. In other parts of the island the nearest water could be anything up to 2 miles away from a camp, particularly if the camp was near the sea

An interesting effect of sub-surface drainage was observed on Roysflya lava flow. The trachybasalt lava, which probably came from Berna Crater, flowed out into the sea leaving the original sea cliffs high and dry inland. The vesicular surface of the flow has weathered considerably with the formation of a number of fairly shallow valleys filled with red and green-black sand and dust. Thus, water draining off the Beerenberg finds a route to the sea via these sand-filled valleys and has excavated sub-surface cavities in the sand, in some instances the roofs of these cavities have collapsed leaving large gaping holes, often up to 10ft. in depth. Quite frequently an apparently solid surface would remain ready for the unsuspecting traveller to walk on and he would immediately disappear bodily into the underlying cavity, much to the amusement of his companions.

Other items of topographical interest are the North and South Lagoons. The North Lagoon which lies just south-west of the Radio Station, is a roughly circular pond-like mass of brackish water about $\frac{3}{4}$ mile in diameter with a maximum depth of 39m. The fresh-water drains off the Beerenberg via the Tornoe River, a mere trickle at the time of year when we saw it. This fresh-water is polluted by the sea during storms when it washes over the storm-bar separating the fresh-water lagoon from the Greenland Sea. From its circular form and the fact that it is surrounded on its landward edges by cinder cones and craters, it is tempting to suggest that it was once a crater. However, we concluded that its presence is due to the formation of the present storm-bar which acts as a primitive dam to the waters of the Tornoe River. The storm-bar was probably formed as a result of the production of the Fugleberg, a 167m. cone on the western edge of the lagoon. This cone acted as a break-water to a current running down the north-west side of the island, with the subsequent deposition of the storm-bar. It is interesting to consider that this cone, made of interbedded red and grey lavas and agglomerates, which is now undergoing rapid dissection by marine action, was in its early history an island similar to Egg Bluff in its initial stages.

The major element in the fauna which the North Lagoon manages to support is a small red fish, which is reputed to have a taste similar to that of trout. It provides an occasional delicacy in the diet of the meteorologists, though unfortunately we had no opportunity to try it.

In contrast to the North, the South Lagoon with a maximum length of 10km., is filled with water only during the winter months or at times of severe storms, when sea water washes over the storm beach, Lagunevollen. For the rest of the year it is a great expanse of soft, wet sand and mud, sprinkled with a great deal of driftwood, probably most of which has come from Siberian forests. The amount of driftwood on Jan Mayen is very considerable: every beach has a very liberal scattering of enormous tree trunks, wreckage from ships, fish barrels and fishing net floats. The latter make quite attractive souvenirs. Thus, though there are no trees growing on the island the supply of firewood is unlimited.

Travel on the South Lagoon is made difficult by the soft nature of the terrain; quicksands make the Basisseletta area north of Egg Bluff rather dangerous. The formation of the South Lagoon was probably by a similar process to that of the North. It appears to have been formed since the [illegible] of the [illegible] and [illegible] Egg Bluff, initially [illegible] to a current running up the south coast. Material transported from the south has subsequently been deposited to form the lagoon, and annexe Egg Bluff to the mainland. Scoresby, who visited the island in 1817 noted that the South Lagoon was composed of two bays, Little Wood Bay from Cape Traill to Soyla and Great Wood Bay from Soyla to Egg Bluff. He makes no mention of the storm beach, but comments on the shallow water extending about a mile out to sea.

The next record of [illegible] map of 1867, which shows the storm beach and also Egg Bluff connected to the mainland by a narrow isthmus. Thus it would appear that the storm beach, Lagunevollen, formed in the short space of 50 years. This seems rather too short an interval for the formation of the bar, and throws some doubt on Scoresby's observations. It is of interest that Scoresby also recorded smoke rising to the north of Egg Bluff in 1818.

[illegible] Soyla or Pillar Rock, have been left stranded high and relatively dry inland. These agglomerate cliffs and their loose scree-aprons are now partially blanketed by masses of bright green plants, which are well-manured by the hundreds of sea-birds perched precariously on ledges of the crumbling grey-yellow rock of the cliff faces. Towards the southern end of the lagoon a large red deltaic expanse, Stokkoyra, runs out onto the soft mud. Immediately behind this delta we observed some fine loess deposits showing good miniature examples of wind erosion.

To the north of Stokkoyra there is a fine 198m. cinder cone, Neumayert; the red cinders and ejectamenta on its flanks are almost entirely covered with the usual ankle-deep blanket of grey lichen.

On the coast beyond Neumayert lies an extensive tract of storm beach material called Haugenstranda, about half as long as the South Lagoon. No lagoon has been developed, instead a desert of round and sub-angular pebbles and boulders mixed with sand and dust has formed. On the surface of the desert we observed some very fine ventifacts (wind faceted pebbles), sculptured by wind-borne sand; the ventifacts had suffered maximum abrasion on south-west and north-east faces indicating the predominant wind directi[illegible] examples of 'kettleholes', depressions formed [illegible] sea-ice, had been developed on the sea-ward ma[illegible] Haugenstranda. The material forming the desert was brought by the same current as that which formed the North Lagoon storm bar; the break-water in this case being Kvalrossen. Kvalrossen (The Walrus) is composed of a "whaleback" of trachyte intruded beneath a mass of tuff and agglomerate; owing to the contiuual build-up of Haugenstranda a classic example of a sea-stack has recently been left high and dry at the northern end of Kvalrossen, called Brielletarnet (tarnet-tower), it is composed mainly of agglomerate and reaches a height of 91m. (280ft).

Kvalrossen forms the main shelter for Kvalrossbukta (Walrus Bay), which was the site of the main base hut of the Expedition [illegible] 10 miles, taking a [illegible] 4 hours, bringing [illegible] Hut which the Glaciological Party occupied. This normal walking speed of about 2 m.p.h. on Jan Mayen gives an indication of the terrain on the island. The slowest and probably the most painful terrain was that of the moraines made of loose unconsolidated boulders, next slowest were the sandy beaches where there was a continual unpleasant drag on one's ankles and if the wind was blowing one suffered quite a painful sand-blasting. The uneven new lava flows in South Jan were also particularly difficult and tiresome to walk over; their surface is extremely rough and is very destructive to footwear. Probably the best terrain for walking was the surface of a fresh ropey lava; unfortunately these fresh surfaces were uncommon so that generally travel was quite a slow and arduous business. On one of the journeys from Jameson Bay to Walrus Bay, via the Radio Station, two of us took what we thought would be a short cut along the beach from Maria Muschbukta to Haugenstranda. The route took us along a narrow sandy beach pitted by the bounce-marks of large boulders which had recently fallen from the very loose agglomerate and lava cliffs towering above us. We had travelled about $1\frac{1}{2}$ miles, being able to get round the headlands which all had rock-falls around their bases, until we came on a headland without a rock-fall. The water was too deep to wade through and the cliffs were too rotten to climb, so we had no alternative but to go all the way back. This time we went around the seaward slopes of Danielssen Crater, a cinder cone rising to a height of 279m. (850ft.). The very steep, 30° angle of rest, sides have deep runnels cut in the loose red and black cinders, ending abruptly at the cliff edge, 300 feet above the sea. Traversing these slopes with a heavy pack was sometimes quite alarming when one began to slide on the unconsolidated material towards a 300 ft. drop.

A further perturbing example of Jan Mayen topography was Luciotta Auga, a roughly circular depression, about $\frac{3}{4}$ mile in diameter, just west of Danielssen Crater. It was completely surrounded by 300 ft. cliffs and steep scree slopes and had a floor of soft wet sand and silt, because the local drain-off was into the depression. This was rather disconcerting to the traveller lost in the mist, who thinking a stream-bed would eventually lead him to the sea suddenly found himself in the middle of a quagmire and hemmed in by high cliffs, occasionally discernible through the thick mist. Though it was not too difficult to find a way out, it was rather a frustrating experience.

Another topographical feature worthy of mention is the eastern coast of the Beerenberg. From the map it can be seen that it is nearly a straight line running north-south, except in the most northerly part where the line is broken by Nordkapphallet. It could be that this line marks a large fault where a great mass has slid off down the submarine slopes of the Beerenberg. This possibility is supported by the fact that within 2 miles of the east coast the sea depth is over 3000ft. Perhaps this possible line of weakness could have been due to a fissure line on the Beerenberg slopes, the fissure lying with a N-S orientation. However, this is but a theory to try to answer one of the many tantalising problems that Jan Mayen has to offer.

The north-western coast of the Beerenberg is similar in appearance to the east coast, except that it is not so steep, and that the sea cliffs are not so high. However, it is equally impassable since a series of steep glaciers stream down it and most of them end in the sea. The north cape lava platform is, as a result of this, cut off to a party travelling on foot from middle Jan. Although on two successive occasions (1938 & 1950) a traverse high on the N.W. snowfield and glaciers has been accomplished, description of these efforts and a cursory reconnaissance of the area lead to the conclusion that it is a both difficult and dangerous undertaking. On the eastern coast a traverse along the fronts of the glaciers at low tide, as done in 1938, is now considered impossible because of the recent glacial advance. It would seem from this that the only practical way to the northern parts of the Beerenberg is by sea. This was done in 1959 and comments can be found in the section dealing with the boat.

Of all the difficult country in Jan Mayen it seems that the glaciers on the flanks of the Beerenberg inhibit the traveller most. Even the less steep ones are a jumbled mass of seracs, crevasses and icefalls, particularly in their lower parts. The most dangerous parts of the glaciers are, however, high on the snowfield at the base of the forty degree cone. In these regions the glaciers suffer a sudden change of surface slope, with the consequent development of crevasse systems, many of which are concealed by a thin surface snow cover.

Southern Jan Mayen presents the traveller with problems too, but they are of a different nature. New lava flows are rough and uneven and are generally difficult to walk over; the incessant mist hampers navigation; compasses, because of the magnetic nature of the rocks are unreliable (this applies in every part of Jan Mayen, even on the glaciers); a series of high cliffs make continuous progress along the shore impossible; steep screes in many places are easy to run down but are virtually impossible to climb up when carrying a pack. Southern Jan is not impossible to the traveller, but progress is slow.

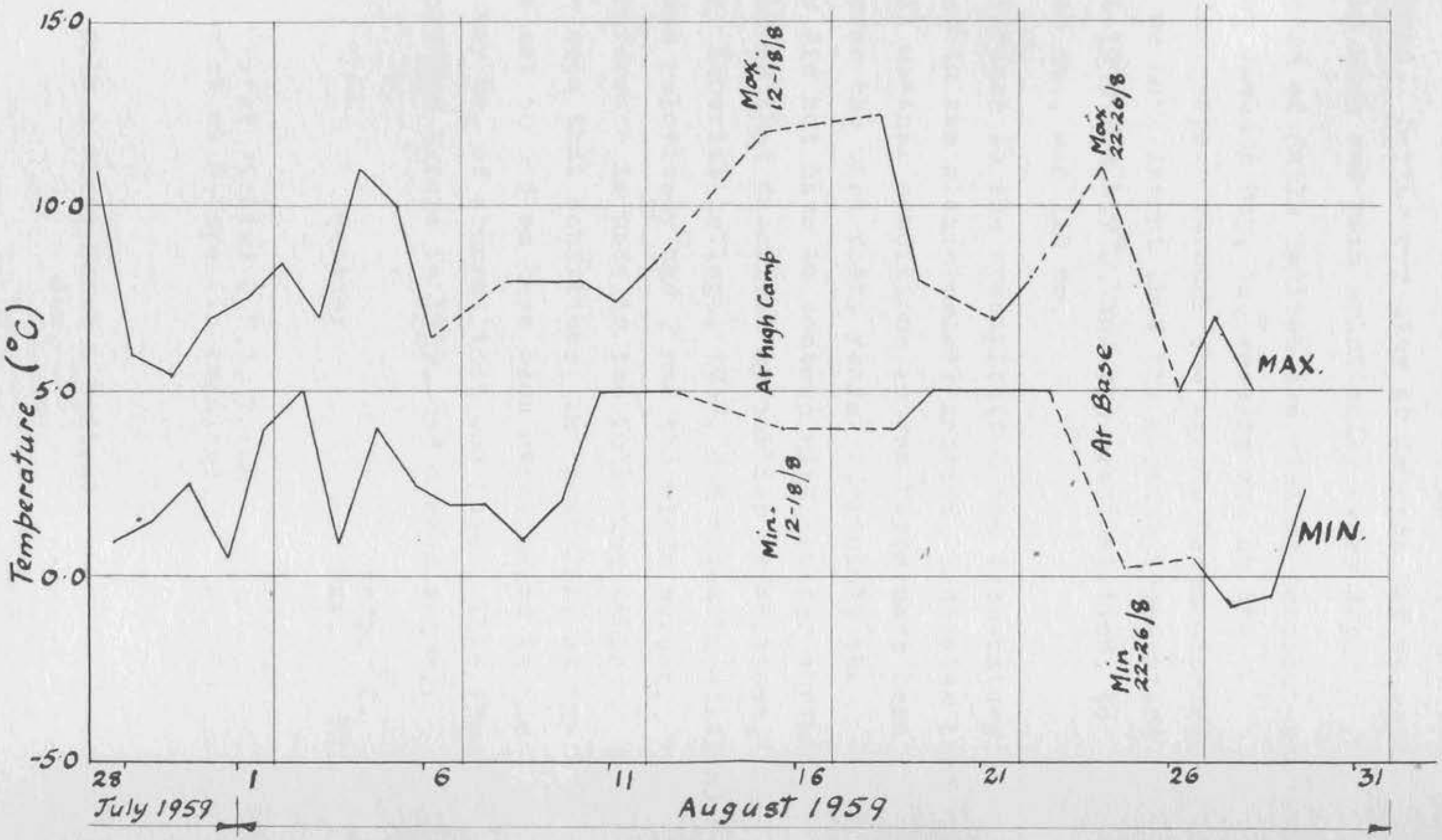
A.I.3 WEATHER.

The weather of Jan Mayen is notorious; it has even been called "the island with the worst weather in the world". In particular, the possibility of an incredibly high, and ever fluctuating wind seem special to the Island. October and November are the months during which the highest wind-speeds have been recorded, the highest so far being 82 metres/sec. (approx. 178m.p.h.). During a hurricane blowing at 64metres/sec., one of the Norwegian meteorologists was killed when blown some distance up a mountainside and hurled violently against the jagged rocks. This was the first fatal accident on the island since the Dutch whalers lost their lives there in the 17th century.

High velocity katabatic winds which rush down the slopes of the Beerenberg are of very frequent occurrence. They give rise to minor whirlwinds that whip up the loose dust and sand on the South Lagoon, the weathered lava surfaces and the beaches of North Jan. These winds, in many cases, are confined to particular localities. It is possible, in one place to have a hurricane, and five miles away to have dead calm.

The most exasperating element of the weather is the almost perpetual cold, wet, clinging mist, which makes surveying of any sort very difficult. Warm moisture-laden air currents from the south-west meeting the cold landmass of Jan Mayen or a cold sea water mass, would appear to be the reason for this thick fog formation. When a strong north-westerly or easterly wind is blowing the island is relatively clear of mist. The katabatic winds would also clear North Jan of mist leaving the South still covered.

MAXIMUM AND MINIMUM TEMPERATURES RECORDED AT JAMESON BAY.



B.C.

This summer, during the three weeks preceding our arrival, Dr.Carstens of Trondheim had perfect, clear weather in South Jan until the day we landed, when the mist returned. During our stay at Jameson Bay we were hampered by mist and rain practically every day.

A record of daily maximum and minimum temperatures was kept at Jameson Bay, the results are on the accompanying graph. Through the Norske Meteorologiske Institutt we have learnt that the average temperature for August 1959 was 4.7°C. and the precipitation, to the nearest mm., was 110 mm.

A reference to the precipitation and temperature data quoted in the glaciological section, indicates that the overall weather conditions in Jan Mayen have been changing over the past forty years. Certainly the 1959 party did not have to contend with weather anything like as bad as that described by earlier expeditions. (see King: Imperial College, 1938, Jan Mayen Expedition). The mist was relatively bad , and the winds strong, but if a reference is made to the following table it will be seen that conditions, in North Jan, at any rate, were not so bad as have been experienced in the past. It may be, of course, that Jan Mayen, like the rest of Northern Europe in 1959, had a good summer:

Date:	Weather	Temp. °C. Max.	Min.
24/7/59	(First sighted J.M.). Thick mist at N.Cape (in evening).	-	-
25/7/59	Calm & misty South & Central Jan.	-	-

Date:	Weather	Temp. °C. max.	Min.
26/7/59	Calm & Misty. Central Jan.	-	-
27/7/59	Misty in Morning; Cold N.W. wind in evening.	-	-
28/7/59	Fine day with little wind. Mist returned 9.00 p.m.	11.0	1.0
29/7/59	Damp & misty; rained slightly.	6.0	1.5
30/7/59	Bright day; mist at 2000ft.	5.5	2.5
31/7/59	Dull misty day.	7.0	0.5
1/8/59	Misty day.	7.5	4.0
2/8/59	Driving rain & sleet. High sea.	8.5	5.0
3/8/59	Very misty in morning. Cleared later in day.	7.0	1.0
4/8/59	Fine in morning. Mist came down later.	11.0	4.0

Date:	Weather	Temp. °C Max.	Min.
5/8/59	Fine day.	10.0	2.5
6/8/59	Thick blowing mist.	6.5	2.0
7/8/59	Cold day; snow at sea level.	-	2.0
8/8/59	Snow at sea level. Cold day.	8.0	1.0
9/8/59	Fine bright day.	8.0	2.0
10/8/59	Very heavy blown rain. High sea.	8.0	5.0
11/8/59	Misty day; raining a little; glacier valley flooded.	7.5	5.0
12/8/59	Misty day, even at 3000ft.	8.5	5.0
13/8/59	Misty day, even at 2000ft.	-	-
14/8/59	Calm & misty at high camp. Bright and hot on snowfield.	-	-

Date:	Weather	Temp. °C. Max.	Min.
15/8/59	Easterly wind; no cloud or mist at sea level.	-	-
16/8/59	Hot fine weather above 2000ft.	-	-
17/8/59	Rain; sleet and a high sea	-	-
18/8/59	Damp misty day.	12.5	4.0
19/8/59	Rained all day.	8.0	5.0
20/8/59	Thick mist all day.	-	5.0
21/8/59	Stiff easterly breeze; bright day.	7.0	5.0
22/8/59	Stiff easterly breeze. Overcast.	-	-
23/8/59	Calm misty day in middle Jan.	-	-
24/8/59	Easterly wind in S.Jan. Not much mist at sea level.	-	-
25/8/59	Fine calm day.	-	-

Date:	Weather	Temp. °C Max.	Min.
26/8/59	Bright cold breezy day. Coating of snow at sea level.	5.0	0.5
27/8/59	Snow on [illegible] wind, Snow during day.	7.0	-0.75
28/8/59	N.W. wind; clear weather	5.0	-0.5
29/8/59	Calm day in Middle Jan. Overcast	-	-
30/8/59	N.W. wind. Cold day. High sea at Walrus.	-	-
31/8/59	Very fine day. Brilliant Blue sky. No mist.	-	-

From the above it can be seen that the glaciological party had about 20 days of mist at sea level out of a total of 39 days in Jan Mayen.

It would seem that when calm misty conditions exist at sea level in North Jan, it is very likely that the upper part of the Beerenberg snowfield (above 3000ft.) will be out of mist and in calm bright sunlight.

A.I.4. ACCESSIBILITY.

We were very fortunate in being able to travel out to Jan Mayen from Alesund, Norway, as guests of the Norsk Polarinstitutt. The Institutt had hired a sealer, the 300 ton "Polarsel", to take us to Jan Mayen with supplies for Dr.Carstens, and then to go on to Eastern Greenland to take off some trappers and meteorologists. The "Polarsel" took us off on her return journey. The voyage from Norway to the island took $3\frac{1}{2}$ days.

The only other means of travel to Jan Mayen is by the relief ship, which visits the island at infrequent intervals. She is another sealer, slightly larger than the "Polarsel", the "Polarbjorn."

In general, apart from the transport provided by these two supply ships, however, Jan Mayen is very inaccessible. It is not on any regular shipping route, and any transport, unless going specifically to Jan Mayen or Eastern Greenland would have to be specially chartered. This, of course, is prohibitively expensive for a small University Expedition.

A.I.5. HISTORY.

At a time of acute rivalry between Dutch and British whalers in Arctic waters, Jan Mayen was discovered by the Dutch sea captain, Jan Jacobsz May during July, 1614, and the first recorded British visit was that of Robert Fotherby, also a sea captain, in 1615. Two years later William Scoresby Junior made the earliest known geological observations on the island, and a sketch map, while in 1861 Dr.Berna and Carl Vogt carried out scientific work, and made a further sketch map, which was supplemented by the studies of Professor Mohn in 1877.

Throughout the International Polar Year 1882-83 an Austrian expedition, remained on Jan Mayen, when a collection of geological specimens, and a first (inaccurate) topographic map (1:100,000), was prepared. Subsequently, visits of only a few days were made by Lord Dufferin (1856), J.C.Wells (1872), C.Rabot(1892), [illegible] (1900 [illegible] of [illegible] 2, 191 [illegible] the [illegible] ective

In 1921 a Cambridge party visited the island, consisting of J.L.Chatworth-Musters (botanist), J.M.Wordie (geologist), T.C.Lethbridge and W.S.Bristowe (naturalists), R.Brown ("campman") and Professor P.L. Mercanton (Lausanne) who joined the party, unexpectedly, before it left Bergen. Geological and glaciological observations were made, the Beerenberg was climbed and geological specimens, collected by Wordie and now in the Hunterian Museum, University of Glasgow, were described by G.W.Tyrrell (1926) to give the first comprehensive petrological account of Jan Mayen rocks.

A short description of the general geology of the island was published by Wordie in the same year.

During the Polar Year, 1932-33, a party of three Austrians made magnetic determinations on the island and also attempted measurements of movement in the snout of the South Glacier, but these latter had to be abandoned on account of bad weather.

Over the summer of 1934, a party of three naturalists, E.G.Bird, his brother C.G.Bird and R.B.Connell, studied the snout of the South Glacier and gathered geographical data for amending Admiralty charts nos. 432 and 2751 respectively, apart from making useful ornithological and botanical studies. A report of this work appeared in 1935.

In 1938 a University of London party from the Imperial College went to Jan Mayen, chiefly in order to extend previous scientific investigations, examine unexplored parts of the island, and improve the accuracy of the Austrian topographic map. Led by A.King, the party consisted of R.Scott-Russell (botanist) and his assistants, D.F.Westwood and P.S.Willington; D.F.Ashby (geologist) who worked with W.H.Ward (surveyor); J.N.Jennings (glaciologist); J.M.Willcox (doctor), who co-operated with C.R.Seligman (ornithologist), and S.R.Nutman (marine biologist).

Ashby made general geological studies, mapped Middle Jan geologically (1:25,000) and collected specimens which are now in the Department of Geology, University of Bristol. Jennings, in carrying out a broad survey of the glaciers, established their recent retreat, helped to make a detailed topographic map of the snout of the South Glacier, and studied ice

phenomena at the summit of the Beerenberg.
The remaining members of the expedition made valuable investigations in their respective fields.

Publications relating to these several studies appeared subsequently except for those of Ashby who was drowned in North Wales after returning safely from the island.

In the summer of 1947 the Oxford University Exploration Club organised an expedition to Jan Mayen, Greenland Sea, under the leadership of A.J.Marshall (physiologist), of the Department of Zoology and Comparative Anatomy, University of Oxford, with the object of extending earlier biological and geological studies on the island, and pursuing certain other investigations not formerly attempted. A.T.J.Dollar, R.Bostram, and D.M.Boyd, all of Glasgow University also accompanied this expedition in order to carry out a programme of geological and glaciological research.

In 1950 a private party consisting of J.W.Wilson, A.T.J.Dollar, G.D.Nicholls and H.J.C.Kirk returned to Jan Mayen in order to continue botanical and geological studies.

In 1921 Norway, realising that Jan Mayen meteorology had an important affect upon the weather of Northern Europe, established a weather station there. In 1928 she annexed Jan Mayen and made it Norwegian territory. During the war the Island was occupied by a combined British, American and Norwegian force, but it was not until after the war that the Norsk Polarinstitutt made the first accurate topographical map of the Island. This is now obtainable at a scale of 1:50,000. The fact that this map took ten years to make is an indication of the difficulty of surveying in the very bad Jan Mayen mist conditions.

A.II. 1. ORGANISATION & COMPOSITION OF THE EXPEDITION.

Initially the idea to go to Jan Mayen in 1959 was conceived at Imperial College in September of 1958. The main stimulus to the original organisers was the report of the 1938 Imperial College Expedition to Jan Mayen whose work provided a basis upon which to organise a further expedition. Two of the Imperial College party had just returned from Iceland in 1958 and were in a position to [illegible] further afield. During [illegible] part of the initial organisation [illegible] Birkbeck College was contacted [illegible] to Jan Mayen since the [illegible] (19[illegible] & 19[illegible]0). H[illegible]ed immediate interest in the [illegible] particularly [illegible] he heard that the Norwegians had recently completed an accurate 1:20,000 map of the Island. Dr.Dollar had worked on the geology of the Island in 1947 & 1950, but had not published his detailed results because he lacked an accurate map on which to base his work. Accordingly he asked to accompany the expedition in order to complete the geological mapping of Jan Mayen and to tie his results with the new map. Because of his experience of the area and seniority Dr.Dollar was asked to lead the expedition.

Then followed a long period of uncertainty. Difficulty was experienced at this stage in getting the Norwegians to give the Expedition a positive offe[illegible] of transport with a date. Dr.Dollar then made a trip to Oslo, in February, and managed to obtain copies of the then unnamed new map and the guarantee of transpo[illegible] to Jan Mayen. No date was fixed at this time.

Meanwhile grants were obtained from the R.G.S., Mount Everest Foundation, London University Research Fund, Gino Watkins Memorial Fund, and the Royal Society towards the cost of the Expedition. Three more people from Birkbeck College were then brought in to complete the geological section of the party which then fully was:

A.T.J.Dollar, Ph.D., F.R.S.E., Leader, Head of Geology Department, Birkbeck College.

J.Banfield, B.Sc., Geologist, Birkbeck College.

K.Brimsmeade B.Sc., Geologist, Birkbeck College.

B.Chadwick, Glaciologist, Imperial College.

F.Fitch, B.Sc., F.G.S., Geologist, Lecturer in Geology, Birkbeck College.

D.J.J.Kinsman, Glaciologist, Imperial College.

P.Smith, B.Sc.(Eng.) A.C.G.I., Glaciologist, Imperial College.

R.G.Wright, B.Sc., A.R.C.S., Glaciologist, Imperial College.

The bulk of the ordering of supplies fell to I.C., which through its Supplies Administration Section ordered most of the food used in Jan Mayen. Details of food and comments can be found in Section A.III.2. and will not be further discussed here.

Equipment presented much more of a problem: investigation of the glaciological equipment and its development and calibration took much time, and the Expedition are here much indebted to the Depts. of Civil & Electrical Engineering within Imperial College for their help in this matter.

Camping and general equipment were more standard but each item had to be assessed and ordered separately. In many cases delivery was delayed and equipment had to be called for by an expedition member, personally.

British Industry it was found, in many cases, was not entirely dependable.

In the rush which preceded the Expedition's departure (Expeditions always seem to be desperate for time at this juncture) over a ton of supplies and equipment were packed into more than 30 assembled crates and bundles in a weekend. Messrs. Kavli then took the equipment and two members to Newcastle; it was here that the Expedition started its journey, which is described in A.II. 2.

Initially it was thought, at Imperial College, that a combined expedition with another College of London University was a desirable thing; indeed, it probably is. The organisation of the 1959 U.L. Jan Mayen Expedition on this account was however, made exceptionally arduous and strenuous. Co-ordination between the two Colleges was difficult; some members suffered from an inability to grasp the major and important points of many situations. Judgement, particularly of the merits of various items of equipment, was poor; the expedition at the organisation stage did not pull together as a team. These points serve to stress the importance of very careful selection of expedition personnel and the necessity of positive direction from the leader over the various broad divisions of an expedition. This direction should be only on the broad points of policy and the members entrusted with particular tasks should be allowed to use their initiative and judgement in their own sphere.

A.II.2. EXPEDITION DIARY.

On Tuesday, [illegible] July, after a weekend of [illegible] packing two members of the Expedition and all the food and equipment, with the exception of the boat and engine, were transported from London to Newcastle by [illegible] Ltd. The Expedition was very grateful for their assistance in this matter.

The six other members of the party went from London to Newcastle overnight by train and arrived early on Thursday, 16th July. Personnel and equipment were passed through the customs and an uneventful sail to Bergen on board the m.v. Leda followed. At Bergen equipment was transferred to the coastal boat the Vesteralen and the party finally arrived in Aalesund at noon on Saturday 18th. Equipment was deposited in a warehouse to await the coming of the 'Polarsel' and supplies of petrol, paraffin and more food were picked up.

The 'Polarsel', a small 300 ton, wooden sealer, bound for Eastern Greenland, via Jan Mayen, left Aalesund with the party on board late on the afternoon of Tuesday, 21st July. A rolling, but relatively calm sail for three days followed and Jan Mayen's bleak North Cape was sighted late on Friday, 24th July. The ship anchored in the bay on the North Side of Jan Mayen Radio, and the commander of the Station came on board. As a result the Expedition were given the use of the trapper's hut at Walrus Gat as a Base and the glaciological party were to be installed in the Jameson Bay hut.

Next morning the ship anchored at Walrus Gat and the Geological party plus stores and equipment were dropped there. 'Polarsel' then sailed on to Guinea Bay in the south of the Island and, in a heavy swell, dropped supplies for Dr. Carstens and the rest of the Norwegian geological party. Finally she sailed on up the south-west coast to Jameson Bay and, in a dangerously heavy swell, dropped the Glaciological party. 'Polarsel' then sailed on to Eastern Greenland.

The Glaciologists were met by a group of four Norwegians, from Jan Mayen Radio, who had very kindly spent the day clearing and cleaning the Jameson Bay hut. The hut was found to be in bad condition, and to be damp, but with a little patching here and there it kept most of the rain away from its occupants.

It is convenient here to give a table listing the movements of the Glaciological party.

Date	Chadwick	Kinsman	Smith	Wright
26.7.59	Walk to Base and back for supplies.			
27.7.59	Spent clearing hut.			
28.7.59	All at South Glacier.			
29.7.59	Bad day, no work.			
30.7.59	At South Glacier. Established Advance.			
31.7.59	Spent day filing drills and preparing thermistors.			
1.8.59	Misty day. Carstens visited Jameson Bay.			
2.8.59	Spent day writing letters. Driving Rain.			
3.8.59	Walk to base	Put in 3 ablation stakes on glacier		Walk to base.
4.8.59	At base	2 more ablation stakes put in.		At base.
5.8.59	2 more ablation stakes put in			
6.8.59	Spent day in recalibrating thermistors. Dr. Dollar came from base.			
7.8.59	Continued with calibration of thermistors. Climbed Egg Bluff and measured temperatures and discharge of fissures.			

Date.	Chadwick	Kinsman	Smith	Wright
8.8.59	Spent day at glacier trying to get in a high line of stakes - Failed.			
9.8.59	Drilled in No.1 Thermistor hole on glacier.			
10.8.59	Stormy day. Spent in.			
11.8.59	Measured resistances of thermistors on glacier.			
12.8.59	Reconnaissence for High Camp. Put in high cache of drills, etc.			
13.8.59	Put in high camp.			
14.8.59	Climbed Haakon VII peak.			
15.8.59	At High Camp. Too much wind and rain to work.			
16.8.59	Put in thermistor hole No. 2 from High Camp.			
17.8.59	Evacuated high camp.			
18.8.59	Egg Bluff measurements.		Cleaned up Hut etc.	
19.8.59	Rainy day. Work impossible.			
20.8.59	Walked along to Kapp Fishburn.			
21.8.59	Went up Ekerold Valley.		Stayed around Base.	
22.8.59	Went to Jan Mayen Radio and then on to Base.			
23.8.59	Stayed at base.	Went to Guinea Bay to look for Dr.Dollar.		Stayed at base.
24.8.59	"	Found Dr.Dollar. Returned to Base.		"
25.8.59	Returned to Jameson Bay			"
26.8.59	Measured flows & ablations on S.Glacier			"
27.8.59	Packed up Jameson Bay hut			Sailed for Norway in 'Polarbjorn'.
28.8.59	At Jameson Bay. Climbed Bernakrater.			
29.8.59	Jameson Bay evacuated and taken to Base.			
30.8.59	Packed up Base.			
31.8.59	Taken off Island by 'Polarsel'.			

All members of the Expedition were in England by 6th September 1959.

It is not practical to enlarge on the above activities chronologically, but below are listed a number of points which might be useful to other parties visiting the Island.

Sea sickness pills ("Sea Legs") are invaluable for the outward journey.

The heavy swells in Jan Mayen are very dangerous and at the least, wetting.

Living, in Jan Mayen, occupies a lot of time. Scientific programmes should take account of this.

Great care is needed in navigation on Jan Mayen. It is well to remember that compasses are unreliable and winds are often local.

Mechanical and electrical contraptions should be as simple as possible. It's highly likely they will be troublesome anyway.

The sea ice off the Greenland coast is troublesome and may delay a relief ship for some weeks. Sufficient food should be available to take account of this.

Lots of books are essential for an Expedition like this.

Enormous quantities of driftwood are available on the beaches which can be used in the hut stoves.

A day's rain can make a glacial valley impassable. Meltwater streams in flood are usually unfordable.

Fresh water is exceedingly difficult to obtain at sea-level and may have to be transported two miles or more. Polythene water containers are necessary for this.

Care should be taken when caching equipment etc. to keep the cache above maximum flood level (Particularly near the snout of a glacier). Maximum flood levels can exceed all expectations.

It is dangerous to wander in Jan Mayen alone. Parties should be of at least two.

Best working times in the summer are mid-day to midnight. Weather is generally calmer then.

Stuffiness and carbon-monoxide poisoning in the huts should be guarded against.

The glaciers, after heavy rain may become very slippery. Crampons are needed to deal with this.

Ski, on the higher snowfield, would be useful. Even a small sledge perhaps.

A human skull was found high in the Ekerold Valley.

Many of the stream valleys are difficult to follow.

Small stone walls will help to protect an exposed camp site.

The Norwegians are extremely kind, but one should not expect to rely on their hospitality.

Finally, Jan Mayen weather is capricious and when camping or trekking one should always keep a good safety factor in hand.

A.II.3 CLIMB OF HAAKON VII PEAK.

As described in the general section A.II.2 a high camp was established on Thursday night 13th August at about 600m. above sea level. This was on a patch of moraine about 800m. from the western side of the South glacier, on the edge of the main Beerenberg snow field.

Friday proved to be a calm misty day at camp, but by the light intensity within the mist layer it was evident that the sun was shining unimpared above. Accordingly it was decided to try to climb the Beerenberg.

The party did not start until about 12.30 a.m. (Norwegian Summer Time) owing to the late labours of putting up the high camp on the previous day. The following is a description of the climb taken from one of the member's diary:

"Up at 11.30 a.m. on a calm misty day. The sun seems to be shining above the mist and so we have decided to have a go for the Beerenberg. After a quick breakfast we started out at 12.30 a.m. carrying a good supply of food, our Duvet jackets, crampons and Ventile suits.

On reaching our dump (of glaciological equipment) at the head of the westerly lateral moraine ridge, we found the sun so hot and the wind so calm that we were all forced to apply a liberal coating of glacier cream and to wear our snow goggles. The conditions could be described as "good Alpine," with little breeze, a burning sun, nothing in the sky except a little high cirrus cloud; below us was an almost infinite sea of rolling mist, with a few black peaks of Southern Jan Mayen poking through it. I climbed for the whole of the way to the base of the forty degree cone (1600m) in

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The intended route lay from the top of the west lateral moraine of the Sorbreen across the gently sloping ice field to the crescent shaped nunatak Fonnrabben, then northwards up the Westerly Kronprins Olavs Bre ridge of the snow field to the nunatak Krylen at the bottom of the 40° cone. Here we had to turn N.E. and climb a wide snow gulley between two of the prominent Beerenberg ribs and on to a steep bulging shoulder. A traverse left finally would bring us to the ridge just south of the main Haakon VII Topp. From here we intended to climb along the ridge.

The first set of crevasses on the snowfield were reached after 3 hours of trudging through ankle deep snow. In 5 hours we were at the bottom of the 40° cone, after having negotiated some very deep crevasses, mostly snow covered, or partially so. I led the first snow slope: good hard deep snow, difficult kicking up to the top of the first rock outcrop. Then we started on rime slopes and Dave continued in the lead. He did a nice little traverse under a steep wall of rime and then Dick's turn came. He chose to lead off to Haakon peak over the left-hand side of the shoulder. By this time we were all wearing crampons, which, we found, bit in to the rime surface well. This allowed us to crampon without the necessity of step cutting. The general angle of the slope was, by that time, about 40°. Over to the left the slope suddenly steepened and we found ourselves on a 60° ice wall overhanging, by more than 1000', a wonderful snow couloir, looking out over one of the glaciers leading down towards the Radio

Station. By this time we had a wonderful panoramic view of half of the Beerenberg snowfield, with its jumbled crevasse systems, concentrations marking the heads of glaciers and the smooth snow cover, the broad main ridge system. Over the sea still stretched a smooth blanket of cloud, but now more of South Jan, including Walrus, was visible. Above us was clear blue sky.

By this time things were getting interesting. Dick managed a successful traverse of the slope (2 x 120' pitches) and we reckon the standard was close on severe. On one pitch a foothold gave under me (the rime!), and I had to hold myself on my ice axe. Dave had a similar experience, but was arrested by the rope.

The sun, by now, had sunk low in the sky, and we were experiencing "white out" conditions. The only way in which we could estimate the angle of the slope which we were on was by touching it with our hand at shoulder level, and estimating the distance between shoulder and this point on the slope. The ridge looked to be hundreds of yards away; in actual fact it was little more than a rope length from us.

Finally, we walked off on to the ridge between Haakon and Wordie peaks. It was here that we had our first view of the inside of the crater. It seemed strangely small, not more than a stone's throw across. This, I think, was deceptive, because of the clarity of the air, the depth of the crater, and the sheerness of its walls. Along the ridge were sprinkled the famous "rime domes", some of them almost 40' high. There was a skewed one on top of Haakon peak, at which we arrived at 9.40 p.m. (We did not climb the rime dome because of its friability).

From there we had a fine view of the Weyprecht glacier and the tremendous crevasses, where it breaks out from the crater 1000 ft. below. They were deep blue inside, and possibly 60' across. There was a slight wind on top, but all down below seemed calm and peaceful; low-level cloud stretched right out over the ocean on both sides and was only broken by several narrow lanes here and there.

At 10.15 p.m. we started down along the ridge and on the way we examined some of the rime domes. These seem to grow indiscriminately and are ellipsoidal in shape. On any overhangs they tend to grow stalactites of ice whose crystal orientation is horizontal. Around the base of each dome, where it joined the ridge, was a small ice cave hanging with stalactites of rime. It was noticed that apart from Wordie Peak and Haakon peak, large rime domes do not seem to occur on the ridge elsewhere. From this it would seem that they are very likely formed by a wind blowing from the W. or N.W. (The orientation of the rime crust on the ridge everywhere bears this out). It seems it is very likely that the domes have some sort of rock or ice nucleus, and that the rime structure has grown around them. They are generally of a honeycomb texture of ice and air, and are probably, as a whole, not hollow.

Before descending finally we climbed a subsidiary peak on the ridge between Haakon and Wordie peak, and had a fine view of the crater and Haakon peak itself. Finally we cramponed down a not very steep slope (by-passing the steep traverse) to the various rock outcrops to collect geological specimens. By this time it was about midnight and the setting sun was lighting some of the ice pinnacles of the N.W. facing glaciers. Also in the south there was the outline of the Beerenberg cast on the cloudfield by the light of the setting sun in the north. On the very far distant western horizon could be seen some of the peaks and ice of Greenland (The Liverpool Coast) although they were quite difficult to detect. They were 250 miles away!

Coming back across the snowfield Chad fell waist deep into a crevasse but was soon excavated.

Finally arrived in camp at 1.35 after 13 hours climbing. A capital day."

Note on Beerenberg "Shadow" on S.Horizon.

A cone of no light existed to the south of the mountain. The reddish colour on the remainder of the horizon was by scattering of the light rays by the atmosphere, the red light alone reaching the horizon, and undergoing scattering (blue light has dissipated itself). The shadow is caused by a zone of no scattering as no light reaches this area, i.e. is not a 'shadow' as such.

A.II.4. FINANCE.

The following is only a very brief financial statement, as the finances of the Expedition are not yet tied up completely. More complete financial figures can be obtained from Dr.Dollar. The Income and Expenditure have been balanced, but at the moment only the Income is known precisely.

Income.

	£
Imperial College Members 4 at £30 each	120
Birkbeck College Members 1 at £30, 3 at £15 each	75
Royal Society Grant	900
University of London Research Fund Grant	700
Royal Geographical Society Grant	50
Mount Everest Foundation Grant	200
Gino Watkins Memorial Fund Grant	30
Birkbeck College loan for boat & engine	250
	£2325

Expenditure.

	£
Equipment, food, etc., ordered through I.C. Supplies Section, about	750
Passages to Jan Mayen, via Norway, meals, hotel bills, etc., about	400
Boat & Engine, about	250
Radios, about	200
Scintillometer, about	235
Stereo camera, film, etc. about	100
Transport of Equipment, etc. about	100
Fares to Newcastle, about	40
Sundry expenses(including items of equipment, maps, etc.) about	250
	£2325

A.III. 1. THE USE OF A SMALL BOAT AS A MEANS OF TRANSPORT ALONG THE JAN MAYEN COAST.

Before the Expedition set out for Jan Mayen it was decided that the most suitable means of transport for the geological parties would be a small 12 - 15 ft. boat with an outboard engine. A loan from Birkbeck College enabled the party to buy a 12 ft. lightweight fibre-glass boat, designed by Todds of Weymouth, and a Perkins 6 H.P. two-stroke outboard motor.

Similar boats had been used by F.I.D.S. in the Antarctic over the past few years, and they were consulted upon the matter. Very firmly, they advised the Expedition that two motors were necessary in Arctic conditions. One, they said, should be stored in the boat as an emergency power unit, and the other used. In addition the Expedition were advised that, for even the shortest journeys full camping equipment should be taken in the boat. It was decided, under protest by some members, that the Expedition's financial state would not allow the purchase of another motor.

In the event, failure to observe these two fundamental principles nearly cost the lives of two of the party. Stores were being ferried from Base at Walrus Gat to North Cape at the northern tip of the Beerenberg. On the return journey a storm blew up, and at this critical moment the engine failed. The propellor became uncoupled from the drive shaft by the failure of a frictional coupling. As a result the occupants of the boat had to row for about five hours before they found a suitable place on which to land. During the time they were rowing there was a constant danger of being turned over by the brash-ice which was being broken off the north-facing glaciers by the storm. The place where the party landed was a small cove near Kapp Muyen. This was surrounded by agglomerate cliffs which proved too rotten to climb. Fortunately radio contact was made with Base (the one and only time the field radios ever worked) and the party were rescued by the Norwegian meteorologists. Quite apart from the precarious boat journey, the incident could have been very serious, as the party had no camping and sleeping equipment with them. Subsequently the boat was only used on safer stretches of coast.

However, there is little doubt that a properly equipped boat, used by experienced people, could be of very great value to a scientific party in Jan Mayen. It must be noted and emphasised that the use of a boat in the heavy swells and on the steep beaches of Jan Mayen is a dangerous undertaking, and every proper precaution should be taken. Life jackets should be worn at all times at sea, and waders are essential. The design of the boat should be suited to the conditions. It should be light enough to be pulled up a steep beach by two men, and should have sufficient stability to be easily controlled in a high swell. These two features are generally quite opposed, but, by the use of fibre glass as a constructional material, it should be possible to effect something of a compromise. If anything the boat taken was too flat-bottomed and tended to slip sideways on the waves. This made control difficult. A more Vee-shaped hull would, however, have been difficult to pull up a steep beach. Two, four horse power outboard motors, possibly Seagull's, would have been safer than the one Perkins 6 H.P. as taken.

(F.I.D.S. use Seagull's). Two motors of the size of the Perkins would have been impossible. A canvas spray deflector was provided on the front of the boat, and possibly less water would have been shipped with an awning covering half the cockpit as well. A pump was provided for baleing, but this was a slow process. Camping kit should be taken in the boat at all times, and a few days emergency supplies as well.

It is thought that a boat could be used with fair safety all along the north-west coast of Jan Mayen. In the south (and presumably the east) there were only about three days out of 35 when the sea was calm enough to permit the use of a boat from the Jameson Bay beach.

A.III.2. FOOD TAKEN BY THE EXPEDITION.

The following food items were taken. Planning was for 8 weeks on the Island (i.e. 64 man-weeks). Any comments about food items take this into account.

Food was split up into basic field units, each for 6 man-weeks in the field, and into general Base Food.

Ten crates containing field rations as follows, and intended for six-man weeks, were taken:

ITEM	COMMENTS
8x12oz. cans of Fray Bentos Corned Beef	About right at $2\frac{1}{4}$ oz/man/day. A good solid basic food.
1. 12 oz.tin Pork Luncheon Meat	Acceptable for variety.
2 x 1 lb. tins Ostermilk	Ostermilk could be bettered. Nespray is better. Perhaps $2\frac{1}{2}$ lb. would have been more acceptable.
12 oz. tin of Scotch Herring in Tomato sauce	Dispensable. A luxury.
10 x $\frac{1}{2}$ lb. tins margarine(Stork)	An important item. About right for quantity. For colder work 15 tins would have been needed. Tinning excellent.
10 x 10 oz.tins of oatmeal blocks	Very fine. As good as lifeboat biscuits.
6 x 1 lb.4oz. tins Scott's porage oats	Excellent. 3 oz./man/day a good ration.
2. 2 oz. tins Nescafe	Useful but dispensable. Not a trekking drink.

ITEM	COMMENTS
7 lb. Life boat Biscuits (Carrs)	Excellent. Ideal for expedition purposes.
1 tin Ovaltine (1 lb.)	Good, but dispensable.
4 x $\frac{1}{2}$ lb. tins dried Potato powder	Useful for thickening soups. 2 tins would have been enough.
$\frac{1}{2}$ lb. tin Liptons tea	Excellent. Definitely the best Expedition drink.
2 x $\frac{1}{2}$ lb. tins drinking Chocolate	Very good.
4 x $\frac{1}{2}$ lb. tins of fruit.	A luxury. Could be dispensed with.
1 lb. tin of honey	Very popular.
12 pkts. of Soup (Various varieties)	Very good. Necessary.
8 lb. sugar.	Not quite enough. 10 lb. would have been better.
3. 1 lb. polythene bags of dehydrated potato strip	Very good.
1 lb. of dehydrated onion	Good, if liked.
1 lb. dehydrated cabbage	Good
1 lb dehydrated peas	Good
24 Kendal Mint cake bars ($\frac{1}{4}$ lb each)	Good, but rather too many for low level work.

ITEM	COMMENTS
1 pkt. (1 lb.) of Horlicks tablets	Dispensable.

The above items fit nicely into a 18" x 18" x 24" tea chest. Also needed to make up 6/man-weeks of rations are the following items. These were packed separately for convenience.

*Salt - $\frac{1}{4}$ lb.	Indispensable. Must not be neglected.
*2 oz. Curry powder	Excellent for Expedition use.
*Cheese 8 lb	Scottish Milk Marketing Board Cheddar Excellent. Packed separately because it tends to be smelly. In polythene wrapper - 10 lb. blocks.
*Chocolate 16 lb (Nestles assorted)	Very necessary. 6 oz/man/day. Must be tinned or it goes off very quickly.

In addition to the above field rations the following is an exact record of the crates taken to Base for general use. The items marked * above were extracted from the base crates and taken out into the field. They are mentioned below again.

CRATE B 1

4. 10 lb Cheeses	See above.
1 lb Ostermilk	See above.
2 x $\frac{1}{2}$ lb Lipton's tea	See above.
8 x $\frac{1}{2}$ lb. Chiver's mashed potato powder	See above

ITEM	COMMENTS
24 x 2 oz. Nescafe	Good at Base. See above.
3 lb Soup powder (vegetable)	Only about 1 lb. used. Not as good as packeted soups.
4 lb. dried tomato	Very good, if a bit strong.
1 lb Ovaltine	Good for Base. See above.
5 lb. Apple Rings (dehydrated)	Very good. Useful in curries.
2 lb. Dehydrated peas	See above.
3 lb. mixed dehydrated vegetables	Quite good.
2 lb. Dehydrated onions	See above.
<u>CRATE B.2.</u>	
4 Cheeses	See above.
8 lb.Sultanas	Fine Expedition food. Good in curries.
1 lb. Custard powder	Useless.
4 oz. Pepper	Needed for seasoning.
$1\frac{1}{2}$ lb. Curry powder	Almost a necessity for an Arctic Expedition. Greatly improves the palatability of food.
1.lb Instant pudding	Not very satisfactory.
4 lb. dried egg powder	Made a nice change. Useful for omelettes, scrambled egg etc.

ITEM	COMMENTS
12 doz. small packets (1 oz) Dextrasol tablets	Not very satisfactory. Energy much more readily available from biscuits.
2 lb. Dehy-drated cabbage	Good if not taken in too large quantities.
2 pkts. Horlicks tablets	Nice to suck; dispensable.
2 lb. Golden Syrup	Useful as a porage sweetener.
5 lb. Jam	A useful addition. Good quality jam is desirable.
2 tins Luncheon meat	See above.
2 tins Scottish Herring in tomato sauce	Useful at base. See above.
3 doz. 4 oz. Mint cake bars	See above. Not a Base food.
6 tubes of Fruit sauce	Dispensable, but a pleasant luxury.
9 lb. flour	Too much, 4 lb. would have been better. Useful at Base.
20 lb. Margarine	See above.

CRATE B 3

ITEM	COMMENTS
18 lb. Sugar	See above.
14 lb. boiled sweets	Rather too many. Good if not sticky.
10 lb. Peanut butter	As an Arctic food, excellent. Liked by some people more than others.

ITEM	COMMENTS
6 lb. flour	See above.
5 x 4 oz. tins Marmite	Very popular and useful.
6 x 4 lb. slabs of Huntley & Palmer's fruit cake	Excellent, but rather a luxury.
2. $1\frac{1}{2}$ lb tins salt (Cerebos)	Very good.
4 pkts Soup	See above.
4 lb. margarine	See above.
6 x 7 lb. tins Life boat biscuits	Excellent. See above.
2. $4\frac{1}{2}$ lb. Sweet biscuits	Excellent in small quantities. Not a basic food.

CRATE B 5

ITEM	COMMENTS
25 lb. Nespray dried milk	Excellent. The best dried milk for an expedition.
4 .$1\frac{1}{2}$ lb. salt	See above.
9. $1\frac{1}{4}$ lb. tins Porage oats	See above
2. 1 lb tins garden peas	A change
11 x $\frac{1}{2}$ lb.tins baked beans	A change
20 lb. margarine	See above.

ITEM	COMMENTS
CRATES B 6 - B 11	
30 lb. Nestles Chocolate in each (150 lb. total)	The Nestle Company were kind enough to pack the chocolate in 5 lb. hermetically sealed containers. These, in turn, were packed 6 to a stout wooden case. Approx. 50 lb. milk, 50 lb. Superfine, 50 lb. fruit & nut were taken. All proved to be excellent, and no trouble was experienced, as in Iceland in 1958, with chocolate going stale.
	FOOD BOUGHT IN NORWAY ON WAY OUT
2 Crates apples	Excellent. Bought in Norway on way out. Only fresh food Expedition had.
20 lb. salt Bacon	This was bought in Norway to supplement the meat rations. Very acceptable.
20 lb. Gouda cheese	Bought in Norway when it was feared that the main supply of cheese had gone off. Good.

It will be noticed, from the above lists, that there was a conspicuous absence of dehydrated meat in the Expedition's diet. This is because it was found impossible to obtain dehydrated meat in 1959, and the basic meat food had to be corned beef. This was no real hardship, although dehydrated meat would have been preferable.

On the whole the above food was satisfactory, if somewhat monotonous. As a result of the Expedition only staying in Jan Mayen $5\frac{1}{2}$ weeks instead of the planned 8 weeks a considerable quantity of food (about one third) was left behind in the Base Hut at Walrus Gat. Future expeditions should not bank on the food being there in the future, as the Norwegians may have used it.

A.III.3. GENERAL EQUIPMENT.

Below is a list of the equipment taken by the expedition, with appropriate comments. It must be emphasised that much of the equipment which was taken was bought by the Birkbeck side of the expedition, and would not have been taken by the I.C. Section. Certain items, however, which were selected by the I.C. party were proved to be redundant.

ITEM	COMMENTS
3 Axes	Stout $1\frac{1}{2}$lb axes, with 18" hafts. Excellent, for use on the driftwood.
1 Auger	Intended for soil and ice boring. Never used.
8 pairs snow anklets	Made by Lawries from heavy elastic. A little too strong. Tend to bruise Achillies tendon.
4 Altimeters	3 Paulin; 1 Watts. Useful, but rather unreliable in Jan Mayen owing to very localised weather conditions. Not very robust.
1 Boxwood Alidade	For use with Plane Table. Good and strong.
Watts Microptic Telescopic Alidade.	Very fine telescope; a little heavy for Expedition use.
Boots	By Bally of Switzerland. Each member was individually measured. Absolutely First Class. Import duty was avoided by having them delivered to the ship at Newcastle.
Boat.	See separate section on Boat.

ITEM	COMMENTS
Boat Trolley	Specially designed lightweight trolley. Intended for taking the boat overland across Middle Jan. Could also be used for carrying equipment. Was not used very much.
3 Polythene Buckets	Very useful for carrying and storing water.
6 prs. spare bootlaces	About 4 pairs used.
36 U.2.Batteries	For torches. Only about 12 used.
3 No.966 Batteries	For Handlamp. Only one used.
12 bulbs for torches.	None used.
4 polythene bowls.	Very useful at and around Base.
1 doz. Brillo Pads	Excellent for cleaning dirty cooking equipment. About 2 doz. more were needed.
4 sets Billie cans	Indispensable.
3 tubes Bostic (black)	Very useful for mending clothes, tents, etc.
Wheatstone Bridge.	See Scientific Equipment and techniques.
Balaclava Helmets	Excellent for keeping head warm. Made by Jaeger.
10 prs. Crampons (2 prs. spare)	Horeschowsky 10 point crampons, individually fitted. Indispensable to glaciological party.
3 doz. candles	Useful towards the end of August.
60 Box corners	Used for sealing returning crates.

ITEM	COMMENTS
4 Rolls Sticky cloth tape.	Very useful for electrical purposes.
8 prismatic oil filled compassee.	Usefulness extremely limited, owing to magnetic nature of rock.
Cameras. Film Exposure Meters	See separate appendix on photography.
18 Tea chests	24" x 18" x 18" tea chests. Fairly good as packing crates. Would have been better to be stronger and slightly smaller. Maximum weight was of the order of 130 lb. For handling in Jan Mayen surf not more than 70 lb. is desirable.
1 Dishwashing mop	Useful at Base.
1 Short ice drill (8') 1 long ice drill (30')	See under scientific techniques.
6 Pkts. "Omo" detergent.	Very necessary for removing grease and washing.
1 Douglas Protractor.	Indispensable for resection work.
8 Duvet Jackets	Made by Esstablisment Grain, Lyon, France. Indispensable for high camps. Useful at sea level. Delivered to ship at Newcastle to avoid import duty.
4 Entrenching tools	Useful around base.
Envelopes Stationery	Always useful.
Engine for boat	See appendix on boat.

ITEM	COMMENTS
8 Field books	Useful as individual log books. Everyone must keep an accurate log.
4 files	(2 triangular, 2 flat). Useful for numerous jobs; especially adjusting cutting edges of ice drills.
First Aid kits.	One large R.A.F. type for Base; four portable ones in polythene bags (All by Boots). All of the kits were extremely poor. There was no liquid antiseptic, and all dressings were in cardboard packs. The selection of drugs etc. was more suited to a tropical expedition. Suggest that future expeditions make up their own kits as follows: 1 large bottle T.C.P. 2 large tins dressings. 6 Bandages (assorted). 1 Pkt. lint. 1 Pkt. compressed cotton wool. 1 large box Codeine tablets. 1 Pkt. Ex Lax. 1 tin Nivea cream. 1 bottle Antiscorbutic tablets. The above is based upon the assumption that only minor ailments can be tended. Jan Mayen anyway, without accidents, is a healthy place.
2 Polythene funnels	Useful for paraffin and petrol pouring.
2 yds. Red flag cloth (36" wide)	Used in strips for stake markers on the glacier. Air-sea rescue orange would have been a better colour.
4 fishing lines (spare hooks, weights, etc.)	Useless. Fish in Jan Mayen just don't bite. Time wasting is fishing in the North Lagoon.
1 Roll nylon guyline	Useful for all kinds of odd jobs.

ITEM	COMMENTS
2 doz. pots Savory & Moore Glacier Cream	Useful and necessary if working high on Beerenberg snowfield. Good for greasing metal goods.
10 pairs Goggles (2 prs. spare)	Necessary high on snowfield.
1 pair Industrial gloves.	For manhandling crates. Not really necessary.
Gloves	8 pairs Mitts: Type with cut-off fingers. Excellent for surveying, field notes, etc. By Jaeger. 8 pairs leather outer-gloves. Ex-W.D. ski gloves. Served their purpose, but tend to leak because of seepage through leather. 8 pairs wind-proof cloth gloves. Good as windproof gloves. 8 pairs woollen gloves. Good but rather cumbersome; should fit well.
1 Electrical Handlamp	Very useful around Base.
1 Claw Hammer.	Very useful; especially for opening crates.
8 geological hammers	Very robust good quality ones.
Spare hafts & wedges	Neither hafts nor wedges used.
6 Haversacs	Necessary for field work.
8 Ice axes	Essential to glaciological party.
8 Black inks	About four times as many as needed. Coloured ink would have been useful.
1 jemmy	Useful for opening crates.
14 Karabinas	Essential to glaciological & climbing parties.

ITEM	COMMENTS
1 Hook shaped knife	Useless.
4. 8" kitchen knives	Useful, but too long & not stiff enough.
12 Kitbags	Essential for trekking.
1 Kettle	Useful at Base.
1 ladle	Useful at Base.
8 Beaufort inflatable life jackets & spare CO_2 cylinders	Were never actually used, fortunately. Neat and compact.
Expedition labels	Specially printed. An unnecessary expense.
Logarithmic tables.	Never used.
Mending wool & needles, etc.	Very useful in the most unexpected places.
8 1 pt. mugs (enamel)	Indispensable.
300 small bars Meta fuel	Better & more convenient for Primus lighting than methylated spirit.
2 lb. $1\frac{1}{2}$" nails	Useful for odd jobs.
Paraffin: 30 galls.	In 7. $4\frac{1}{2}$ gall. jerrycans. Assumed that each primus uses $\frac{1}{2}$ pint/day. Calculated for 8 weeks stay. About 30% too much was taken as a result of availability driftwood.
Petrol: 80 galls.	(18. $4\frac{1}{2}$ gall. jerrycans). About 30 galls. only used because of decision not to use the boat very much.
500 gauge Polythene sheet	Very useful for covering outside stores and caches.

ITEM	COMMENTS
Polythene bags 500 gauge	About 100 were taken, in assorted sizes. Very useful for keeping out the damp from food, etc.
6 ice pitons	Not used owing to curtailment of high altitude programme. Would be very necessary for a party working high on the Beerenberg ice field.
2 pr. pliers	Indispensable.
4 pressure cookers (1 gall)	Made base cooking (particularly of dehydrated food) easy.
8 enamel plates	Useful.
6 Primuses	4. 1pint; 2. $\frac{1}{2}$ pint. Behaved very satisfactorily.
6 sets of spares for Primuses	Includes spare washers; nipples; prickers nipple key. Not used very often, but indispensable.
3x2 pt. polythene paraffin bottles	Indispensable for carrying paraffin to high camps.
Pencils 2 gross assorted coloured 2 gross black	About 3.5 gross too many.
4 Pencil sharpeners & spare blades	Very useful in the field.
4 plumbobs	Dispensable.
Plane table & tripod	Necessary for resection.
Plane table paper (Whatmans) (6 sheets)	Not used.

ITEM	COMMENTS
7 Yukon type pack frames	Essential for carrying heavy loads.
2 hemp ropes. 150' long: about 1" circumferance.	Very useful with boat and for numerous jobs around Base.
Nylon Ropes (5. 120', $1\frac{1}{4}$" circ) Nylon slings	Indispensable for safe glacier travel.
19 Rubbers (Erasers)	About 10 too many.
Field Radios	76 K/s transistorised B.C.C. sets with a supposed range of up to 30 miles. Only worked once. Completely useless on all but sight-line communication.
Sweaters	Lambswool by Jaeger (one each). Others from Norway (cheap there).
Woollen socks	2 prs. each issued; by Jaeger. Most people had 5-6 pairs of socks.
2 Screwdrivers	Intended for Engine & glaciological drill. Used for other things as well.
1 Gross No. 8 $1\frac{1}{2}$" screws.(wood)	Not all of them used, but are difficult for an expedition to do without.
1. 24" bowsaw	Very necessary for sawing driftwood.
1 24" bowsaw spare blade	Never used fortunately.
16 string vests(Norwegian)	Indispensable for Jan Mayen.
8 prs. long woollen pants. (Arctic Convoy Issue)	Never actually used very much at sea level. They would be very necessary for an expedition working at high level.

ITEM	COMMENTS
1 Spade	Lightweight as spades go; Almost indispensable around Base.
4 Rolls Sellotape	Very necessary at Base. Can be used for a very wide variety of jobs.
8 Snow Shoes	A mistake. Never used and never likely to be used in Jan Mayen.
Scale Rule (Triangular)	Used in conjunction with Plane Table.
Slide Rule	Used on Results. Accurate enough for this kind of work.
$11' \times \frac{3}{4}'' \times \frac{3}{4}''$ Ramin Wood Stakes (40)	For Glaciological purposes. See glaciological section under techniques used.
Tents	2 Black's Mountain Tents. These were taken as high altitude tents. Their design and method of suspension is definitely faulty. They rely on external A type poles for their structure, and the tent is hung from these by passing the main guylines over notches in the ends of the poles. This system has the advantage that any side wind force on the tent is transmitted to the poles in the form of a direct thrust, but, more important, the guys are likely to be cut through by the movement of the poles in a high wind. In addition, because of this suspension system, the tent is virtually impossible to erect single-handed in a high wind. 2 Edgington's B-Meades with flysheets. These proved to be satisfactory for use by parties travelling by sea. They are rather too heavy for a party on foot. Properly erected, and with flysheets, these tents are hard to better.

ITEM	COMMENTS
Tents (cont.)	<u>1 Everest Meade in 'Wyncol' material.</u> This was used at high camp and proved to be extremely satisfactory. It was the same tent as used in Iceland in 1958, but had since been proofed. The proofing appeared to have improved the tent's waterproofness. <u>1 Pyramid Tent in 7 oz. 'Ventile' material.</u> This Arctic sledging tent was the same one as taken to Iceland in 1958 (See Final Report). It was never used in Jan Mayen, but undoubtedly is a tent which is very suitable for these conditions.
Tent Repair Materials, needles, etc.	Very necessary for an expedition which spends most of its time under canvas.
8 Rubber-coated torches	Were used a little towards the end of August.
2 Reels, strong thread.	Necessary for general sewing purposes.
Tilley lamp	For lighting the hut. Gave a lot of trouble starting, but this was possibly due to the incompetence of the operators.
Tilley lamp spares	2 Vapourisers; 4 mantles; 2 glasses. Some used, but not very successfully.
8 Black's Icelandic special Sleeping Bags	Excellent. Thoroughly reliable.
8 Assorted lighter inner sleeping bags	Needed at times.
8 Lilo Air beds (rubber)	Very fine. Not a single puncture! (New at start of Expedition).
3 Tracing Pads	One would have been ample. Necessary.

ITEM	COMMENTS
1 Theodolite	Microptic No. 1 (Watts). Excellent, if a bit heavy for expedition use.
Tripod	Standard one. Works well, but about three times as heavy as it need be.
2 Thermometers	+60°C to - 20°C, 0.2°C divisions. Excellent, if somewhat friable. For field work a proper case is needed.
2 Maximum & minimum thermometers (with magnets)	Good ego boosters. Worked well.
Tacheometric tables Traverse tables	Tacheometric tables used.
18 Thermistor & calibration curves.	See section dealing with glaciological techniques.
1 Teapot	Useful at Base.
1 large tarpaulin sheet	Given free; proved to be rotten. A very useful item in Jan Mayen.
Ventile over suits	These were Ex - W.D. exposure suits and when many of the flaps etc. had been removed they proved to be almost ideal protection against Jan Mayen weather. Ventile material for outer-clothing is a 'must' in Jan Mayen.
2 Mole type wrenches	For glaciological drill. Useful for wrenching anything.
6x2 gall. polythene water containers	Absolutely essential in Jan Mayen. Water is very difficult to get at low altitude, because of sand.
4 Bundles of soft wire	Very useful.

ITEM	COMMENTS
2 prs.waders	Prevented people getting their feet wet when using boat.
2 Ronson lighters	Useful in place of matches.
18 bottles Whiskey	Very useful for barter with the Norwegians. Very little drunk by the expedition.

Other scientific equipment was taken by the Birkbeck College side of the Expedition, but as this was not used by the Imperial College side, it will not be discussed here.

A.III.4. PHOTOGRAPHY IN JAN MAYEN.

Because of the mist and the almost uniform greyness of the lavas, Jan Mayen light[illegible] is du[illegible] from the photographic point of view. This presents quite a problem in the selection of suitable film, particularly black and white film. Ideally of course, colour photography is more suited to these conditions, but difficulty arises because of the cost and inconvenience of production of colour prints for reports, etc.

For black and white photography a fast film is desirable. This suffers from the disadvantage, that misty conditions tend to emphasise the grain of a film, and, anyway, fast films have large grain size. A very slow film on the other hand lacks contrast because of the fineness of the grain, and so it would seem that a medium speed fine grain film with as high a contrast as possible is desirable. F.P.3. about suits this requirement. Its speed can be doubled, (to 100 A.S.A.) by developing it in May and Baker "Promicrol" developer, without any detrimental effect upon grain size, but contrast suffers a little.

In actual fact, the glaciological section of the expedition generally took Pan F as a black and white film. On the whole the results were a little flat, particularly as they were developed in "Promicrol". F.P.3. would, without doubt, have been better.

Ectachrome colour film was taken by the glaciological party, and the results were generally disappointing. Something seemed to have gone wrong in the processing of the film since the party returned, as about 75% of it has an overall greenish tint.

A small amount of Kodachrome was taken as well and the results from this are generally very much better. It seems that the Kodachrome processing is more standard and reliable, and, further, the garish colours possessed by the film tend to emphasise the rather drab and normally unphotographable topographical features. The only disadvantage of Kodachrome is its slow speed. For colour film, it is necessary, in Jan Mayen, because of the high latitude, to use an ultra-violet filter all the time.

A tripod is almost essential for serious photography in Jan Mayen, particularly for taking panoramas. It should incorporate some form of levelling and swivelling device, similar to a theodolite. The normal tripod, which has a knuckle type joint, is useless for this purpose because it is impossible to take a level panorama with it.

B.IV.1. THE GENERAL GLACIOLOGICAL PROBLEM IN JAN MAYEN.

As previously stated in the general section, the only place where true glaciers exist is in the North of the Island, on the flanks of the Beerenberg. By true glaciers we mean a snow or ice field which, in some parts, is constantly moving and flowing to a lower altitude, in order that the total melting (or ablation) may balance the total deposition of snow. An excellent discussion of this problem of glacial balance is to be found in "Venture to the Arctic", edited by R.A.Hamilton, Pelican Books, and so it will not be further considered here. The Beerenberg snowfield and associated system of radiating glaciers are shown on the general map in Section A.I.2.

Basically the area is simple. The Beerenberg consists of two superimposed truncated cones. The lower one is a gently sloping plateau, running down to the sea in some places, but in others stopping abruptly as a series of near vertical cliffs as much as 200 ft. high. The upper part of the mountain is of a different character. It consists of a steeper truncated cone, with side walls at about 40° to the horizontal, and sits slightly eccentrically (in plan) on the more gently sloping plateau. In the centre of this cone is the remains of the volcano crater. It is a deep, vertically sided basin, which is only broken in the north, by a gigantic gash in the crater rim. Through this break in the northern wall the biggest glacier in Jan Mayen, the Weyprecht Glacier, flows. The crater itself acts as a collecting basin for the glacier. The crater rim thus forms a continuous ridge, which incorporates the highest peaks of Jan Mayen in it; the ridge runs from

Haakon peak in the west, round a $2\frac{1}{2}$ mile snow plastered horse-shoe to Hakluyttoppen in the east. Just above the junction of the 40° cone and the main snowfield marks the start of most of the Jan Mayen glaciers, with the exception of the Weyprecht, which starts from the crater basin lip. At their start, and on the snowfield (the plateau) the glaciers occupy shallow valleys . It is only when they flow over a cliff or are very steep that they have cut deep valleys for themselves, and even then, considering the nature of their rock beds, the valleys are by no means really deep (By comparison, say, with Alpine valleys). It is thought that most of the snow accumulation for the glaciers occurs in the upper part of the Beerenberg snowfield and the lower part of the 40° cone. There is little evidence of snow accumulation high on the ridge, since precipitation appears to have been mostly in the form of rime. Further there seems, in these regions, to be relatively little movement of the rime crust, except possibly by avalanche, because no evidence of crevassing was noted up high.

On the western side of the Beerenberg none of the glaciers terminate in the sea. On the north facing side, the Weyprecht glacier, which pours from the crater basin, may be seen to discharge directly into the sea. The actual ice-front protrudes beyond the coastline by as much as 50m. The general angle of the glacier is very steep: it descends 2000m. in $5\frac{1}{2}$ Km. (i.e. its average slope is 1:2.75). By now it has cut a substantial trough, bounded by steep rock walls at each side and as much as 600m. deep. Further eastwards is another glacier, the Kjerulfbreen, which discharges into the sea, but this glacier differs from the Weyprecht in that it is fed from the Kronprinsesse Marthas Bre section of the snowfield. The next glacier, eastwards, the Svend Foynbreen now discharges into the sea. In 1938 and 1949 it did not do so. The east coast of Jan Mayen comprises a series of very steep cliffs some 300m. high. The glaciers Dufferinbreen, Frielbreen, Prince Haralds Bre, Griegbreen and Williebreen, tumble down over these cliffs and discharge directly towards the sea. As on the north coast, these glaciers have now cut steep sided troughs into the cliffs. The shelving of the Beerenberg ice field down to the south-east coast is not so steep as elsewhere on the mountain. Only one real glacier, the Sorbreen (South Glacier) exists here, although the rather indeterminate expanse of ice edge, the Fotherbybreen, might be classed as a glacier as well.

Of the Jan Mayen glaciers, the Sorbreen is the most readily accessible glacier from middle Jan. It is confined to a broad hummocky valley by high side moraines and rock walls and is fed from a large area of the southern part of the Beerenberg snowfield. Of the southern and western glaciers which do not terminate in the sea, it is the most well defined, and occupies the most definite valley. It is the combination of the qualities of accessibility and entrainment in a well defined valley which have been the reasons for the study of the glacier in the past. This past record, the only one which exists for a Jan Mayen glacier, was largely the reason for the 1959 study of the Sorbreen, since it is by a comparison with previous records that most can be learnt.

Before a detailed description of the work on the south glacier is given, it is opportune here to list the Jan Mayen glaciers, other than the Sorbreen, and to make comparisons of 1959 observations (if any) with previous records (if any).

Glacier	Previous Observations.	1959 Observations.
Kerchoffbreen	*Observed in 1938. A definite retreat before 1938. In 1949 some 1400m. from the sea.	Observed only from a distance. It seemed, that like the South Glacier, this too was advancing. A steep ice front pushing a mound of moraine.
Charcotbreen	*1938, Snout 183m. from shore. Nearly reached the sea in 1882-3. In 1949 was about 1300m. from the sea. A definite retreat.	Only observed from a great distance.
Jorisbreen	*Some 500m. from the sea according to Austrian map (1882-3) Retreat obvious by 1938. In 1949 some 700m. from the sea.	Only observed from the sea. Edge of ice seemed more definite than as shown on 1949 map.
Hamarbreen	Not mentioned by Jennings. A glacier with its own cirt. Shown on Austrian Year Map(1882-3) as about 50m. from sea. Some 1200m. from sea 1949. Retreat.	Observed only from the sea. A very definite ice-edge.

Glacier.	Previous Observations.	1959 Observations.
Weyprechtbreen.*	Drains from crater. Austrian map (& observation) shows it entering sea. Did in 1949. Still does. Moved 3m. in 24 hours; 2.34 m. in 23 hrs. (Separate observations) in 1882. (Does not record in which position measurements were taken).	Seen only from the sea and Haakon peak. Obviously flowing very quickly.
Gjuvbreen. *	Called by Jennings, East Weyprecht. Not shown on Austrian map. In retreat in 1938. Some 500m. from sea in 1949.	Seen only from sea. Appeared to be inactive.
Kjerutfbreen.*	1882 Austrians observed it flowed into the sea. Jennings could find no sign, in 1938, of a lowering of surface level. Average flow rate 1882 0.19m/day (Near side of glacier)	Seen only from sea. Calving regularly.
Svendfoynbreen.*	Austrian map shows glacier ending in sea. Jennings in 1938 said it was 50 ft.(17m.) from shore. In 1949 it was 50m. from shore.	North cape party state that this glacier definitely terminates in the sea at all states of the tides.
Sigurd Glacier.*	Not shown by Austrian map. Jennings states 1 mile from the sea in 1938. About same distance in 1949 from sea.	Not observed.

Glacier.	[illegible] Observations.	1959 Observations.
Dufferinbreen.	[illegible] entering sea on [illegible] (1861) & on Austrian map (1882). In 1938 some 152m from sea. About 30m. from sea in 1949.	Not observed in 19[illegible].
Frielbreen Prince Haroldsbre (converging together)	Austrians show it entering sea. Jennings says it was possible in 1938 to walk round it (some distance from shore line). 1949 map shows it entering sea.	Not observed
Griegbreen.	Shown in 1882 as entering sea. Jennings says it finished on shore in 1938. Some 150m. from sea in 1949.	Not observed
Williebreen.	In 1882 shown entering the sea. Jennings says it terminated on shore in 1938. In 1949 it is shown entering the sea side by side with another glacier the [illegible]breen. Presumably formerly assumed to be one and the same as Williebreen.	Not observed
Petersbreen.	Austrians show it entering the sea in 1882. In 1938 about 457m. from the sea. 1949 some 600m. [illegible]	Not observed
Fotherbybreen.	[illegible] show it on their map. [illegible] [illegible]es vaguely. [illegible] [illegible]ble 1000m. from the sea. In 1938 Jennings thought it to be retreating. Some 800m. from the sea in 1949.	Not observed

* Indicates that there is further discussion of this glacier in Journal of Glaciology, October 1958, No. 4. "Glacial Retreat in Jan Mayen" by J.N.Jennings. Further reference to the Sorbreen can be found in Journal of Glaciology October 1949, page 338, in a letter from J.N.Jennings.

All the 1949 dated references and measurements are taken from the new 1:50,000 Norsk Polarinstitutt topographical map. This was made from air photographs flown in 1949. The map is remarkably accurate.

The fact that Jan Mayen glaciers occupy relatively shallow valleys which radiate outwards from the base of the 40° cone, has already been discussed. It is difficult to estimate the order of thickness of the glaciers, but it is thought (with the possible exception of the Beerenberg crater) that at no point are they thicker than about 200m. The only places where the glaciers have carved sizeable valleys for themselves are in the north and east where they have etched their way into the sea cliff-lip as they tumble over it. Comparatively short term glacial action will quickly erode deep gashes under these conditions.

In view of the quite exceptionally high flow rates of the Jan Mayen glaciers - which would, in part, explain their erosional abilities - it would seem that the glaciation in Jan Mayen has been going on for a comparitively short geological time. This supports the theory that the Beerenberg is of Pleistocene origin. Certainly there is no evidence that it has been submerged below an ice sheet, and the only traces of glaciation on the Island can be found in the valleys which the present glaciers have obviously occupied. Further, the friable nature of the lavas which compose [illegible] and [illegible] of [illegible]

High [illegible] flow [illegible] being equal [illegible] of precip[illegible] tends to slow [illegible] glacier flow.

(d) Winds, humidity and cloud cover. These particularly affect ablation and sublimation. Humidity will prevent sublimation from the glacier surface; cloud cover will hinder ablation. Wind direction may well affect precipitation, which will in its turn affect flow.

(e) The thickness of the glacier. Thin glaciers have a high flow rate in many cases, provided that bottom friction is not too great to counteract this. The thickness of a glacier is bound up with its steepness, and it is debatable whether it is necessary to express both these parameters when discussion is confined to general terms.

(f) The geometric form and size of the glacier bed, and particularly if there are any abrupt discontinuities in it. A valley profile without abrupt changes, which is continuous and smooth will help easy flow; hindrance is caused by hummockyness. A glacier flows more easily in a bed which it has occupied for some time.

(g) The roughness of the glacier bed. This is greatly affected by the nature of the rocks which compose it. Rocks containing clay minerals tend to form boulder clays which lubricate the underside of the glacier and encourage flow. Glaciers thus tend to flow more easily in their valleys with time.

(h) Glaciers which terminate in the sea. These have their bed resistance lowered in their final parts and thus tend to be faster flowing by comparison with a glacier which terminates by ablation.

From the above points it is evident that a glacier is in a precarious and delicate equilibrium; its modes of flow are the result of a careful balance of many variables. From the gathering of its snows, through the stage, the recrystallisation, the flow to maintain continuity, to the ablation in the lower levels, the glacier itself is a manifestation of the above and possibly other variables. Any slight change in its environment, even for a single season will be followed by a change in the position of the ice front and the flow rate. In many cases it is impossible to give the exact cause of a change, and only if it is a relatively prolonged process will it be possible to correlate the change with a change of meteorological regime.

In the case of the glacier studied in Jan Mayen, the Sorbreen, points (a) to (h) are approximately as follows:-

(a) Steepness: about 1:5 (compared with 1:2.75 for the Weyprecht). One of the less steep glaciers in Jan Mayen.

(b) Mean annual temperature is close to $0^{\circ}C$, and the range is about $11^{\circ}C$ on the average. The flow would be expected to be very plastic and there be relatively little seasonal variation, on this account.

(c) At the present time the annual precipitation is of the order of 700mm. This is rather high.

(d) Winds in Jan Mayen are very local and variable. No prediction as to their effect upon glacial flow can be made. Relative humidity is high (at sea level anyway) and is about 85% on the average. At higher levels it is also likely to be high, judging from the rime formations which occur there. Cloud cover is notoriously high in Jan Mayen. This will inhibit ablation.

(f) The Sorbreen valley is very hummocky. Consequently the glacier is very crevassed.

(g) The rocks in Jan Mayen, in general, do not contain clay minerals and hence the glaciers get little lubrication in their beds.

(h) Several glaciers (not the Sorbreen) terminate in the sea in Jan Mayen. These are the faster flowing glaciers.

It would seem from above that in Jan Mayen we are likely to have relatively fast flowing glaciers since points (a), (b), (c), (d), tend to encourage flow. These, it is considered, dominate (f) and (g). In actual fact the Jan Mayen glaciers do flow quickly, and very much more so than would be expected. Glaciers which flow into the sea flow faster than those which terminate by ablation, it is found.

B.IV.2. GLACIOLOGICAL TECHNIQUES USED.

The work done on the Sorbreen fell broadly into four headings, each employing separate techniques:

(a) Survey of the ice edge.

Unnamed copies of the new Norwegian map at a scale of 1:20,000 were obtained. It was decided that it would be best to plot the ice edge directly on to these rather than make a new map.

At first prismatic compass resections, from known points on the lateral moraines, to the ice-edge were done. Checks on these resections from different positions showed them to be so inaccurate as to be useless. It is presumed that the strong magnetic anomalies in the area were responsible for these inaccuracies. (See Section B.V.6) and thereafter three point resection with a Douglas protractor was employed for positioning. (See pp. 129, "Hints to Travellers" R.G.S., Vol. I., described is "third method" - use a celluloid sheet which will take a pencil, rather than tracing paper). The position of the glacier snout as worked out by resection, coincided with a tacheometric traverse done from the high tide mark at the point x in Fig. 5. It proved, on 30.7.59, to be at 1030m. from the sea (point x) and at a height of 85m. above high tide mark. It is thought that the horizontal distance is accurate to within ± 20m. at the very worst.

(b) Ablation Measurements.

In order that the rate of surface lowering of the glacier by melting, could be examined, a series of Ramin wood stakes, 11 ft. long x $\frac{3}{4}$" square were inserted into drill holes six feet deep in the ice. For the purpose

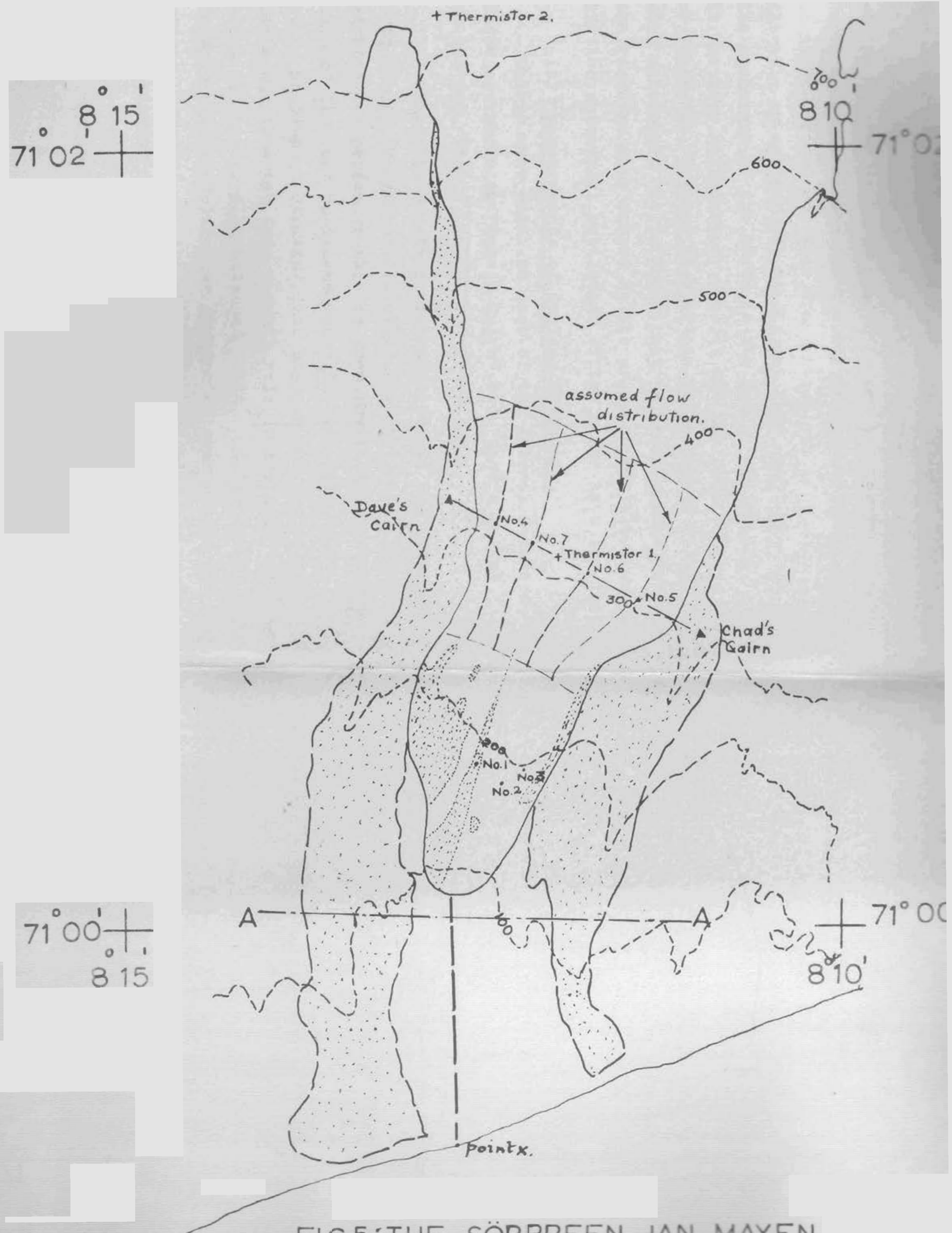


FIG 5: THE SÖRBREEN, JAN MAYEN.
contours in metres

of the measurement it was assumed that, [illegible] the lower ice (5' - 6" deep), the stake [illegible] in a fixed position and the rate of surface [illegible] of the glacier could be read off from the stake. Ramin wood was chosen for the stakes because [illegible] straight-grained and free from knots, and [illegible] slightly on wetting (it was thought this would improve the anchorage of the stake in the ice). In general it was very satisfactory, but it did not grip the ice or freeze in, because each of the holes became filled with meltwater. It is hoped that no grave errors in the readings were caused by the presence of meltwater, and the consequent settlement of the stake [illegible]

(c) Measurements of surface movement

Cairns were built on each of the lateral [illegible] These are shown as "Dave's Cairn" and "Chad's Cairn" on the map, Fig. 5.

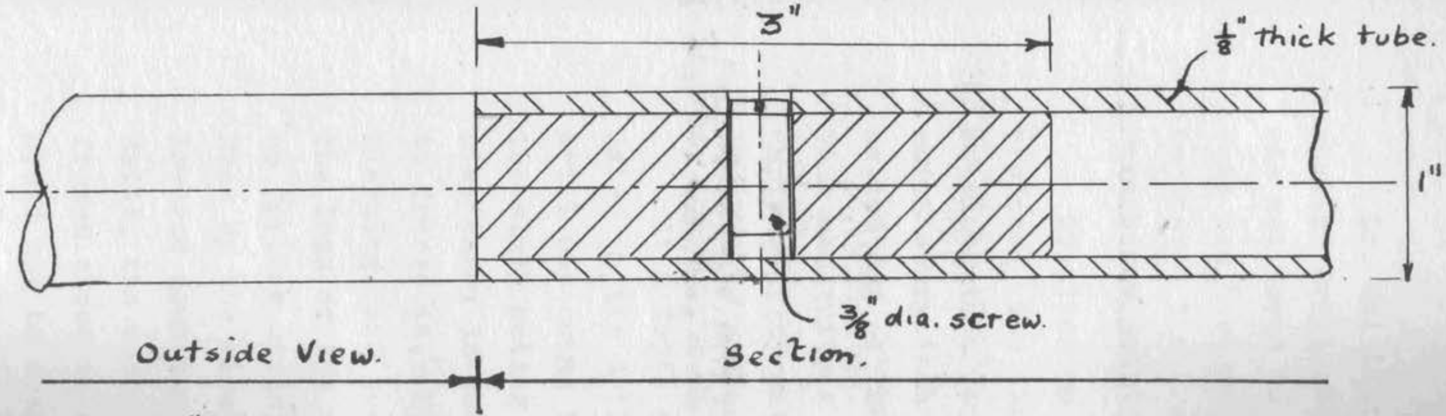
A theodolite (Watt's microptic No. 1) was [illegible] over one of the cairns, levelled, and the other cairn sighted. A person on the ice then positioned a stake [illegible] each of the four positions shown in Fig. 5 (No.4, No [illegible] No.6, No.5) on a straight line between the two cairns. [illegible] stake was inserted into a drill hole in the ice, [illegible] and a red marker flag attached to it. At the end of [illegible] 20 days the theodolite was re-erected over one of the cairns, levelled and the other cairn sighted. A party on the glacier then found the original position of the stake relative to the two cairns, and measured its displacement with a tape along the surface of the glacier. In this way the average surface flow, during the period, and in a particular position, was calculated.

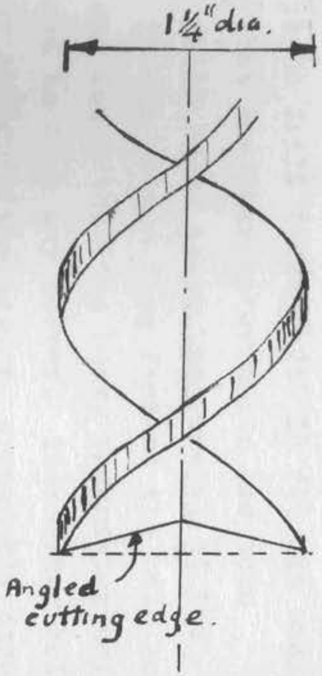
(d) Temperature Measurements.

Ice temperatures at the surface of the glacier were measured with a standard mercury in glass thermometer, reading to 0.2°C. Unfortunately, because of a badly designed carrying case this thermometer was eventually broken and no high level temperature records were obtained.

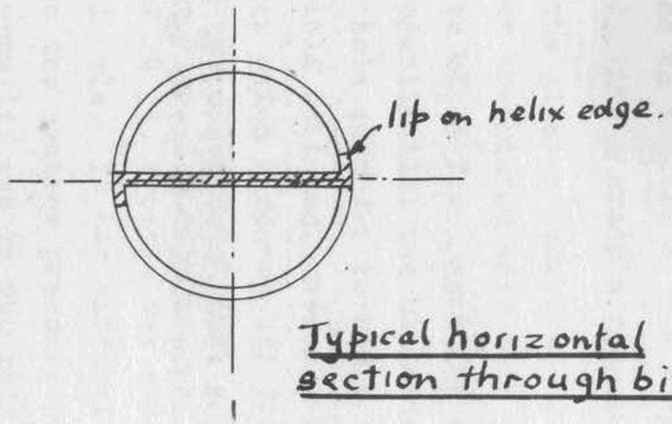
Temperature within the ice at depth was measured by drilling a hole down to the depth required, placing down in the hole, at intervals, specially calibrated thermistor units, and measuring the temperature electrically on a wheatstone bridge.

Before the Expedition took to the field it was decided that it might be necessary to drill down as far as 30 ft. into the ice, and accordingly Messrs. Leonard Farnell of Hatfield, constructed a drill for this purpose. The drill was about 32ft. long when completely assembled. It was made up, as is shown in the accompanying drawing, of 10 aluminium alloy tubes each 3' long, 1" diameter, and $\frac{3}{32}$" thick. The joints were as shown in the drawing. They proved to be satisfactory, except that some of them were too tight a fit. A file soon remedied this. The drill and rods were motivated by a normal type 5" throw non-reversing brace with a similar joint system to the rods. The bits were normal scotch nosed augers and it was found that best results were obtained if the bit nose was modified so that the edges were angled inwards as shown in the diagram. It was also found that the bit with a small flange on the outer edge of the helix was more satisfactory as it tended to retain the ice core better. A paper discussing the merits of various ice drills can be found in "Symposium of Chamonix, Sept. 1958, On the physics of the movement of ice, International Association of Scientific Hydrology", publication No. 47, pages 105-110, by W.H.Ward.





Sketch of bit end.



Typical horizontal section through bit.

ICE-DRILL DETAILS

Dr. Hal Lister kindly lent the Expedition a smaller drill about [illegible] ft. long, but, by and large, this was not found to be as satisfactory as the Farnell drill. This was because a normal "chuck and bit" joint was used to fasten the brace to the top of the rods, and the rods were screw jointed, like a sweep's rods.

Drilling on the glacier proved to be quite a lengthy process. The first thermistor hole took 5 hours to complete to a depth of 24 ft. Every few turns (which means every inch practically) the whole drill had to be hauled out of the hole in order to clear the bit of ice. This was quite a cold business, made all the more unpleasant by water which streamed off the drill and completely soaked the operator's hands and arms.

At a depth of 24 ft. trouble was experienced with water in the drill hole. It was difficult to pull the drill out owing to the suction pressure of the water and ice-slush acting upon it, and if the rods were left stationary in the hole for very long they quickly tended to freeze in. This situation at 24 ft. depth was alarming, and because the party were unwilling to risk the loss of the drill to the ice of the South Glacier, no further attempt to drill deeper than 24 ft. was made. Even by the time that the thermistor units had been lowered down the drill hole, after the removal of the drill, the water in the bottom five feet of the hole had frozen since it was found that the heavy thermistor units could not be coaxed to sink any deeper. Thermistor hole No. 2, at a higher altitude was easier, presumably because the ice there was not so well compacted.

The temperature at various points down the holes was measured by means of thermistor units. These consist of a glass covered, bead type thermistor (Supplied by Mullard Ltd. - VA 2000 series), of about 1500 ohms, at 25°C, which was sealed into a piece of heavy lead tubing $\frac{1}{2}$" in diameter and 9" long, by Shell epoxi-resin. The leads were of normal low amperage wire (Woolworths). The units were previously calibrated on a Tinsley portable Wheatstone bridge (1.5v). Temperatures during the calibration (done in oil) were taken as low as -12°C by using a freezing mixture of salt and ice. Trouble was experienced with these thermistor units in Jan Mayen, and finally it was found that they are extremely non-linear in their voltage - amperage relationship. The bridge taken to Jan Mayen operated on a 4.5v. flat battery and this high voltage produced a heating effect in the thermistors. The bridge was subsequently operated on a torch battery and it is thought that the measured temperatures are accurate to ±0.5°C.

Before the actual measurements were taken on the glacier, time was allowed (24 hours) for a thermal equilibrium to be established in the drill hole. Most of the thermistors froze in and have been left for posterity.

B.IV.3. GLACIOLOGICAL RESULTS AND ANY CORRELATIONS.

Before proceeding to discuss the glaciological results in detail, it must here be emphasised that many of the deductions contained in this section of the report are based upon assumptions and extrapolations. No excuse is made for this, because in each case the final numerical result is a realistic one when compared with observations in the field. It is not claimed that any of the assumptions are accurate because of this, but that the assumptions represent a possibility and are reasonable in the present state of knowledge. As more data is obtained the assumptions will be modified or dispensed with in order that they might fit the facts.

(a) Position of the Glacier Snout.

A tacheometric traverse from the sea (high tide mark and the point x on the map, Fig. 5) indicated that the glacier ice front was 1030m. from the sea. A check for altitude above high tide mark gave 85m. which corresponds very well with 1030m. from point x and the contouring of the map. Resection, done with a Douglas protractor gave an ice front in almost the identical position given by the tacheometric traverse.

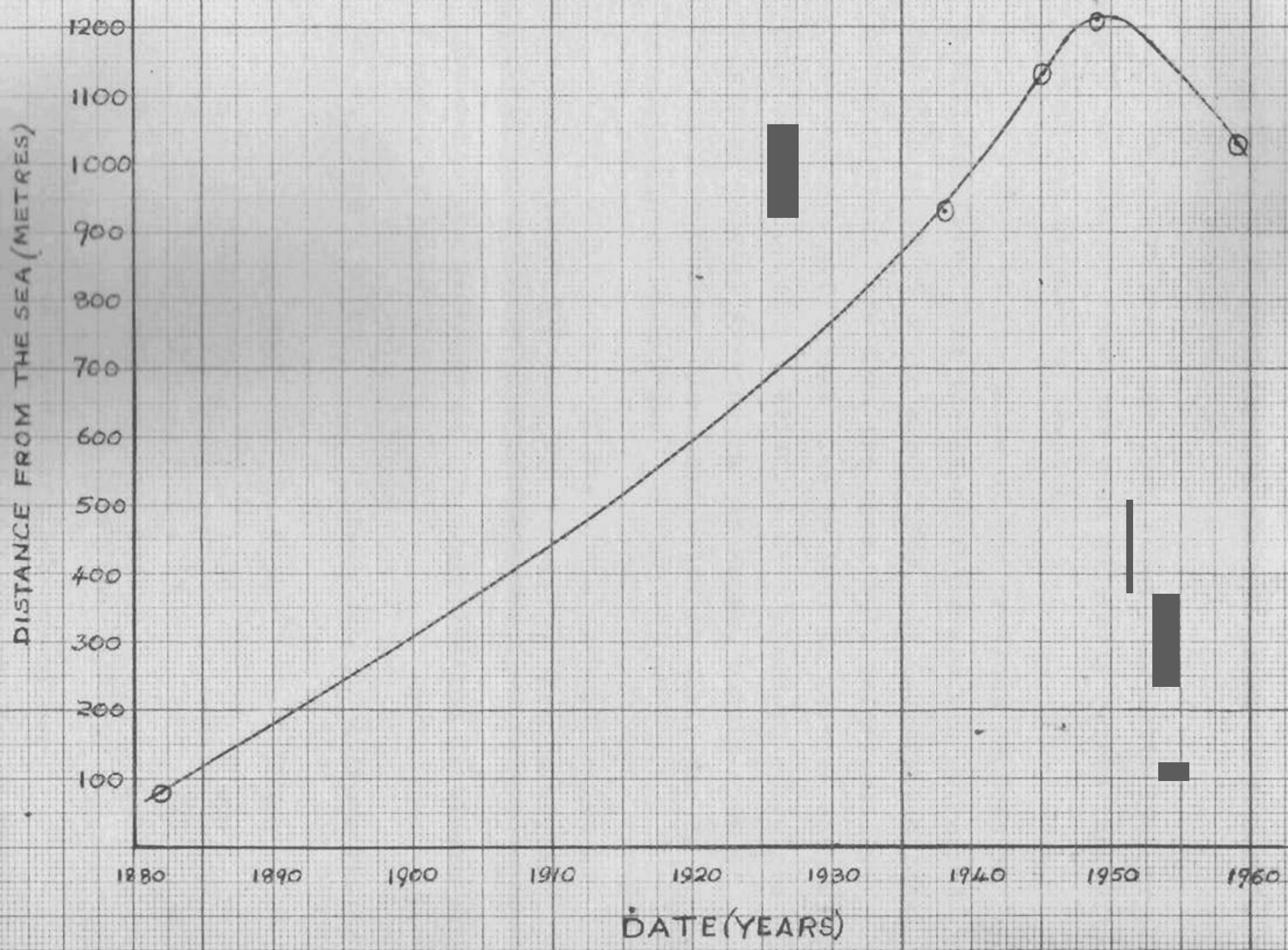
An investigation of the records for the Sorbreen have revealed the following table:

Year.	Observation by	Distance from the sea (Metres)
1820	William Scoresby, Jun.	Discharging into the sea.
1882	Austrian Polar Year Expedition.	About 80.
1938	Imperial College Jan Mayen Expedition (Ward's Map).	930
1945	Air Photograph	1130
1949	Norwegian Map (Based on air photographs)	1210

PLATE 2. The snout of the Sorbreen as seen from the westerly lateral moraine. Note the extensive moranic cover of the ice.

THE SEA-TIME RELATION

(showing general retreat and then advance)



1959	U.L.Jan Mayen Expedition (By resection & tacheometric traverse).	1030

These observations, with the exception of Scorsby's, are plotted out as Fig. 1.

It can be seen that from about 1820 until 1949 or 1950 the glacier front has been generally retreating. After this it has started to advance.

A glance at the table of the previous records in B.IV.1 indicates that the Svend foynbreen has retreated and then advanced again since 1949. It is possible that other glaciers have done the same, but, unfortunately, there was not sufficient time in 1959 to examine them all. This is not sufficient evidence upon which to postulate a general glacial advance in Jan Mayen, but in view of the climatic changes discussed below it would not be unreasonable to assume one.

Fig. 2. is a plot of the annual precipitation in Jan Mayen since 1922 when the Norwegian Meteorological Station was first established there. The following table represents the averages of the precipitation in blocks of a number of years:

No. of years in block	Dates	Mean date	Average Precipitation for block(m.m.)
5	1922-1926	1924	369
5	1927-1931	1929	450
5	1932-1936	1934	563
3	1937-1939	1938.5 (i.e.June 1938)	640

3 year's break in readings because of war.

Met. Station switched from Jameson Bay on the South side of the Island to present position near the North Lagoon.

Plate 1. Close-up of the snout of the Sorbreen, showing the way in which the advancing ice snout is pushing a mound of moraine before it.

Fig 2: ANNUAL PRECIPITATION, JAN MAYEN ISLAND, SINCE 1922.

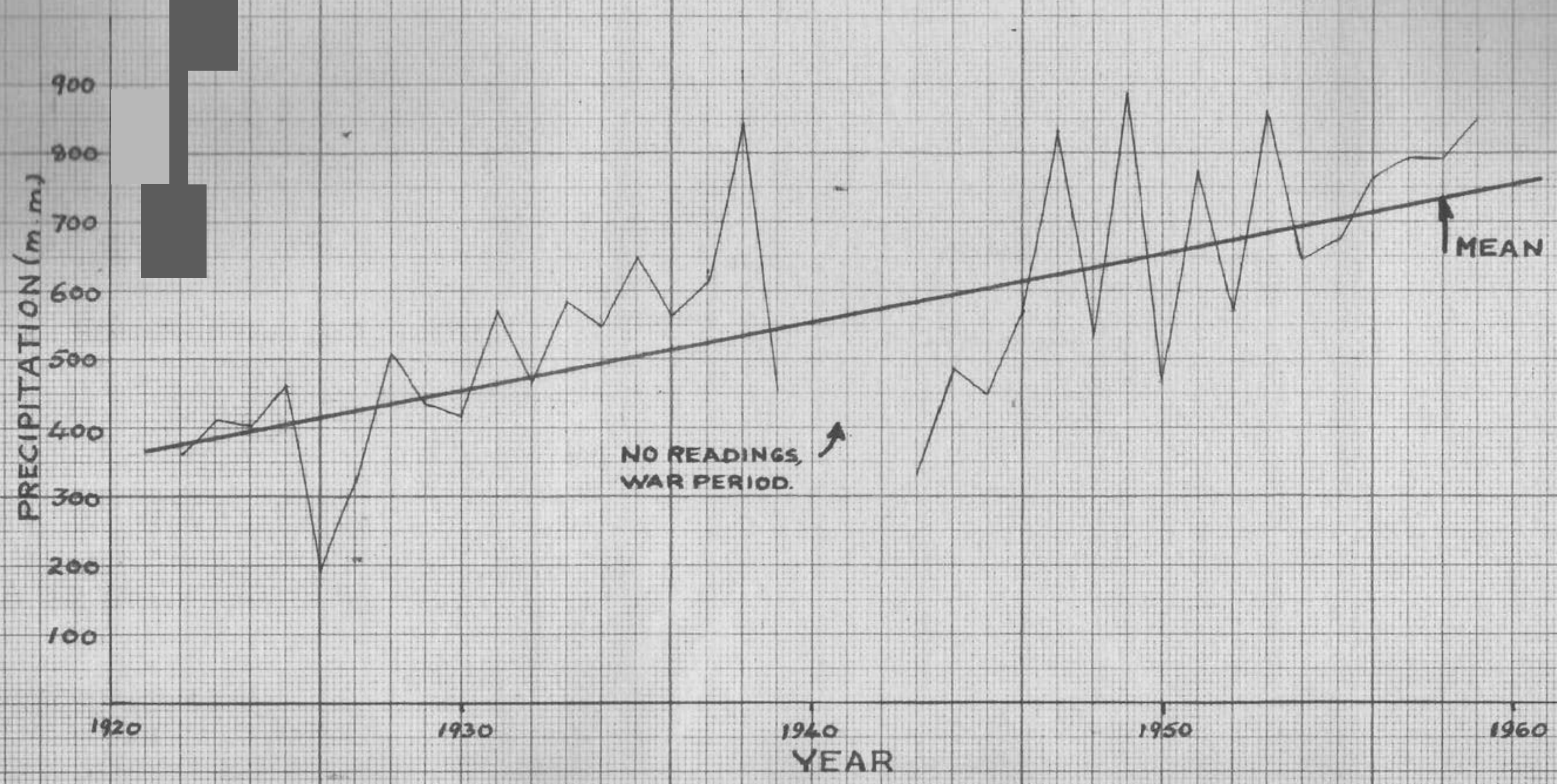
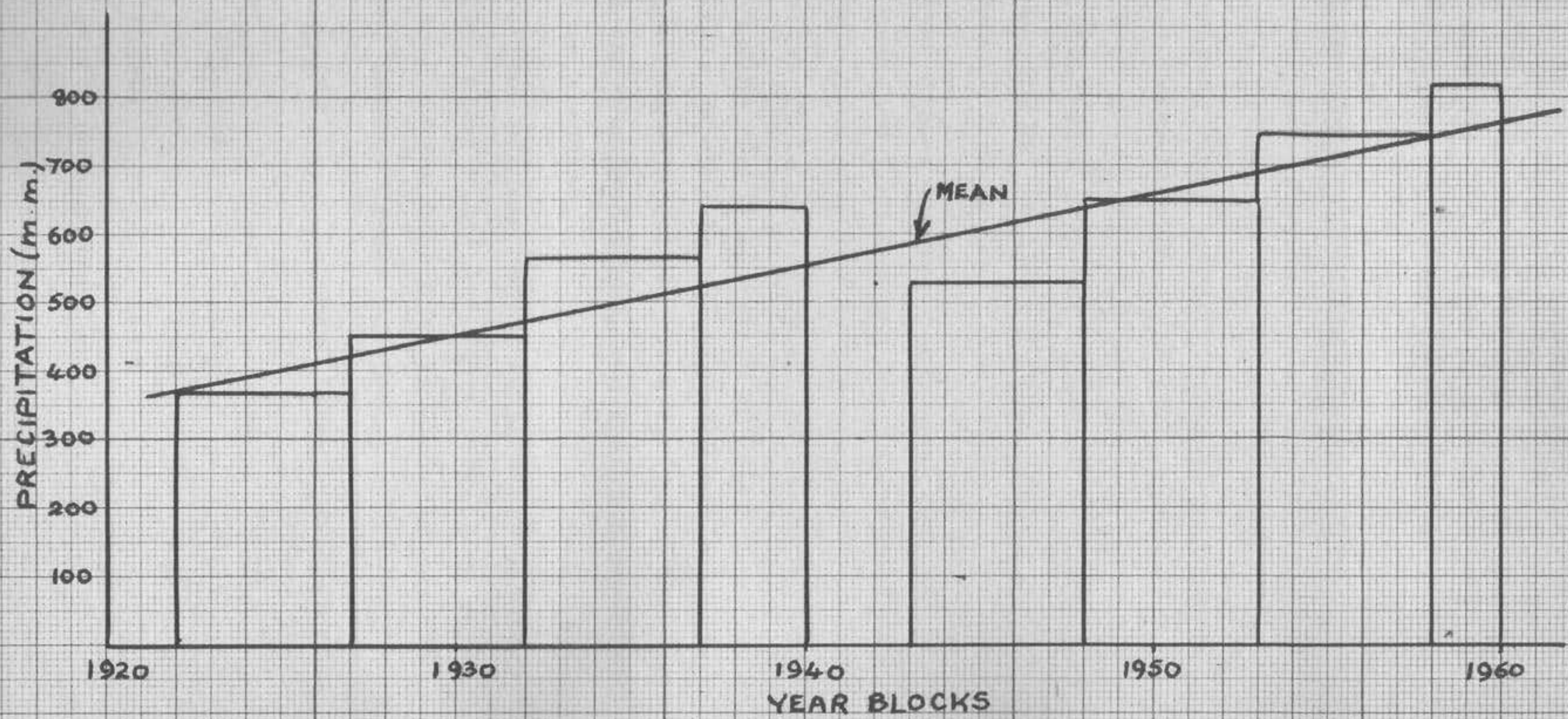


Fig 3: METHOD OF FINDING CHANGE IN MEAN PRECIPITATION USING A NUMBER OF YEARLY BLOCKS.



No. of years in block	Dates	Mean Date	Average Precipitation for block (mm.)
5	1943-1947	1945	529
5	1948-1952	1950	648
5	1953-1957	1955	744
2	1958-1959	1959.0 (i.e.Jan.1959)	815

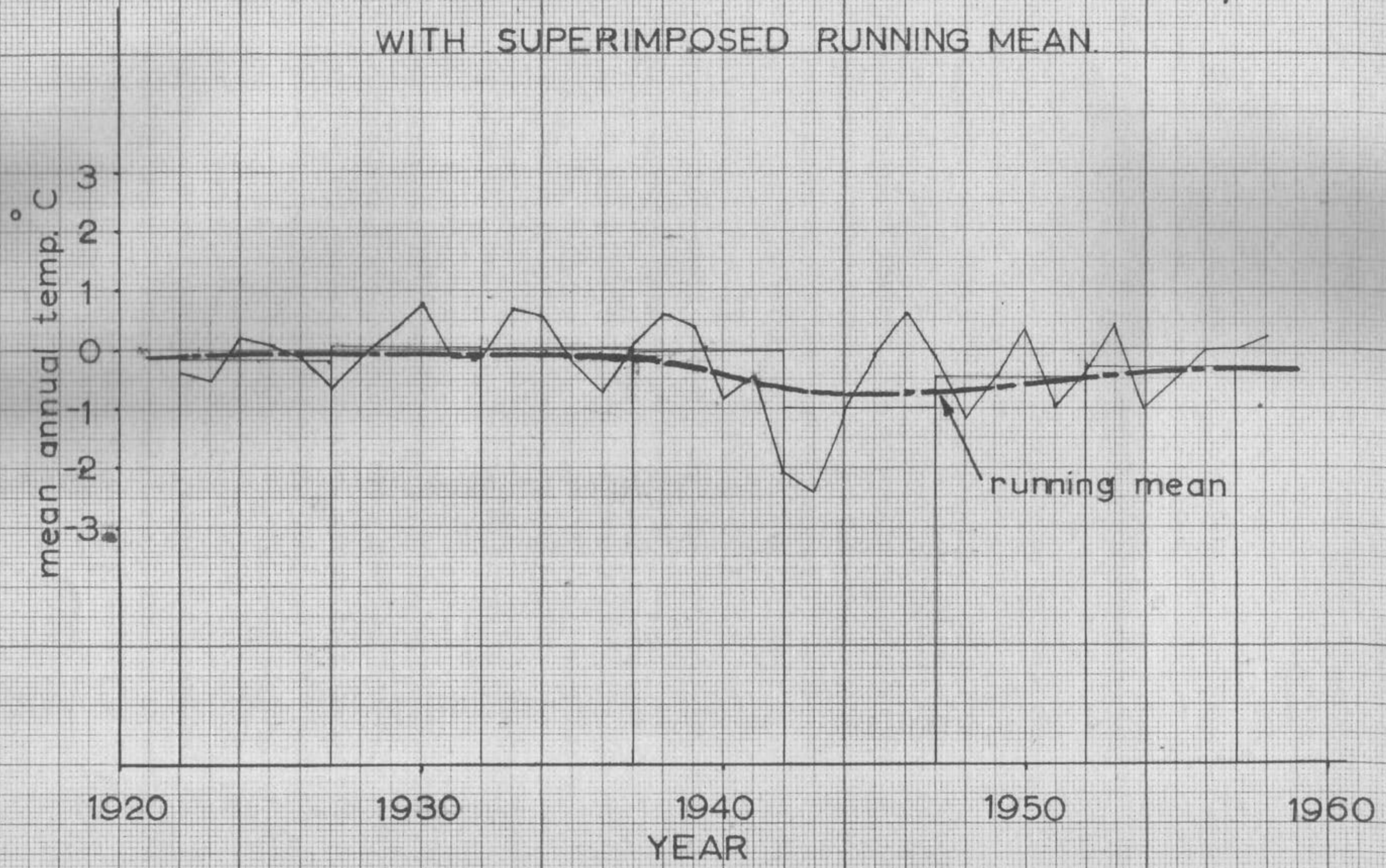
Fig. 3 is the plot of average precipitation for the block against mean date of the block. The slope of this line, the running mean, represents the average rate of increase of annual precipitation since 1922. It will be seen that this is of the order of 1 cm/year and that the annual precipitation since 1922 has increased on the average from about 370 mm. to about 740 mm. That is it has about doubled.

The fact that during the war years the place of observation was switched from Jameson Bay to the North Lagoon, only adds to the case for an increase in precipitation, since it is generally agreed in Jan Mayen that the southern side of the Island is wetter than the north, because it is exposed to the easterly and southerly rain-bearing winds . The fact that there is a drop between the 1938.5 block and the 1945 block, and then a rise only adds weight to this argument.

Fig. 4 is a plot of mean annual temperature since 1922 (at about 20m. above m.s.l.). The temperatures have been split up into a series of blocks in a similar way to the precipitation, and an average found:

No. of years in block	Dates	Mean Date.	Average mean annual temp. for block (°C)
5	1922-1926	1924	-0.14
5	1927-1931	1929	0.06
5	1932-1936	1934	0.06

FIG4: MEAN ANNUAL TEMP. VARIATION SINCE 1922, WITH SUPERIMPOSED RUNNING MEAN.

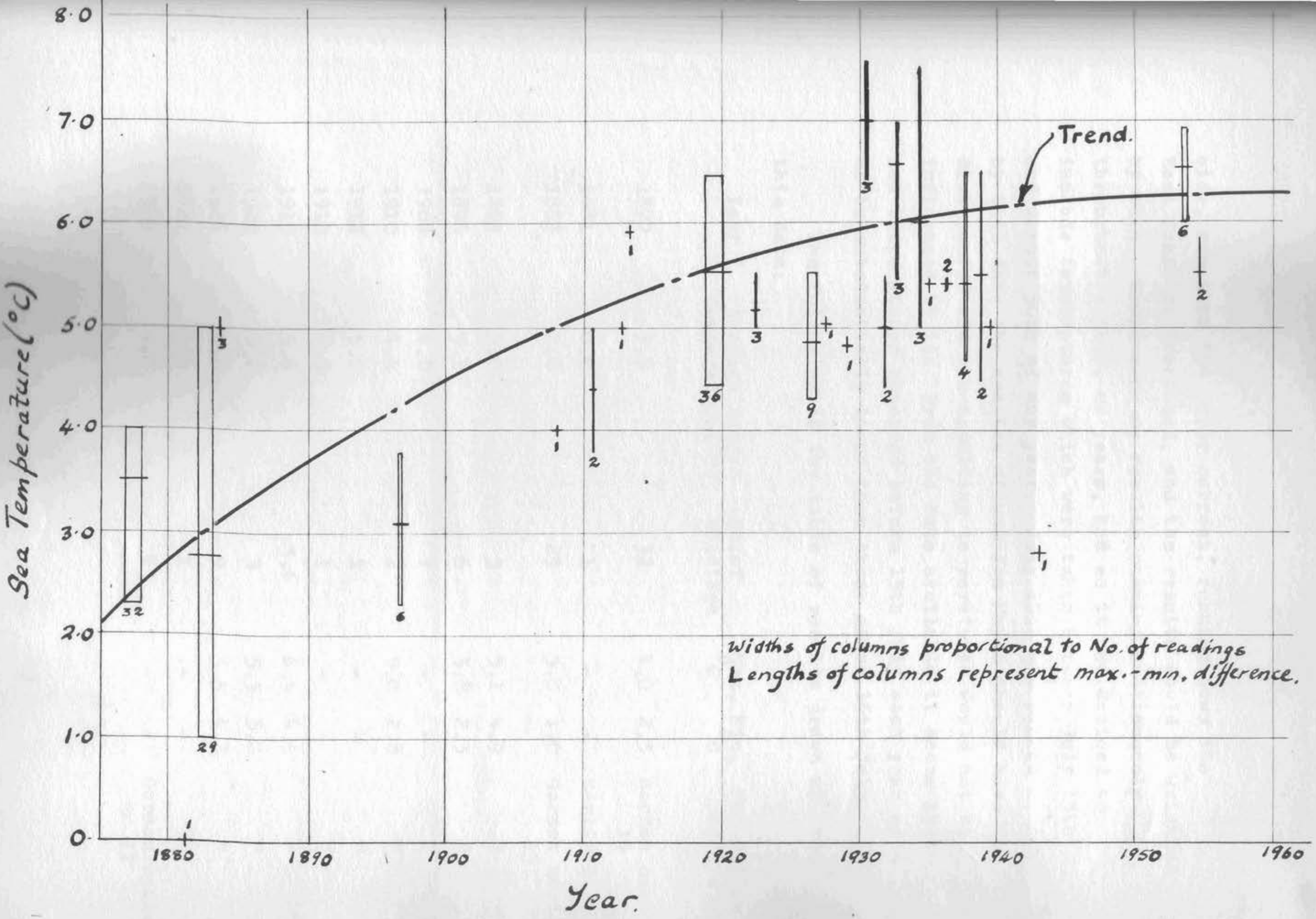


No. of years in block	Dates	Mean Date	Average mean annual temp. for block (^{o}C).
5	1937-1941	1939	-0.04
5	1942-1946	1944	-1.00
5	1947-1951	1949	-0.46
5	1952-1956	1954	-0.30
2	1957-1958	1958.0 (i.e.Jan.1958)	0.10

It can be seen that from 1922 to 1945 the running mean temperature falls slightly and since 1945 it has been increasing slightly. There is a marked fall during the early war years in the mean annual temperature, which may in part be due to inaccuracies in results because of the shifting of the meteorological station, but a similarly low sea temperature was observed off Jan Mayen during this period. It is not thought that the shifting of the meteorological station from the south to the north coast of the Island would have had any significant effect upon the mean annual temperature observed there.

An investigation of sea temperatures in the Jan Mayen area of the Greenland sea has produced some interesting results. The Meteorological Office kindly supplied all the data that they had on sea temperatures in the ten degree square, No.253, bounded by the longitudes, 0^{o}, $10^{o}W$, and the latitudes $70^{o}N$, $80^{o}N$. Interpretation of these temperatures proved difficult since the readings were both sporadic and spasmodic. However, it was finally decided to use all results bounded by the longitudes $7^{o}W$ and $10^{o}W$, and latitudes $70^{o}N$ and $72^{o}N$. This is approximately a rectangle of sea, with Jan Mayen about its centre, 120 nautical miles long (N. to S.) and about 62 nautical wide (E. to W.) An approximate square was not investigated because it was thought that this would, on its westerly

PLATE 3. A view from the sea of the Weyprecht Glacier on the N.W. coast. The right-hand peak is Haakon VII peak.



Sea Temperature (°C)
Year.
Trend.
Widths of columns proportional to No. of readings
Lengths of columns represent max.-min. difference.

side, run into the polar current, running down the East Coast of Greenland, and the results would be weighted by this. There were no results running continuously throughout a year, or years, and so it was decided to include temperatures which were taken between July 15th and August 30th of any year. July 15th was picked because by this date the sea-ice around Jan Mayen should have disappeared and the resulting temperatures would not be influenced by it. From the data available it seems that sea temperatures observed before 15th July each year seem to be substantially lower than those after 15th July.

The following is the table of results drawn up from this data:

Year	Average Sea Temperature(°C)	No. of Readings	Max. °C	Min. °C	Met. Office series
1877	3.5	32	4.0	2.3	German series 15
1881	0.0	1	-	-	Series 1.
1882	2.8	29	5.0	1.0	German series 15.
1883	5.0	3	5.1	4.9	"
1896	3.1	6	3.8	2.3	"
1908	4.0	1	-	-	"
1910	4.4	2	5.0	2.8	"
1912	5.0	1	-	-	"
1913	5.9	1	-	-	"
1919	5.6	3.6	6.5	4.5	"
1922	5.2	3	5.5	5.0	"
1926	4.8	9	5.5	4.3	"
1927	5.0	1	-	-	"
1929	4.8	1	-	-	German series II

Year	Average Sea Temperature(°C)	No. of Readings	Max. °C	Min. °C	Met.Office series
1930	7.0	3	7.6	6.5	German Series I
1931	5.0	2	5.5	4.5	"
1932	6.6	3	7.0	5.4	"
1934	6.0	3	7.5	5.0	"
1935	5.4	1	-	-	"
1936	5.4	2	5.4	5.4	"
1937	5.4	4	6.5	4.7	"
1938	5.5	2	6.5	4.5	"
1939	5.0	1	-	-	"
1943	2.8	1	-	-	Series 4
1954	6.6	6	6.9	6.0	Series 9
1955	5.6	2	5.8	5.5	"

These are plotted out in Fig. 14. It can be seen that the envelope of the readings shows a general increase of sea temperature between 1877 and the 1930's. It seems that the rate of increase of sea temperature after about 1935 is not so great as during earlier part of the century, and that, there has been little increase in temperature during the last few years. Of course, the number of readings available in this area is not great enough to be able to tell, accurately, what is happening but this seems to be the general trend. The trend ties in well with the glacial retreat and then advance.

It is known that, amongst other things, variation in precipitation, mean annual temperature and sea temperature, with time, could cause a shift in the glacial fronts. If it is assumed that the glacial advance is general in Jan Mayen, and not just confined to the South Glacier, which from the preceding discussion, seems reasonable, the advance is very likely dependent upon the above factors.

It is thought that the main reason for the present advance is the very large increase in the annual precipitation in the last few years. The marked drop in the average mean annual temperature between 1940 and 1949 may have been a contributing factor in the early stages of the advance, but it is not thought to be the most important factor. The slowing down of the sea temperature rise over the last 20 years should also have been a contributing factor. No speculation will be attempted here on the reasons for the increase in precipitation, but there is obviously room for more work in this field.

(b) Ablation Measurements.

As stated in B.IV.2., stakes were drilled into the surface of the glacier at the points shown on the map, Fig. 5.

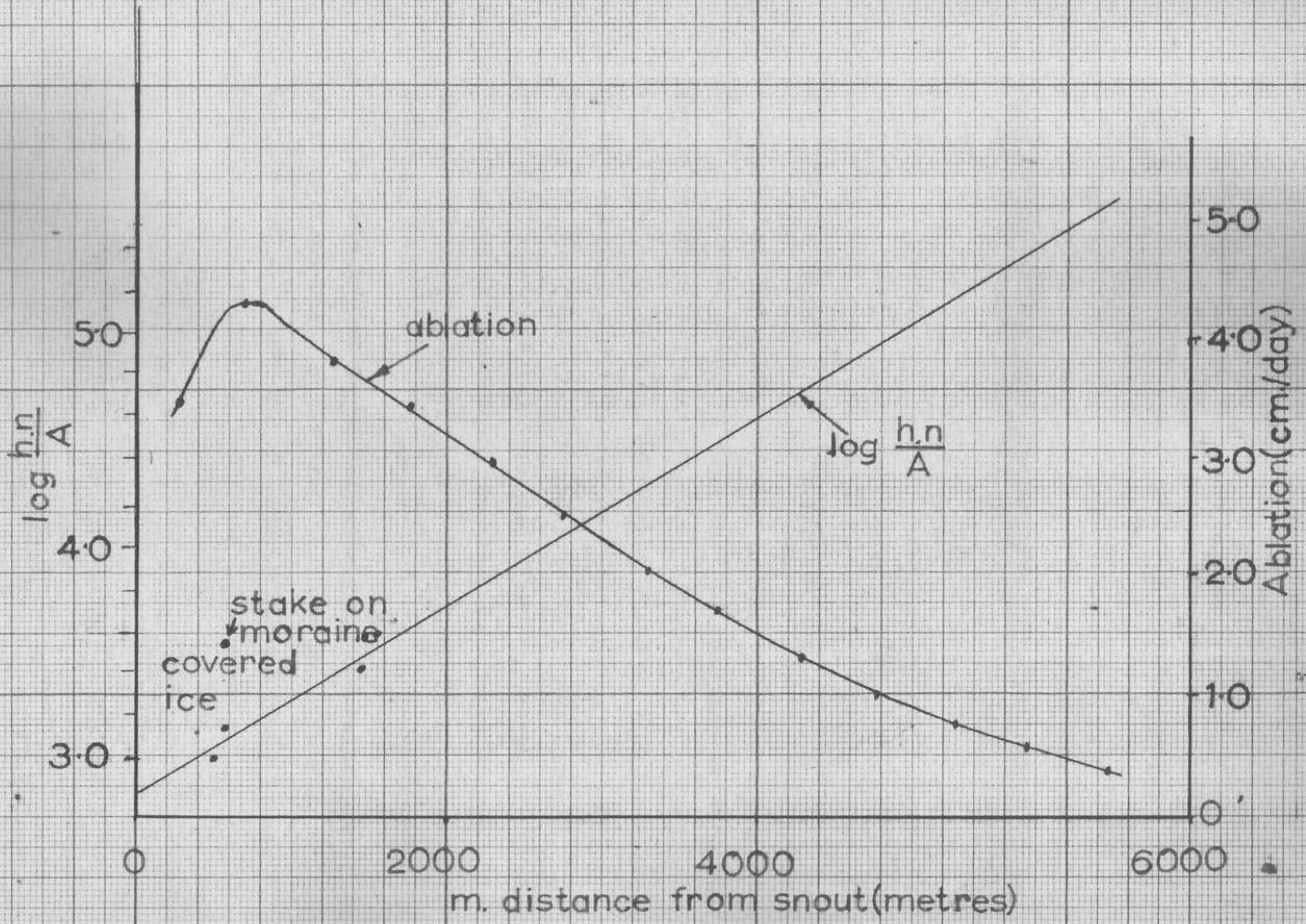
The following is a table of ablations etc. as recorded at these stakes.

Stake No.	Altitude, h metres	Distance from glacier snout, m (metres)	Ablation, A (metres)	No. of days (m)	Rate of Ablation (m/day)
1 (on moraine covered-ice	182	540	0.482	23	0.021
2	180	480	1.070	23	0.0464
3	198	570	0.940	22	0.0408
4	306	1530	0.685	22	0.0312
5	304	1470	0.698	22	0.0317
6	305	1420	0.812	21	0.0386
7	308	1410	0.864	21	0.0411

It will be noted that stake No. 1, on moraine covered ice has about half the ablation rate of the other stakes in the same area.

From above the following table has been drawn up:

FIG6: ABLATION CURVES



Stake No.	Distance from glacier snout, m (metres)	Altitude / Ablation Rate $= (\frac{h \times n}{A})$	$\log_{10} (\frac{h \times n}{A})$
1	540	2570	3.4099
2	480	1040	3.0170
3	570	1400	3.1460
4	1530	4900	3.6902
5	1470	4640	3.6665
6	1420	4050	3.6075
7	1416	3800	3.5798

Fig. 6 is the plot of m against $\log_{10} (\frac{h.n}{A})$.
A logarithmic function was made to fit the readings because it is felt that there is some sort of none linear (possibly logarithmic) relationship between ablation and altitude. It will be seen from the plot that there is a great scatter on the readings and they are all confined to the lower 2000m. of the glacier. In order to make some attempt, however, to balance ablation and flow, the curve has been extrapolated as shown in Fig. 6 and the corresponding ablations, at successive points on the glacier, calculated from it.

In this way it is possible to find a total volume ablating from the glacier each day. To do this the glacier has been divided up into 15 strips (Fig. 7) and from them the following table has been drawn up:

Strip	Area of strip (Sq.metres)x10^2	Ablation (m/day)	Volume = Ablation x area (m^3/day) (V)
1	1,800	0.0343	6,200
2	3,400	0.0426	14,500
3	4,000	0.0378	15,200
4	5,300	0.0338	17,900

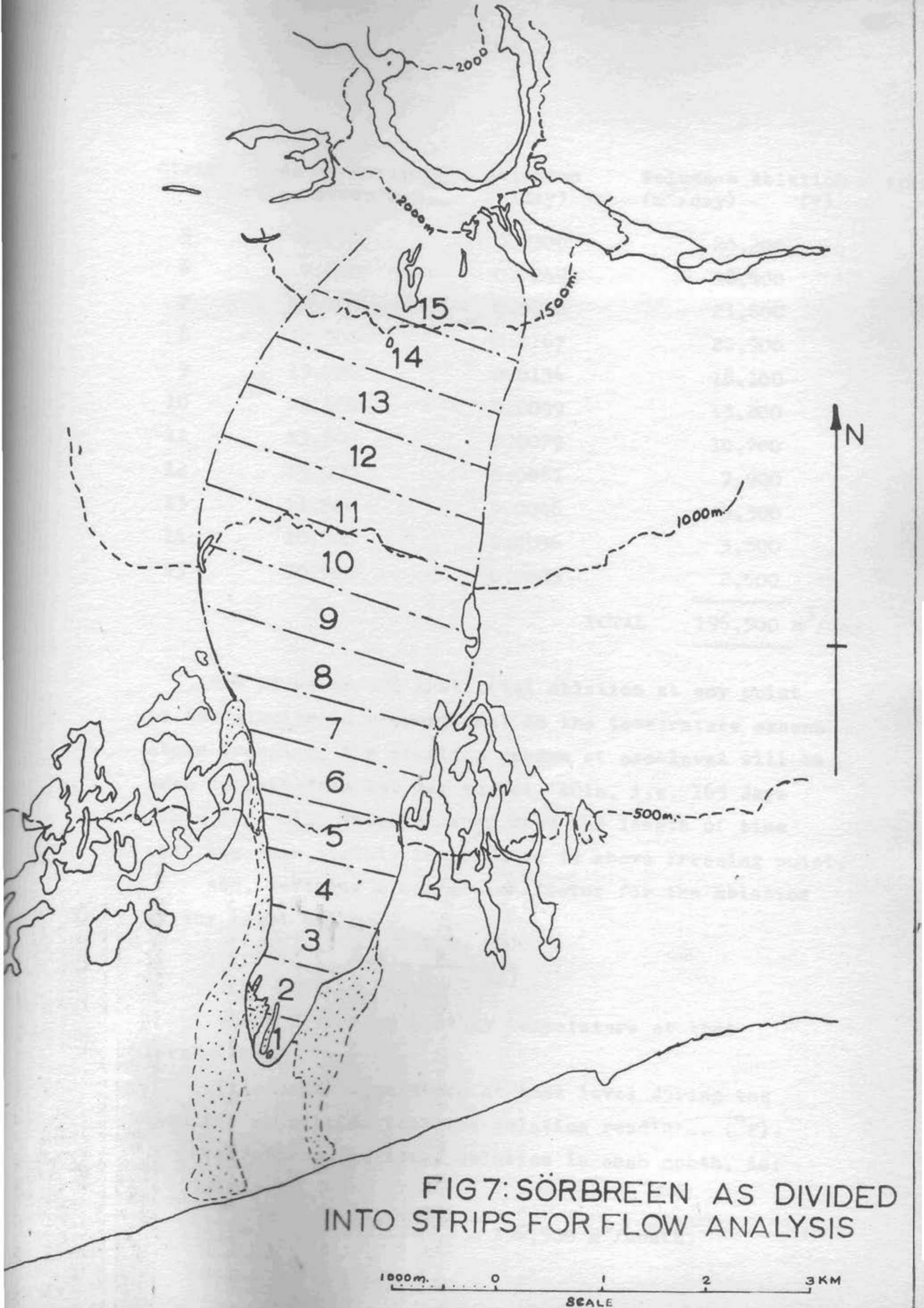


FIG 7: SÖRBREEN AS DIVIDED INTO STRIPS FOR FLOW ANALYSIS

Strip	[illegible]ea of Strip (sq. metres)x10^2	Ablation (m/day)	Volume = Ablation x area (m^3/day) (V)
5	6,750	0.0300	20,200
6	7,400	0.0249	18,400
7	10,400	0.0208	21,600
8	12,500	0.0167	20,900
9	13,500	0.0134	18,100
10	13,300	0.0099	13,200
11	13,500	0.0079	10,700
12	13,000	0.0061	7,900
13	11,500	0.0046	5,300
14	10,500	0.0036	3,800
15	10,500	0.0025	2,600
		TOTAL	196,500 m^3/day

Now if we assume that total ablation at any point on the glacier is proportional to the temperature excess above freezing, the ablation season at sea-level will be seen to last from 1st May to Oct. 10th, i.e. 163 days (From Fig. 8). This is based upon the length of time that the mean monthly temperature is above freezing point.

And, defining a correction factor for the ablation at any level as:

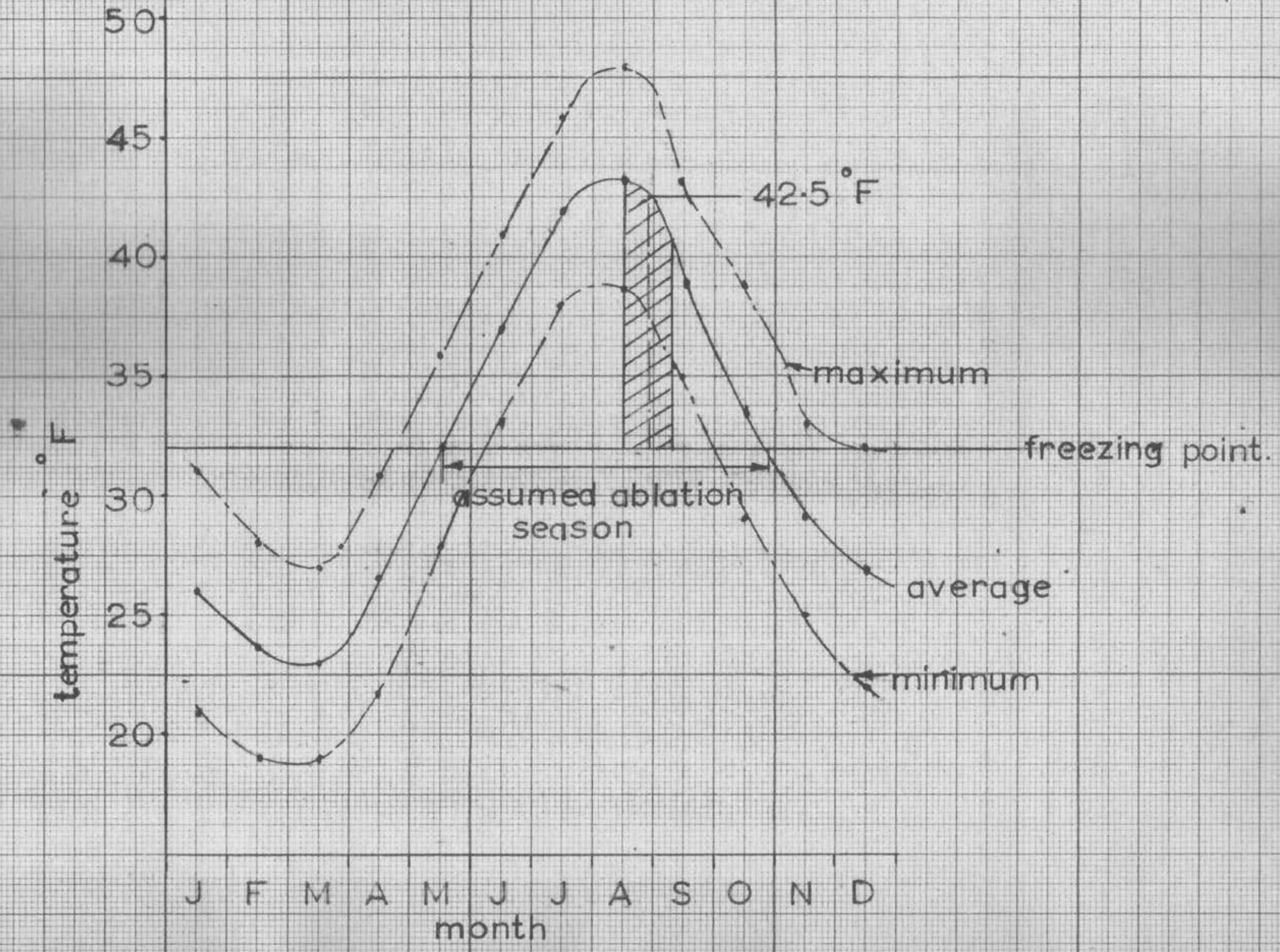
$$K = \frac{(T_m - 32)}{(T_o - 32)}$$

where T_m [illegible] monthly temperature at that level (^oF).

T_o = mean te[illegible]ture at that level during the time [illegible]dition[illegible] the ablation readings. (^oF).

Therefore, the total ablation in each month, is:

$$\sum_{\text{Strip 1}}^{\text{Strip 15}} D. \frac{(T_m - 32)}{(T_o - 32)} . 196,500 \text{ m}^3/\text{month}.$$


50
45
40
35
30
25
20
temperature °F
42·5 °F
maximum
freezing point.
assumed ablation season
average
minimum
J F M A M J J A S O N D
month

Where D is the number of days in the month

The total ablation in a year is thus:

$$\sum_{\text{1st May}}^{\text{10th Oct.}} \cdot \sum_{\text{Strip 1}}^{\text{Strip 15}} D. \frac{(T_m - 32)}{(T_o - 32)} \cdot 196,500\ m^3/\text{year}$$

At sea level (Strip 1, approx.) the ablation season may be calculated as:

Month	No. of days in month	$\frac{(T_m - 32.0)\ D}{42.5 - 32.0}$
May	31	7.4
June	30	21.3
July	31	33.2
August	31	30.4
September	30	12.0
October	10	1.0
	TOTAL 163	TOTAL 105.3

It may be seen by this process that the effective ablation time, assuming ablation occurs at the rate observed by the expedition in August, is 105.3 days, by comparison with the 163 actual days.

Higher on the glacier, however, the effective ablation season is still further reduced by the temperature lapse rate. If we assume that there is no significant melting at 1400 m., at any time of the year, and the lapse rateis linear from sea level to this altitude, then for each 100m. rise there is a decrease of T_o by

$$\frac{(42.5 - 32)\ 100}{1400} = 0.75^{\circ}F.$$

Taking the strips 1 - 15 and correcting for the lapse rate we have:

Strip	Effective Ablation Season $= 105.3 . \frac{(10.5 - \frac{Altitude(m)}{100})}{10.5}$ (days)	Total Ablation for each Strip ($m^3/yr.$) = Volume (V) x Ablation Season $\times 10^4$
1	105.3	65.0
2	97.6	141.0
3	90.1	135.0
4	87.0	148.0
5	75.0	152.0
6	67.5	124.0
7	60.0	129.0.
8	52.5	109.0
9	45.0	81.4
10	37.5	49.5
11	30.0	32.1
12	22.5	17.8
13	15.0	8.0
14	7.5	2.9
15	-	-
	TOTAL	1194.7

Total melting in a year is:

11,940000 m^3 of ice at the same density as that in the lower parts of the glacier, (i.e. compacted firn).

If this is discharged continuously throughout the year, then an average of 32,800 m^3/day melts. Therefore this volume has to flow through the firn line section in an average day. If the surface speed of the glacier at the firn line is assumed to be the same as that along the line of stakes 4,7,6,5 as measured, and the width of the glacier trough the same, then total volume passing

$$= A_1 V_o \cdot d_o W.$$

where V_o = surface speed of glacier (Average)

d_o = depth of glacier

W = width of glacier

A_1 = area of flow vertical flow profile (Fig.9) = 0.66 (assumed).

$$\text{depth of glacier} = \frac{\text{flow}}{A_1 V_o W} = \frac{32{,}800}{109 \times 910 \times 0.66}$$

$$= \underline{\underline{50.1\ \text{m}}}$$

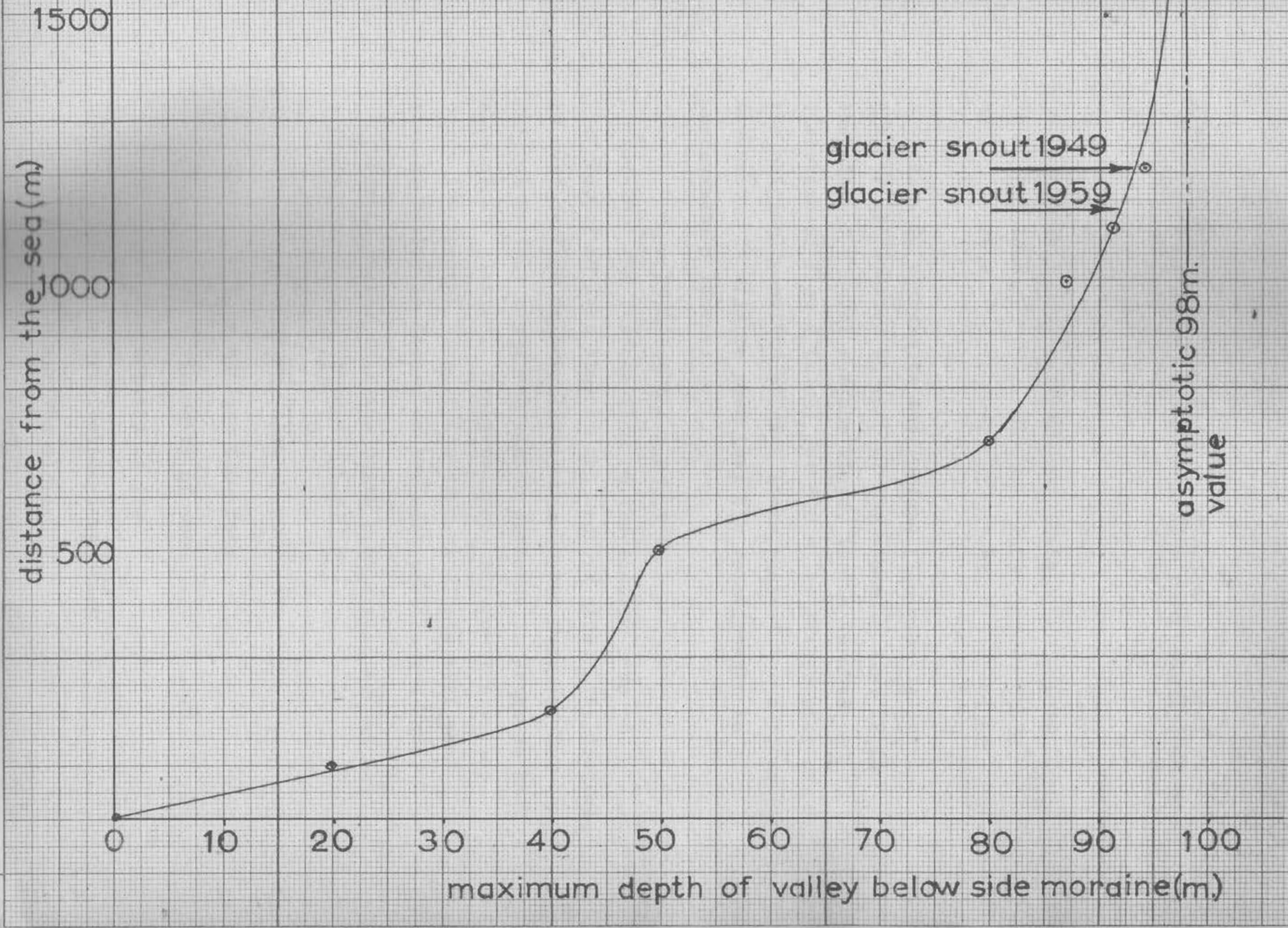
An examination of the map will show that this is a reasonable result. In fact, if a series of profiles are drawn at right angles to the main line of the glacier valley and, the maximum depth of the valley below the moraines is plotted against distance from the sea, Fig. 10 is the result. It will be seen that the valley is tending towards an asymptotic value of 98 m. deep. The moraines themselves are 30-40 m. high, and this gives a depth of glacier of 60-70 m. which is the same order as that calculated above.

(c) Flow results

A line of stakes was put across the glacier in the position shown on the map. The displacement of these stakes from the line was later measured, as described in B.IV.2. and the surface flow at the point in question was obtained.

The following is the table of results obtained:

FIG.10. DEPTH OF VALLEY FLOOR BELOW SIDE MORAINES–DISTANCE FROM THE SEA RELATION



Stake No.	Observed surface movement (m)	Time (days)	Average flow rate (m/day)	General surface slope (500 m. either side)
4	29.2	22	1.31	0.160
5	14.1	22	0.64	0.120
6	22.8	21	1.09	0.152
7	29.2	21	1.31	0.162

Fig. 11 represents the surface flow profile of the glacier as measured at each of the stakes. Fig. 12 is the plot of general surface slope, in the assumed direction of flow (Fig. 5) for 500 m. at either side of the original position of each stake, against the surface movement. It will be seen that the relationship is approximately linear:

$$V_c = 29.6 \tan \theta - 3.20.,$$

and that the surface flow on the eastern side of the glacier is less than on the western side. The decrease in surface flow is very likely due to the decrease in general surface slope and also a decrease in depth on this side of the glacier. Cross sections through the valley below the present glacier ice-edge, indicate that the glacial valley is deeper on the west than on the east.

Perutz states that the depth Z of a glacier may be expressed by:

$$Z = \sqrt{\frac{2\mu}{\rho g} \frac{V_o}{\sin\alpha}}$$

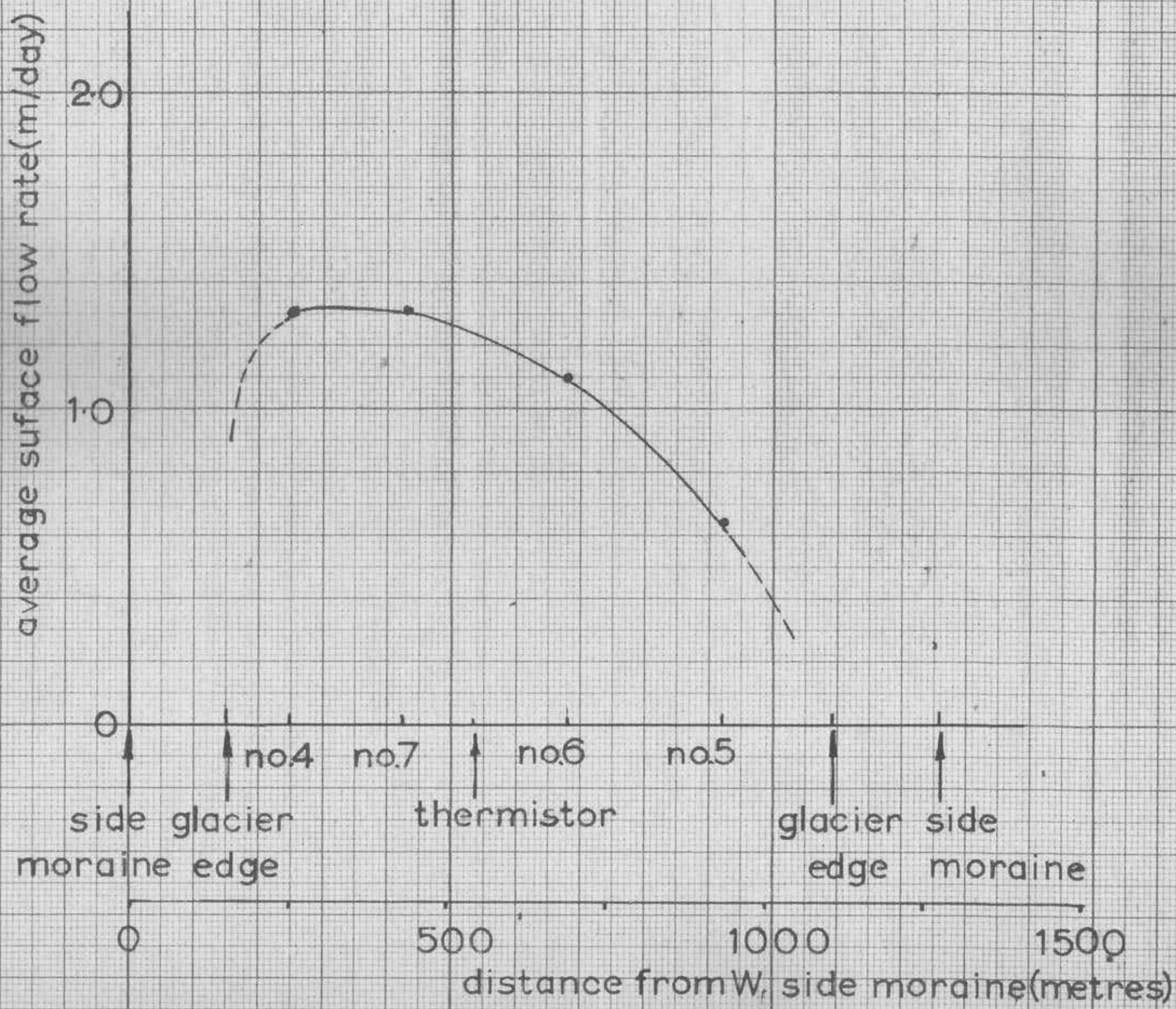
where V_o = surface flow rate

μ = viscosity of ice

ρ = density of ice

g = gravitational constant

α = surface slope,


average suface flow rate(m/day)
2·0
1·0
0
no.4
no.7
no.6
no.5
side moraine
glacier edge
thermistor
glacier edge
side moraine
0
500
1000
1500
distance from W, side moraine(metres)

and assuming that the cross-section of the glacier bed is a semi-elipse, whose major axis is great by comparison with its minor axis.

Reducing this to:

$$Z = K\sqrt{\frac{V_o}{\tan\alpha}}$$

Assuming that μ, ρ, g are constant, and that $\sin\alpha = \tan\alpha$, we get:

Stake No.	Average flow rate (V_o)	General Surface slope ($\tan\alpha$)	$\sqrt{\frac{V_o}{\tan\alpha}}$
4	1.31	0.160	2.86
5	0.64	0.120	2.31
6	1.09	0.152	2.68
7	1.31	0.162	2.84

The values of $\sqrt{\frac{V_o}{\tan\alpha}}$ have been plotted in their respective positions on Fig. 11.

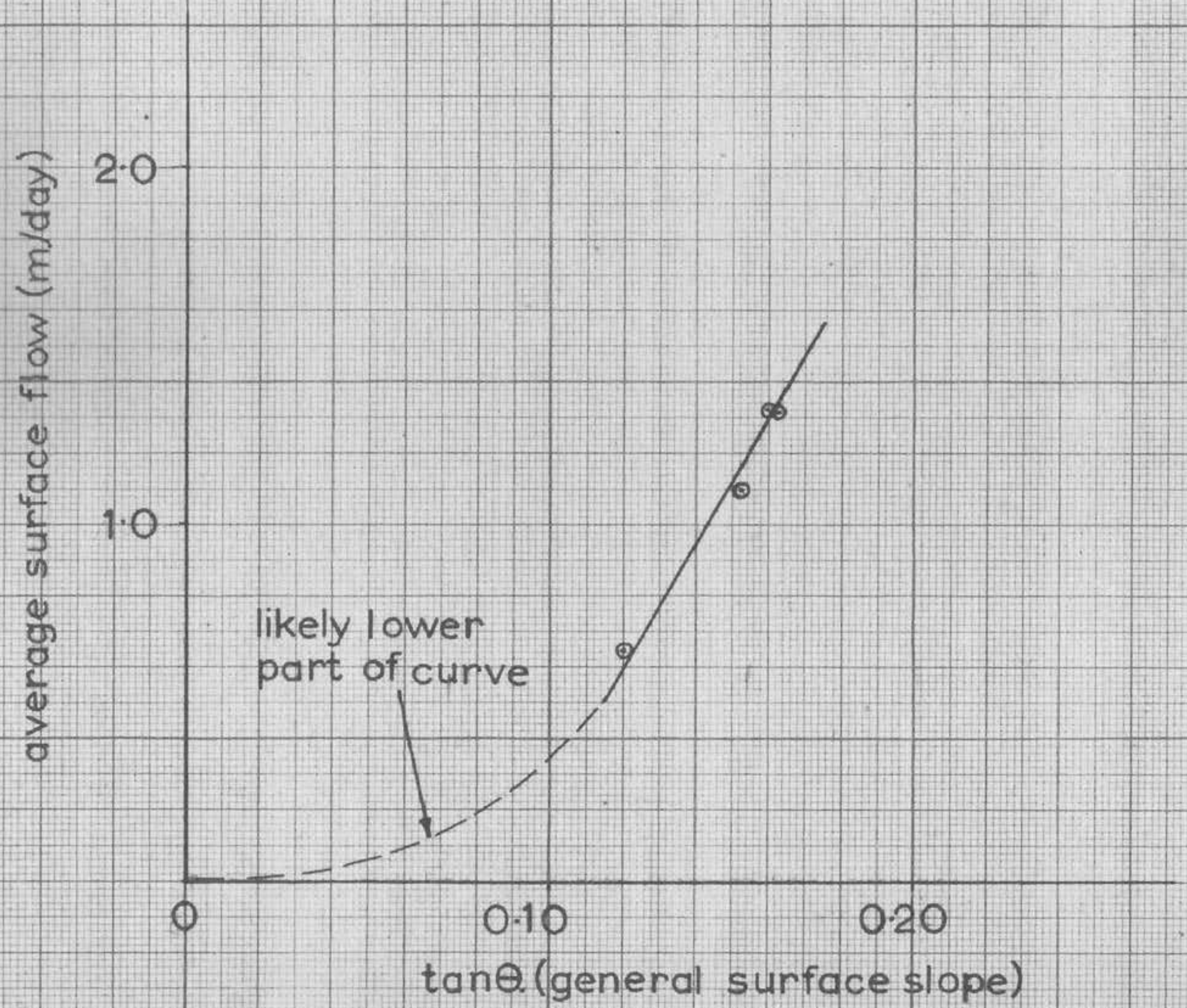
A cross section drawn in the position A, A, on Fig. 5 through the lower valley will be seen to have an average valley section similar to the plot of $\sqrt{\frac{V_o}{\tan\alpha}}$ This is shown in Fig. 13.

It is realised that the above calculations are based upon the viscous flow law which assumes no slip at the glacier bed. The plastic flow theory (Nye) although it assumes slip at the bed will yield no glacier depths from a knowledge of surface slopes and surface flows, and thus cannot really be tested here. The truth probably lies somewhere between the two theories.

(d) Temperature measurement.

Temperature measuring points 1 and 2 were established as shown on the map. Point 2 was not taken to the centre of the glacier, because of the difficulties of getting

FIG 12. SURFACE FLOW - SURFACE SLOPE RELATIONSHIP.



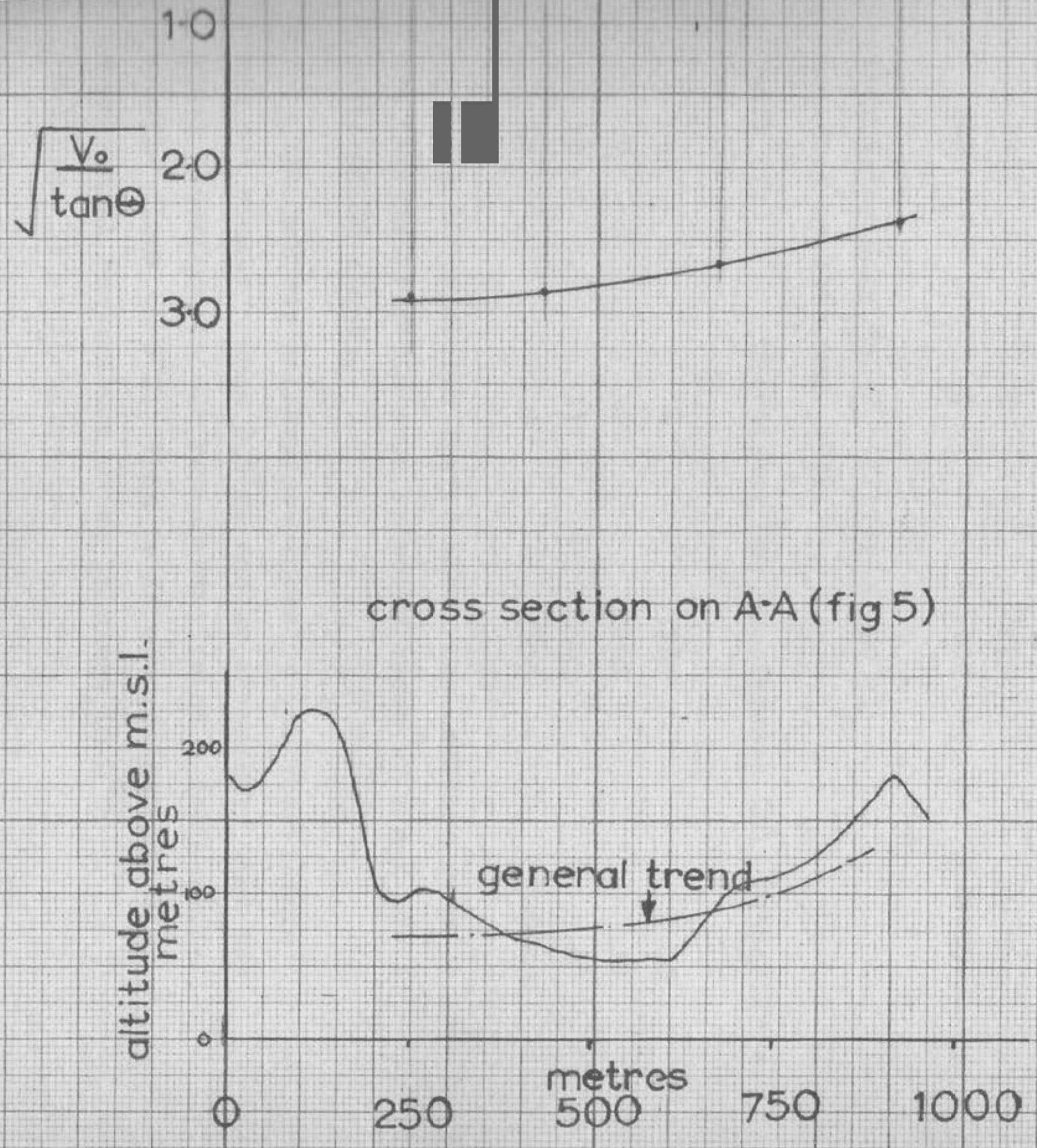


FIG 13 COMPARISON OF A DISTANCE ACROSS GLACIER — $\sqrt{\frac{V_o}{\tan\theta}}$ PLOT AND A CROSS SECTION LOWER DOWN THE GLACIER VALLEY

there. The region about 750 m. is very crevassed.

The following are the temperatures as recorded in the drill holes:

Thermistor hole 1. Altitude 312 m.

Measured on Aug. 11th 1959.

Depth (ft)	Thermistor No.	Resistance (Ω)	Temperature °C
5	6	3288	+0.25
10	3	3404	-0.10
14	2	2920	+0.00
19	1	2900	-0.25

Thermistor Hole No. 2. Altitude 730 m.

Measured on 16th Aug. 1959.

Depth (ft)	Thermistor No.	Resistance (Ω)	Temperatur °C
4	4	3780	0.00
7	10	2660	-0.30
10	11	2640	0.00
18	9	2800	+0.40

The temperatures listed above are obtained from the thermistor resistance value by means of a set of calibration charts.

The maximum calibration error of the thermistors was not greater than 0.5°C, and so it appears that the above measurements are representative of a temperature profile close to 0°C. This is in accordance with the mean annual temperature which is close to 0°C. (See Fig. 3) at theselevels.

(e) <u>Time taken to dissipate the total volume of ice contained within the South Glacier.</u>

A rough calculation for the sake of interest, will give the order of time that it takes for all the ice in the present South Glacier to dissipate.

Assuming the glacier to be 70m. thick, and its area, 13,735,000 m^2. Its volume is:

$$70 \times 13{,}735{,}000 = 962{,}000{,}000 \ m^3$$

Now if each year the glacier dissipates 11,940,000 m^3 (by ablation)

The time taken for the ice in the glacier to change completely

= 81 years.

Even if this estimate is inaccurate by a factor of two or more, it tends to confirm the absence of any old (geologically speaking) ice in Jan Mayen.

B.V.1. <u>GEOLOGICAL SPECIMENS COLLECTED.</u>

Geological specimens were collected by the Glaciological Party: the majority of these specimens (those listed below) are deposited in the Geology Department at Imperial College.

A selection of Jan Mayen rock types were presented to the Geological Survey Museum: the slide numbers below refer to these specimens, identical ones of which are to be found in the Imperial College Collection.

1. Olivine grains and crystals from Beach sands.
2. Beach sand.
3. Frost-shattered pebbles.
4. Volcanic Bombs - a series of specimens ranging up to 18" in length.
5. Representative collection of rock types from the medial moraine of the South Glacier.
6. Representative collection of rock types from the terminal moraine field of the South Glacier (9) & ([illegible])
7. Augite crystals from (i) Ankaramite-flow above [illegible] moraine, South Glacier.
   (ii) Moraine west of the top of the west lateral moraine, S.Glacier
   (iii) Rim of Berna Crater.
   (iv) Beaches.

In all cases the crystals bore a coating of congealed lava.

8. Representative collection of rock types contained in the agglomerate cone of Egg Bluff.
9. Tuff and agglomerate from Egg Bluff.
10. Trachy-basalt from Roysflya lava flow. (12).
11. Ankaramite from Eckerold Valley. (7).

12. Ankaramite from flow above east lateral moraine of the South Glacier.(10).

13. Tuff from Hapbukta (11).

14. Trachyte from South Jan. (8).

15. Ankaramite-base of Hapbukta cliff. (6).

16. Series of specimens from the agglomerate mass of [illegible]

17. Trachyte with biotite crystals spanning vesicles - Kvalvoss.

18. Lava Stalactites - Guinea Bay.

19. Specimens from Fugleberg cone.

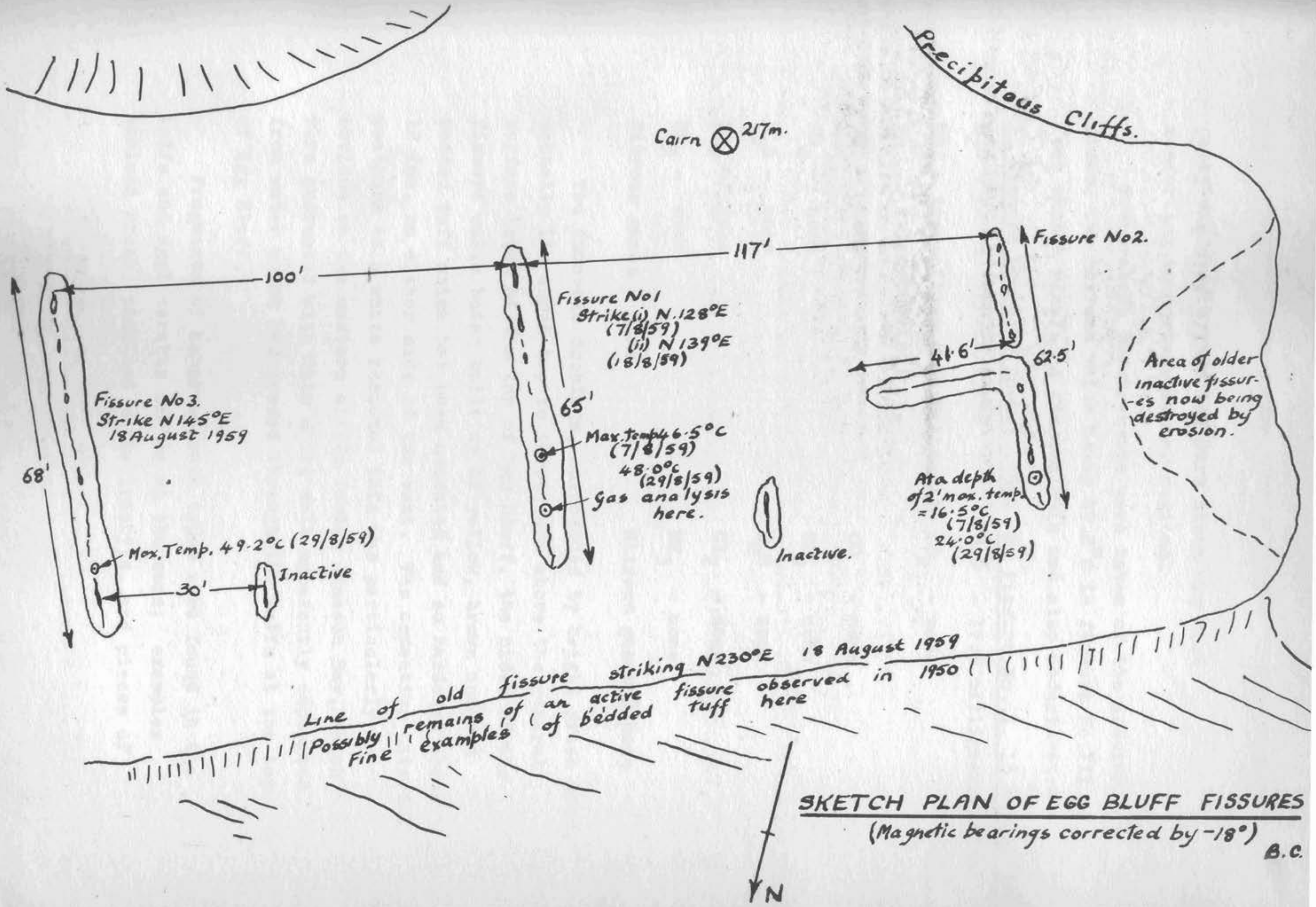
20. Beerenberg specimens from high outcrops encountered whilst en route to Haakon VII Peak.

Numbers such as (6) refer to rock slides of these specimens.

Note: Many of the rocks above referred to as ankaramites are not true ankaramites (as per Johansson) but are merely olivine and augite-rich basalts. The above nomenclature is used in conformity with that used by A.T.J.Dollar in his description of the rock types of Jan Mayen.

B.V.2. EGG BLUFF.

Egg Bluff (Eggøya) is a cinder and dust cone now undergoing rapid destruction by the sea on three sides, by well-developed gully erosion on the northern landward side. Only a short time ago in 1935 a large part of the eastern cliff fell into the sea, this collapse was apparently triggered off by an earthquake. It appears the southern half of the original cone has been completely removed and now the sea occupies the area of the cliff. This mass of well-bedded tuff and agglomerate rises to a height of 217m. (670ft.) on its western extremity and here fine views are obtained of the South Lagoon to the south-west, Mid Jan in the north and the [illegible] to the east. Egg Bluff has very steep 34° angle of rest slopes on its northern flanks which tail off in an asymptotic curve into the South Lagoon. Classic examples of gully erosion were observed on these slopes. On the east and west seaward sides precipitous cliffs plunge sharply into the sea; the bases of the cliffs are not protected by much fallen material and are therefore exposed to the continual battering of the stormy Greenland Sea. It seems that there must be quite an active current operating to sweep away the material which is continually falling off the crumbling cliffs. Egg Bluff has the honour of being the only remaining site of volcanic activity on the island. The "activity" is confined to a few insignificant fissures, looking like elongated mouse-holes, from which is emerging a continuous draught of steam. The name Egg Bluff is derived from the tale that some bright fellow managed to boil an egg in one of the fissures - it was done to perfection in 20 minutes! It is worth recording that the only material use we could find for these blasts of steam was during a snow-storm when a member of the



SKETCH PLAN OF EGG BLUFF FISSURES

(Magnetic bearings corrected by -18°) B.C.

party discovered that the warm steam was most comforting to certain lumbar regions.

Temperature measurements were taken of the issuing steam, the maximum value being 49.2°C in fissure No.III (see sketch plan). A gas analysis was also undertaken:-

1. Fissure No. 1. 7 August 1959.	2. Fissure No. 1. 18 August 1959
H_2O - 22 milligrams/litre	H_2O - 17.5 milligrams/litre
CO_2 - trace (less than 0.1 mg/l) (atmospheric?)	CO_2 - none
CO - none	CO - none
SO_2 - none	SO_2 - none
H_2S - none	H_2S - none
Cl_2 - none	Cl_2 - none
NH_3 - none	NH_3 - none
Nitrous gases - none	Nitrous gases - none

The fumavole openings, surrounded by bright green moss, actually lie about two to three feet above the general surface level of the top of Egg Bluff, the sides of the fissure walls being built up of yellow, brown and red bedded tuff which has been cemented and so hardened about 12 ins. on either side of the vent. The cementing material weathers to a white residue; this was particularly obvious on the eastern cliffs facing Jameson Bay, which were encrusted with this white salt apparently deposited from water which had seeped through the tuffs at the top of Egg Bluff.

Fragments of numerous rock types were found in the tuffs and agglomerates making up the cone; examples include green, pink and white trachyte, and pieces of a vesicular basalt with a white zeolite grown in the gas cavities. The most unusual find in the agglomerate was a number of well-rounded fine-grained basaltic pebbles, often up to 6 ins. long. Since they could not have been wind-borne nor washed to a height of 600 ft. by the sea, it is generally thought that they were washed on to Egg Bluff in its initial stages when it was just protruding above sea-level and have been pushed up to higher levels by the force of subsequent eruptions.

Many of the rock fragments on the summit had a plume of damp dust on their eastern sides indicating a prevailing east wind direction.

B.V.3. LAVA CAVES.

Lava 'caves' were found in Guinea Bay and in the lava flow above Lagunaflya. At Guinea Bay the cave was small and had largely collapsed: walls were covered with small lava stalactites. The 'caves' developed above Laguneflya were much larger; the largest being some 400-500 ft. long, 15-30 ft. wide and 5-15 ft. high. In places the roof had collapsed, the present cave comprising a series of lengths of tunnel. These flow tunnels are gently sinuous in plan and show flow bends and channels along their floors and lower walls. The roof and walls are covered with small lava stalactites Some parts of the tunnels are infilled with compacted wind-blown snow and pools of water. The tunnels have widely undergone collapse and only this one large example exists: many older tunnels are now represented as parallel-walled channels in the lava flow surface, commonly largely infilled with wind-blown sand.

The tunnels are sub-parallel or slightly diverging as they become farther from the source of the lava.

Minerals of Beach Sands in addition to Olivine:

Pyroxene - together with olivine commonly formed dominant part of the beach sands.

Hornblende - common as a constituent of the sands, especially in South Jan.

Other minerals rare: remainder of sand composed of rolled basalt fragments, many of them being magnetic.

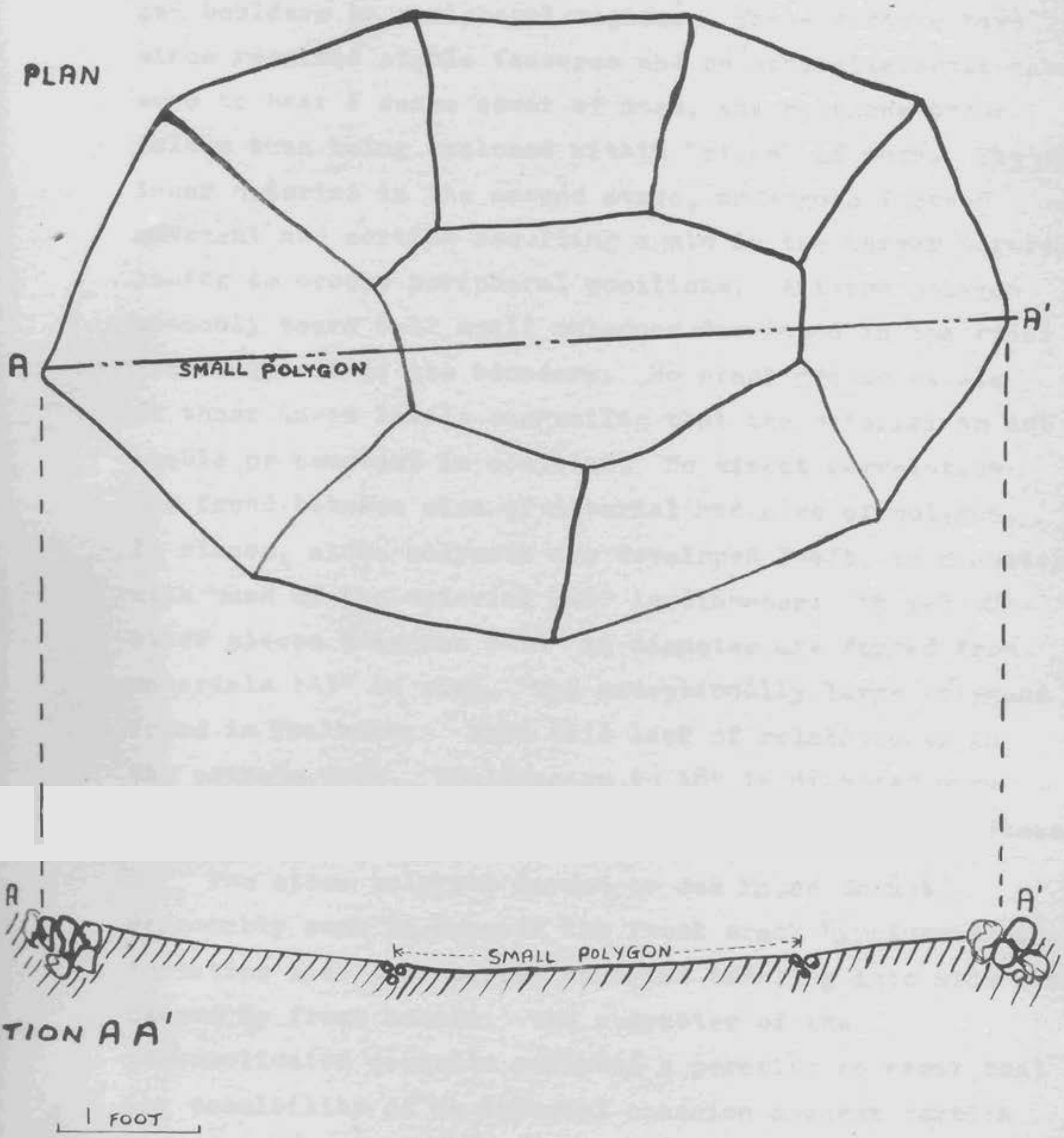
V-5. SOLIFLUCTION FEATURES.

Solifluction features are widespread and are found on surfaces almost down to sea level. The widespread nature of these features may be largely attributed to the excessive development of unconsolidated surface deposits of sand and broken rock, the direct result of the mechanical disintegration of the rocks by frost action.

Much of the ground is terraced, the terracing being sometimes accentuated by growth of moss on the sloping terrace front. Stone polygons are widely developed on all level areas of loose material and range in size from one foot to 10-12 feet in diameter. One excessively large 'polygon' developed in the fine material (maximum diameter $\frac{3}{4}$" - 1") of an old outwash fan was accurately surveyed and is drawn below: the coarser pebbles formed the boundaries of the 'polygon' and finer material lay within: very slight doming was developed, estimated at about 1 ft. The whole outwash fan bore a series of these polygons of which this was the most perfect. The more normal stone polygons were of smaller dimension and commonly showed development of smaller secondary polygons within.

On Antarcticboget the rims of the larger 'parent polygons', composed of the large boulders, bore heavy growths of moss which served to accentuate the structures markedly. Where the ground surface sloped at more than a few degrees stone stripes were formed; these were in all sizes to a maximum of 6-8" between individual stripes. They developed in all grades of materials, even in fine sand. The very slightly sloping surfaces of many terraces bore small stone stripes.

STONE POLYGON



g2a. SKETCH OF TYPICAL 'POLYGON-WITHIN-POLYGON' DEVELOPMENT.

The development of the "two stage" polygon suggests possibly a two stage mechanism of formation. The first stage resulted in a removal of the very large sized pebbles and boulders to peripheral regions. These regions have since remained stable features and on Antarcticberget have come to bear a dense cover of moss, the polygons themselves thus being enclosed within "rings" of moss. The inner material in the second stage, undergoes further movement and sorting resulting again in the larger particles coming to occupy peripheral positions. A large polygon commonly bears 6-12 small polygons developed in the finer materials within its boundary. No plant growth exists on these inner levels suggesting that the material is not stable or constant in position. No direct correlation was found between size of material and size of polygon. In places, stone polygons are developed 3-4ft. in diameter with much of the material 2-6" in diameter: in yet other places polygons 8-10' in diameter are formed from materials 1-3" in size. The exceptionally large polygons found in Thelbukta show this lack of relationship in the extreme case. Boulders up to 18" in diameter were observed to have been involved in the solifluction process.

The stone polygons formed on Jan Mayen do not reasonably seem to support the frost crack hypothesis of formation i.e. the coarser material toppling into wide cracks opened by frost action. The character of the unconsolidated deposits reflects a porosity so great that any possibility of an internal cohesion amongst certain portions would seem to be unacceptable. Owing to the lack of very fine material the deposits generally tend to compact loosely and to behave as series of individual grains rather than as small areas each with an internal

LARGE POLYGON

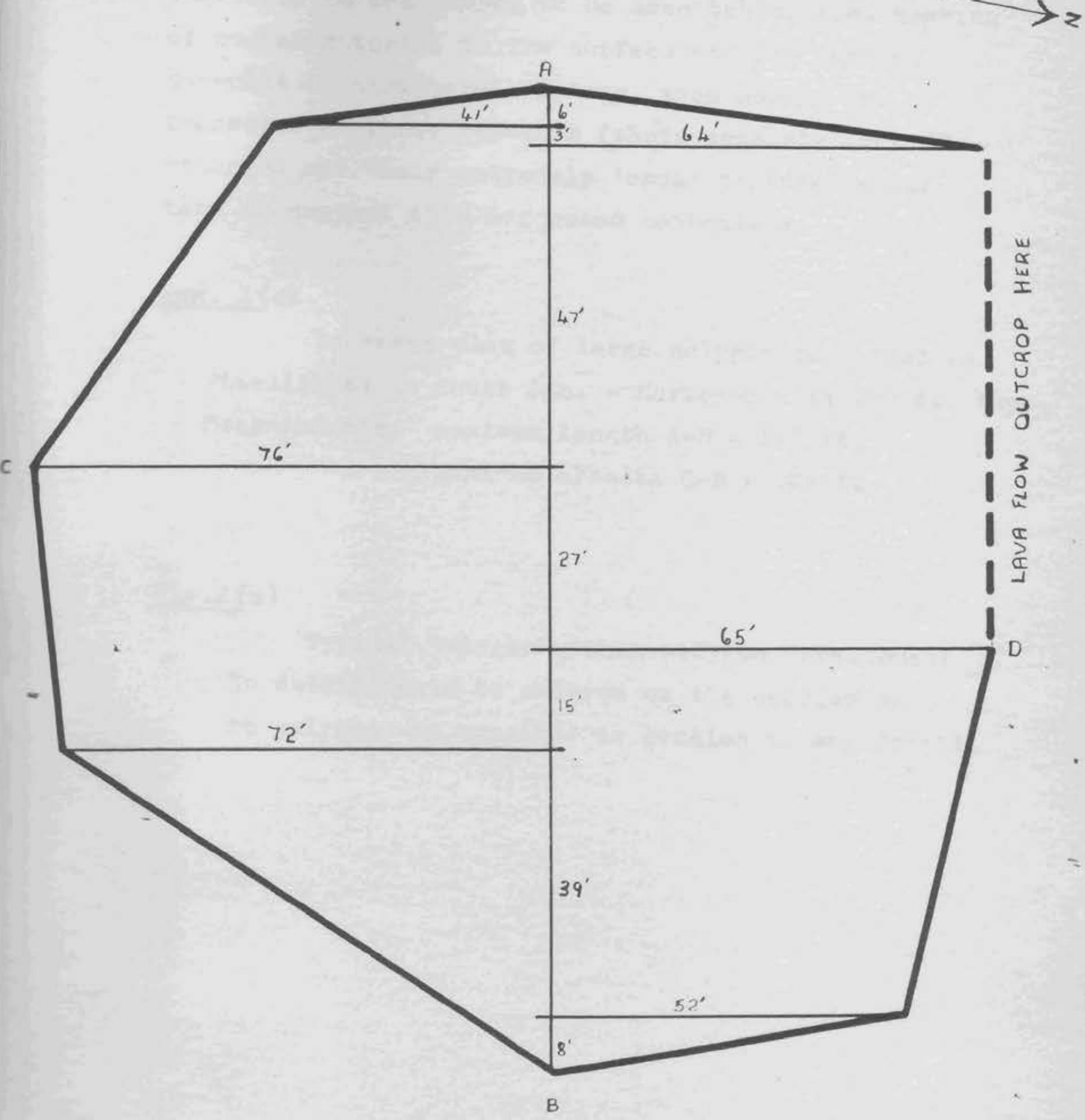


Fig1a. Sketch showing configuration of Large Stone Polygon described in text.

cohesion. If the "convective" hypothesis of polygon formation is considered to be acceptable, i.e. heaving of coarse material to the surface and its lateral movement to peripheral regions, then surely the character of these deposits (their complete lack of cohesion and their extremely 'open' texture) would tend to support this suggested mechanisam.

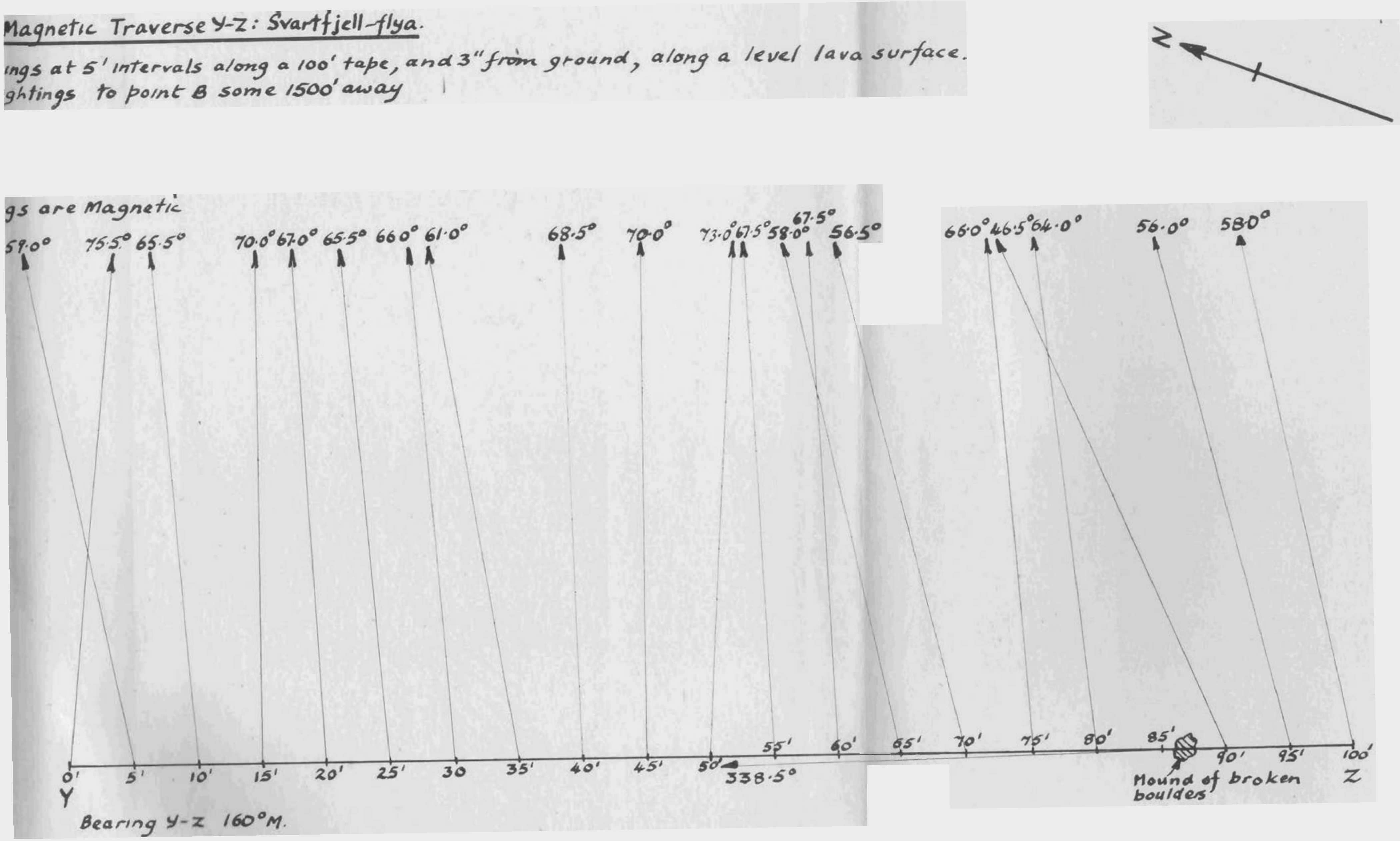
Fig. 1(a)

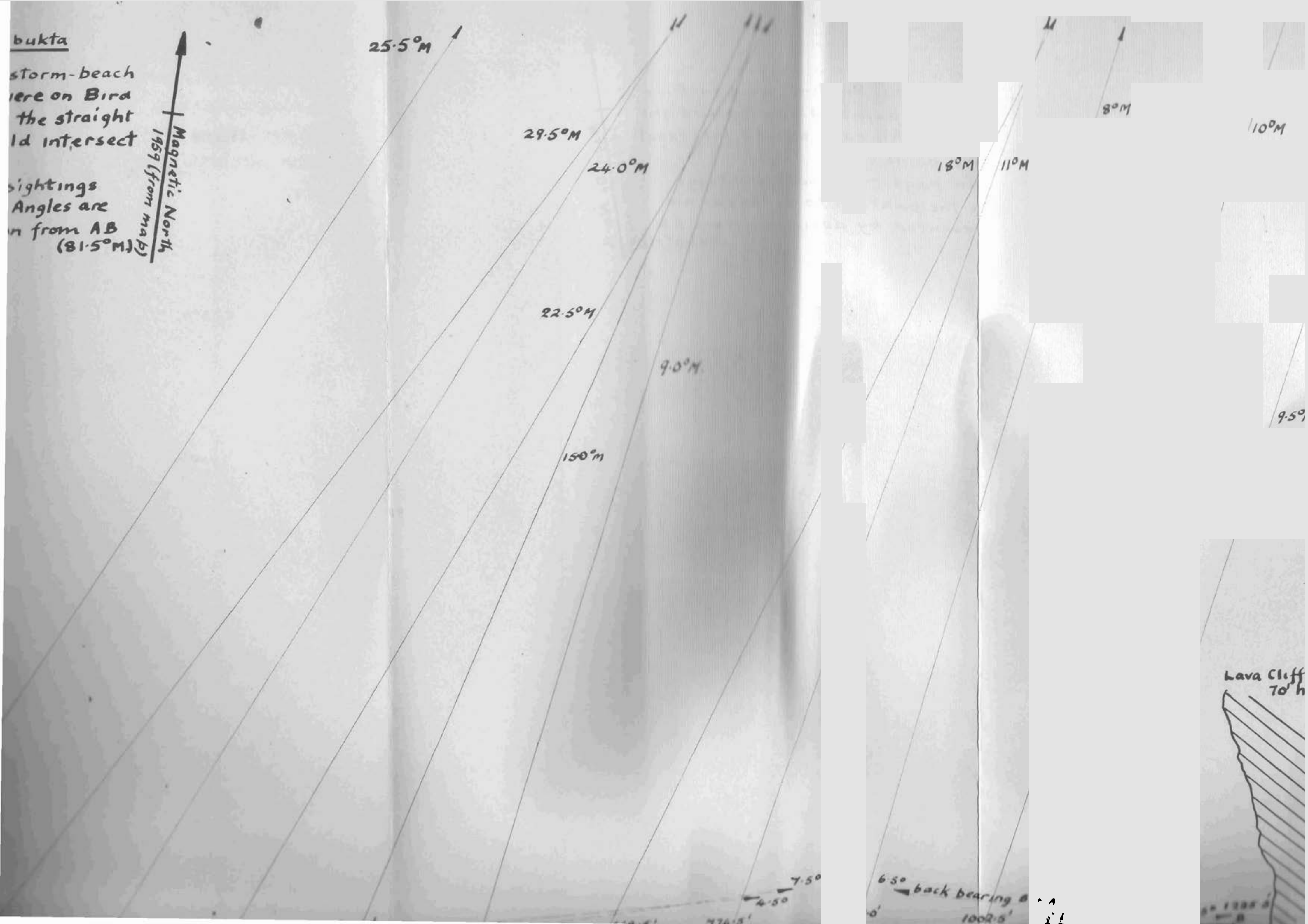
Accurate plan of large polygon developed in Titellbukta in South Jan. - Surveyed with 100 ft. tape. Measurements: maximum length A-B = 145 ft.
maximum breadth C-D = 141 ft.

Fig.2(a)

Typical polygon-within-polygon development. No detail could be entered on the section as no polygon was examined in section in any detail.

(a) Mag


Magnetic Traverse Y-Z: Svartfjell-flya.
ings at 5' intervals along a 100' tape, and 3" from ground, along a level lava surface.
ghtings to point B some 1500' away
gs are Magnetic
59.0° 75.5° 65.5° 70.0° 67.0° 65.5° 66.0° 61.0° 68.5° 70.0° 73.0° 67.5° 58.0° 67.5° 56.5° 66.0° 46.5° 64.0° 56.0° 58.0°
0' 5' 10' 15' 20' 25' 30 35' 40' 45' 50' 55' 60' 65' 70' 75' 80' 85' 90' 95' 100'
338.5°
Y
Z
Mound of broken bouldes
Bearing Y-Z 160°M.
N


bukta
storm-beach
ere on Bird
the straight
ld intersect
sightings
Angles are
n from AB
(81·5°M)
Magnetic North
1959 (from map)
25·5°M
29·5°M
24·0°M
22·5°M
9·0°M
15·0°M
18°M
11°M
8°M
10°M
9·5°
7·5°
4·5°
6·5°
back bearing
Lava Cliff
70' h

at 3 inches above the lava surface. The results are plotted on the diagram. Of particular note is the reading at 85ft. from Y where a small lava block has caused a deviation of about 90° from the correct reading.

B.V.7. FLORA.

A small collection of vascular plants was made and specimens of these are deposited in the Botany Department of the Imperial College: identification was largely carried out by Dr.Kershaw of that department. The following species were collected:-

Polygonum viviparum.
Poa alpina
Veronica alpina
Oxygria digyna
Ranunculus glacilis
Taraxacum sp.
Sibbaldia procumbens
Cerastium alpinum
Saxifraga groenlandica

One lichen and one liverwort were also brought from the island but neither were in an identifiable condition.

Plants in general are markedly absent from the greater part of the island. The most extensive plant cover encountered was probably the almost luxuriant development of moss on Antarcticberget. Elsewhere, plants occurred very sporadically, commonly in stunted form except where exceptionally favourable conditions existed - such as below the cliffs east of the South Glacier where water supply and the required soil nutrients were readily available. Over the majority of the island combinations of adverse conditions drastically affect plant growth (high winds, loose soil cover, lack of watercaused by high porosity of the soils, lack of soil nutrients etc.)

In no place was a true soil observed, the necessary organic debris being wanting.

Only mosses and lichens grow anywhere in sufficient abundance to 'colour' the landscape: higher plants are too sporadic in occurrence. At Guinea Bay the landscape is dominantly of a grey-green colour owing to the lichen growth: in yet other areas an intensive local growth of moss gives the landscape a bright yellow-green colour as in Walrus Gat.

More complete floral studies have been carried out by previous expeditions, especially the 1938 I.C.Expedition.

B.V.8. FAUNA.

The only land mammal is the Artic Fox, of which the members of the Expedition saw several. These are thought to have reached the Island on floating ice-possibly from Greenland. The fox used to be trapped for fur but for the last twenty years or so they have been under fairly rigid protection: they have thus increased greatly in numbers. The fox lives on sea-birds which it catches on the beaches and cliffs.

Occasional polar bears come to the Island, having drifted southwards on the pack ice from north-eastern Greenland - one bear was shot off the south-western tip of Jan Mayen in the winter of 1959.

Seals abound in the waters around Jan Mayen when the pack ice is beginning to clear. We saw one seal - thought to be an Atlantic Seal - about 200yds. off shore near the South Glacier.

Several species of birds were seen -

1. Puffins - on sea cliffs.
2. Guillemots - on sea cliffs.
3. Large white gulls - possibly Iceland Gulls - on sea cliffs and beaches and up to two miles inland.
4. Fulmar Petrels - on sea cliffs and beaches; young birds seen swimming in sea.
5. Turnstones - fairly abundant on beaches and up to 1 mile inland.
6. Species of wader resembling a dunlin - common in small flocks of 6-30 feeding at the edge of the sea.
7. Finch-like bird - possibly Snow Bunting or Snow Finch: adult pair and family noted on one occasion.
8. Large white birds - possibly Bewick Swans: two such birds seen flying past the Beerenberg

at height of about 6000 ft. towards the south-east. One seen also on lagoon on Ullerengeader

Insects.

Several species of flies were noted but not identified: also a peculiar scarlet coloured insect. Aphid-like in body build - common on pebbly beaches where it could be found coating many of the rocks as an almost solid red film.

Small crustacean found on the sandy beaches - used by the waders as food.

B.V.9 METEOROLOGY.

(Day to day temperature and general weather observations can be found under A.I.3.)

An account and weather statistics of the seas surrounding Jan Mayen may be found in the Meteorological Office publication "Weather in Home Waters and the North-Eastern Atlantic" (M.O.446) Vol. II part 7 "Norwegian andBarents Sea

The weather conditions experienced on the island tended often to be extremely local: commonly North Jan would be clear of cloud whilst South and Middle Jan were enveloped in sea-fog or low level layer cloud, and vice versa. Winds were very variable and local in character: on the Beerenberg flanks alternating reversals of air masses commonly occurred, a layer of cloud which was moving up the mountain would suddenly start moving away as a katabatic gust rolled down the mountainside.

Sea-fog and low-level layer cloud commonly enveloped much of the island below 2-3000ft. The number of days without such a development were few. When above this low-level layer-cloud it could be seen to stretch almost unbroken to the horizon. Stable air existed above this "blanket" and was usually associated with north-westerly winds. High winds and rain came predominantly from the south east. The most interesting clouds developed during our stay were most definitely the spectacular wave-clouds When the wind lay in the north-west quarter these clouds were of common development, especially lenticular wave clouds. The Beerenberg mass, causing the north-westerly winds to rise, developed on its leeward side on 27th July a most spectacular laminated wave cloud.

C.VI.1. ACKNOWLEDGEMENTS.

The Expedition would here like to acknowledge the help given by numerous individuals and firms: without their assistance the Expedition would have been impossible. Listed below are a few of our helpers. It is hoped that those people not mentioned will not think we are ungrateful. Lack of space prevents mention of them all by name.

Individuals.

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R.Scott-Russell, Esq.
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A.J.Marshall, Esq.
A.King, Esq.
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Professor Wager, F.R.S.
Professor J.Sutton
A.Stephenson, Esq.
H.R.Hewer, Esq.
P.F.Taylor, Esq.
Gilbert Wilson, Esq.
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" " Maintenance Department.
The British Glaciological Society.
The Admiralty.
The Norwegian Embassy in London.
The Norwegian Government.
The Royal Air Force.
Ministry of Agriculture, Fisheries and Food
The Meteorological Office.

Firms.	Item. supplied
Kavli Ltd.	Transport of kit. London - Newcastle
Thomas Black Ltd.	Camping & climbing equipment.
Robert Lawrie Ltd.	Climbing equipment.
Mullard Ltd.	Thermistors.
Tinsley & Co.	Loan of Wheatstone bridge.
C.B.Cow & Co.	Air beds.
Shell Resins Ltd.	Acralitic Resin
Leonard Farnell Ltd.	Glaciological drill.
Jaeger & Co.	Sweaters, socks, gloves, balaclavas
Establishment Grain	Duvet jackets.
Bally (Switzerland)	Boots.
Benjamin Edgington	Flysheets for B-Meades
The Beaufort Rubber Co.	Self-inflating life jackets.
Perkins Ltd.	Outboard motor.
Todd & Co.	12 ft. fibre glass boat.
Ilford	Film
Kodak	Film
British Communications	Field Radios.

Firm	Item Supplied.
The B.P. Company	Petrol, oil, paraffin.
Smiths Clocks	Watches.
Cutrock Engineering Co.	Geological Hammers.
The Venus Pencil Co.	Pencils.
The Ronson Co.	Lighters.
Savory & Moore.	Glacier Cream.
Burroughs Welcome	Harzine tablets.
S.Zimmerman & Co.	Pack frames.
Northern Mail Order Co.	Ventile suits.
Prestige Ltd.	Pressure cookers.
Boots Pure Drug Co.	Medical kits.
Samuel Putney	Ramin Wood Stakes.
Tranatlantic Plastics	Polythene bags and sheet.
Ever Ready Co.	Torches.
Gallenkamps	Thermometers.
Australian Dried Fruit Co.	Raisins.
Huntley & Palmer	Biscuits. Oatmeal blocks.
Marmite Ltd.	Marmite.
Tate & Lyle	Sugar.
Horlicks Ltd.	Horlicks drink and tablets.
Cadburys	Drinking chocolate.
Van den Bergh	Margarine.
Oxo	Corned beef, Luncheon meat.
Mapletons	Peanut butter.
Glaxo	Ostermilk
Felton & Crepin	Dried Egg.
Thames Rice	Rice.
Romney	Kendal mint cake.
Cerebos	Scotts porage oats & salt.

Firm.	Item supplied.
Carrs of Carlisle	Biscuits.
I.Beer & Co.	Cheese.
Chivers	Jam, Honey.
Liptons	Tea
Wander & Co.	Ovaltine.
Condima & Co.	Dehydrated vegetables.
Crosse & Blackwell	Tinned fish.
Anglo Swiss Food Co.	Knorr Swiss soups.
Batchelors	Packeted soups.
Pascall	Sweets.
McDougalls	Flour
Brown & Polson	Glucose tablets.
Keddie	Tubes of sauce.
The Nestle Co.	Chocolate & Nespray.

C.VI. 2. BIBLIOGRAPHY.

King, A.J.: Imperial College Expedition to Jan Mayen Island 1938, Geographical Journal 1939. Nov.

Jennings, J.: Glacial Retreat in Jan Mayen. Journal of Glaciology, page 167, No. 4. 1948. October.

Perutz, F.M.: Glacier flow. Journal of Glaciology. 1947.

Wordie, J.M.: Jan Mayen Island, Geographical Journal, March, 1922, pp.180-95. (Including a history of Jan Mayen with many references).

An account of climbing the Beerenberg by R.Scott-Russell (1938 I.C. Expedition). can be found in the Alpine Journal, No. 51. (1939) p. 18-28.

Other records of visits to Jan Mayen can be found in the following issues of the Geographical Journal:

No.85(1935) 553-557 (Byrd Bros.)
No. 31 (1908) 645-47 (Duchess of Bedford)
No. 38 (1911) pp.537-38.

Boyd, Louise A.: American Geographical Society "North East Coast of Greenland". Two volumes - pub. about 1948. Many photographs.

Geology: Wordie: Trans. Roy. Soc. Edinburgh 1926.
Tyrell: Petrology of Jan Mayen.
G.D.Nicholls: "Geology of N.E.Jan Mayen" - Geol. Mag. 1955.
R.C.Bostrom: "Geology of Jan Mayen". Science News. Pelican No. 9, 1948, 84-87.

A more comprehensive list of references can be found in the Library of the Royal Geographical Society, London, and the Scott Polar Research Institute, Cambridge.