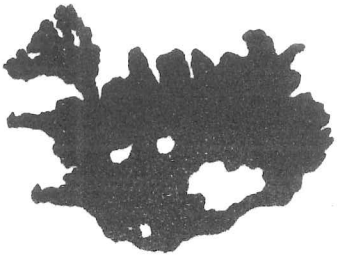
Iceland



Expedition 1980 Report

Patron

Sir Vivian Fuchs F.R.S.

Foreword.

This year's expedition to the Austur Reykjadalir region of south-central Iceland was the second one undertaken from Thorpe St.Andrew School.

Many people have asked me why I return to the same area in Iceland and not lead expeditions to other areas in Iceland or other countries.

Austur Reykjadalir is a superb area of Iceland and is ideal for expeditions providing not only excellent material for surveys but also plenty of adventure.

Over the last 10 years the area has changed, in some cases dramatically and I never cease to be amazed by the whole nature of the environment.

Each expedition to the area increases our knowledge of it. Each expedition is different because each expedition has different leaders and members and they provide a new outlook on the area.

Most importantly it provides a unique opportunity for young people to find out more about themselves. They have the opportunity to push themselves to their limits, to achieve something they thought they could never do and to experience a totally new environment to that in which they live.

The experience is not always easy, in fact at times the individual may ask himself 'What am I doing here?' However, the experience is usually enjoyed by all even if it is in retrospect!

I hope that this report will encourage more young people to participate in ventures such as this in the future.

Members of the Expedition.

Members of the Expedition.

Leaders.

Owen Hunt	Churchill Fellow 1978, Leader of expeditions to Iceland 1970,78;Norway 1971, Lapland 1972
Guy Hawkins	Churchill Fellow 1980. Expeditions to Iceland 1970 and 1978.
Dr. Dave Clarke	
Diana Clarke.	

Members.

David Hubbard
David Gates
David Pinnock
Raymond Charig
Jonathan Schofield
Jeremy Hardingham
Michael Branfield
Joelle Darby
Johanna Penny
Hannah Innes
Siobhan Needham
Marco Guggi
Erica Losh-Atkinson
Hugo Roche
Jasper Warwick
Andy Welles
Robert Hughes

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Contents.

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Maps.

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Part I

1. Introduction

Introduction.

Iceland lies between 63°24' and 66°33' north latitude and between 13°30' and 24°32' west longitude. It is 490 kms. from east to west and 312 kms. north to south. Its nearest neighbours are Greenland (300 kms.), Scotland (800 kms.), and Norway (970 kms.).

Floki Vilgrdarson gave the country its name in 866 A.D. after seeing a fjord full of pack ice.

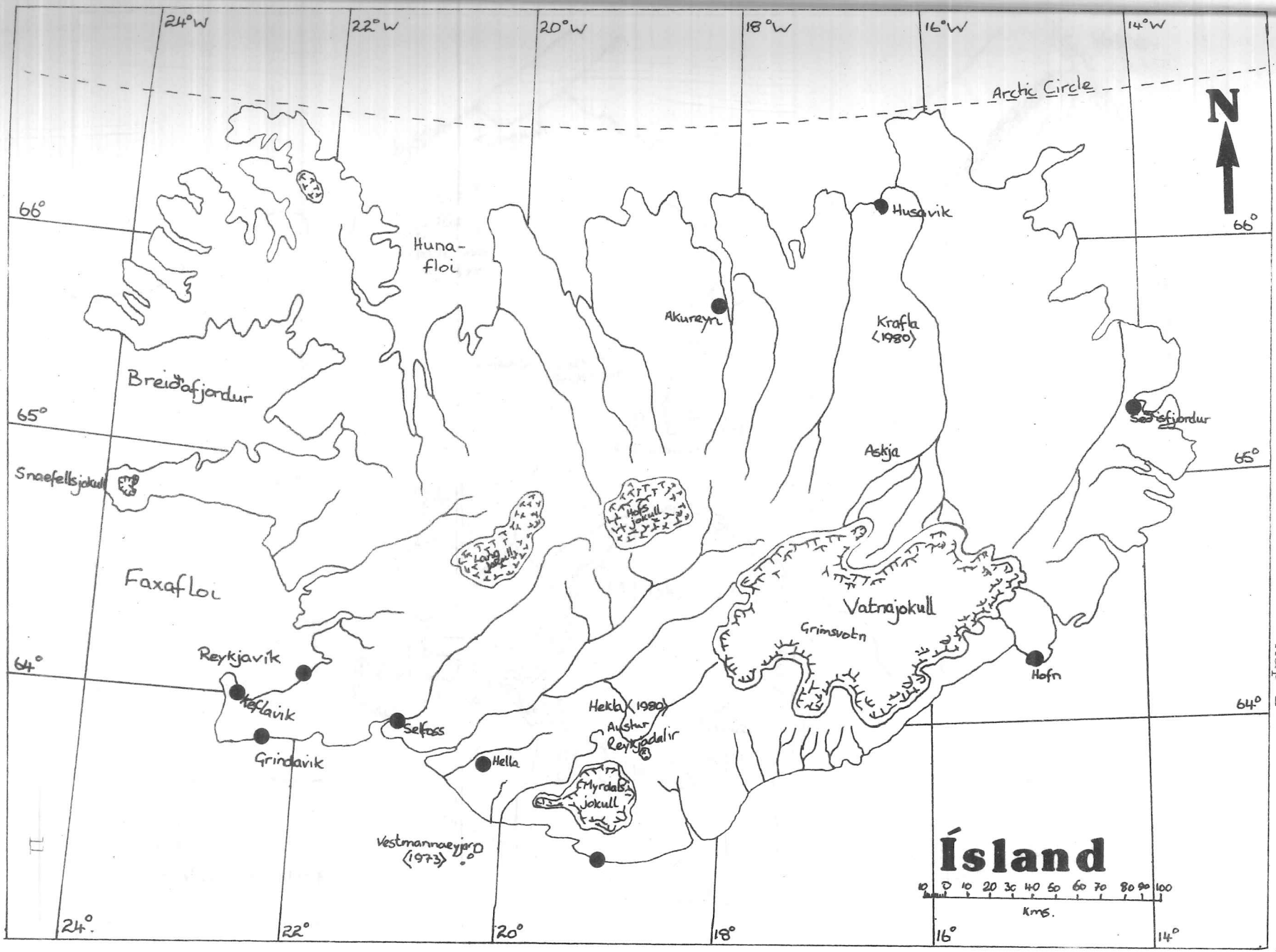
Geologically Iceland is still young and the process of its formation is still going on. Iceland is in large part a table land broken up by tectonic forces. Its interior consists entirely of mountains and high plateaus devoid of human habitation. There are numerous fissures running in a N-S direction in the north, and in a N.E.-S.W. direction in the south. This area is a continuation of the Mid Atlantic Ridge, astride which Iceland sits, and contains numerous active volcanoes.

Iceland is the home of glaciers and ice caps. Some 11% of the country is covered by ice, the largest single area being Vatnajokull.

The area of Austur-Reykjadalir lies in the volcanic zone of south central Iceland to the south-east of Hekla and to the north-west of Torfajokull. It is the most hydrothermally active area in Iceland and contains more than 100 hot springs of various sizes.

Geologically the area is composed mainly of acid rich lavas including Rhyolite, Obsidian and Pumice.

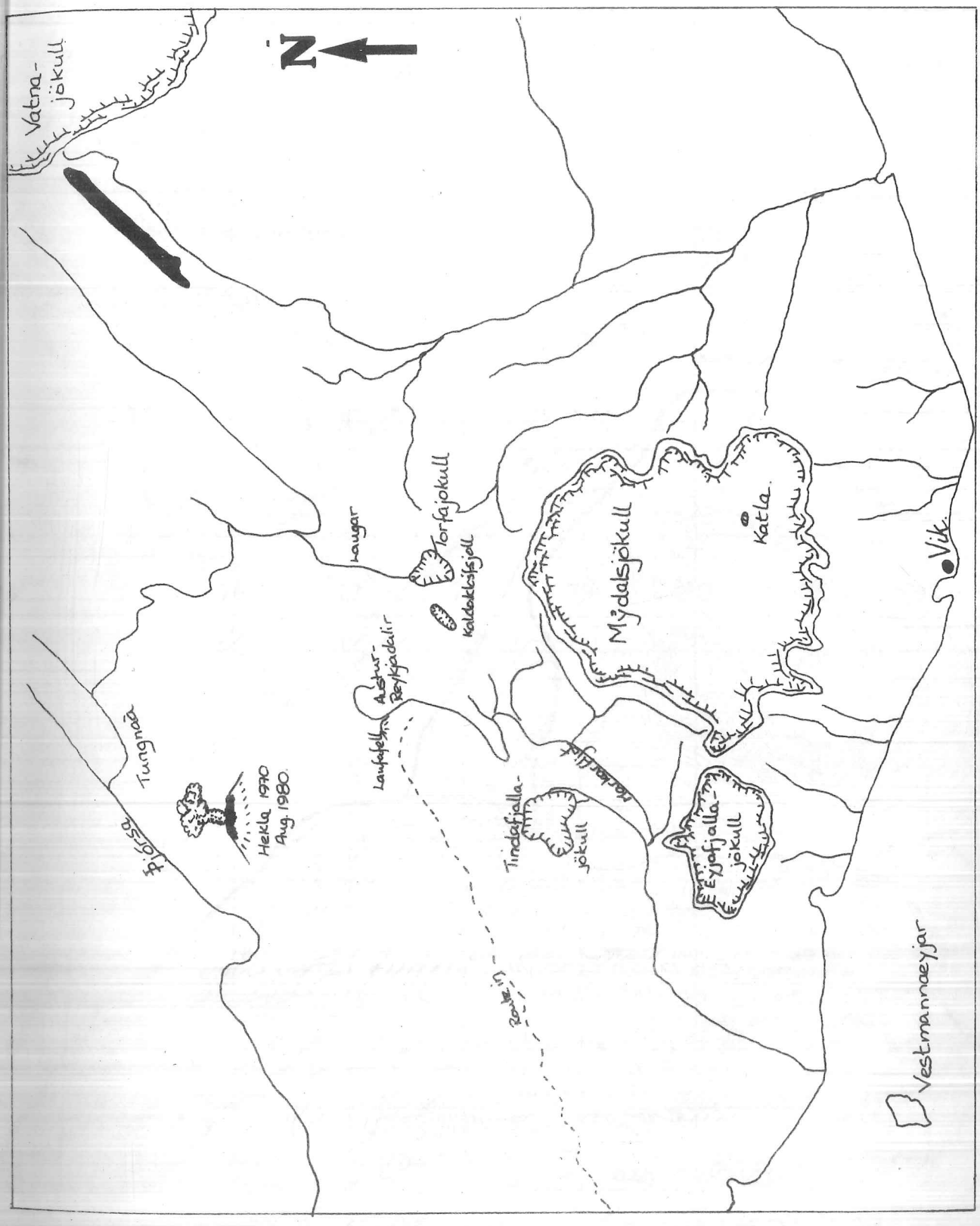
The nearest town,Hella is some 60 kms to the west along a rough ash track.

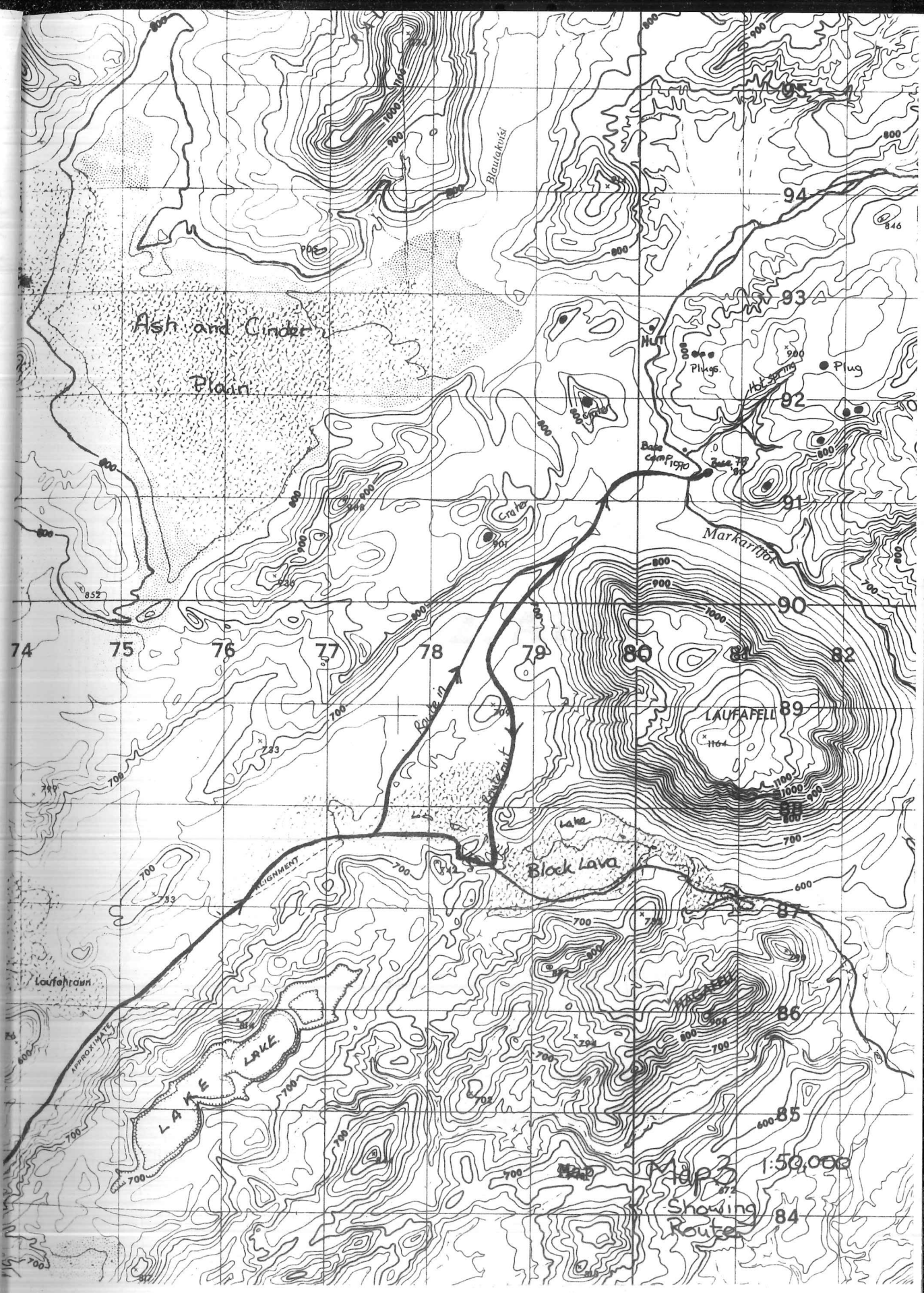

24°W
22°W
20°W
18°W
16°W
14°W
Arctic Circle
N
66°
65°
64°
Husavik
Huna-
floi
Akureyri
Krafla
(1980)
Breiðafjordur
Seyðisfjordur
Askja
Snaefellsjokull
Hofs
jokull
Langa
jokull
Faxafloi
Vatnajokull
Grimsvotn
Reykjavik
Keflavik
Hofn
Selfoss
Hekla (1980)
Austur
Reykjadalir
Grindavik
Hella
Myrdals
jokull
Vestmannaeyjar
(1973)
Ísland
10 0 10 20 30 40 50 60 70 80 90 100
Kms.
24°
22°
20°
18°
16°
14°

Map 1

Map 2.

South central Iceland.




Ash and Cinder
Plain
Blautakvisi
Hut
Plugs
Plug
Hot spring
Base camp
Crater
Markarfljot
LAUFAFELL
Route in
Route out
Lake
Block Lava
ALIGNMENT
APPROXIMATE
LAKE
LAKE
Laufahraun
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
Map 3 1:50,000
Showing
Route

2. Aims

2. Aims of the Expedition.

The aims of the expedition were twofold. Firstly, to carry out a number of geographical, geological and biological surveys in the area of Austur-Reykjadalir.

The area has not been studied in any great detail and these surveys will help to build up our knowledge of the area. Some of the surveys had been started in 1978 and we were able to carry out comparative studies with our 1980 findings.

Our second aim was adventure, and in Austur Reykjadalir there is no shortage of this. Members of the expedition were to be taught how to use ice axes, crampons, ropes etc. We had also hoped to climb the volcano Hekla and to visit the northern frimges of Myrdalsjokull but owing to a number of factors including shortage of time(the surveys took longer than expected) we were unable to do either.

Our scientific programme was divided into a number of sections:

a) Mapping.

Last expedition (1978) saw the start of the updating of the 1:50,000 map of the area. We planned to continue this in 1980.

b) Geographical Studies.

i) Geothermal Areas.

In 1978 we began mapping the location of the numerous hydrothemal areas within Austur Reykjadalir. This expedition we planned to continue this survey checking our 1978 results and noting any changes that may have occured.

ii) Volcanoes.

This survey was to be linked with the study of Hrafntinn-ahraun and Hrafntinnusker. We also planned to locate and study other eruptive sources in the area.

iii) Geology

This survey was to be linked with the survey on volcanoes. We planned to produce a map of the area showing lava flows, eruptive sources and rock types.

iv) Weather

Daily measurements of the following were to be made:
maximum and minimum temperatures
wind speed and direction
cloud cover and type
precipitation

v) Rivers.

Changes in the level of the river Markarfljot were to be made together with measurements of velocity and material carried in suspension.

c) Biological Survey.

A detailed study of the flora was to be made especially around hot springs. Specimens of bryophytes and lichens were to be collected for the Natural History Museum in London.

We were able to complete most of the surveys and in the following pages we have written up our results, recording any problems we had with the surveys. One or two surveys have led to ideas for future studies. We plan to begin these in 1982.

3. Geographical Surveys

a) Base Camp Hydrothermal Area.
b) The Geothermal Area of Hrafntinnusker.
c) Geology.
d) Volcanoes and Lava Flows.
e) Snow and Ice.
f) River Study.
g) Weather.

3. Geographical Surveys.

a) Base Camp Geothermal Area.

The Base Camp Geothermal area was one main area of study. We spent over 400 man-hours measuring and studying the area. On the next four pages are the maps we made of this geothermal area.

This Geothermal area was first studied on the 1970 Expedition when it was accurately mapped by G.N.Hawkins and O.J.Hunt. In 1978 we remapped the geothermal area and carried out a comparative study. (see Ísland 1978). That study was used as a basis for our survey in 1980.

Since 1978 there have been a number of changes to the area. The main pool had four new vents and the secondary pool on the north bank of the river that formed between 1970 and 1978 had been mostly filled in with deposits of sulphur and silica. The activity in this area was still high and there were at least 8 distinct steam vents, some in the bed of the stream, which had appeared since 1978.

Tremendous amounts of energy are coming to the surface at this location. Over 1000 kJ/min. are being transferred to the water in the stream as it passes through the steam vent area associated with the secondary pool. In 1970 it was calculated that this geothermal area produced enough heat to boil over 16,000 litres of water per minute!

On the southern bank of the river the new pool of 1978 has enlarged considerably and new steam vents have opened up here as well.

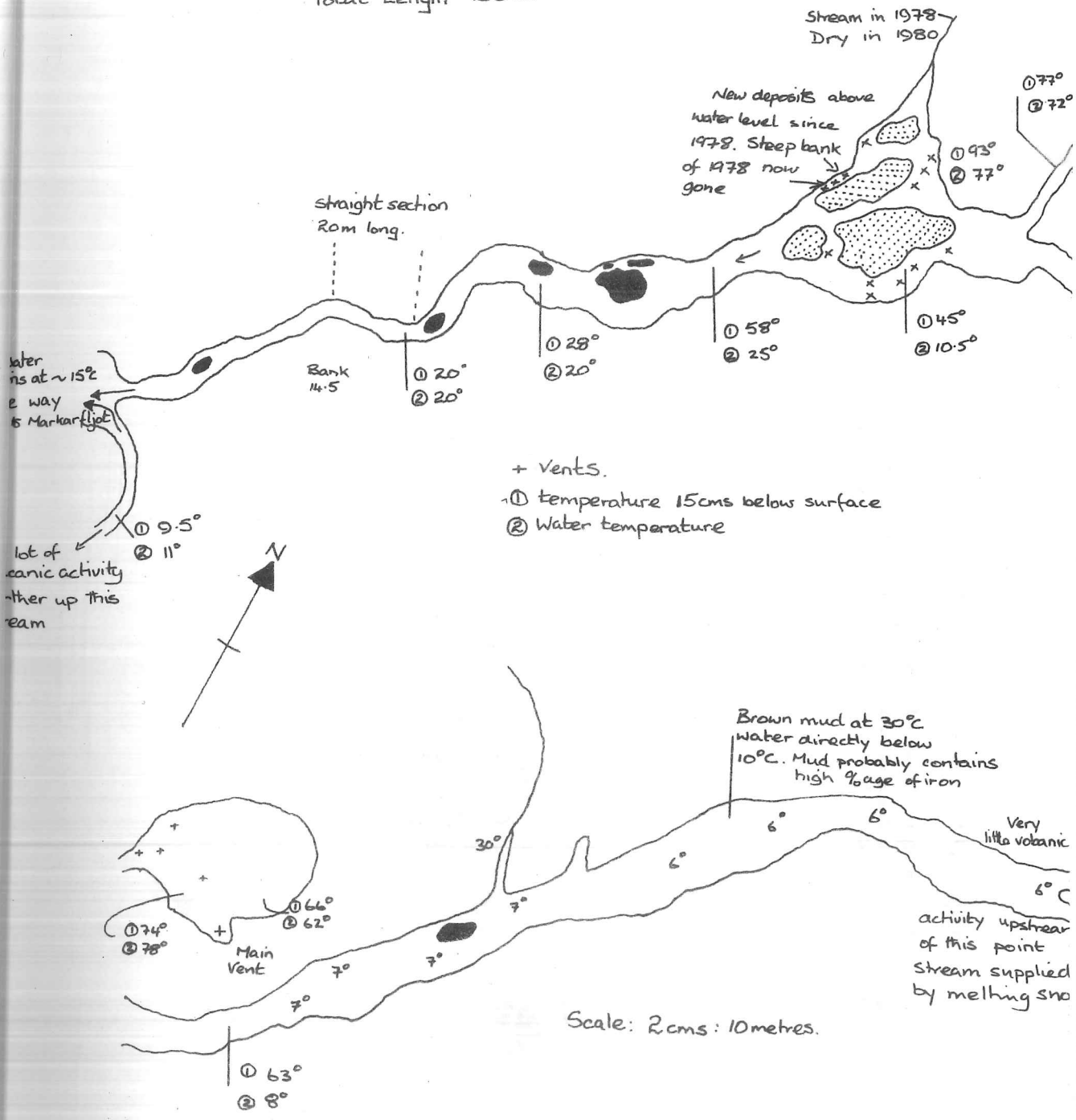
Conclusion.

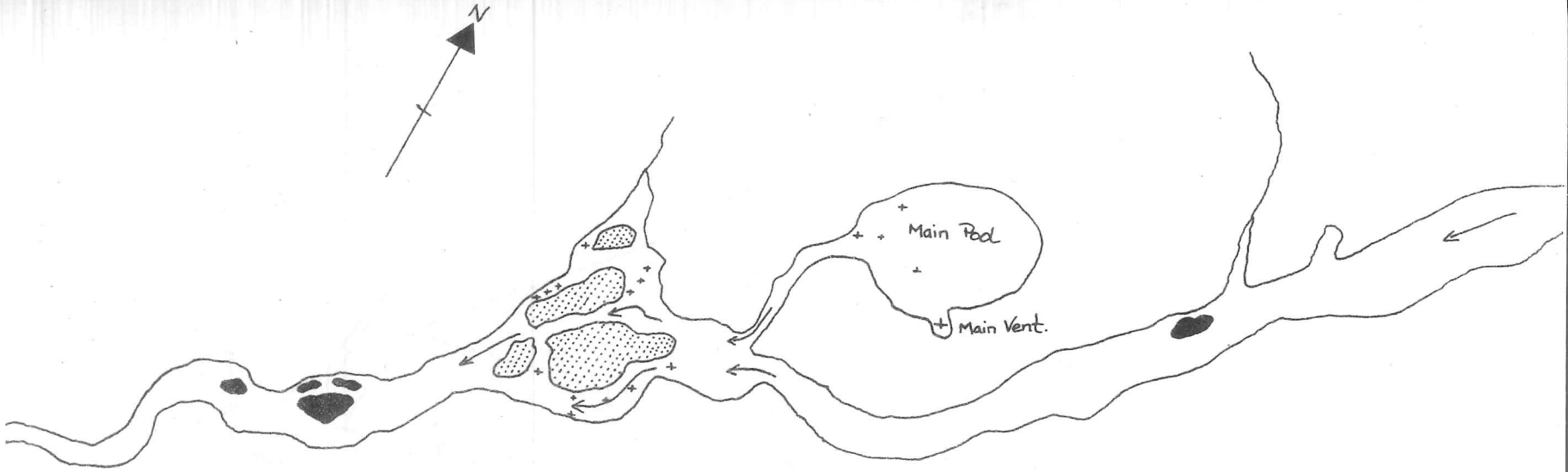
The increased activity of the pool, noticeable over the four weeks of the expedition, was probably due to the general increase in activity in the south-east axis of the volcanic zone. In fact it could have been due in part to the rising

Map 4

Stream and Hydrothermal Area near Base Camp.

Total Length 130 m.





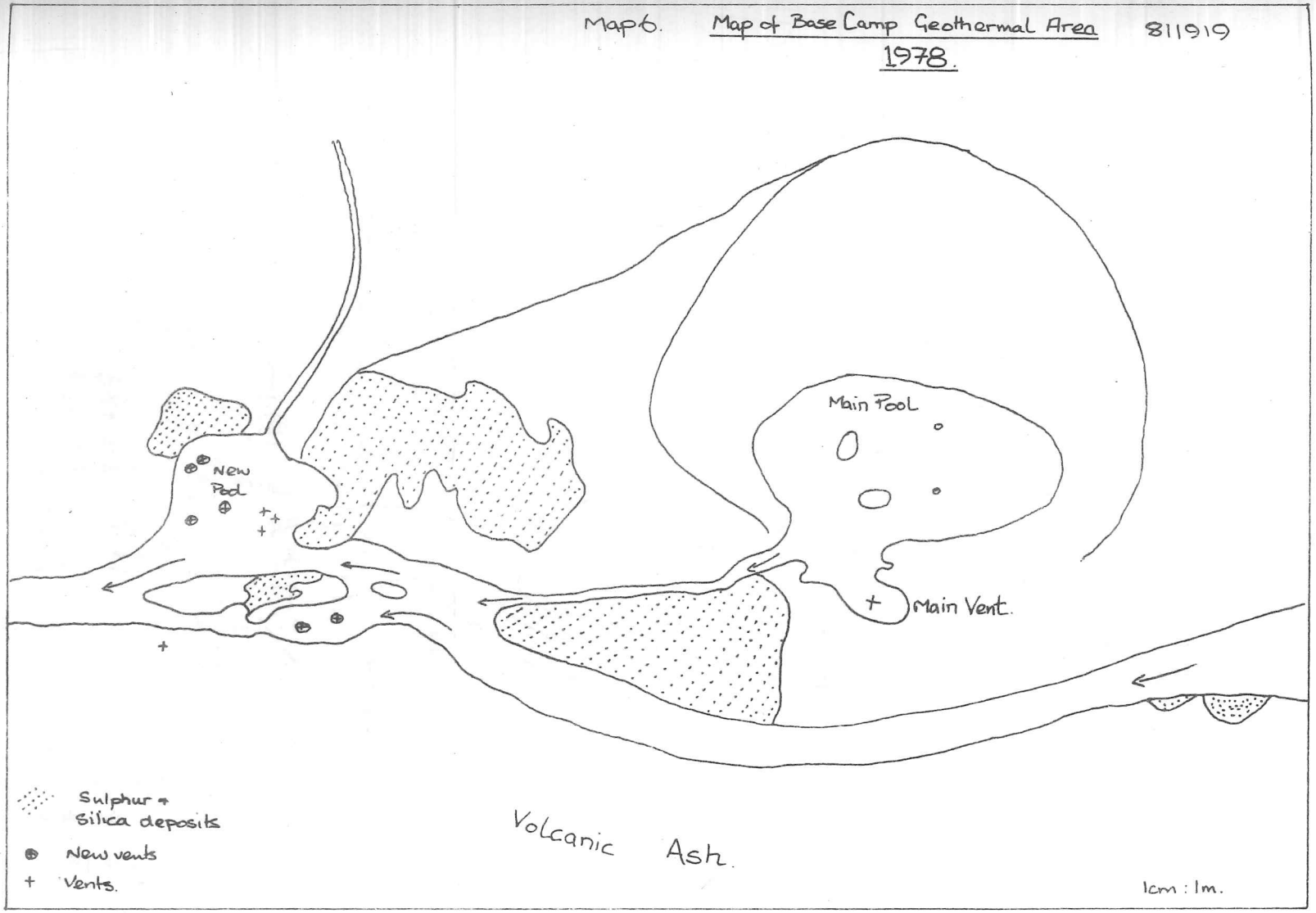
Map5. Stream + Hydrothermal Area near Base Camp.

⟨end sections missing see page ⟩.

Scale: 2 cms : 10 metres

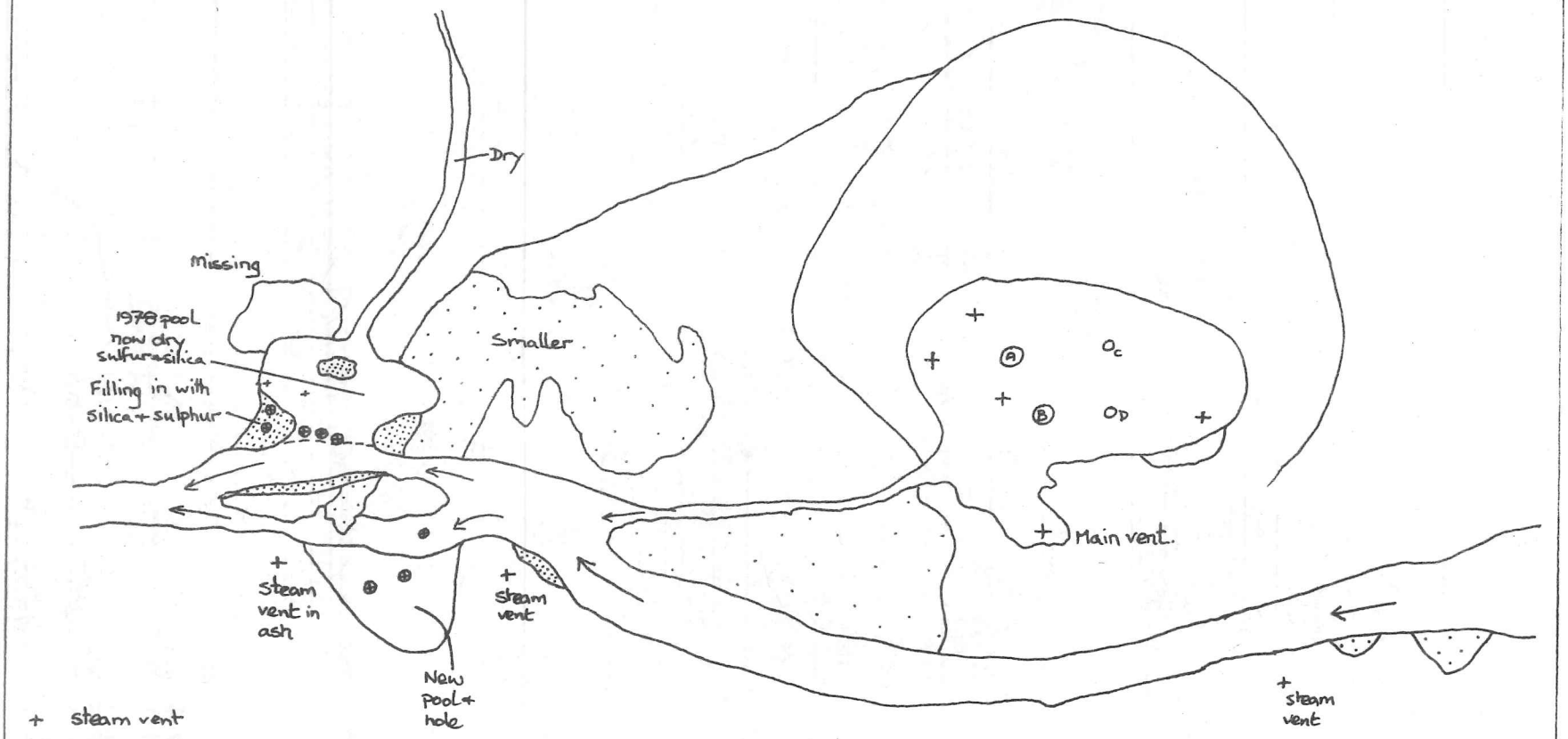
Map 6. Map of Base Camp Geothermal Area 811919

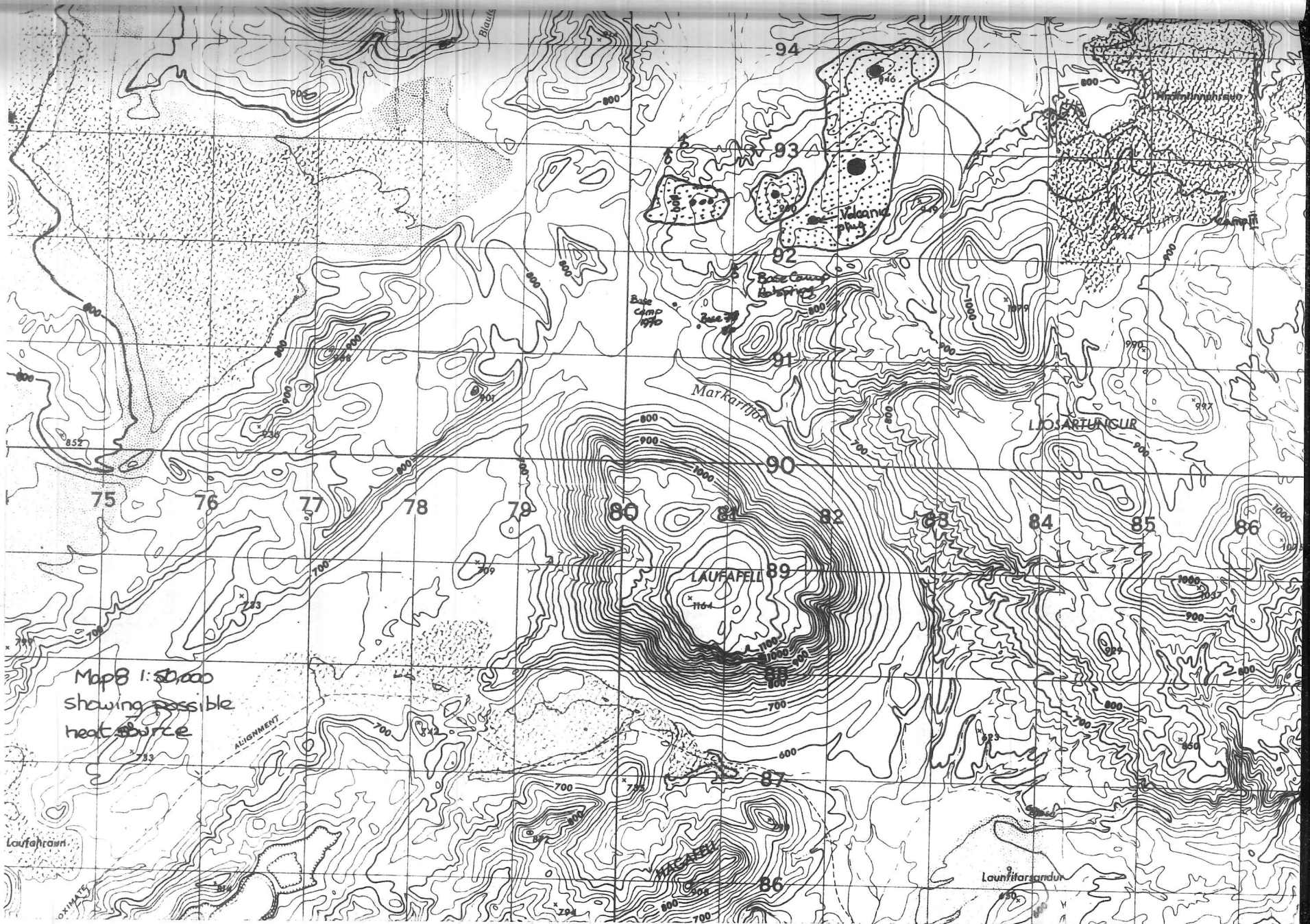
1978.



Map 7. Map of Base Camp Geothermal Area

1980




Map 8 1:50,000
showing possible
heat source
LAUFAFELL
LJÓSÁRTUNGUR
Markarfljót
Base Camp
Volcanic Plug
ALIGNMENT
Laufahraun
Launfitarsandur
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94

magma beneath Hekla which erupted three days after we left Iceland.

This is rather a unique area of activity being the only large source within a 10 km. radius. It is likely that the heat originates from beneath the lava flow and volcanic plug to the east at grid reference 818923 (map p. 23). The valley in which the geothermal area is located has been cut through the lava flow.

The flow rate of the spring is very small but such as there is probably originates from ground water percolating down to the hot volcanic rocks.

We plan to continue our study of this area in 1982.

b). The Geothermal Area of Hrafntinnusker.

The 10 sq. kms. of the geothermal area of Hrafntinnusker is one of the most active in Iceland. In 1978 when we started mapping the location of the hydrothermal sources we did not realise that the numbering system we used would lead to confusion in 1980. We have, therefore, renumbered the hydrothermal sources and have divided the into a number of zones.

Zone A - the area to the north of Hrafntinnusker and east of the stream flowing through camp IV.

Zone B - the area to the west of camp IV and north of the glass lava flow west of Hrafntinnusker.

Zone C - the area west of Hrafntinnusker including the Ice Hole, and the glass lava flow.

Zone D - the area west of the head waters of the river Markarfljot.

(see map 9 on page 26).

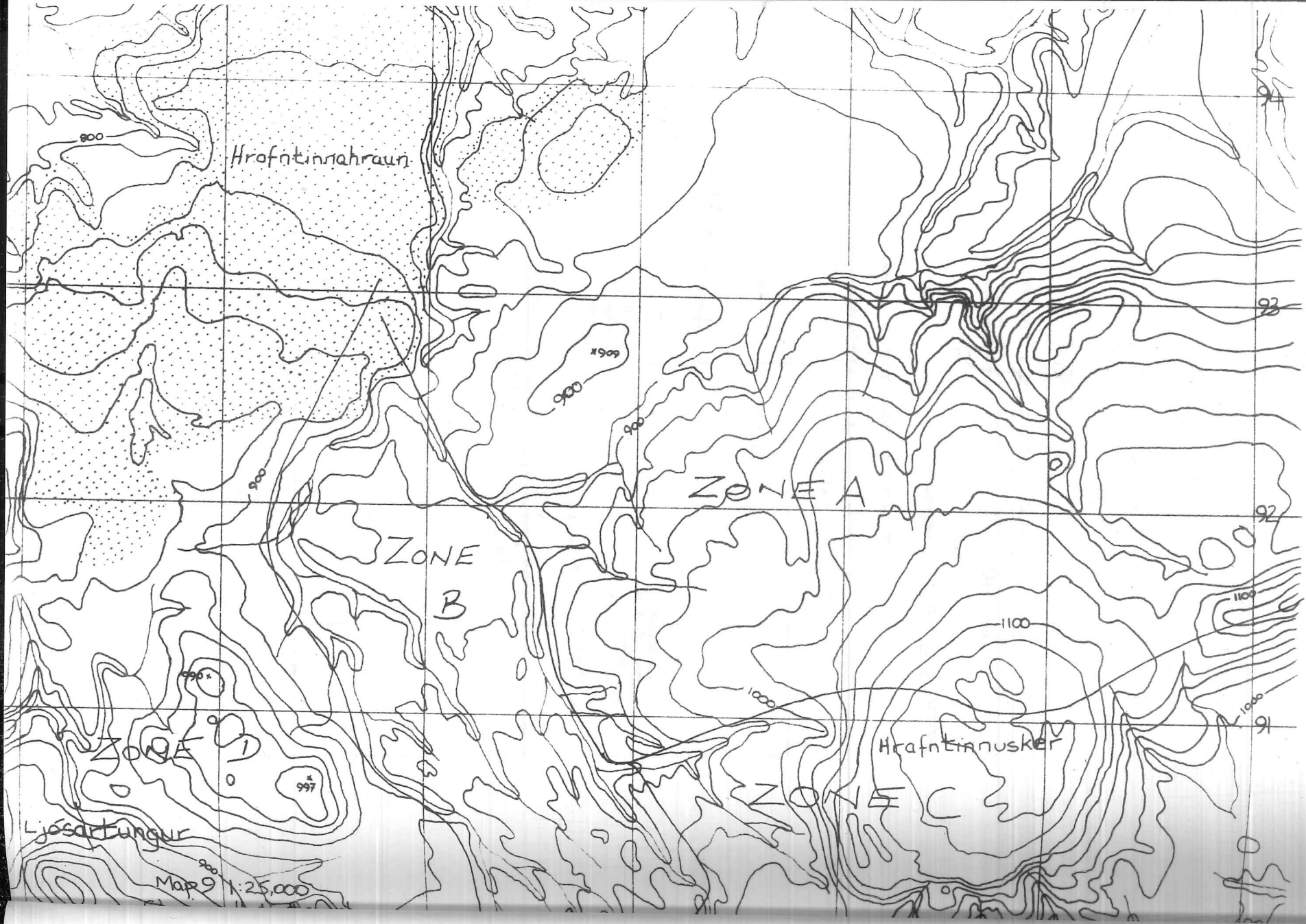
The Geyser.

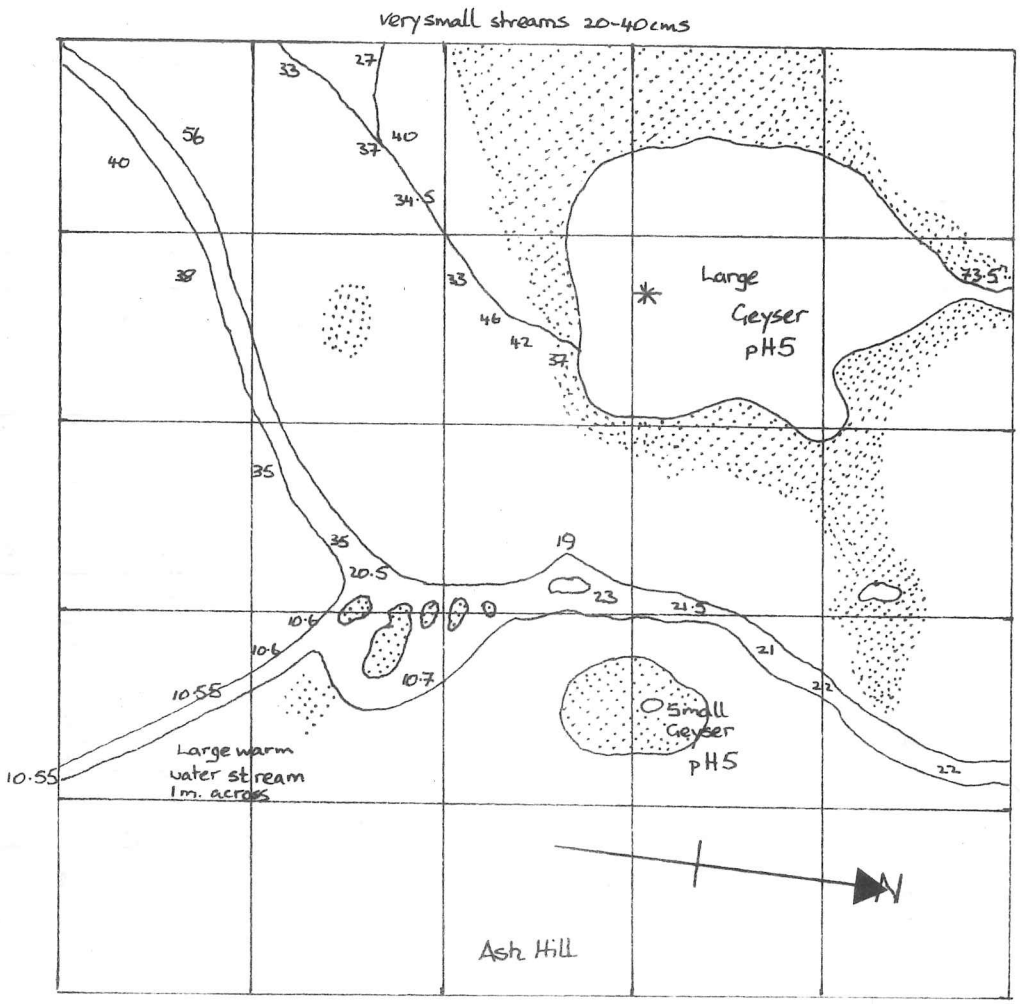
This year we were able to carry out some mapping of the area of the Geyser and we also carried out some measurements of eruption heights and times. (see results on following pages).

All regularity has gone from the eruptions of the geyser. In a period of 1 hour 40 secs. a total of 55 eruptions over a height of 8 metres were recorded. The time gap between these eruptions varied between 2 secs and 268 secs.

As can be seen from the graph on page 28 a considerable number $\sim$30% of the eruptions took place at intervals of less than 25 secs.

It was apparent, therefore, that the geyser continued to show increased activity first noticed in 1978 although the pattern of the activity had changed. It will be interesting to carry out a comparison in 1982.


Hrafntinnahraun
ZONE A
ZONE B
ZONE C
ZONE D
Hrafntinnusker
Ljósártungur
Map 9 1:25,000



⁘ : Sulphur areas.

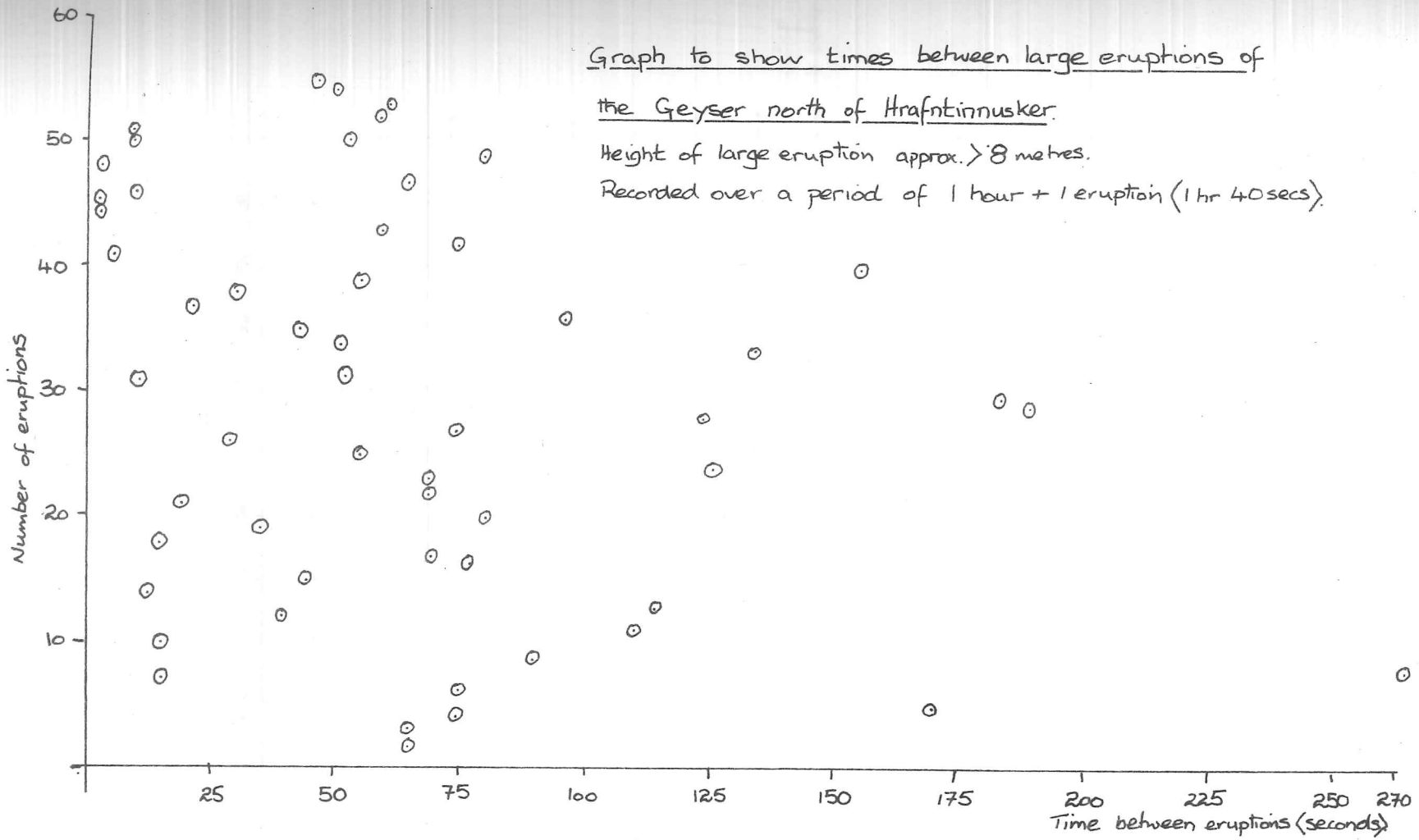
10·55 : Figures indicate temperature of water (°c)

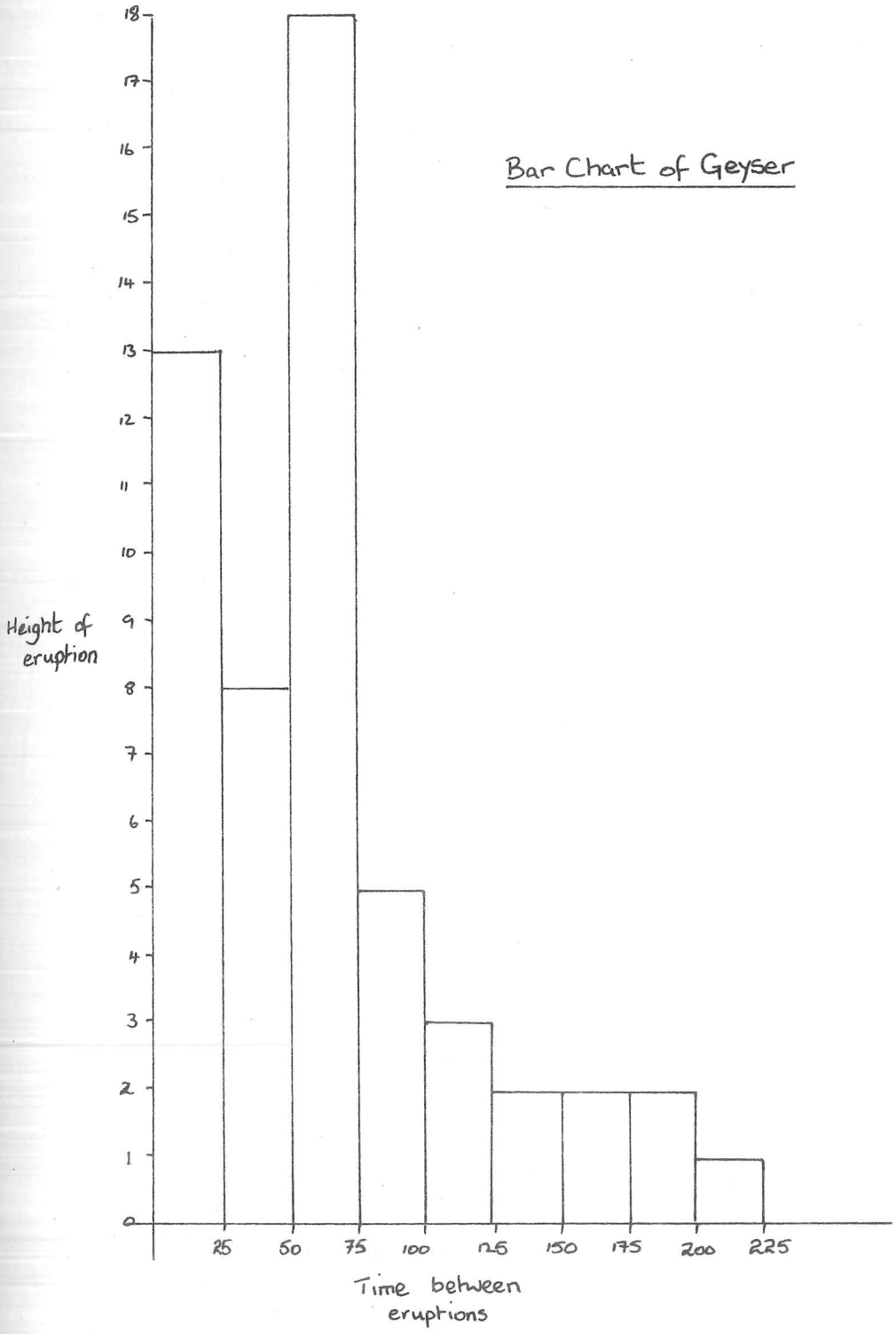
✱ : main eruptive source in geyser pool.

Scale: 2·5 cms : 10 metres.

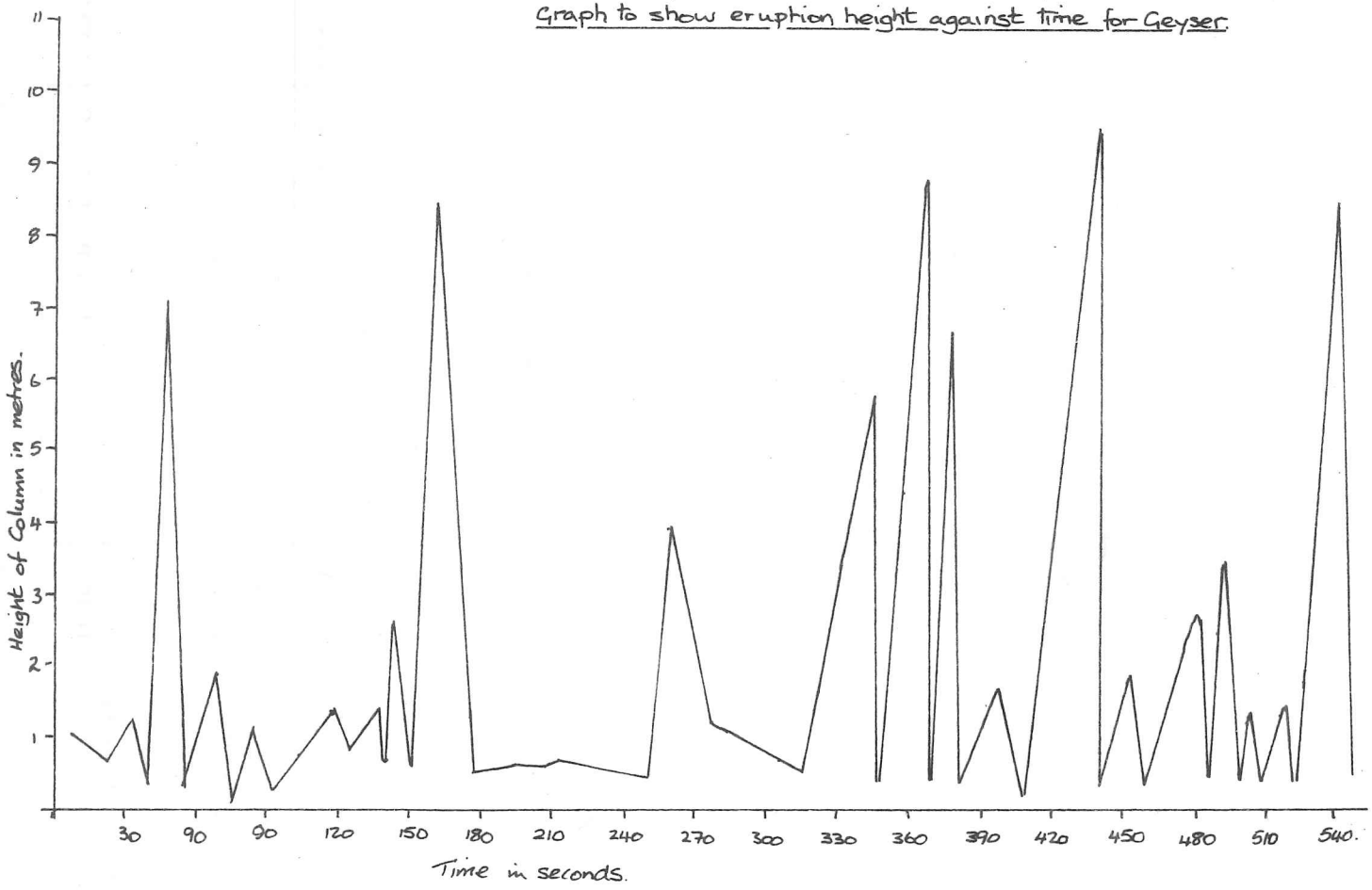
Map: 10

Map of large Geyser and surrounding hot springs north of Hrafntinnusker.


Graph to show times between large eruptions of the Geyser north of Hrafntinnusker
Height of large eruption approx. > 8 metres.
Recorded over a period of 1 hour + 1 eruption (1 hr 40 secs).
Number of eruptions
60
50
40
30
20
10
25
50
75
100
125
150
175
200
225
250
270
Time between eruptions (seconds)


Bar Chart of Geyser
Height of eruption
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
25
50
75
100
125
150
175
200
225
Time between eruptions

Graph to show eruption height against time for Geyser.

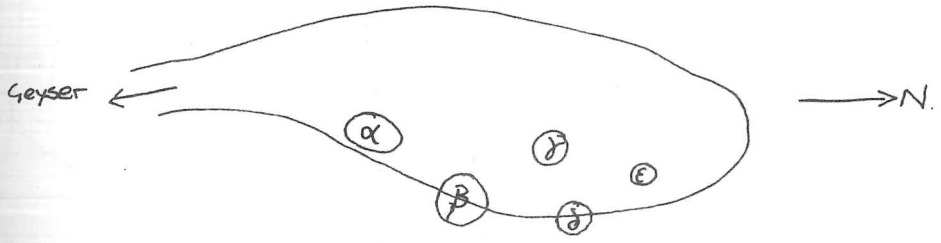


Small Geyser.

A small geyser was located to the east of the large one (see map 10 on page 27). This was unpredictable. On one occasion this geyser erupted to a height of approximately 2 metres every 20-30 minutes. The following day no eruption was recorded over a period of 4 hours. This may have been due to an increase in atmospheric pressure.

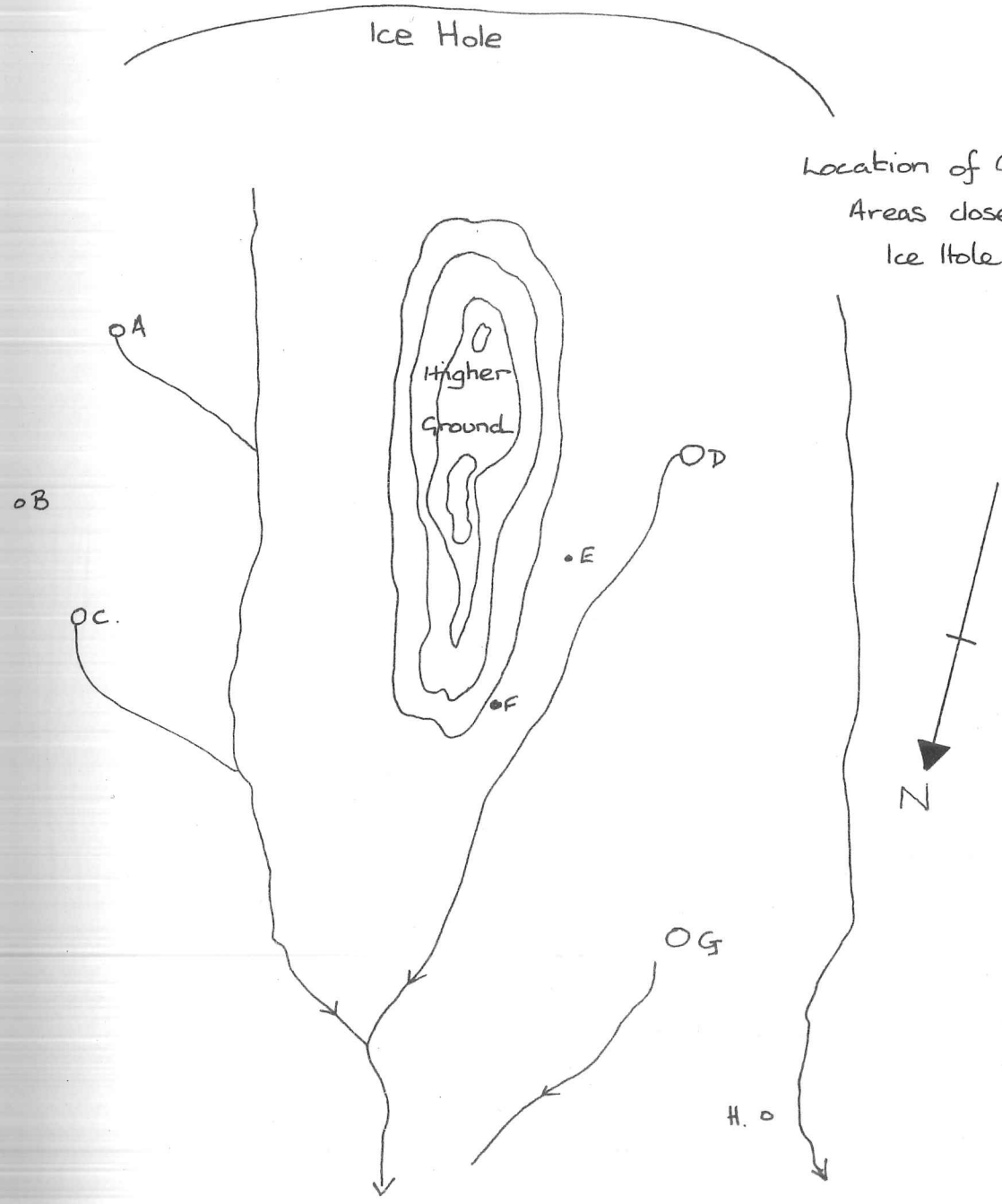
Hydrothermal Vents.

The two geysers were surrounded by a number of smaller vents. Five of these were situated in an area on a slope NW of the main geyser. These were studied in some detail.

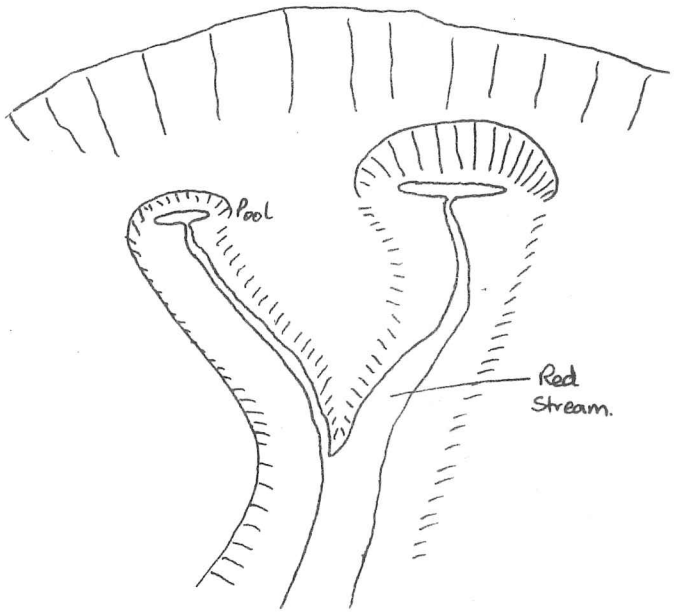


Hot spring	Area sq.m.	Depth cms.	pH	No. of vents	Deposit and discharge.	
α	2	0-4	4	5	blue	small patches of moss growing close by.
β	2	50	4		blue	
γ	0.5	20	4		blue	
δ	1.5	10	4		yellow	
ε	0.5	3	4		orange	

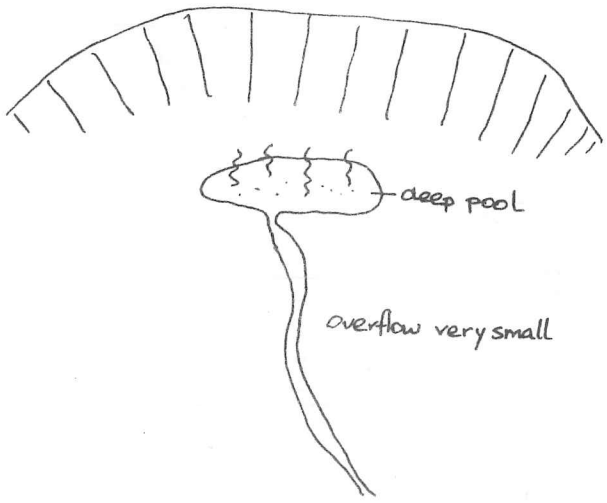
The very low pH i.e. high acidity, of all the hot springs surveyed was to be expected. Sulphur is probably oxidised to SO_2 and SO_3 which dissolve in the water forming S(IV) and S(VI) acids.



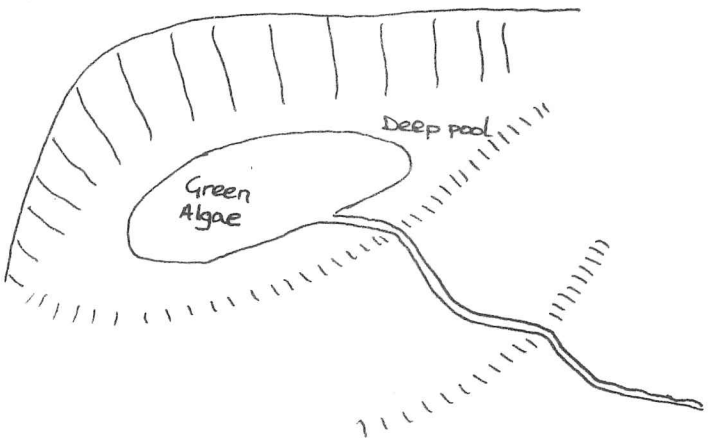
Arrows show direction of flow in streams.



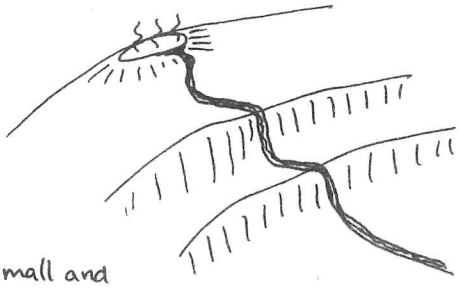
Hydrothermal
Area A.



Hydrothermal
Area C.

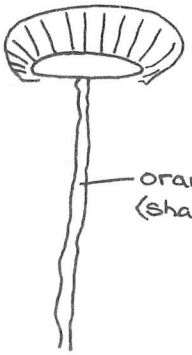


Hydrothermal Area D.



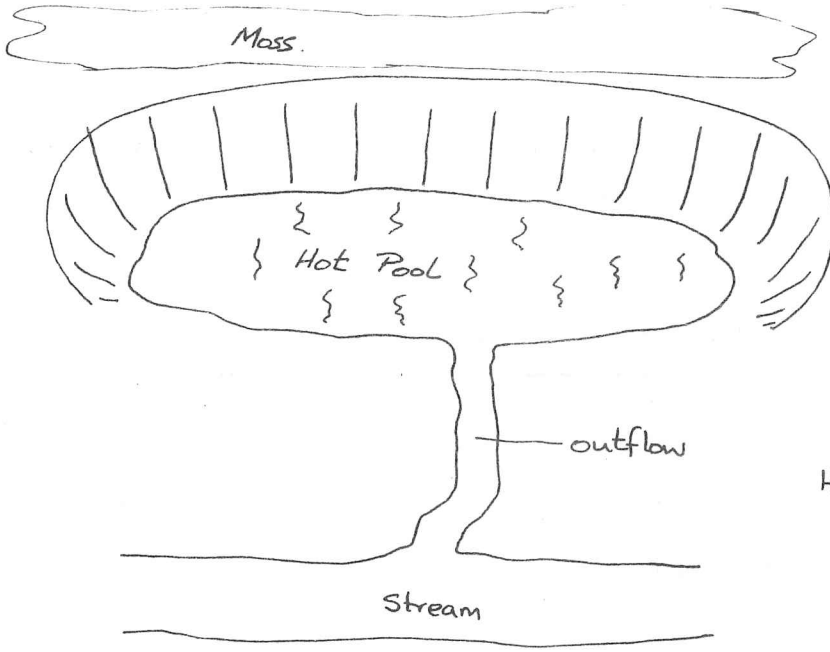
small and fast flowing.

Hydrothermal Area F.



Hydrothermal Area G

orange algae (shallow spring).

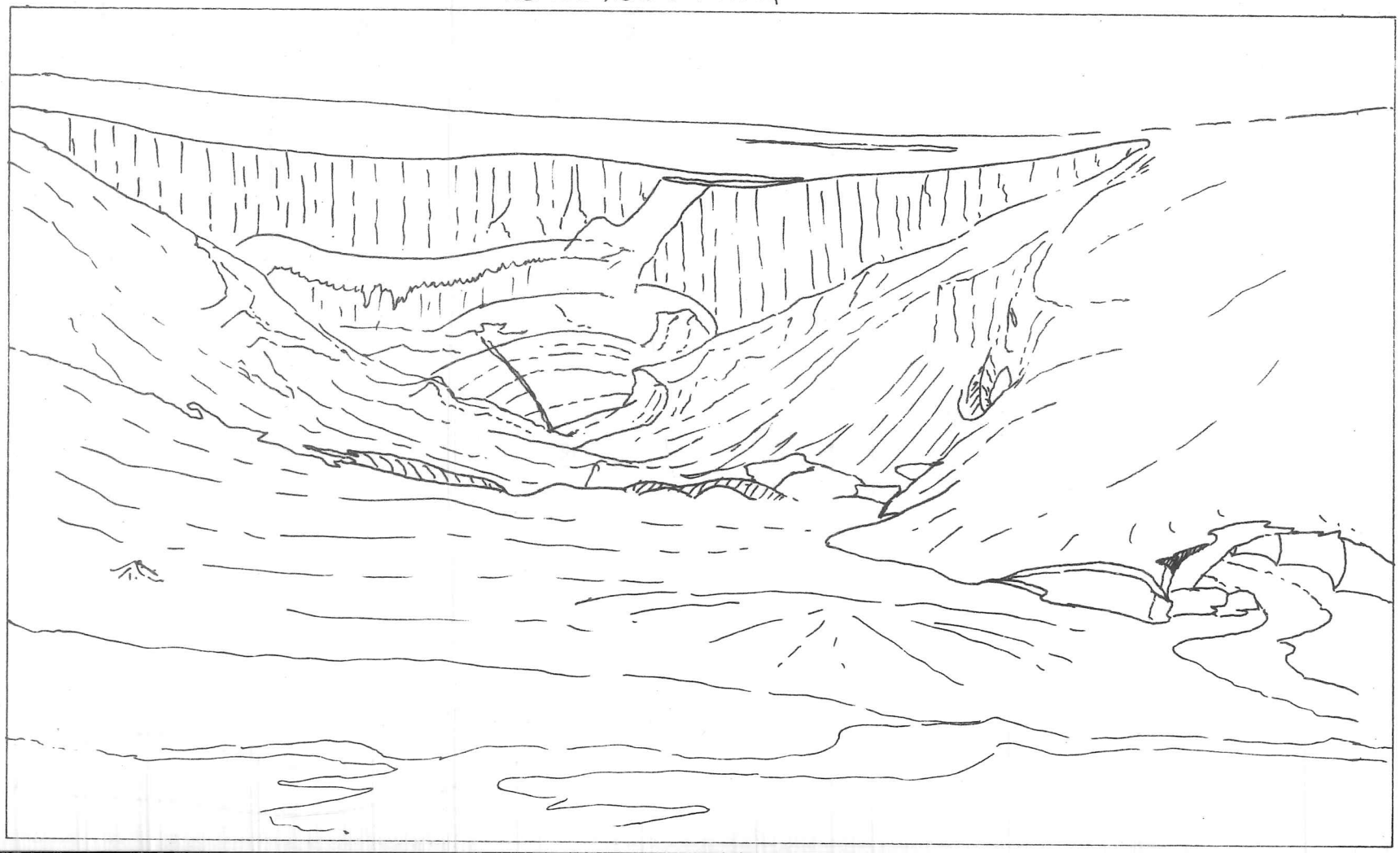


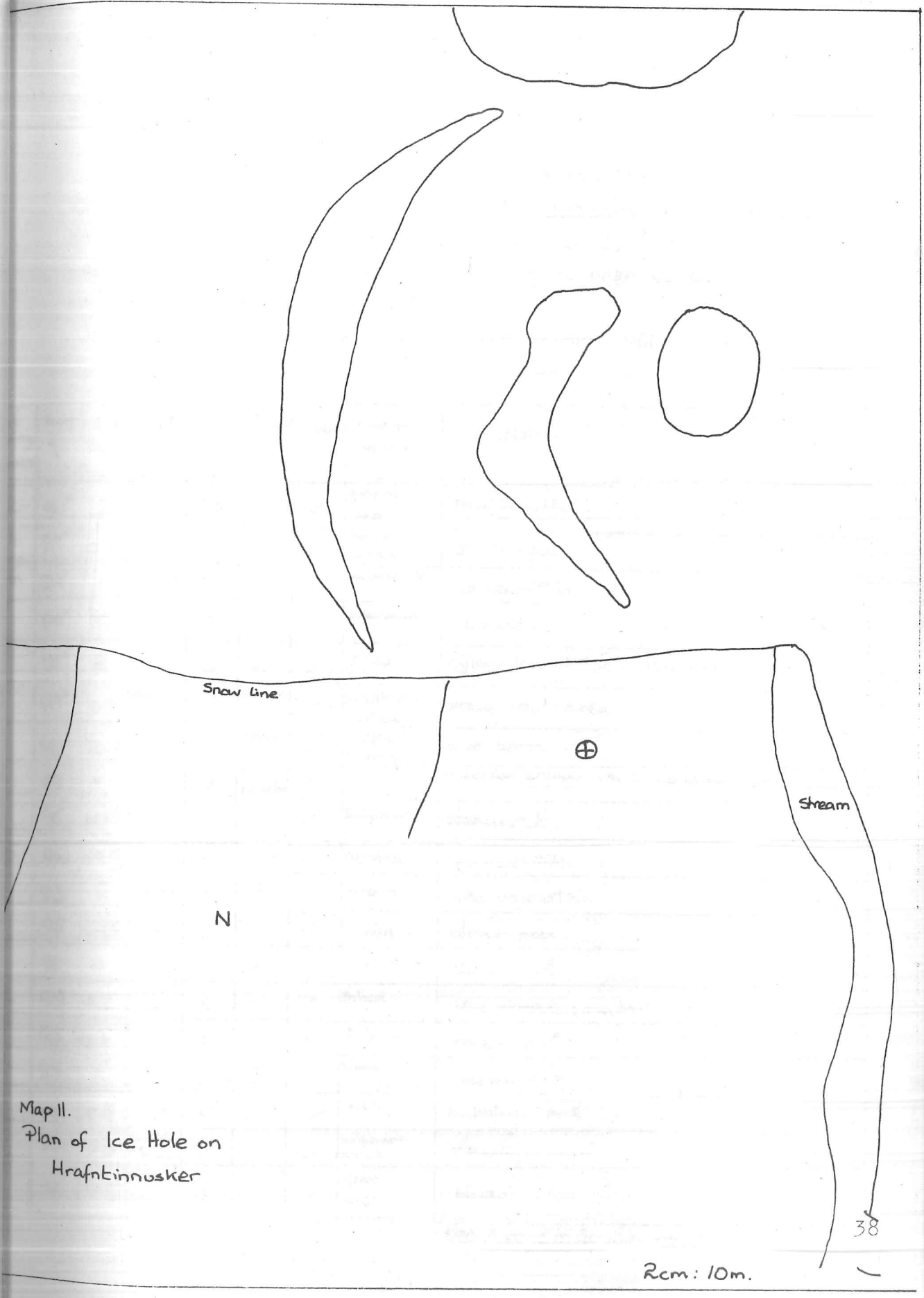
Hydrothermal Area

H.


Sketch of
Camp IV.

The Ice Hole on Hrafntinnusker.





Map 11.
Plan of Ice Hole on
Hrafntinnusker

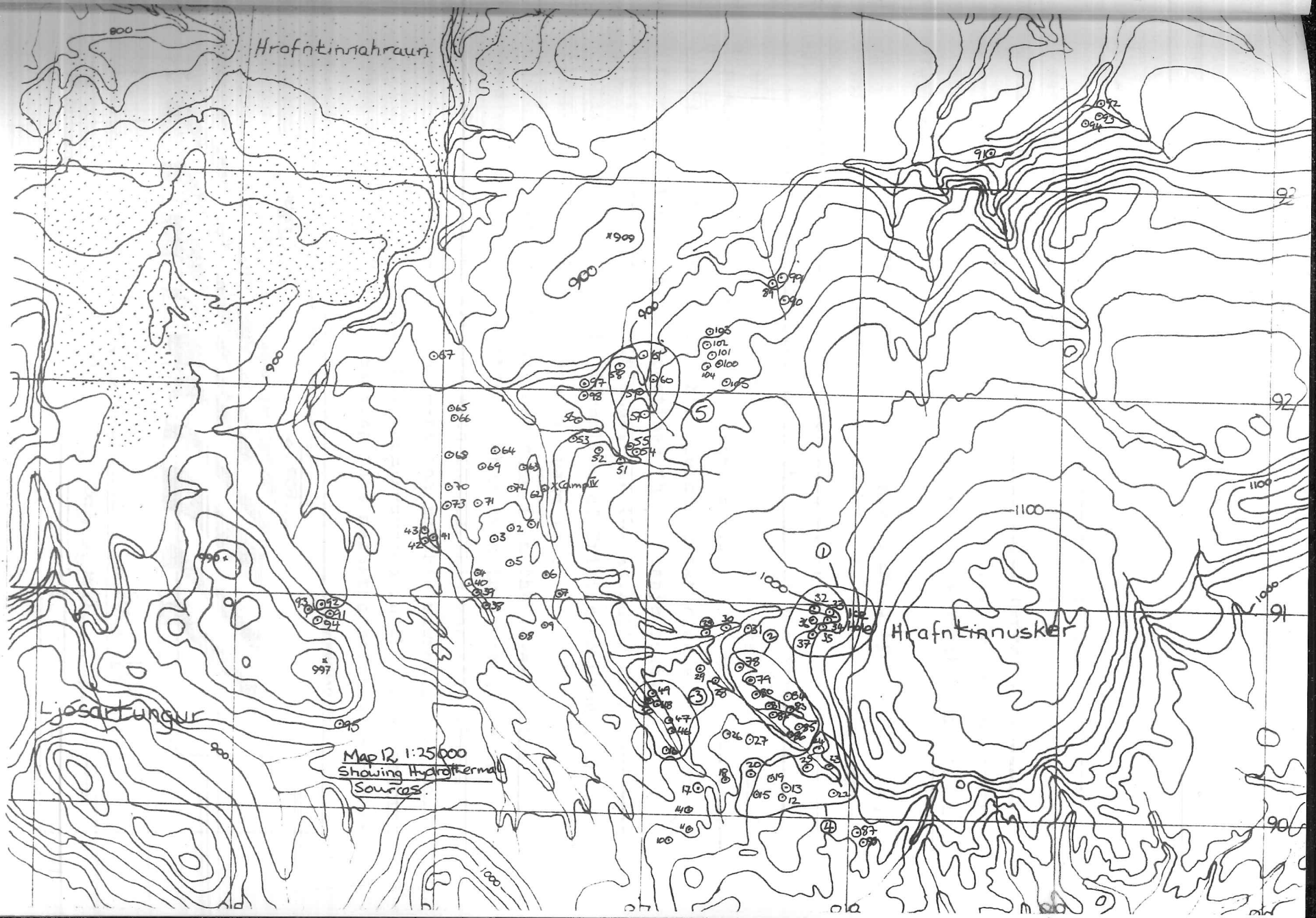
Hydrothermal Areas.

In 1978 we started mapping the location of the hydrothermal vents in the area. This mapping was continued in 1980 and we have modified the numbering system used in 1978 since some confusion resulted. It will be from the map on page 40 that we shall continue our survey in 1982.

Below are tabulated the results of our 1980 survey.

ing mber	Temp °C	Area Sq.m.	Depth m.	pH	Number of Vents	Deposit	Type of Deposit	Notes.
2-	97°	2	?	7·8	1	✓	grey mud gas	muddy water
4 ge. ea	97°	0·75	0·15	4	1	✓	red & white	green algae
	94°	1	0·15	5	1	✓	red & white	no vegetation
	96°	10	0·4	7	1	✓	grey mud	clear water
	95°	8	—	3	2	✓	silica	highly coloured rocks. Muddy pool
	95°	40	dry mud	—	many	✓	sulphur & silica	steam vent area
	96	60-70	0·5	3-4	many	✓	sulphur & silica	mud pools
	88	1	—	7	1 v. powerful	—	—	v. active steam vent constant jet.
	95	point	—	7	1	✓	sulphur	steam vent
5	96	point	—	5	1	✓	sulphur	no vegetation
	93	1	0·02	5	7	✓	kaolin	little vegetation
	98	0·25	—	5	1	✓	kaolin	clear pool
	92	4	0·05	5	3	✓	sulphur	clear pool
t	98	0·2	—	5	1	✓	silica	little steam fountain
	93	0·2	-	7	1	✓	sulphur	opaque pool
	85	1	-	5	7.	✓	silica	colloidal blue
	96	0·5	0·15	5	2	✓	silica	bubbling pool
	90	20	unable to measure	5	?	✓	sulphur & silica	opaque
	92	0·5	a few cms	4	—	✓	grey mud.	blue.

see Appendix for other results.


Hrafntinnahraun
Hrafntinnusker
Ljósártungur
Camp IV
Map 12 1:25000
Showing Hydrothermal
Sources.

c). Geology.

Introduction

Modern theory has evolved to the present idea of plate tectonics. The theory proposes a surface of rigid plates floating on the hotter, fluid mantle layer beneath. Thease plates are free to move and the motive force is thought to be provided by deep seated convection currents in the Earth's interior.

Plate movements result in margins marked by earthquakes, volcanoes and allied seismic activity. Adjacent plates may converge, diverge or slide past each other.

When plates diverge, as in the case of the North America and Eurasia plates, tension cracks occur and magma is extruded forcing the plates apart at a rate estimated to be in the region of 10 cms. per year. At these points ocean ridges are formed from basaltic magmas. Sometimes the volcanic activity can lead to to the formation of islands. In the Atlantic Ocean volcanic activity has lead to the formation of Tristan da Cunha, the Azores and Iceland.(see map 14 page 42).

Proof for this theory has come from the lavas of the sea bed either side of the ridge. When lava is erupted particles in the lava become aligned with the Earth's magnetic field. Over the past few million years the Earth's magnetic field has reversed itself and this has been recorded in the lavas erupted onto the ocean bed. By mapping this magnetic pattern on either

Diagram 1.

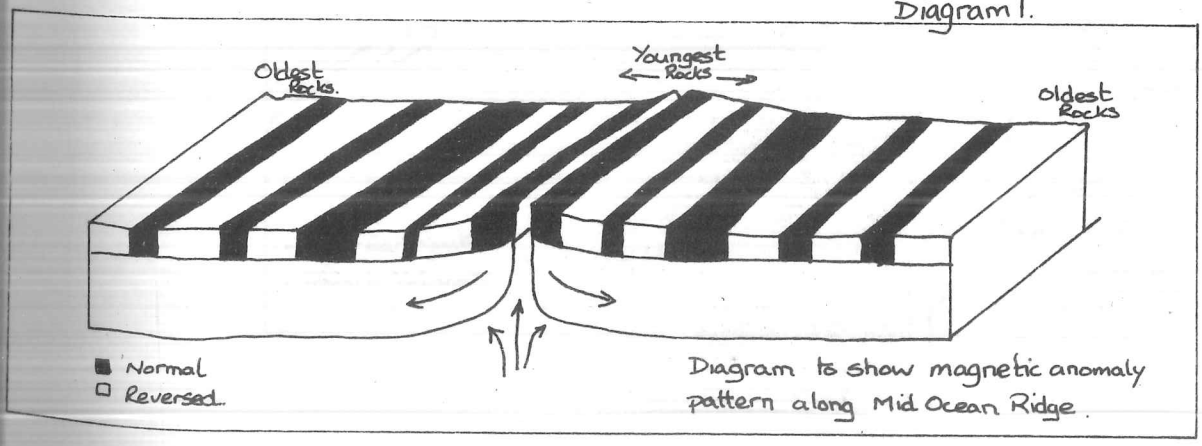
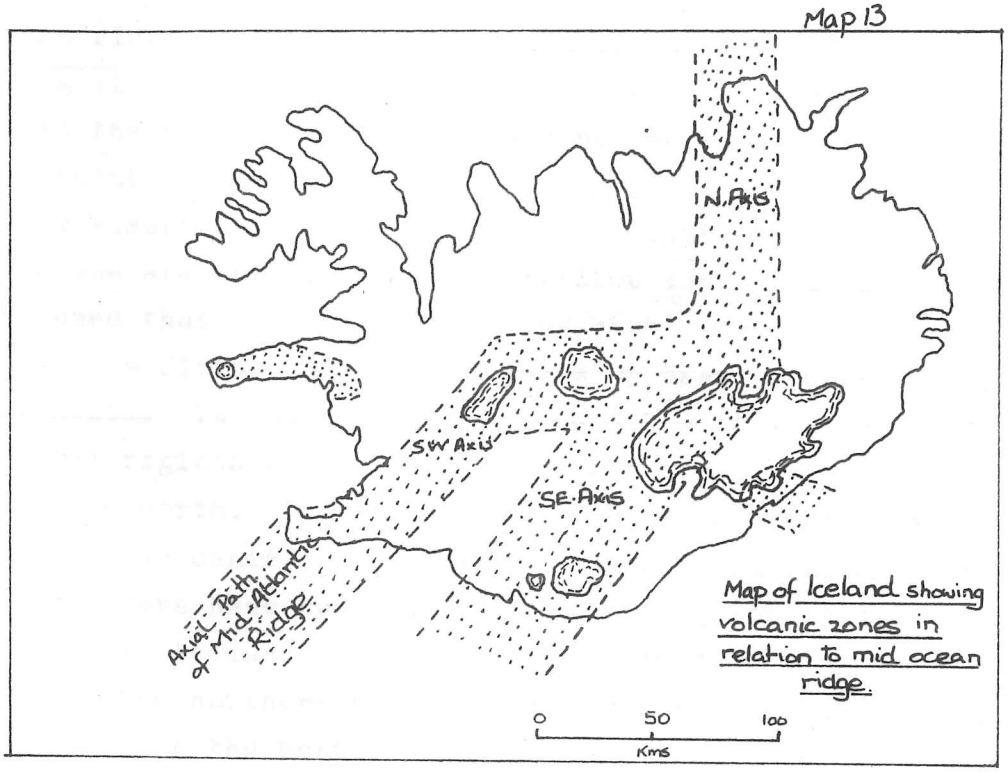


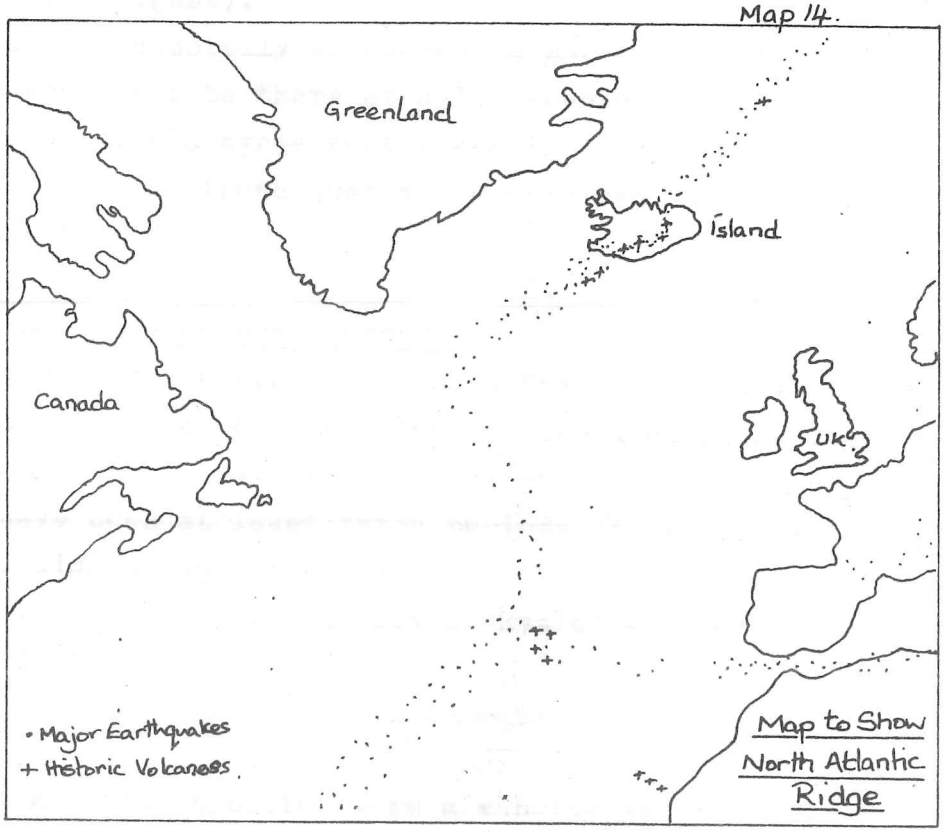
Diagram to show magnetic anomaly pattern along Mid Ocean Ridge.

Map 13



Map of Iceland showing volcanic zones in relation to mid ocean ridge.

Map 14.



Map to Show North Atlantic Ridge

side of the ridge a symmetrical pattern of roughly parallel alternating fields can be observed (see diag. 1 page 41). Minerals in the rocks can be dated and so the rate of spreading can be calculated.

This movement also explains why the oldest sediments in the present oceans are no more than 150 million years old although it is presumed that the oceans are very much older.

Iceland is divided into three parts by axes of present day Earth movements. Two axes, one in the south-west and one in the south-central regions may or may not be conected. The third axis is in the north. (see map 15 page 45). All three axes lie in the neo-volcanic zone to which volcanic eruptions of the last million years have been almost exclusively confined.

Activity in Iceland is now mainly confined to the south-east axis and the northern axis. Both axes have shown activity in 1980. Twice in the North (March and July) and once in the south-east axis (August).

Iceland is undoubtedly an anomolous part of the mid-Atlantic Ridge or it would not be there at all. Nonetheless the results of recent measurements agree that there is an extension at right angles to the general trend just as is required by the spreading ridge hypothesis.

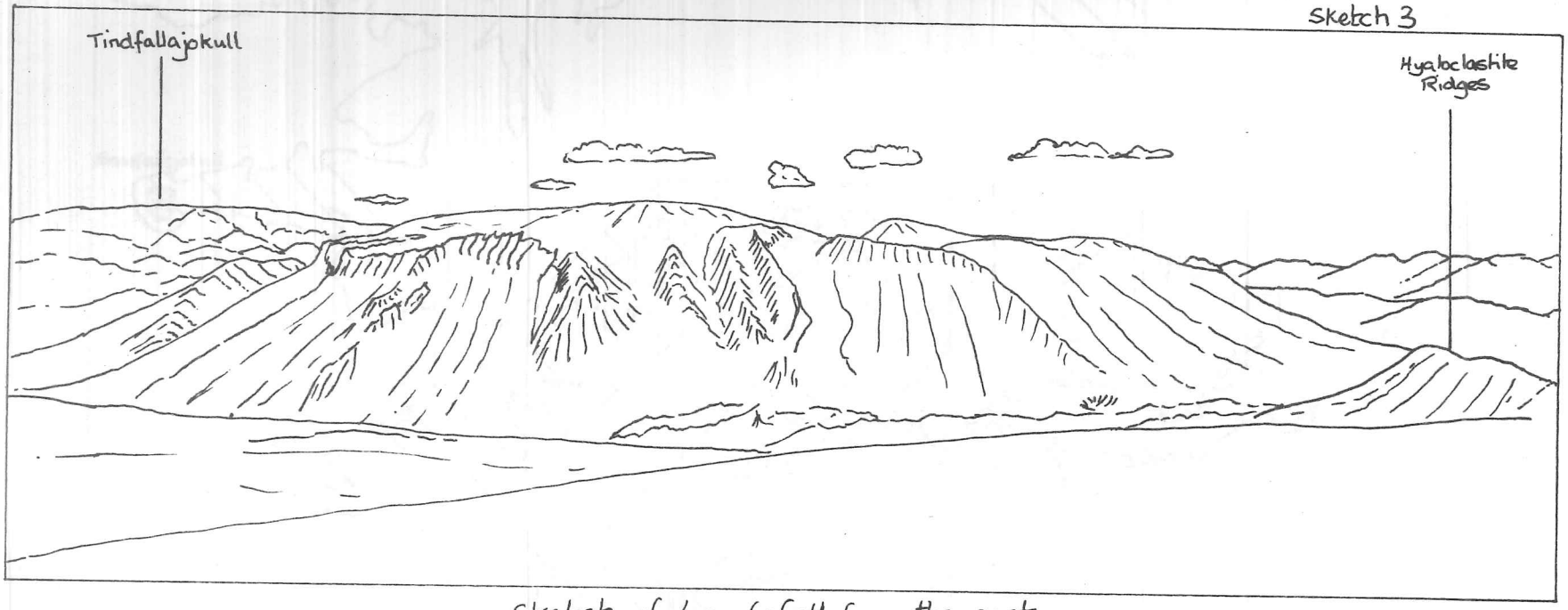
Austur-Reykjadalir - General Survey.

This area is the western part of a Rhyolite massive in the south central volcanic zone near Hekla. The area is part of the largest and most intensive hydrothermal area in the country.

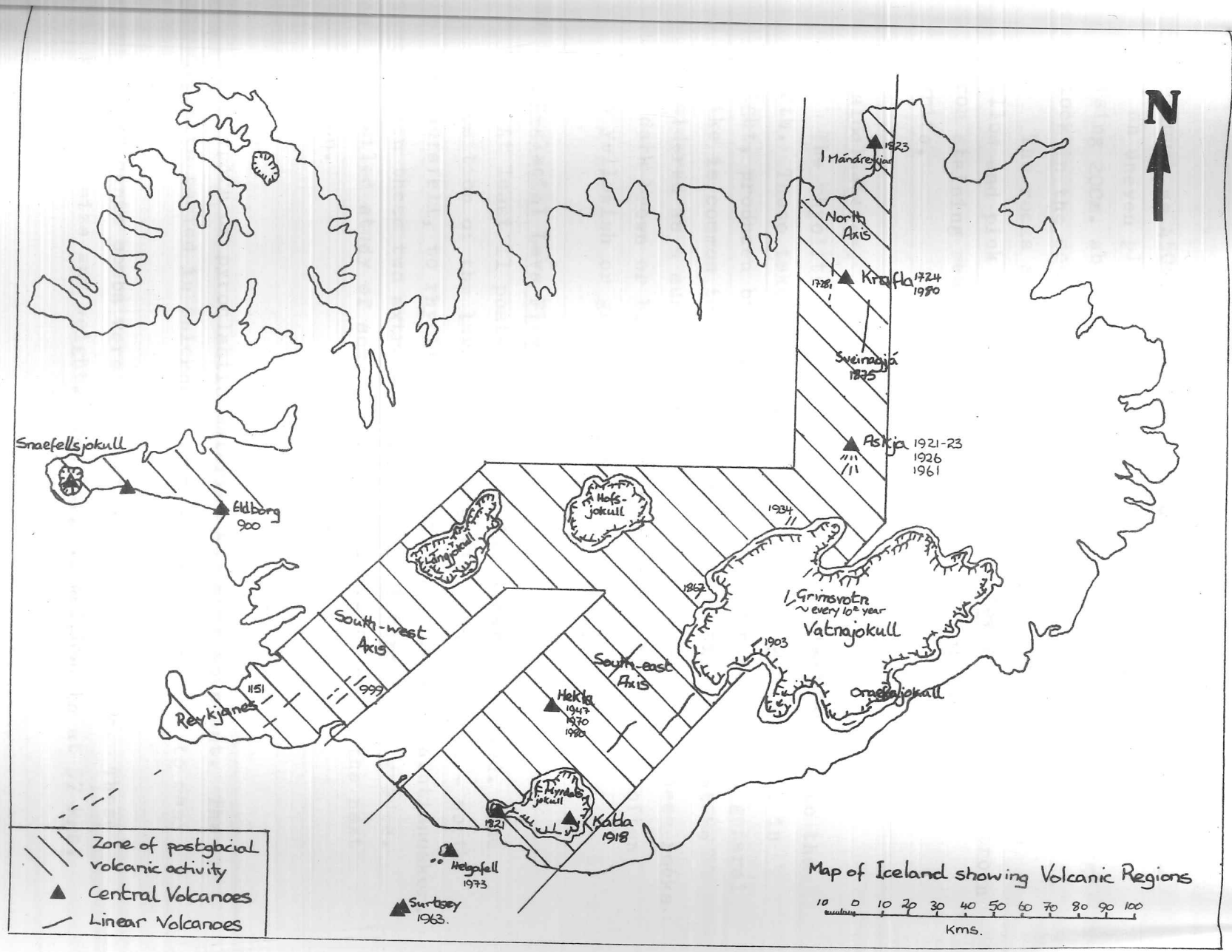
There have been at least three periods of igneous activity: Pre-glacial, Glacial and Poast Glacial. Each period is typified by distinct types of rock. Rhyolites, Hyaloclastites and Obsidian, respectively.

Rhyolites.

The pre-glacial Rhyolites form a massive which rises steeply



Sketch of Laufafell from the east.



Map of Iceland showing Volcanic Regions

(as much as 450m.)above the surrounding country. It consists of an uneven plateau surmounted with domes and conical hills rising 200m. above it. Valley glaciation has isolated a large block in the south west called Laufafell.

The rocks are mainly light coloured greyish rocks with yellow and pink tints. The colour is often masked by the brown iron staining resulting from the oxidation of the included pyrite.

Hyaloclastites.

The rhyolite massive is bounded by hyaloclastites to the north. These take the form of low NE-SW ridges 90-120m. in height, produced by sub-glacial fissure eruptions. The general strike is common to the mid-Atlantic Ridge Axis and must be considered as a surface expression of that feature. These rocks are dark brown or black, finely grained basaltic lavas often with yellowish or greenish tints.

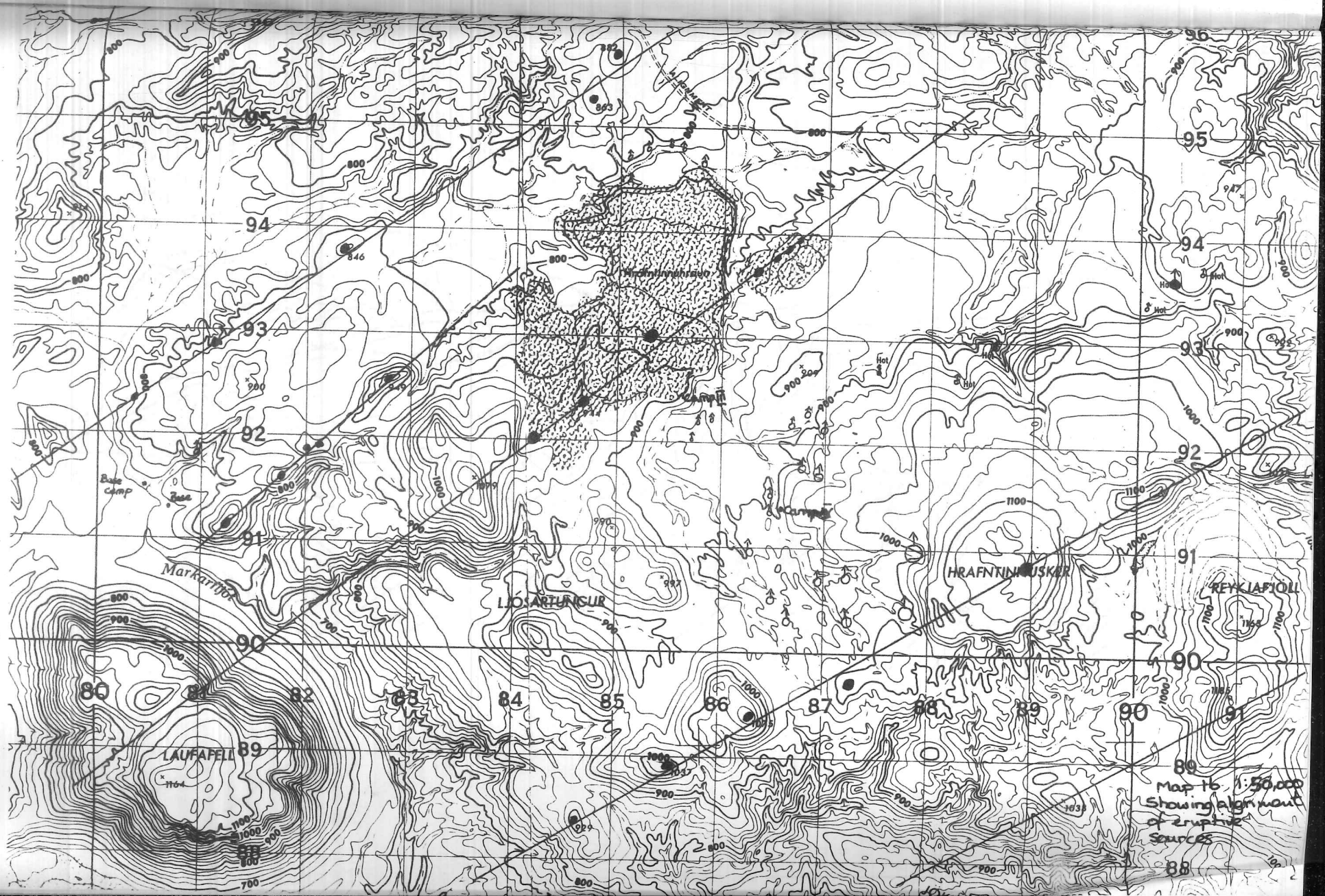
Post-glacial Lava Flows.

At least 11 post-glacial lava flows were observed. The composition of the lavas varied greatly from basaltic - north of Laufafell, to rhyolitic at Hrafntinnahraun and Hrafntinnusker. Between these two extremes were several intermediate grades. A detailed study of some of these flows is found in the next section.

Tephra.

Tephra or pyroclastic material was most abundant. The deposits varied in thickness from a few centimetres to many metres.

Volcanic bombs were abundant near some craters. These varied in size and weight. The largest weighed in at 57 kgs.


LAUFAFELL
LÓSÁRTUNGUR
HRAFNTINNUSKER
REYKJAFJÖLL
Base Camp
Camp
Hot
Map 16 1:50,000
Showing alignment
of eruptive
sources

Sketch 4.

Rock Pinnacles on the edge of Laufafell.
(Southern end).

Hydrothermal Activity.

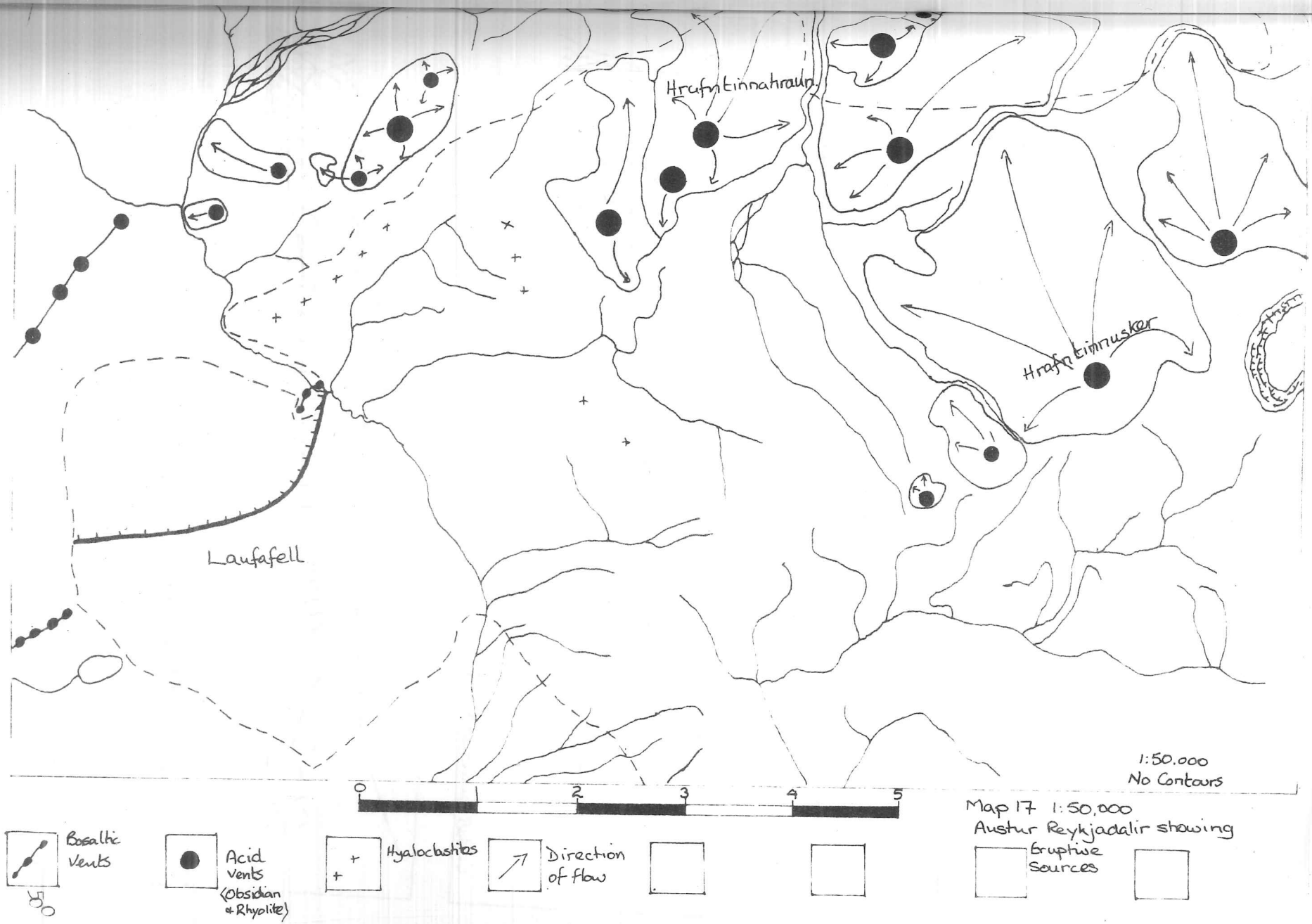
Hot springs and allied activity have been studied in some detail but it is appropriate to mention their probable origins. The largest numbers of fumaroles and solfataras are found on the surface of rhyolitic areas. Most frequently they are found around the edges of the glassy flows which, presumably are acting as a cap and are not so readily disintigrated by the hot emmisions. The prescence of the fumaroles and solfataras on the surface is due to the slow solidification of rhyolitic magma at great depths accompanied by the emmision of hot gasses. The hot vapours cause an intense disintigration of the rhyolite which leaves clayey material which is bright yellow or reddish brown. These colours are brilliantly displayed at Landmannalaugar to the east of the area. The solfataras are even more brilliant due to the local deposition of yellow sulphur crystals and white selenite crystals and salicilic acid. The red colour frequently found is due to iron III compounds.

Conclusion.

The area is an unusual one for Iceland in that its lavas are generally acidic and are almost totally surrounded by basic basaltic magmas. This is probably due to the following reason.

When a volcano ceases to erupt the still liquid magma deep below the surface begins to cool. The lighter, silicon rich magma rises to the top of the magma chamber. At the next eruption acid lava will be emitted first. The longer the interval between eruptions the more likely an acid lava will be erupted. If a short time exists between eruptions then the lava will probably be basic. Hence the fact that some Icelandic volcanoes emit both acid and basic lavas.

This area is extremely interesting geologically. The variety of lava types and scenary produced is remarkable. This year we began a detailed study of the lava flows of Hrafntinnusker.



Map 17 1:50,000
Austur Reykjadalir showing

d). Volcanoes.

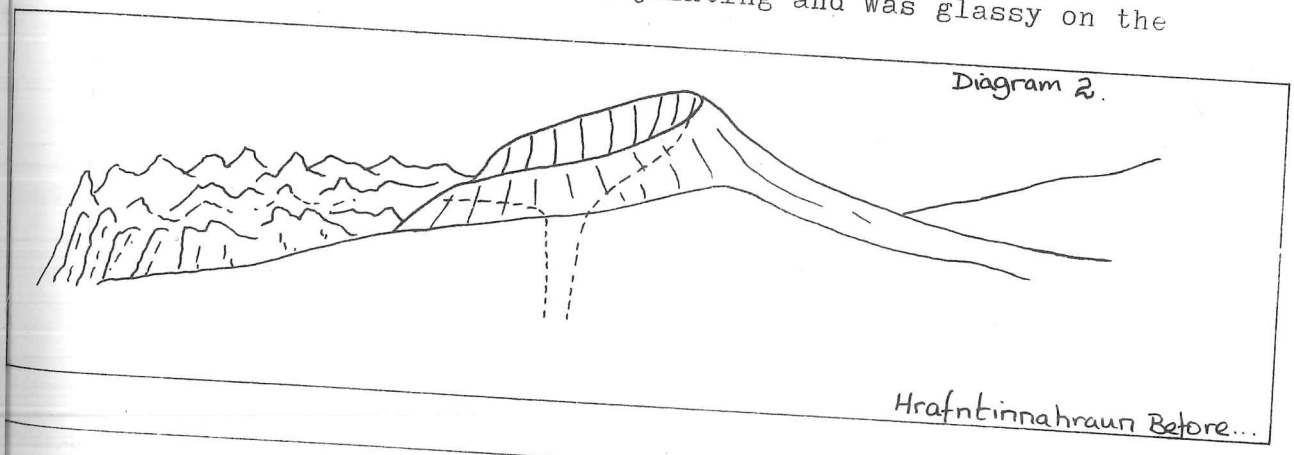
1. Hrafntinnahraun.

In 1978 we began a survey of this crater and lava flow based on an earlier study started in 1970.

In 1970 a scale map of the crater was made. In 1978 this map was checked and some additions made.

This year we mapped in detail the surrounding areas marking in areas of pumice, obsidian and major volcanic bombs. (see map on following page).

The crater seems to have collapsed probably during the final stages of eruption. The central vent was quite distinct. Here the lava had solidified as it rose vertically from the ground. It also showed block jointing and was glassy on the



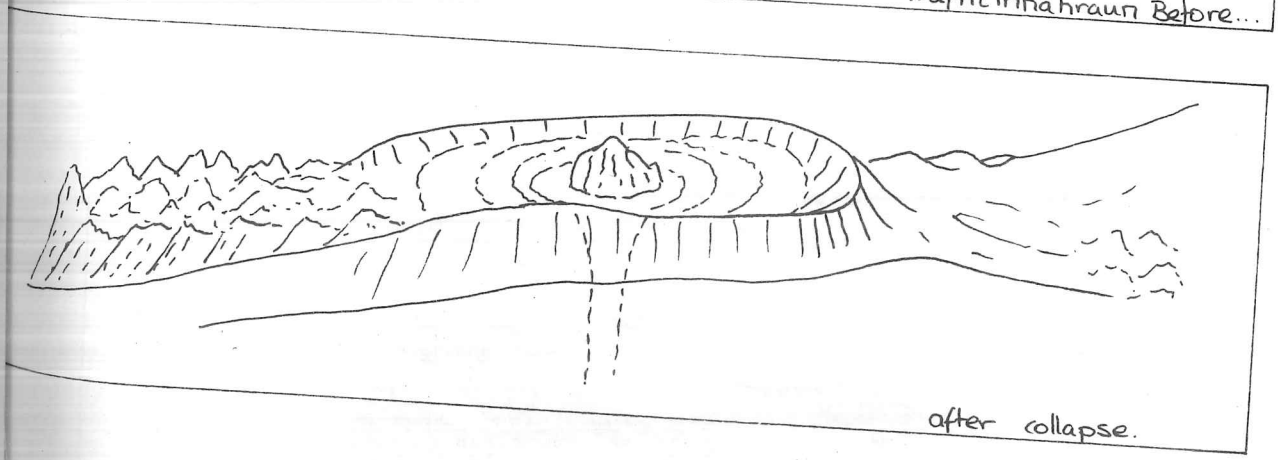
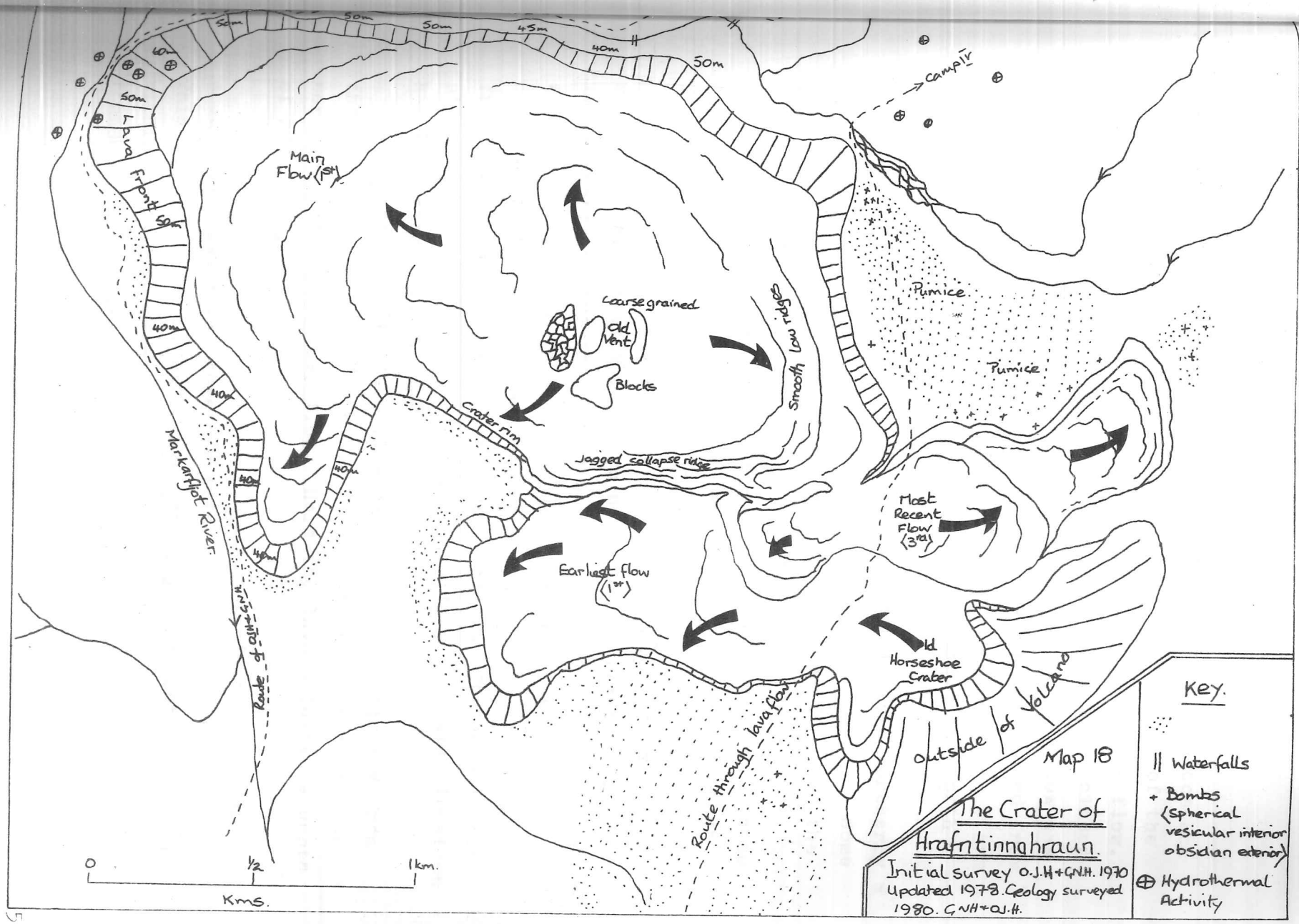


Photo. 1. The Ice Hole on Hrafntinnusker. This hole was formed by hot springs beneath the firn.

Photo. 2. General view of Austur-Reykjadalir. Note [illegible] Hole to the left background.


50m
50m
50m
45m
40m
50m
60m
50m
Lava Front
50m
40m
40m
40m
40m
40m
Markarfljot River
Route of 1974 Road
Main Flow (5th)
Course grained
Old Vent
Blocks
Crater rim
Jagged collapse ridge
Smooth low ridges
Earliest flow (1st)
Most Recent Flow (3rd)
Pumice
Pumice
Horseshoe Crater
Route through lava flow
outside of Volcano
Camp IV
0
½
1km.
Kms.
Map 18
The Crater of Hrafntinnuhraun.
Initial survey O.J.H+G.N.H. 1970
Updated 1978. Geology surveyed 1980. G.N.H+O.J.H.
Key.
Waterfalls
Bombs (spherical vesicular interior obsidian exterior)
Hydrothermal Activity

surface and on the bottom where the flow had been in contact with the ground and had cooled rapidly. The texture of the lava altered to a fine dull grey from each side of the flow. The first flow was erupted from the horseshoe ash and cinder cone to the south west of the main vent. This lava flow was rough in texture and consisted of large blocks separated from each other by areas of ash and cinder. There were some signs o of frost shattering. The lava had flowed almost due north for a distance of approximately 1.75 kms.

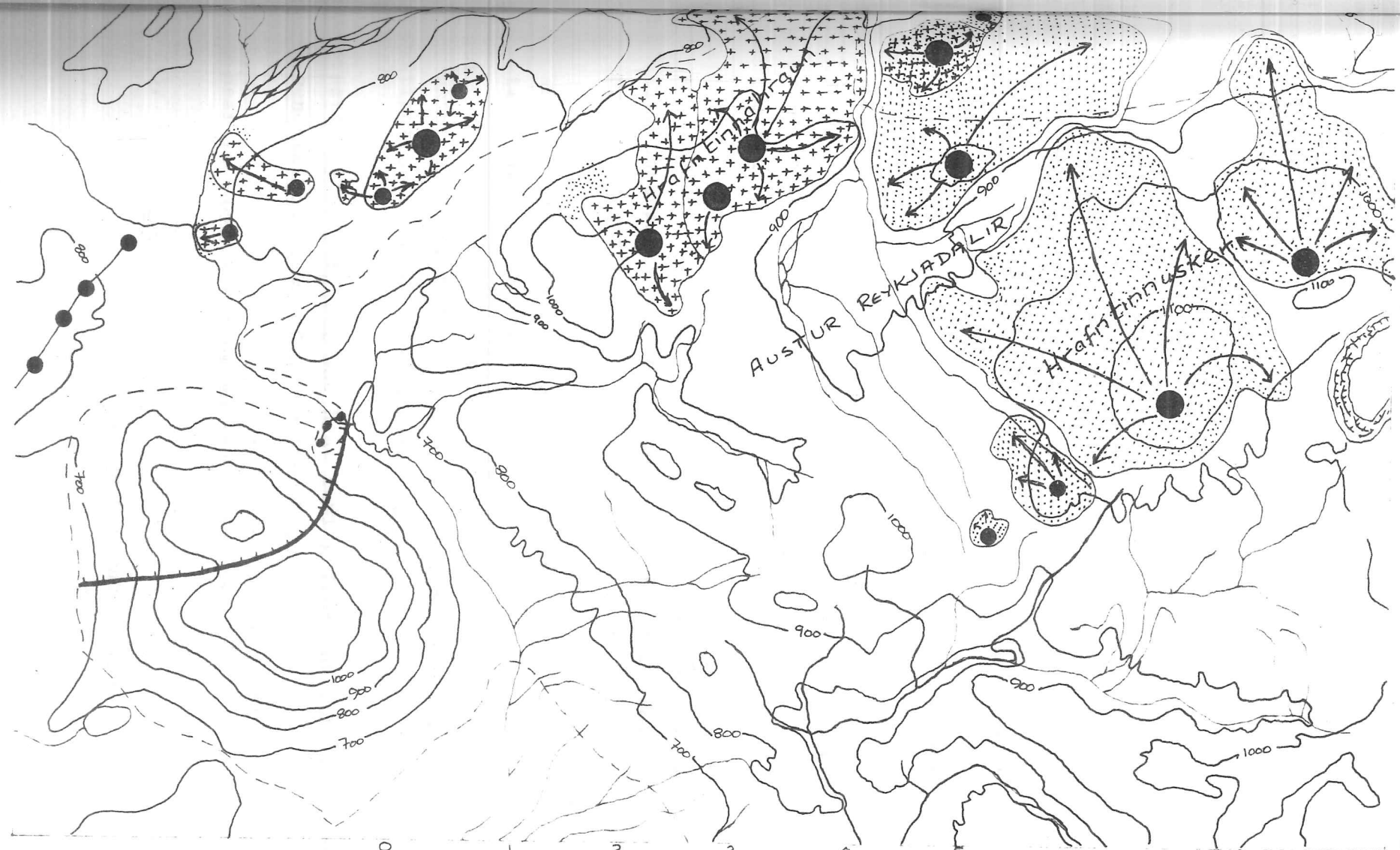
The main flow, the second, flowed mainly in a northerly d direction altering the course of the river Markarfljot. Some of the lava also flowed eastwards. The maximum distance the lava flowed from this vent was approximately 1.75 kms.

To the north of this flow were a few hot springs. These were minor in comparison with thos further to the south but follow the same pattern in that they occur at the edge of the lava flow. These springs have been located on the map of the crater. Some activity was also noted on the northern side of the Markarfljot but these were not observed in any detail as it was not possible to cross the river at that point.

The most recent flow, the third, flowed almost due south from a vent on the edge of the large crater. The actual location of the vent is still uncertain, but its probable location has been marked on the map.

The depth of the lave flow has only been estimated from the height of the lava fronts. The greatest depth is to the north on the second lava flow. Here the lava attained a depth of 28 metres.

Considerable quantities of pumice were found at points around the lava flow, together with many volcanic bombs. This is indicative of explosive activity. No bombs were found within the perimeter of the crater. The largest bomb was found on the southrn flank of the crater and weighed approx-



Map of Austur-Reykjadalir showing lava flows & eruptive sources.

Map 19. 1:50,000.

imately 57 kgs.

Many of the bombs had vesicular interiors and a glassy exterior which had cracked when the bomb had landed and was still semi molten.

2. Hrafntinnusker.

The flows of Hrafntinnusker are rather impressive. They were erupted from a vent at the summit of Hrafntinnusker and flowed in all directions but mainly towards the north. These flows are the largest of their kind in this area.

The surface consists of blocks of obsidian varying in size from pebbles to blocks over a metre across. Some of the obsidian showed detailed flow banding, folding and faulting. Between the blocks of obsidian the surface consisted of pyroclastic material, mainly lapillae 0.5 - 2 cms in size. The obsidian was not the purist found, however, and in many blocks contained bands of grey rhyolite. In some areas bubble glass was found. This was formed when the molten glass had gas bubbling through it when it solidified. The gas bubbles have been preserved and some superb specimens were found.

The edge of the flow drops steeply down 10 - 15 metres at an angle of 45^{o}-66^{o}. To the north it appears that there were two flows one on top of the other.

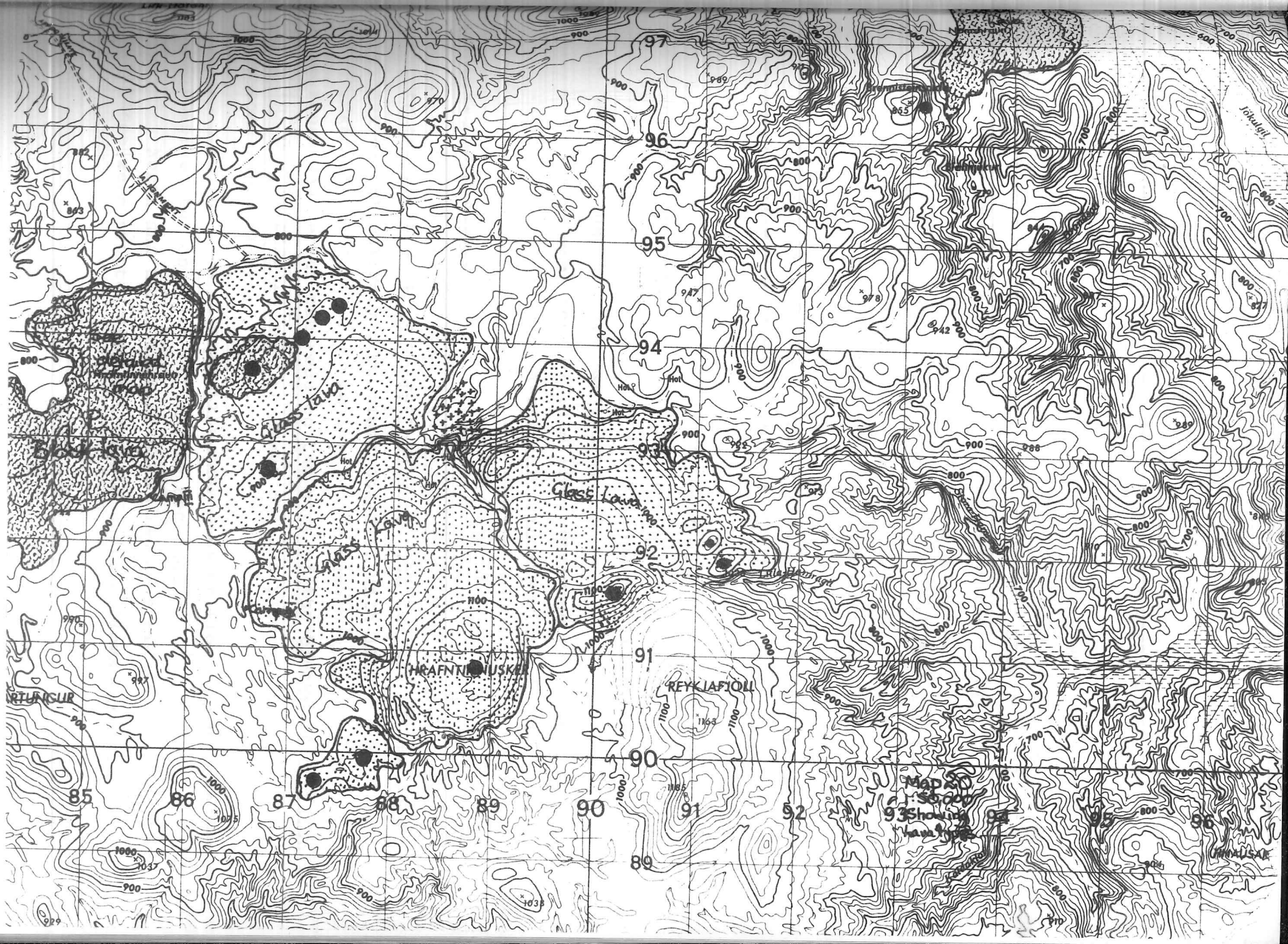
It would, therefore, appear that the flows on Hrafntinnusker were erupted in two, possibly three phases. More investigation is needed on this point.

It is from beneath these flows that the main hydrothermal activity is derived, the heat coming from the cooling magma beneath the flows of Hrafntinnusker.

The thickness of the flows was rather difficult to measure. Near it edges the flow varied in thickness from 10 - 25 metres.

3. Glass Lava Plain.

To the east of Hrafntinnahraun and to the north of Hrafn-


Glass lava
Glass lava
Glass lava
HRAFNTINNUSKER
REYKJAFJOLL
Map 20
1:50 000
Showing
97
96
95
94
93
92
91
90
89
88
87
86
85

tinnusker was a glass lava flow and a small block lava flow. It had been erupted from 2 main vents and three minor ones. (see maps 19, 20 pages 54,56).
The lava had flowed mainly to the east and consisted of lapillae and massive blocks of obsidian near the flows edges. These blocks were nearly pure black in colour and showed little flow banding and few impurities. Below the surface the rock was a dull grey to black in colour becoming coarser.

This flow was separated from the flows of Hrafntinnahraun by a steep sided gorge containg the river Markarfljot. The flow was not so well separated from the flows of Hrafntinnusker. To the east there was a steep sided gorge containing a fast flowing stream. Further west the flows were separated by a small gulley formed by erosion of the line of weakness between the two flows.

Along the southern edge of this flow there was more hydrothermal activity. The lava again acting as a cap to the still hot magma beneath. No time was allowed for investigation of the northern edge of this lava flow.

The central part of this flow consisted of a block lava flow but this was not investigated in any great detail.

4. Other Flows.

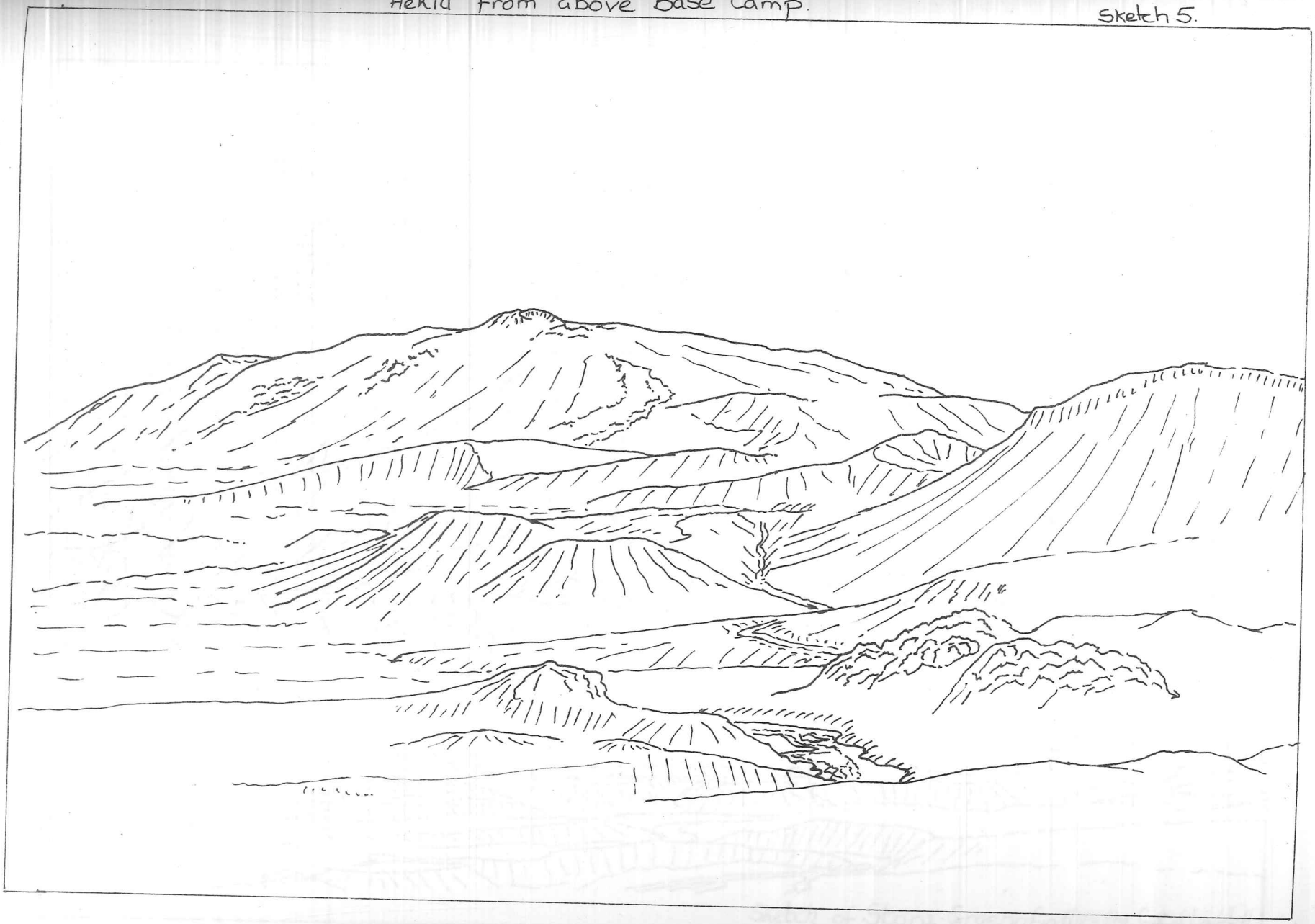
One minor obsidian flow was erupted from a single vent to the south west of Hrafntinnusker. The surface of the flow was almost entirely pure black obsidian with little ash. The edges of the lava flow were steep, in some places over 50°. Frost shattering has reduced the size of the blocks of obsidian to 10 - 15 cms. in size and many smaller pieces. There were some large blocks.

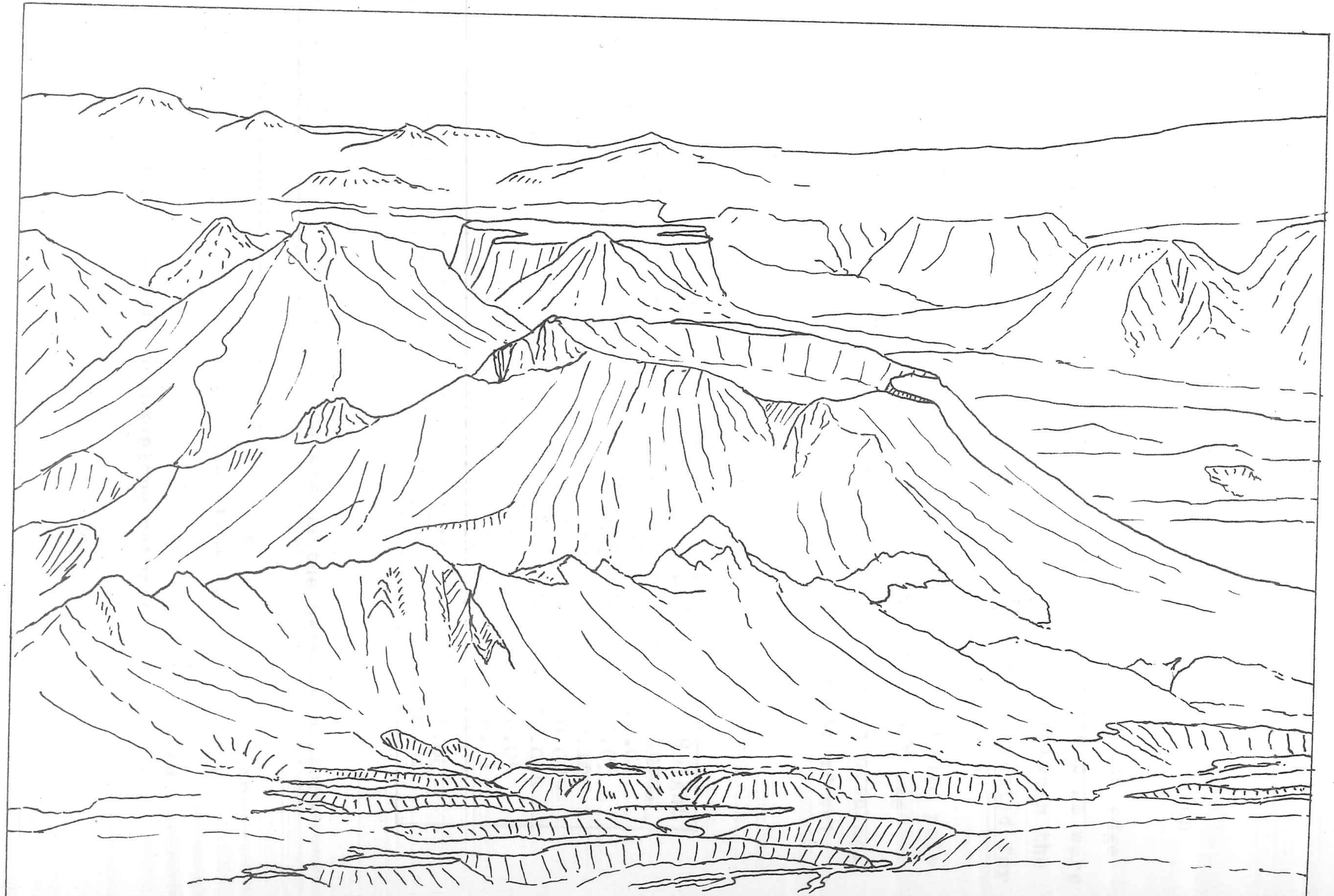
To the east of Hrafntinnusker another flow of obsidian was observed but only its outline is recorded.

North and north east of base camp were two more flows. These were erupted from four vents and the flows were glassy in

Hekla from above Base Camp.

Sketch 5.





Sketch of Stóra-Graenafjall to the South of Laufafell.

e) Snow and Ice.

A survey was carried out to determine the rate at which the snow in the Base Camp valley melted.

The ice retreat was monitored by placing pegs on the edge of the ice front at 2300. Twenty four hours later the pegs were moved up to the ice front and the distance measured between the ice front and the pegs original position. This was repeated for the 10 days of the survey.

The height drop was also monitored by driving a range pole through the ice into the ground beneath. The ice level was then measured down to the top of the pole at 2300 each evening. The pole was removed during the day so that it did not affect the ice level immediately around it.

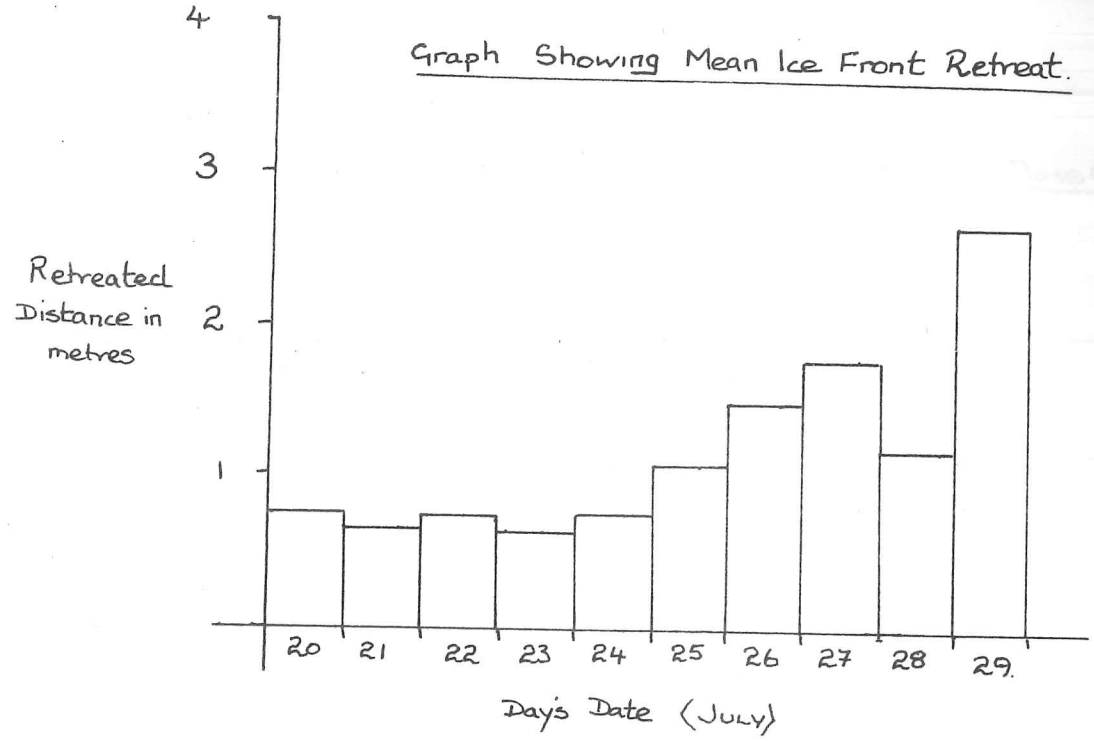
Results.

Day	1	2	3	4	5	6	7	8	9	Height Loss.
20 July	0.43	0.8	0.33	0.3	0.06	1.05	0.8	1.5	1.53	0.07
21	0.2	1.12	1.61	0.55	0.05	0.92	0.87	0.45	1.2	0.05
22	1.46	0.78	0.42	0.32	0.15	1.29	0.87	1.0	0.6	0.10
23	0.5	0.52	0.4	0.58	0.12	0.64	1.0	0.66	1.35	0.075
24	0.98	0.52	0.45	0.8	0.7	1.15	0.9	0.85	0.45	0.065
25	0.56	1.65	1.22	2.85	2.74	0.47	0.85	0.3	0.21	0.05
26	1.39	1.19	0.96	2.26	2.09	0.6	1.65	2.55	0.35	0.11
27	3.37	3.24	3.03	2.08	1.78	0.6	0.61	0.39	0.8	0.07
28	3.44	1.26	1.96	0.92	1.22	0.26	0.25	0.42	0.72	0.06
29	5.00	4.39	5.25	2.93	2.9	0.8	0.81	0.97	0.62	0.09

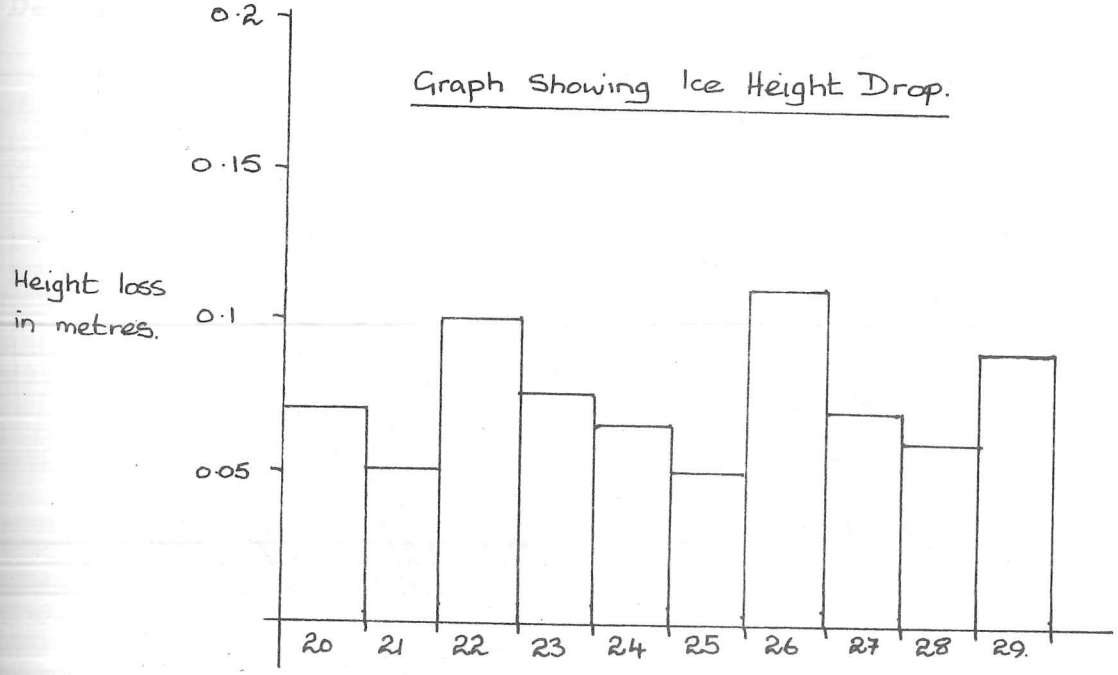
The loss in height of the ice was due to ablation. The most rapid retreat of the ice was on the hottest days of the survey.

These results were then shown as a graph and were also plotted on a map of the valley. The right hand bank of the valley was a north facing slope and the snow did show less rapid retreat. The south facing slope retreated at a faster rate.

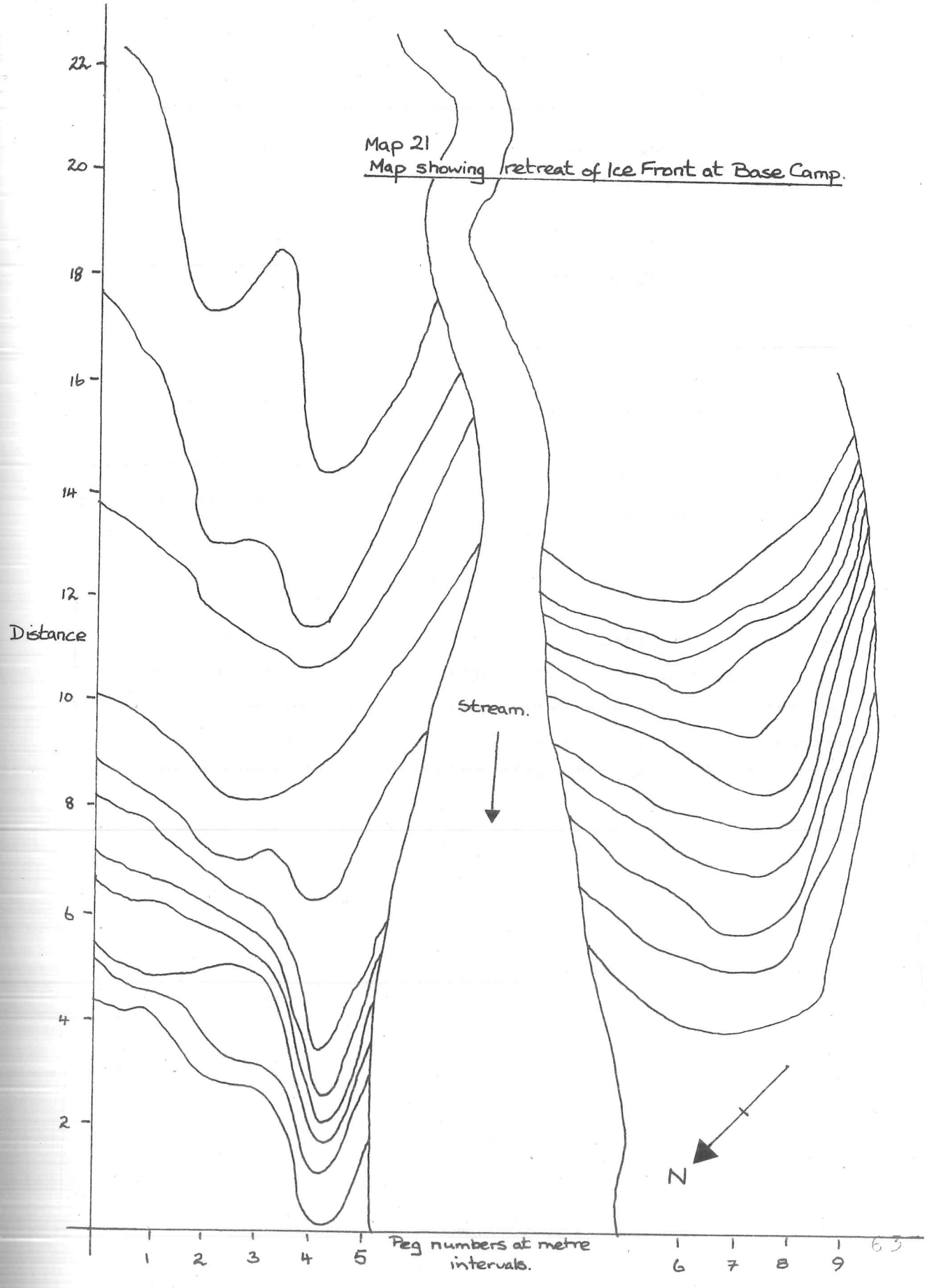
Graph Showing Mean Ice Front Retreat.



Graph Showing Ice Height Drop.



Map 21
Map showing retreat of Ice Front at Base Camp.

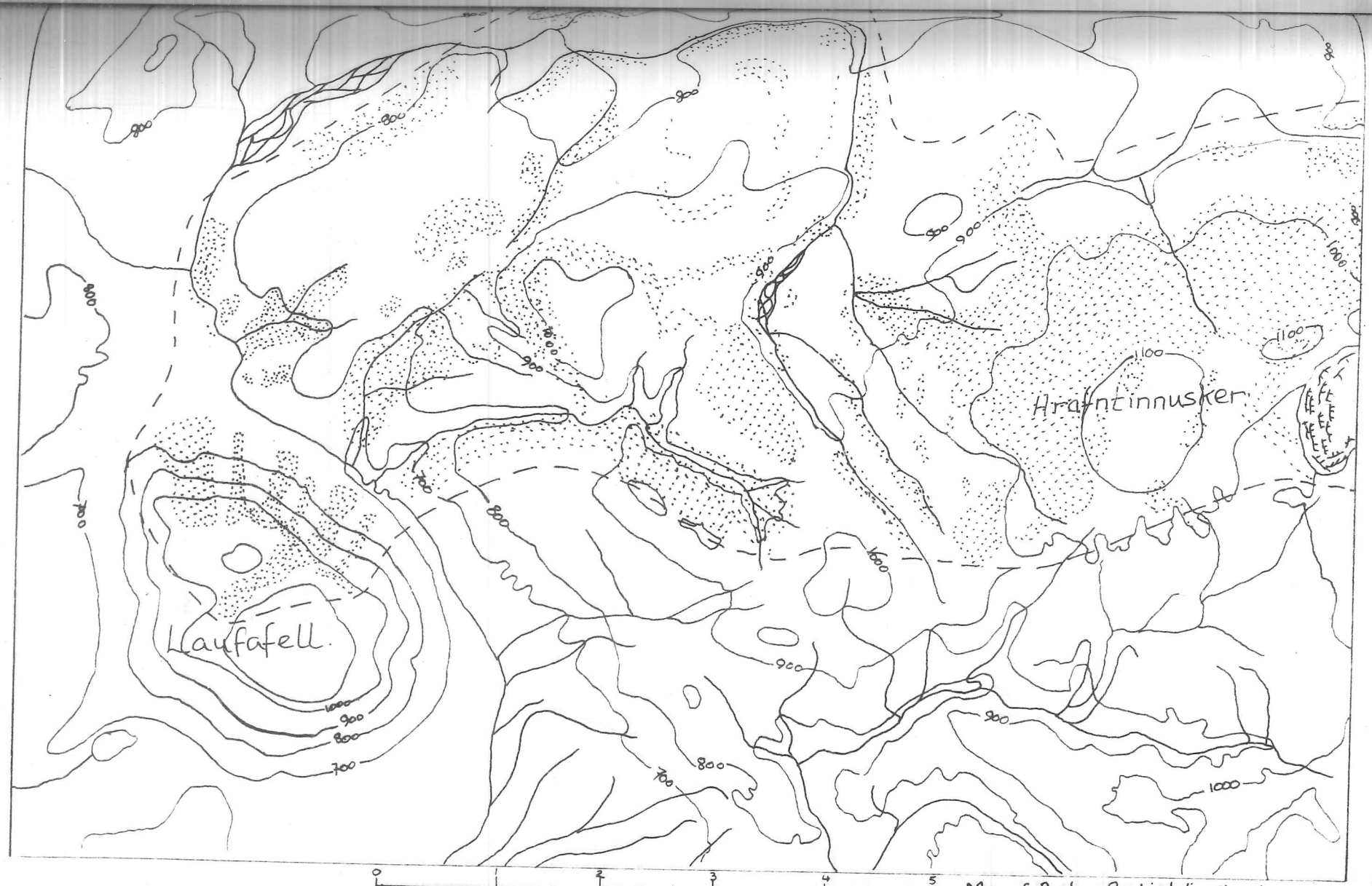


Snow cover in the area was far greater than in 1978. This was apparent on arrival at base camp - the valley was almost covered in snow. In 1976 Base Camp valley was entirely covered in snow.

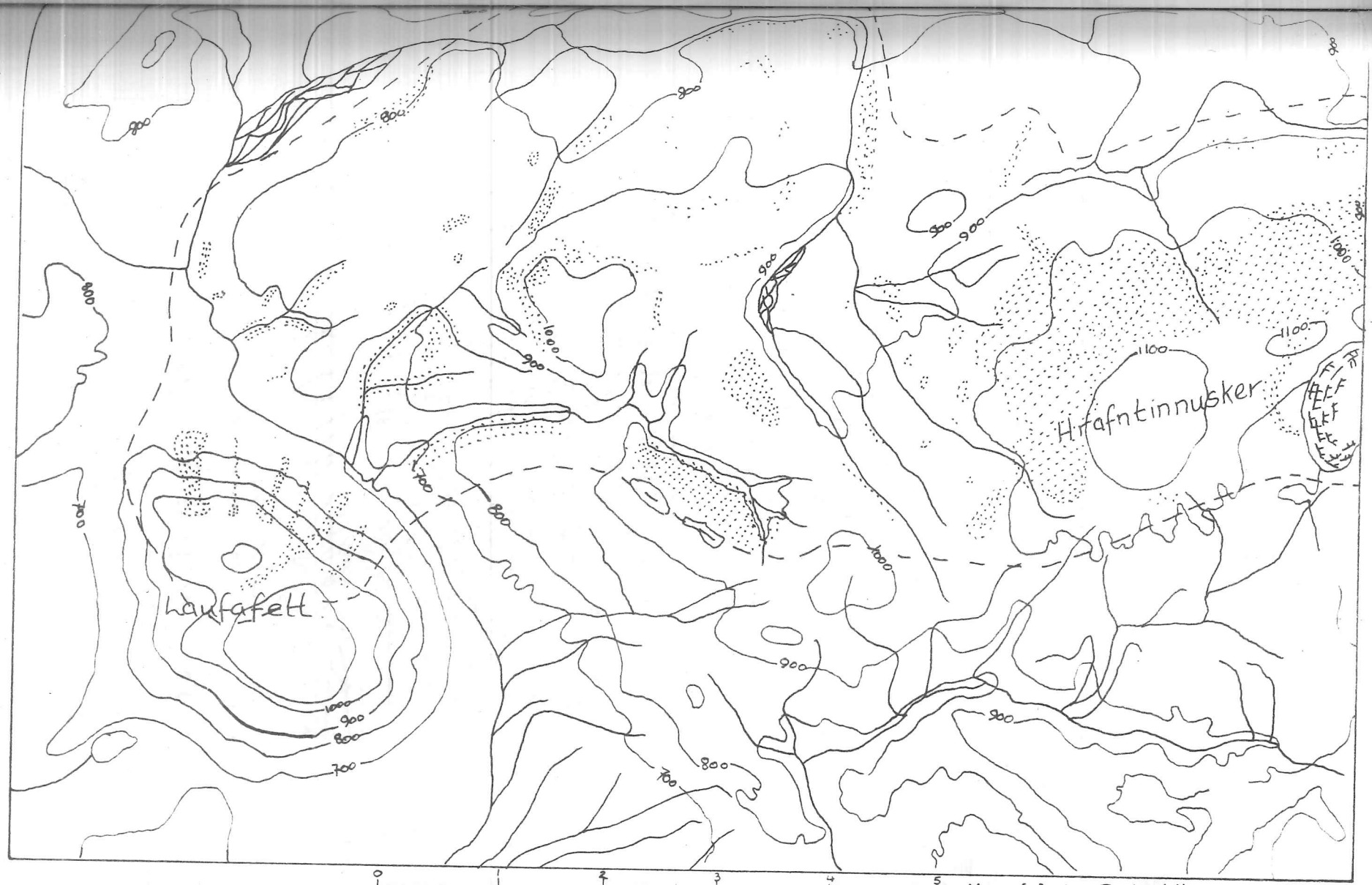
Laufafell was covered to a greater extent than in 1978

On the following pages are two maps showing the snow cover in the area. The first one shows the snow cover in July when we arrived. The second map shows the snow cover in mid August just before we left. Comparing the two shows that a considerable quantity of snow disappeared in the time we were in the area. We were only able to cover a small area with this survey but it is indicative. The area around the northern slope of Hrafntinnusker has shrunk around the edges but has only decreased in height in the centre. This would indicate a considerable depth of snow, a result born out by the depth of snow at the Ice Hole.

The sketch after the maps shows the interior of an ice tunnel. There were many ice tunnels in the area formed by streams flowing through the winter snow when the thaw sets in. The pattern is formed by the ice melting and the water running along the surface before dripping off. The peaks in the surface are where the water drips off.



Map of Austur Reykjadalir showing snow cover in mid July 1980

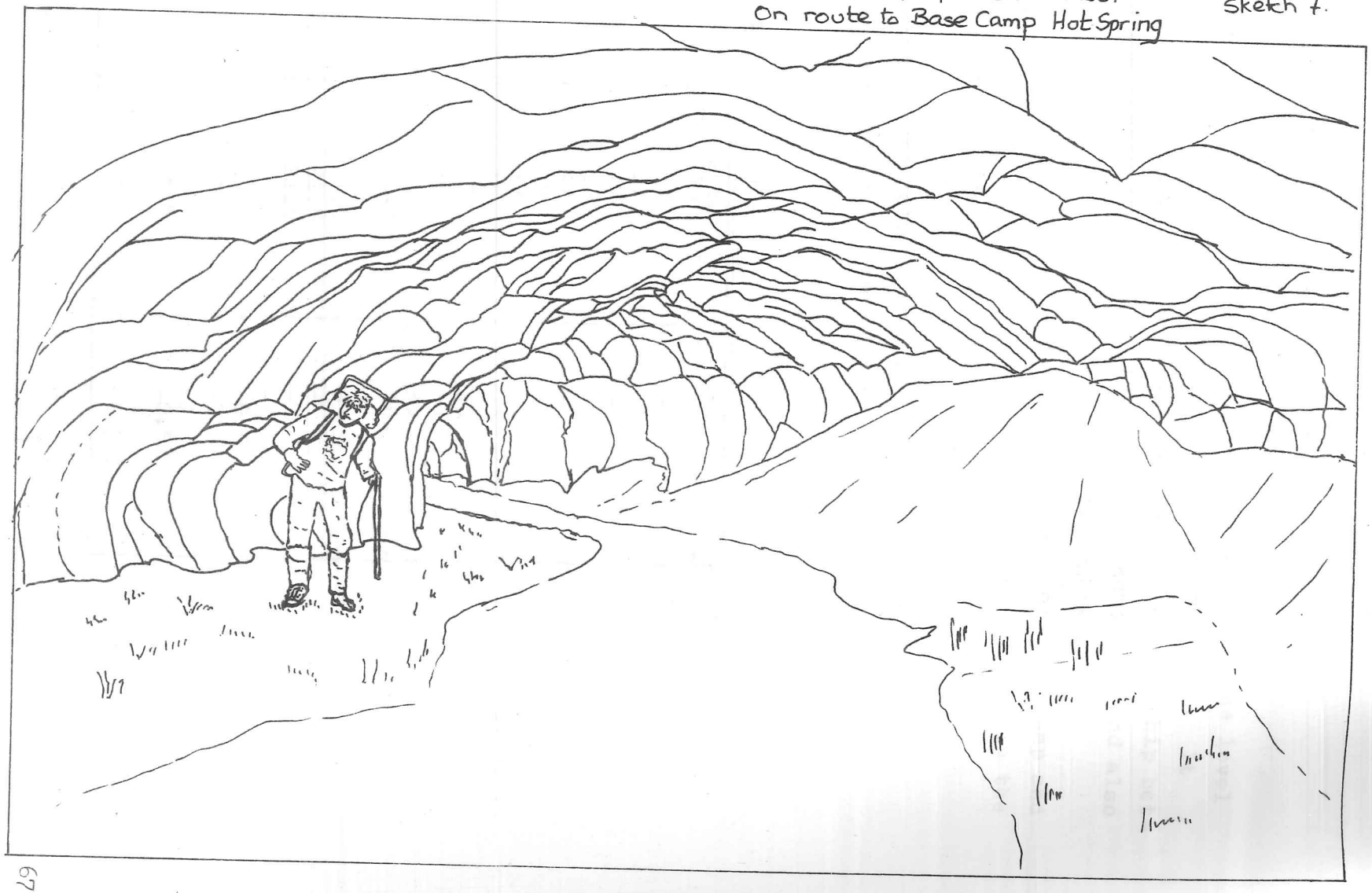


Map of Austur Reykjadalir showing Snow Cover in mid August 1980

Map 23.

Detail of roof of Snow Tunnel.
On route to Base Camp Hot Spring

Sketch 7.



f. River Survey.

This survey involved measuring the changes in the level of the river Markarfljot during our stay at Base Camp. It was aimed at finding out whether there was a relationship between the change in level and the weather conditions, and also whether the relationship was constant or otherwise.

A point was selected about 500 metres from base camp and hourly readings of the measurnig rod, which was placed in the river, were made.

Three twenty four hour studies were undertaken:

1. 21st - 22nd July 0800 - 0700
2. 22nd - 23rd.July 2300 - 2200
3. 3rd - 4th Aug. 2300 - 2200.

Results. 1. 21st - 22nd July

Time	Height	Deviation
0800	17	-
0900	17	-
1000	17	-
1100	17	-
1200	17	-
1300	17	-
1400	17	-
1500	17	-
1600	18	+1
1700	19	+1
1800	20	+1
1900	21	+1
2000	21.5	+0.5
2100	21.5	-
2200	21.5	-
2300	21.5	-
2400	21.5	-
0100	21.5	-
0200	21	-0.5
0300	20	-1
0400	19	-1
0500	18.5	-0.5
0600	18.5	-
0700	18	-0.5

Comment.

The next four hours were recorded as well and the height dropped to 17 cms for this length of time.

Weather.

Fairly dull, cold at night; overcast.

2. 22nd July - 23rd July

Time	Height	Deviation.
2300	22	-
2400	22	-
0100	22	-
0200	21	-1
0300	20.5	-0.5
0400	20	-0.5
0500	19.5	-0.5
0600	19.5	-
0700	19.5	-
0800	18.5	-1
0900	18	-0.5
1000	17.5	-0.5
1100	17.5	-
1200	17	-0.5
1300	17	-
1400	17	-
1500	17	-
1600	17	-
1700	17	-
1800	17.5	+0.5
1900	18.5	+1
2000	19	+0.5
2100	19	-
2200	20	+1

Comments.

Readings are in cms.

Weather

Dull, overcast, cool. Temperatures lower than 22nd.

3. 3rd - 4th August

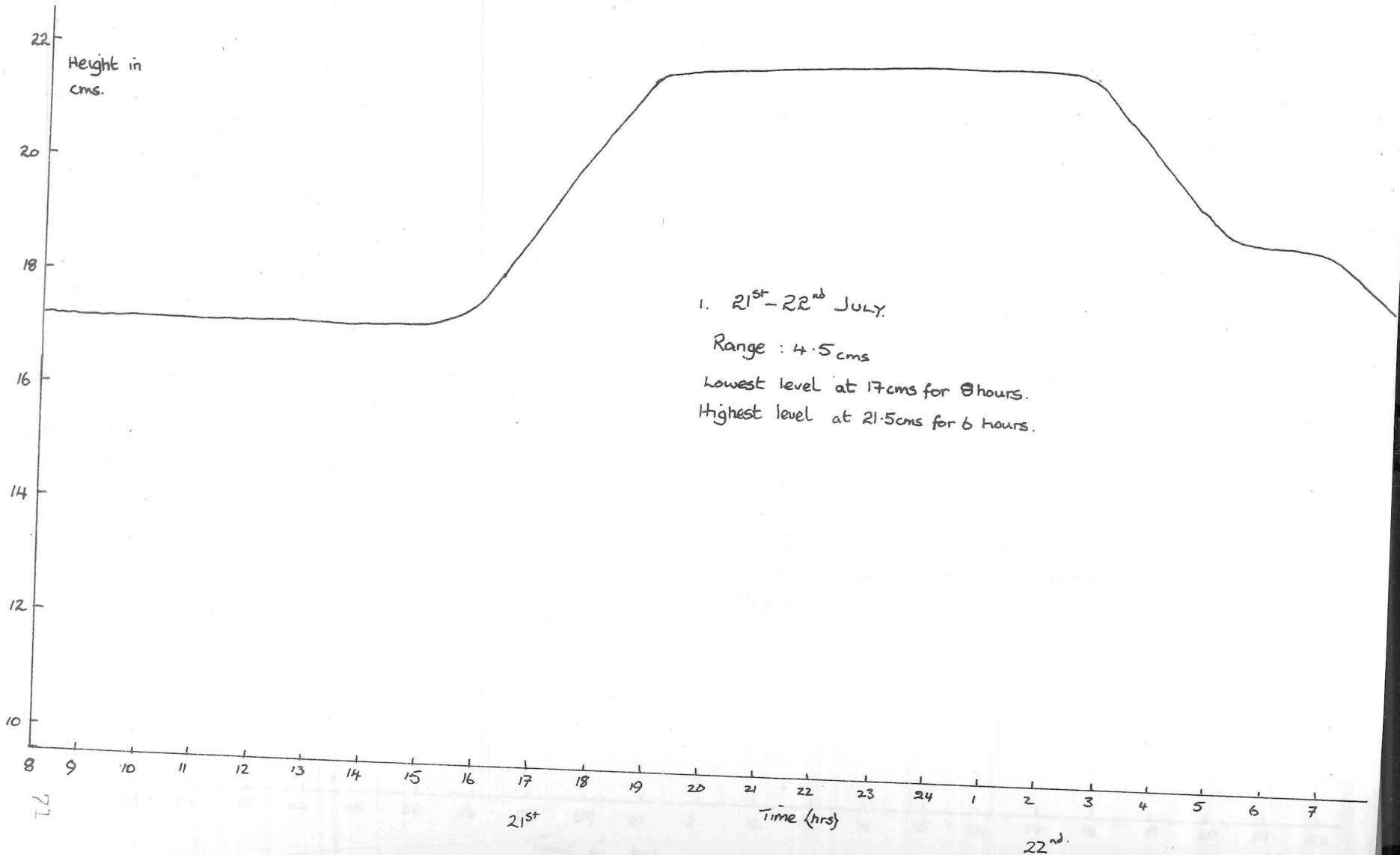
Time	Height	Deviation
2300	25	-
2400	24.5	-0.5
0100	23.5	-1
0200	22.5	-1
0300	21.5	-1
0400	21	-0.5
0500	20	-1
0600	19.5	-0.5
0700	19	-0.5
0800	18.5	-0.6
0900	18	-0.5
1000	17.5	-0.5
1100	17	-0.5
1200	16.5	-0.5
1300	16.5	-
1400	16.5	-
1500	16.5	-
1600	17	+0.5
1700	19	+2
1800	21	+2
1900	23	+2
2000	25	+2
2100	25	-
2200	25	-

Comments.

This survey was carried out 12 days after the other two. The measuring rod was removed for the move to camp IV and was replaced in a position as near to the original as possible.

Weather.

The weather was much warmer, long periods of sun, nights also mild.

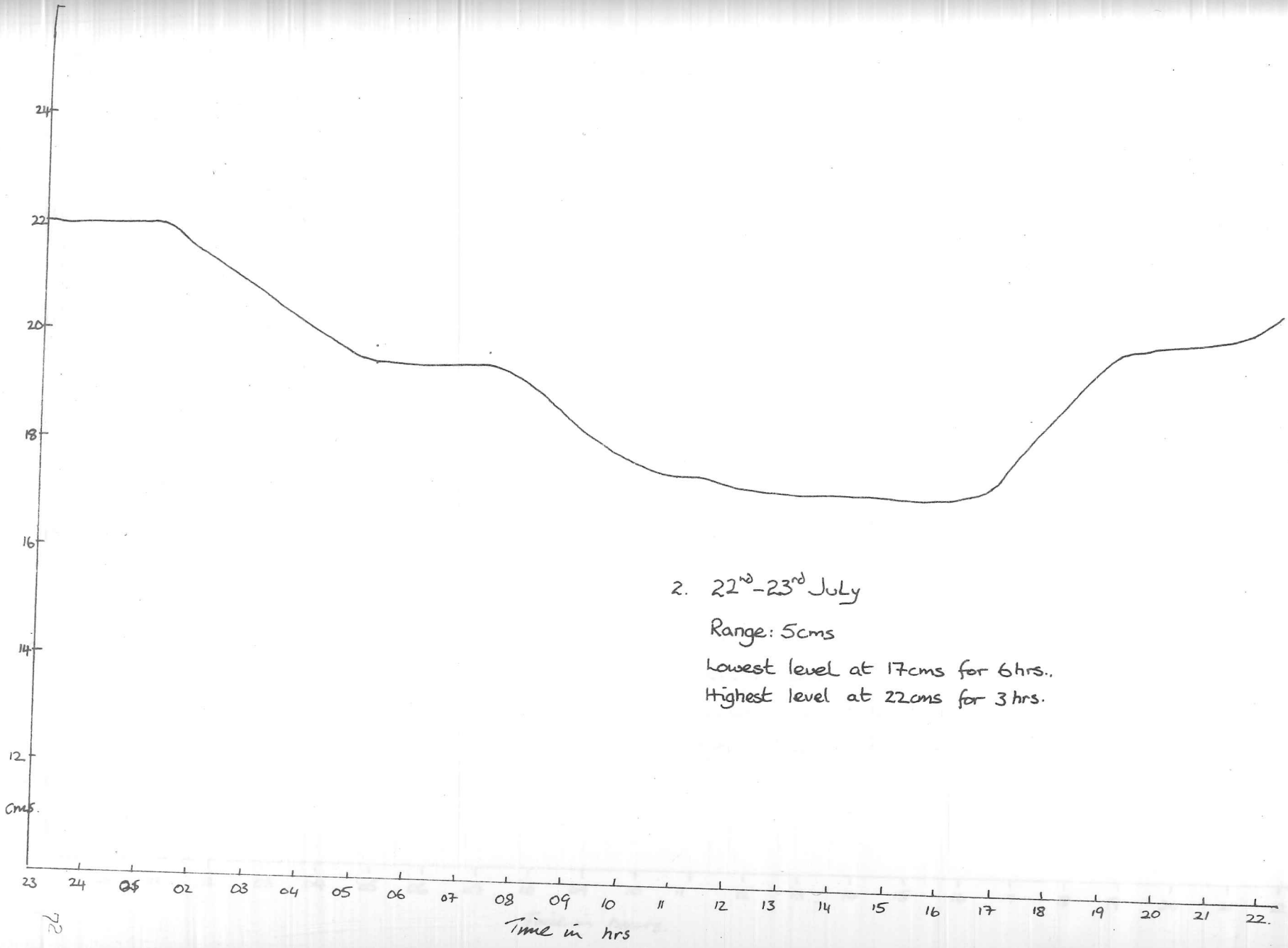


1. 21st – 22nd July.

Range : 4·5 cms

Lowest level at 17cms for 8 hours.

Highest level at 21·5cms for 6 hours.

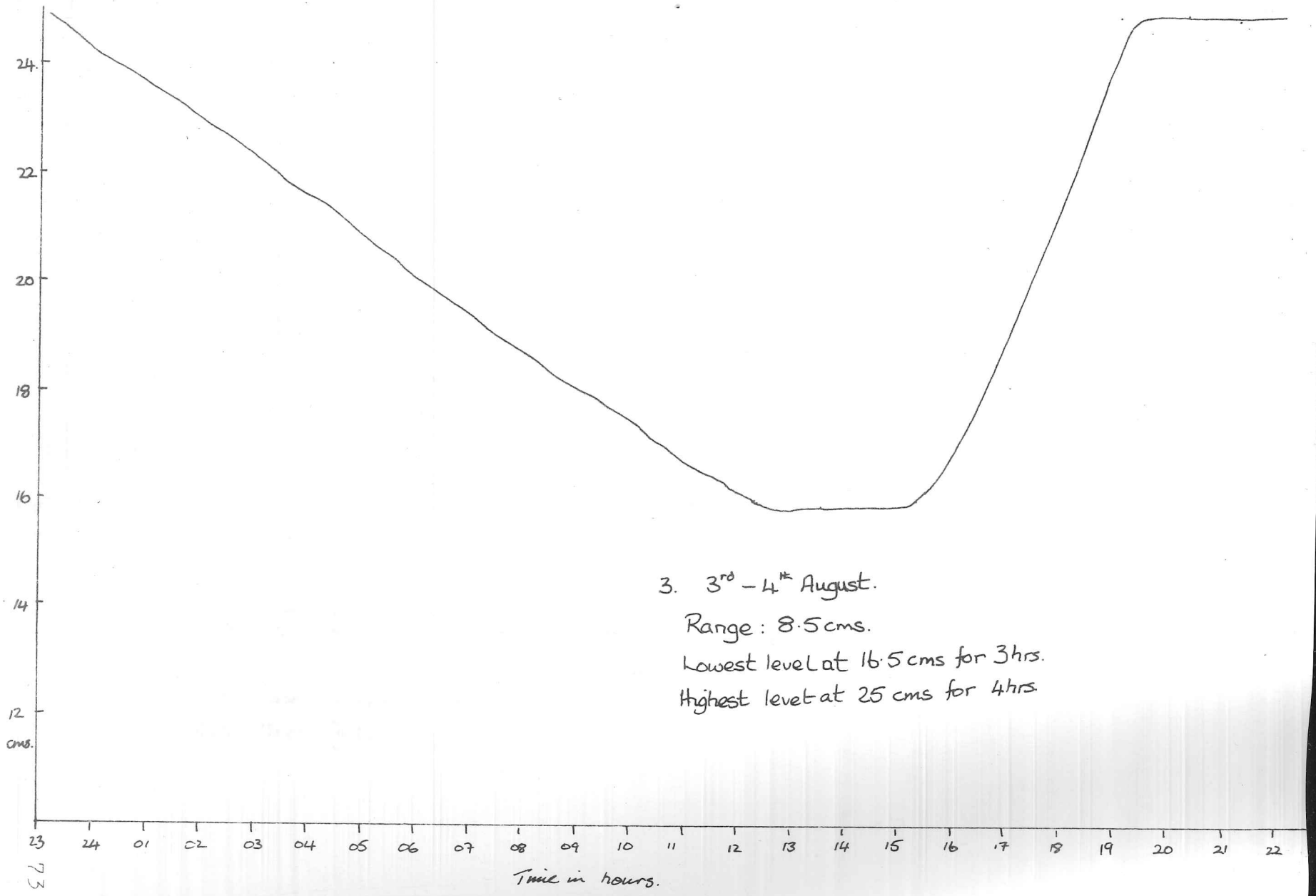


2. 22nd-23rd July

Range: 5cms

Lowest level at 17cms for 6hrs..

Highest level at 22cms for 3 hrs.

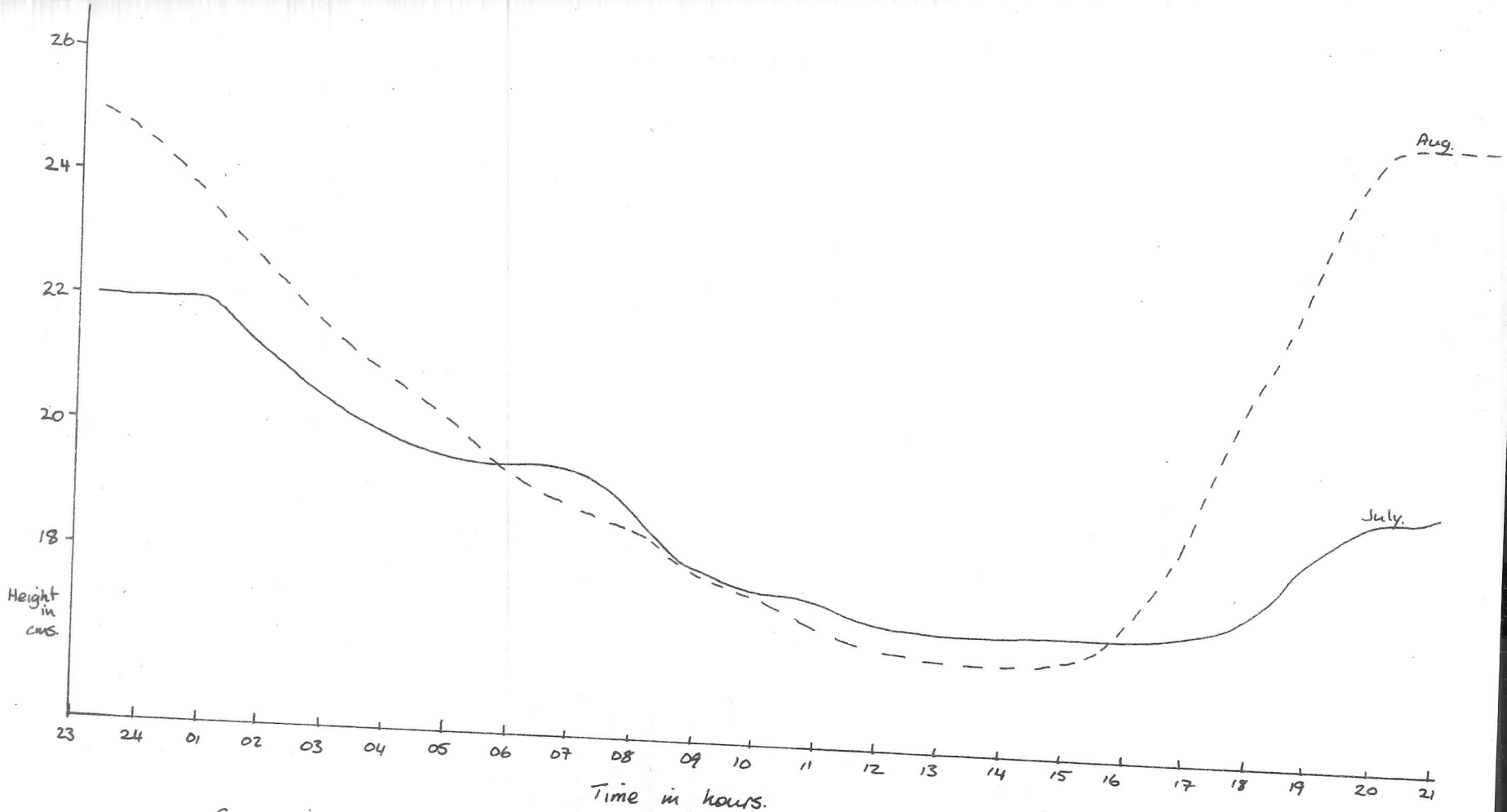


3. 3rd – 4th August.

Range: 8.5 cms.

Lowest level at 16.5 cms for 3 hrs.

Highest level at 25 cms for 4 hrs.



Comparison between 3rd + 4th August & 22nd + 23rd July.
River Markarfljot.

Conclusion.

If the graphs of the first two surveys are joined it is possible to estimate the probable shape for the intervening 12 hours. A wave form is created.

The amplitude of the wave is determined by environmental conditions e.g. runoff, precipitation, sun etc.

The graphs show that the river rises at about 1500 - 1600 and reaches a peak at around 2200 - 2300. This is due to the fact that there is a time lag between the rainfaal and time this extra water runs off into the rivers and streams.

On hot days a similar process takes place. The sun melts the snow and the meltwater filters into the streams. Maximum melting occurs around 1400 and thus there will again be a time lag before this meltwater reaches the river Markarfljot.

Unfortunately we were unable to complete our studies of the river deposits and load. However, it was observed that fine deposits of silt had been deposited some 2 - 4 metres above the present level of the river. Something that had not been observed in 1970 or 1978. This would indicate that there had been a rapid thaw of the winters snow possibly later in the year than usual which caused the river to flood much more than in previous years. From the evidence of these deposits and the tidelines of pumice that we found some distance from the river bank it must have been a spectacular sight!

g) Weather.

For this survey we made daily recordings of the following:
Maximum and minimum temperatures
Precipitation
Wind speed and direction
Clouds
Relative Humidity

However, during the storm of the 29th-30th.July when the store tent was nearly destroyed, the records that we had made were blown away into Markarfljot together with the weather station and most of the weather instruments.

Fortunately some of the records were found and we have been able to make a chart of some sort using written accounts in various diaries.

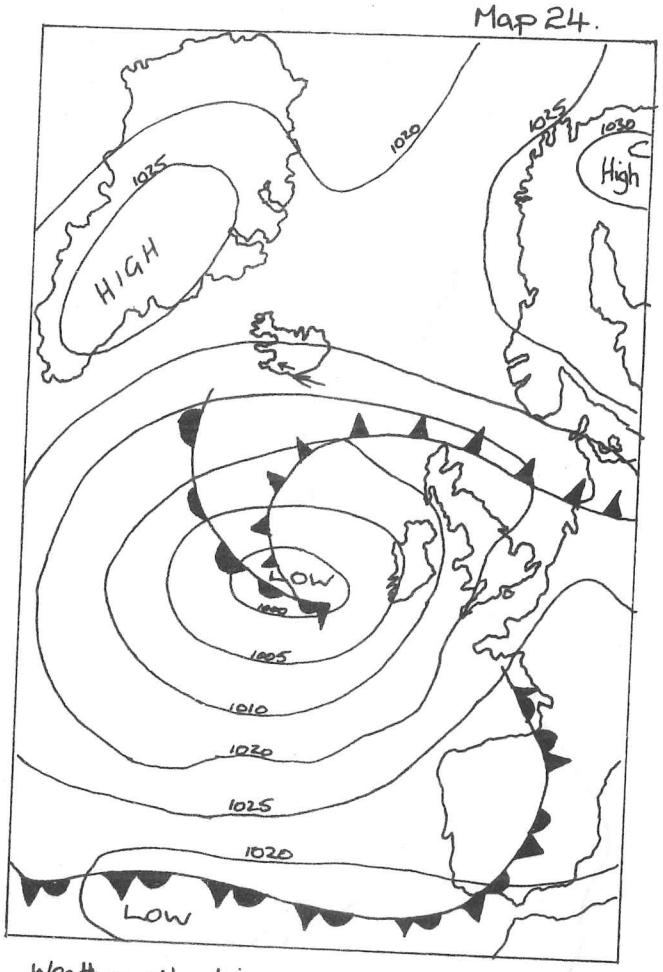
The first week of the expedition was by far the coldest. Temperatures dropped well below zero at night on a number of occasions and only rose a few degrees above during the day.

Later on we had some of the best weather I have experienced in Iceland when the skies were clear and the temperature were high enough for us to walk around in swimming trunks.

In the third week the weather changed again and we had heavy rain, fog and very high winds. On one occasion the weather was so poor we were unable to leave base camp.

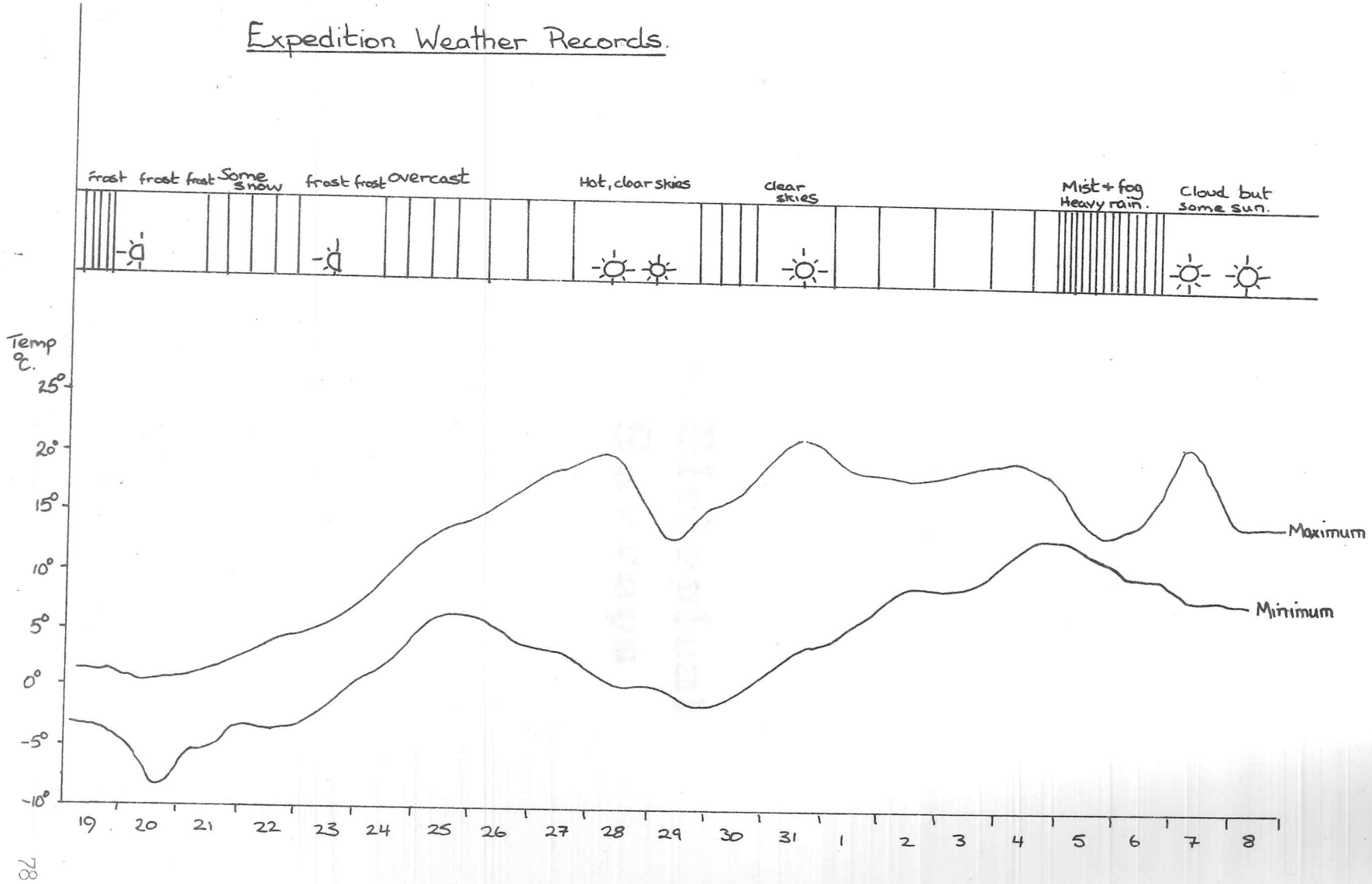
What records we have are recorded on the following pages.

Map 24.



Weather situation on July 30th 1980. The low pressure south of Iceland caused strong east winds to blow It was on this night (possibly) that the store tent was partially destroyed.

Expedition Weather Records.



4. Biological Surveys

4. Biological Surveys.

1. Habitat Analysis.

Synecology - the study of all organisms in a particular habitat.

Autecology - the study of one particular organism in different habitats.

Our studies were synecological in nature and we used quadrat and transect sample techniques.

Quadrat

Samples with this technique were taken at random over a particular area at the Base Camp Hydrothermal area. A list of the species present were made and a record of their frquency made.

$$\text{Frequency} = \frac{\text{Number of occupied quadrats}}{\text{Total number of quadrats}} \times 100\%$$

Transect

This technique is used to give a profile of a habitat along a certain length. Frequency can then be determined as in the above equation.

Both vertical and horizontal transects were carried out at different sites.

A quadrat was placed along the transect line every other metre and a record made of the frequency of the species in the quadrat.

0 - 10%	rare	= r
11 - 40%	occasional	= o
41 - 70%	frequent	= f
71 - 100%	abundant	= a

Vertical line transect on Volcanic Ash. N. facing slope of stream valley.

Date: 28·7·80

Location: N. facing bank of camp IV river. 35° Slope 15 m from river

Habitat: Lava Slope

Observations: Gravelly bank, occasional mosses near hot springs. Vegetation sparse.

Species \ Site		1	2	3	4	5	6	7	8	9	10	11	12	33	34	35	36	37	38	39	40	41	42	43	44	45
Racomitrium sp (moss)	A	a	a	f	o	r	-	o	o	o	o	r			r	-	-	f	-	-	a	o	a	o	f	o
Grass sp.	C	r	-	-	r	-	-	-	-	-	-	-			-	-	-	-	-	r	-	-	-	-	r	-
Silene acaulis (moss campion)	E	-	r	-	-	-	-	-	-	-	-	-			-	-	-	-	-	r	-	-	-	-	-	-
Ameria maritima (thrift)	N	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	r	-	-	-	-	-	-
Equisetum palustre (marsh horsetail)	J	-	-	-	-	-	-	-	-	-	-	-			-	r	-	-	-	r	-	-	-	-	-	-
Cerastium alpinum (alpine mousear)	G	-	-	-	-	-	-	-	-	-	-	-			r	-	r	o	-	o	r	o	o	o	o	o
Oxyria digyna (mountain sorrel)	H	-	-	-	-	-	-	-	-	-	-	-			f	-	f	-	r	-	-	-	-	-	-	-
Saxifraga stellaris (stony saxifrage)	K	-	-	-	-	-	-	-	-	-	-	-			-	-	o	-	r	-	-	-	-	-	-	-
Lichen sp	L	-	-	-	-	-	-	-	-	-	-	-			-	-	-	r	-	-	-	r	-	r	-	-
Fungus sp	Q	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
Sedum sp (stone crop)	B	r	r	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-

Steep Lava Bank No vegetation for 40 metres.

Quadrat 1–45 Distance = 88 m.

Date: 7·08·80

Location: Waterfall near Base Camp, Laufafell

Habitat: Fresh water river bank near waterfall.

Observations: Continually exposed to spray from waterfall.

Species \ Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Dandelion	r	r	r	r	r	-	-	-	r	-	r	r	r	r	-				
Racometrium	a	a	f	a	a	a	a	a	a	a	r	a	a	r	a				
Marsh horsetail	r	-	-	-	-	-	-	-	-	-	-	r	-	-	r				
Grass sp.	r	r	r	r	r	o	r	r	r	o	o	o	o	o	r				
Alpine saxifrage	r	o	-	-	-	r	-	-	o	r	-	-	r	-	-				
Mossy saxifrage	f	f	r	r	o	r	f	f	o	o	r	o	o	r	o				
Fungus sp.	r	r	-	-	-	-	-	r	-	r	-	r	r	-	-				
Lichen sp.	o	o	r	r	o	r	o	r	o	o	-	r	o	r	o				
Mountain sorrel	-	r	r	r	r	-	r	-	-	r	-	-	-	-	r				
Thrift	-	-	r	r	-	-	-	-	-	-	r	-	-	-	-				
Starry saxifrage	-	-	-	f	-	-	-	-	-	-	-	-	-	-	-				
Moss campion	-	-	r	-	r	-	-	-	-	r	o	-	o	-	-				
B	-	-	-	-	r	r	r	-	-	-	-	-	-	-	-				
C	-	-	-	-	-	-	o	r	r	-	r	r	-	r	-				
D	r	-	o	f	r	r	-	-	o	-	-	-	r	-	-				
E	r	-	-	-	-	-	r	o	r	r	r	r	-	r	r				
Mousear	-	r	r	-	-	-	-	-	-	-	f	-	-	o	-				
G	-	-	-	-	r	-	-	r	-	-	a	-	-	r	-				
H	-	-	-	-	-	-	-	r	-	-	o	-	-	-	-				
I	r	r	-	o	-	-	-	o	r	-	r	-	-	-	-				
Alpine speedwell J	-	r	-	-	r	r	r	-	-	-	-	r	-	-	-				
K	-	-	-	-	r	-	r	-	r	r	o	-	-	r	r				
L	-	-	r	r	r	-	-	o	r	r	-	-	-	-	-				

Vertical Line Transect

Date: 21·07·80 | **Location:** Base Camp Hot Spring

Habitat: South facing slope of grey volcanic ash. Fairly rocky.

Observations:

Species \ Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Thrift	r	r	-	r	-	-	r	-	-	r	r	-	r	-	-	r	r	-	-
Alpine Mousear	o	r	-	r	-	r	-	o	r	r	r	o	-	-	-	r	-	o	-
Racomitrium	r	o	-	r	r	o	r	o	f	o	o	f	o	-	r	r	r	a	a
Mountain Sorrel	-	r	-	r	-	r	-	r	r	r	r	r	r	r	r	o	r	o	r
Mossy Saxifrage	-	-	-	r	-	-	r	r	r	r	-	-	-	r	r	r	r		-
Lichen sp.	-	r	-	o	-	r	-	r	r	o	o	o	r	r	r	r	r	r	r
Moss campion	-	-	-	-	-	-	-	-	r	-	-	-	r	r	-	-	-	-	-
Grass sp.	-	-	-	-	-	r	r	-	r	r	-	-	r	r	r	-	r	-	r
Fungus sp.	-	-	-	-	-	r	-	-	-	-	-	-	r	-	-	-	-	-	-
Marsh horsetail	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-
Stonecrop sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	r	r	r	-
Alpine saxifrage	-	-	-	-	-	r	-	-	r	r	-	-	-	-	-	r	-	-	-
Starry saxifrage	-	-	-	/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

continued on next page.

Vertical Line Transect (cont)

Date: 21.07.80 **Location:** Base camp hot spring.

Habitat: South facing slope of grey volcanic ash. Fairly rocky.

Observations:

Species \ Site	20	21	22	23	24	25	26	27	28	29	30	31.
Thrift	r	-	-	-	-	-	-	-	r	-	r	-
Alpine Mousear	r	o	f	r	o	o	o	r	f	r	r	-
Racomitrium	o	a	a	a	a	a	a	r	f	a	f	-
Mountain Sorrel	r	o	r	-	r	r	r	r	r	r	r	r
Mossy Saxifrage	r	r	-	o	r	-	-	-	-	-	-	-
Lichen Species	r	r	r	r	r	r	r	f	r	o	r	r
Moss campion	-	-	-	-	-	-	-	r	-	r	r	-
Grass sp.	-	r	r	r	r	r	r	r	r	r	-	o
Fungus sp.	-	-	-	-	-	-	-	-	-	-	-	-
Marsh horsetail	-	r	-	r	-	-	-	-	-	-	-	-
Stonecrop sp.	r	-	-	-	-	r	-	-	r	r	r	-
Alpine saxifrage	-	r	r	-	-	-	-	-	r	-	-	-
Starry Saxifrage	-	-	-	-	-	-	-	-	r	-	-	-

Horizontal Line Transect, Lava Slope.

Date: 22.07.80 **Location:** Base Camp Hot Spring.

Habitat: South slope near hot spring. (north facing)

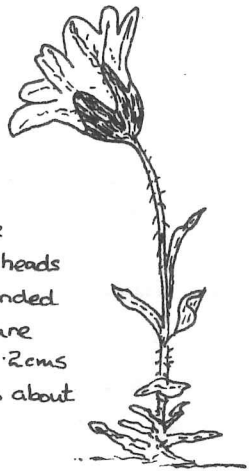
Observations: Vegetation quite moderate

Species \ Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Grass sp.	o	–	r	r	–	–	–	–	–	r	–	–							
Alpine mousear	–	–	–	f	–	–	–	–	–	o	–	–							
Thrift	r	–	–	r	–	–	–	–	r	r	–	–							
Racamitrium	f	f	f	a	–	–	a	–	f	a	f	–							
Mountainsorrel	–	–	–	–	–	–	r	–	r	–	r	–							
Alpine speedwell	–	–	–	–	–	–	r	–	–	–	–	–							
Dandelion.	–	–	–	–	–	–	r	–	–	–	r	–							
	←	distance 23 metres									→	→							

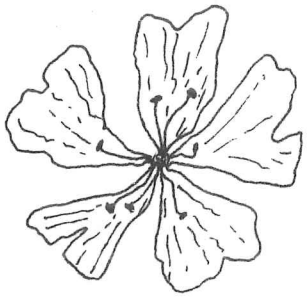
The frequency of the species over the four transect areas studied was calculated to give a league table of species present viz:

Species	Frequency %
Racometrium sp.(moss)	79.60
Lichen sp.	42.72
Grass sp.	40.78
Oxyria digyna (mountain sorrel)	37.86
Cerastium alpinum (alpine mousear)	36.89
Saxifraga hypnoides (mossy saxifrage)	27.18
Ameria maritima (thrift)	19.42
Silene acaulis (moss campion)	12.65
Saxifraga oppositofolia (alpine purple saxifrage)	12.62
Dandelion sp.	11.65
Sedum sp. (stonecrop)	9.70
Equisetum pawstre (marsh lovestail)	7.80
Fungus sp.	5.82
Veronica alpina (alpine speedwell)	3.80
Saxifrage stellaris (starry saxifrage)	

Increasing abundance



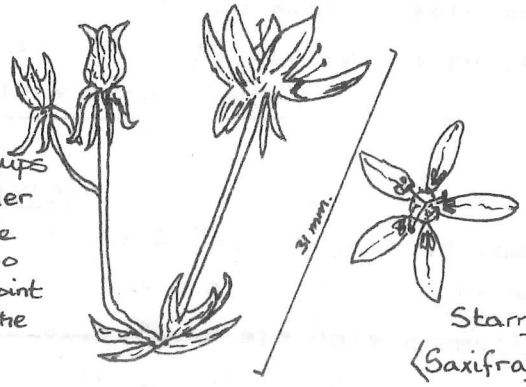
Can have one or two flower heads Leaves are rounded at end, and are usually 0·5 - 0·2cms long. Flower is about 1·5cms wide.



White flower, five double petals with marked veins. Light yellow centre. Fine hairs on all but flower head —white hairs. Readish stalk Leaves sometimes lighter in centre

2cms.

Moss Campion
⟨Silene Acaulis⟩



Red buds, in groups of 3 becoming paler closer to stem. Five petals, white, with two yellow dots near the point at which they meet the stem.

Starry Saxifrage.
⟨Saxifraga Stellaris⟩

Agar Plate Cultures.

We attempted to culture samples of water from the hydrothermal area at Base Camp. The conditions would be ideal for bacterial growth i.e. warmth, humidity and a plentiful supply of minerals.

After several attempts using supposedly aseptic techniques we found it impossible under the existing conditions to produce reliable cultures.

Lichen Samples.

These were collected at all of the three camps we used- Base Camp, Camp IV and Landmannalaugar as well as from the block lava flow of Hrafntinnahraun. They were collected on the substratum on which they were found to be growing (wherever possible) and air dried before being wrapped in tissue paper and packed carefully ready to be shipped back to England. Lichens have a long preservation life if dried properly and do not require any special preservation techniques.

On return to England a brief identification was carried out as far as possible before the samples were sent to the British Museum (Natural History) for full identification and recording by the Botany Department.

Identification of Flora.

The Icelandic flora is North European in character. About 97% of the vascular plants are also found in Norway and about 86% in the British Isles. There are only a small number of species of vascular plants and about 1/3 of these are characterized as arctic-alpine species while the rest are boreal species. This small number of species of vascular plants in Iceland is only partly conditioned by the climate. The main cause for this limiting of species is the Pleistocene Ice Age and the limited possibilities of immigration due to the isolation of the country. About half of all the vascular plants are regarded as glacial

survivors.

Snow cover in winter is an important ecological factor in most parts of the country and on favourably exposed mountain slopes a luxuriant vegetation of herbs and grasses are found in areas sheltered by snow during the strong winter winds. The central highlands and mountains are almost bare of vegetation above the 700 m. level and therefore our campsites which were above this level proved to be very sparse in floral cover. However, scattered individuals of hardy arctic-alpine species of vascular plants do occur along with lichens and mosses.

The main vegetation to be found is a moss which grows along the edges of meltwater streams and rivers. The carpets of moss are almost entirely Racomitrium lanuginosum and Racomitrium caescens. In the lava flows there are always some crevices and depressions where ferns, herbs and grasses find shelter. The warm soil around the hydrothermal areas also offers favourable conditions for many plants.

The key from the previous expedition was used along with other reference books to identify the flora. The main species found were:

Silene acaulis	Moss campion
Cerastium alpinum	Alpine mouse ear
Seclum sp.	Stonecrop
Ameria Maritima	Thrift
Saxifraga oppositofolia	Purple saxifrage
Saxifraga hypnoides	Mossy saxifrage
Veronica alpinum	Alpine speedwell
Ranunculus sp.	Buttercup
Taraxacum sp.	Dandelion
Saxifraga stellaris	Starry saxifrage

Lichen Growth.

It is hoped that the next expedition (1982) will be able to locate particular lichens and determine their growth rate since 1980. Lichens are very susceptible to ecological condit-

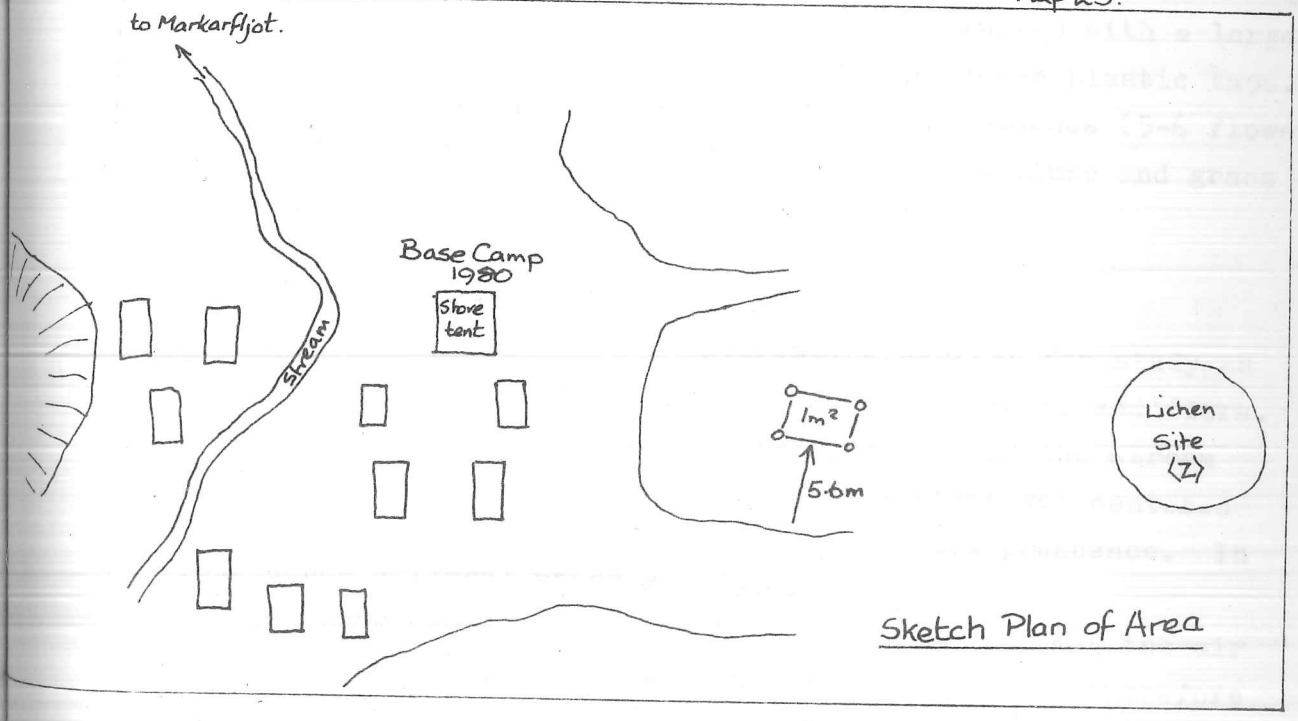
ions and especially climatic conditions. It is hoped that a correlation between their growth rate and the known weather conditions may be found.

The area under study is indicated on the plan of the area used for colonisation (z). (see below)

The lichen substratum was marked with green plastic tape which it is optimistically hoped will remain during two Icelandic winters. To aid in identifying the lichens to be studied maeasurements of the area were taken.

The site is a mound above base camp and the lichen samples were taken at several lavels down from the top and at regular intervals along the circle round the mound.

Map 25.



Sketch Plan of Area

Colonisation

Colonisation of an area over a period of time gives an indication of the environmental conditions over that time and it can also aid in the understanding of a plants ability to colonise any particular area and the factors that affect this process.

It was decided to determine an area near to base camp which was marked and its position recorded. The area was almost void of any surface vegetation. It is hoped that the next expedition in 1982 will be able to find this area of about $1m^2$ and record the flora growth and therefore determine to what extent colonisation, if any, has taken place.

The area to be investigated was 5.6 m. from the edge of the gulley in the north side of the larger gulley (near second valley) directly above base camp on the south-south-west facing slope. Each corner of the metre square was marked with a large stone which was marked with a piece of blue/green plastic tape. The existing vegetation consisted of 2 small bunches (5-6 flower heads) of Thrift. A very small (30-40mm) moss clump and grass sp. (3-4 heads).

Snow Tunnel Study.

Snow tunnels provide an interesting habitat for study as they provide a fairly hostile environment for fauna and flora. There were no apparent fauna species present and the stream running through the tunnel, on which this study was centered had no evidence of insect larva or other fauna prescence. In consequence a floral study was done.

The snow tunnel is a hostile environment in that the air temperature is low, there is little or no light and therefore photosynthetic plants would have difficulty in growing, and the acidity and temperature of the stream water are low.

Due to the possibility (although fairly remote) of the tunnel roof collapsing special care was taken when collecting

the data and only a distance of 20 m. was covered into the tunnel.

Results:

Site	Description.	
	Stream Bank	Stream
I Entrance	Very damp and boggy Vegetation: mainly moss with little grass in places.	Shingle bottom with fronds of very green moss present on rocks. pH 5
II 8m. Light level High	Damp. Moss is greener tending to point towards entrance. Grass growing vertically.	Shingle bottom. Less moss, darker green in colour. pH 6
III 16m Less light.	No grass, drier. Moss less luxuriant, shorter strands. small number of mushrooms.	Bed appears to be a fused layer of shingle. Few large stones. No moss pH 6
IV 20m. Diffuse light	Fine moss, dark green in colour around large stones on side facing entrance, no grass.	Conglomerate bottom Few stones. No vegetation. pH6.

This study gives a good indication of a rapid change in the environmental conditions within a short distance and the effect these changes have on the vegetation.

Where the light conditions are good to fair(Sites I and II) there are good growths of moss. The depth of green colour is an indication of the moss adapting to the availability of light which in consequence affects its photosynthetic ability. When the light level is decreased (sites III and IV), the moss became less luxuriant, and tends toward the light source at the entrance.

The pH, which is slightly acidic at pH6, is fairly constant through the 20 m. length of the tunnel investigated and therefore we can conclude that this has no effect on the growth of the moss within the stream.

The air temperature increased slightly into the tunnel and this could account for the prescence of mushrooms (not identified into class) at site III.

A clear adaptation by the moss to the environmental conditions is given by the way its strand length decreases from entrance to siteIII.

Study of River Moss.

The stream that passes the hot spring at base camp and eventually runs into the river Markarfljot provided an interesting area for study. There was a very obvious change in its distribution, growth patterns and colour within a relatively short length of the stream. It was therefore decided to try to determine what factors were responsible for this dramatic change in its growth and distribution.

Samples of the moss were collected at various sites and brought to the laboratory for examination. pH values and temperature values were taken at these sites and qualitative and quantitative measurements were made of the moss growth.

Results:

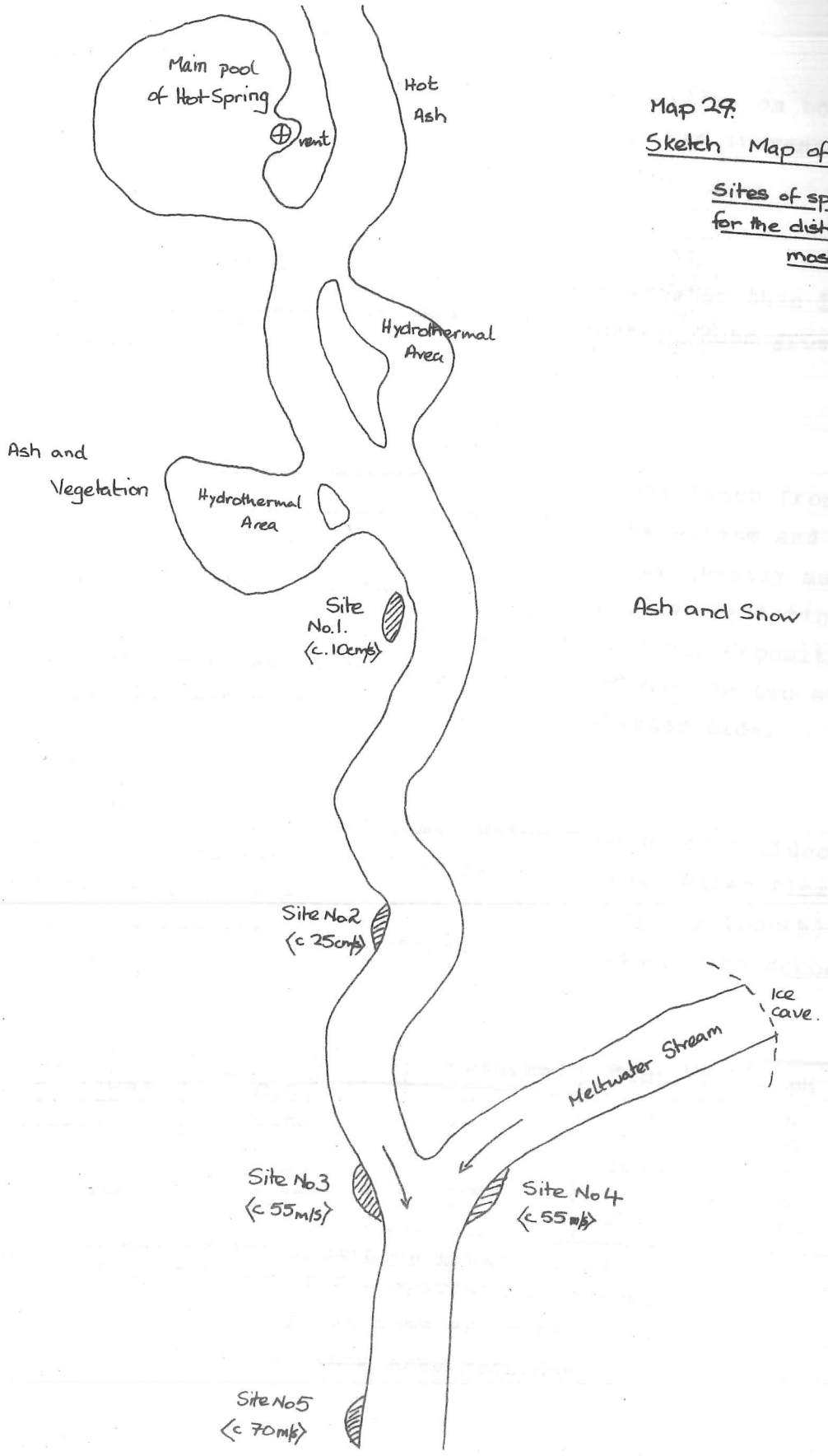
Site I.

Situated approximately 10m downstream from the main hot spring. The sample was taken from a small outlet of the main flow. The velocity was slower than the main stream and the water slightly warmer (see table). The area had an abundant growth of moss in shallow water on the south-west facing bank. On the opposite bank there was very little growth.

Sulphur deposition, indicated by a white-yellow precipitate on the moss was minimal.

Site II

Situated approximately 25m. downstream from the hot spring.



Map 29.

Sketch Map of Stream Showing Sites of specimens taken for the distribution of moss.

The water temperature decreased but was uniform on both sides of the stream. The velocity of the stream was increased. Moss growth sparse. Some sulphue deposition.

Site III.

Situated 55 m downstream. Velocity greater than I and II Stream deeper. Water temperature increased. Moss growth frequent.

Site IV

Situated 55m downstream. The sample was taken from the far side of the confluence of the hot spring stream and the glacial meltwater stream. The water was consequently much colder. There was no sulphur deposition. The vegetation was increased. Where the two streams joined sulphur deposition was observed. There was a definite division where the two streams joined. The water was clearer on the meltwater side.

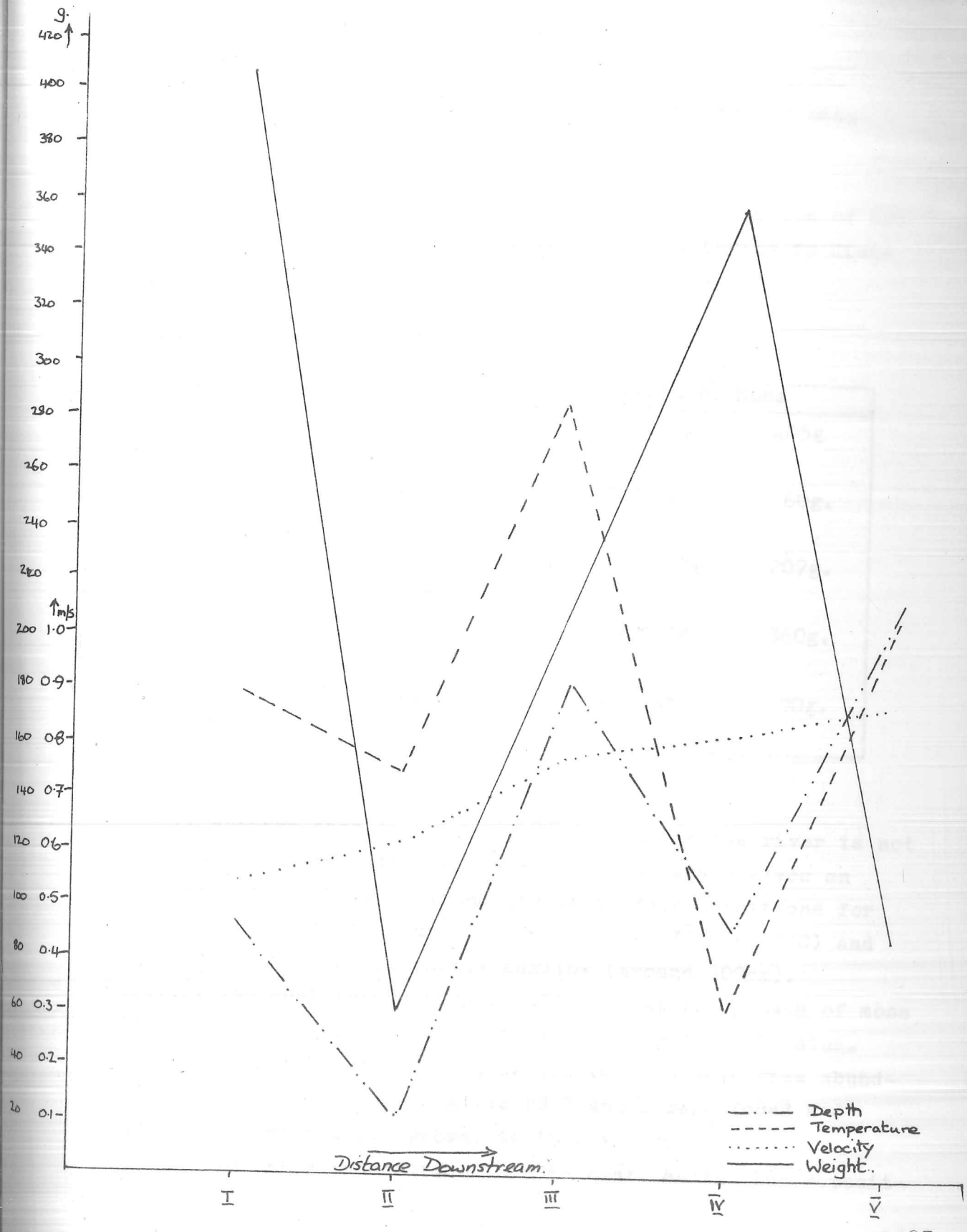
Site V.

Situated 70 m. downstream. Water warm on both sides although some variation in temperature noted. Water flow faster. Depth increased. Moss on the hot spring (north) side has sulphur deposits on it whereas on meltwater side deposition is less.

Site	Velocity(m/s)	Depth(mm)	Temp.^{O}C	pH
I (10m)	0.54	194	9.0	4
II (25m)	0.62	123	7.5	5
III(55m)	0.78	286	14.5	5
IV (55m)	0.82	196	3	4
V (70m)	0.89	316	10.5	6.

A measure of the growth or abundance of the moss was determined roughly to use for comparison purposes.

An area covered by the moss was measured and the weight of the moss growing within this area recorded.


g.
420
400
380
360
340
320
300
280
260
240
220
m/s
200 1·0
190 0·9
160 0·8
140 0·7
120 0·6
100 0·5
80 0·4
60 0·3
40 0·2
20 0·1
Depth
Temperature
Velocity
Weight.
Distance Downstream.
I
II
III
IV
V

The weight was moss + water that was soaked in the moss. This gave us a rough indication of how much 1 mm^2 of moss weighs.

$$1\ m^2 = 2.5\ kg.$$

From this it was possible to obtain an indication of the abundance of the moss quantitatively without having to disturb the moss and ecology.

Abundance of Moss.

Site	Area	Weight of Moss	
I	750 x 216mm = 0.162m^2	0.405kg	405g
II	300 x 80 mm = 0.024m^2	0.06kg	60g.
III	470 x 176 = 0.083 m^2	0.207 kg	207g.
IV	610 x 236 = 0.144m^2	0.36 kg	360g.
V	252 x 143 = 0.036m^2	0.09kg	90g.

Conclusion.

It appears that the growth of the moss in the river is not affected by the velocity of the water. The graph gives an indication that the moss finds itself in fair conditions for growth when the temperature is low (between 3°C and 9°C) and also when the stream is fairly shallow (around 200mm). However, the most interesting result is that the growth of moss and its abundance is affected by small changes in pH value. At sites I and IV where the pH is low (4) the moss grew abundantly whereas at the other sites pH 5 and 6 were found and although the moss still grows, it is not abundant.

It was very interesting to note that the sulphur deposit-

ion (as a sulphur precipitate) was more noticeable at the sites where the moss was abundant and from this it can be assumed that the moss has adapted to acidic conditions in the water caused by the sulphur dissolving to form a slightly acid stream and that it has a high sulphur tolerance in that it will grow abundantly in areas where sulphur precipitation occurs.

Soil Study

Introduction.

A study of environmental factors having effects on flora and fauna can give an indication of why certain species grow or are found where they are and can also give a guide to which type of flora could grow at any given point if introduced.

One easy method of determining the nature of the ground is to take soil samples for analysis. These samples can then be used to determine the nature of inorganic particles e.g.sand clay etc. which in turn gives an indication of the porosity of the soil i.e. clay particles are small and cling together and, therefore,the air spaces (in which water can be absorbed) are small. The porosity also has a direct effect on ventilation and aeration.

The acidity or alkalinity of the soil (pH) has an effect on the type of flora that can grow and the temperature also has an effect.

Decaying organic matter - humus is produced by bacteria breaking down the dead organisms in the soil. This humus is rich in minerals and therefore ideal for plants.

Method of Collection.

The sites chosen were as different as possible and taken from within a 500m square, around the geothermal area near base camp. (GR 811919).

Site.	Description.
A	Half way up north facing slope under mossy vegetation
B	Next to stream under snow and under mossy vegetation.
C	Near to hot spring.
D	Under snow
E	On top of ridge above hot spring.

The samples were collected at a constant level below the surface of 5 cms. They were placed in air tight collecting tubes and brought back to the laboratory for analysis.

Analysis.

A cricible was weighed empty and reweighed again with the sample. This gave the net weight.

The samples were then dried overnight in an oven and re-weighed to give the dry weight. This is then repeated to ensure all moisture is removed.

From these results the % water content of the samples can be deduced.

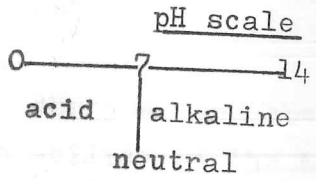
To determine the % humus content (% of organic matter) the samples were burnt down to a residual inorganic mixture, and the weights recorded before and after. The pH of the samples was taken using moist pH paper at base camp.

Inorganic analysis of the samples could not be done without complex equipment which was not available at base camp.

Results. (see next page)

1. pH values.

sample	pH
A	6
B	5
C	4
D	7
E	6-7



The results for sample D are suspect as the collecting tube was found to be cracked on return.

2. Water and Humus Content.

Sample	Net weight(g)	Dry weight(g)	Burnt down weight(g)
A	13.92	12.56	12.33
B	14.96	12.62	12.43
C	13.98	12.39	12.18
D	12.39*	11.70	11.49
E	17.13	15.86	15.63.

* suspect as tube was cracked.

Sample	%Water content
A	9.7
B	15.6
C	11.3
D	5.5
E	7.4

Sample	%Humus content
A	1.8
B	1.5
C	1.69
D	1.79
E	1.45

Conclusion:

All five sites proved to be similar in humus and water content although the pH of the soil did vary from 7-4.

It can be seen from the results that the conditions for growth of fauna and flora are not very favourable. The humus

content is very low and therefore the nutrient supply for flora is poor - this is why only mosses, which are adapted to these conditions grow in abundance but other vascular plants have difficulty in establishing a good growth.

Although the air is damp for most of the year and the ground is waterlogged from meltwater, the ability of the soil to retain this moisture is poor and drainage is very good. This is indicated by the low % water content which bears out the premise that the area in which we were studying possesses desert like conditions.

Analysis of the soil samples back in England revealed that 80% of the sample was made up of iron compounds. The remaining 20% was more difficult to analyse but was found to be composed mainly of silicates with a small quantity of sulphur.

Photo. 3. Base Camp Hot Spring in 1980

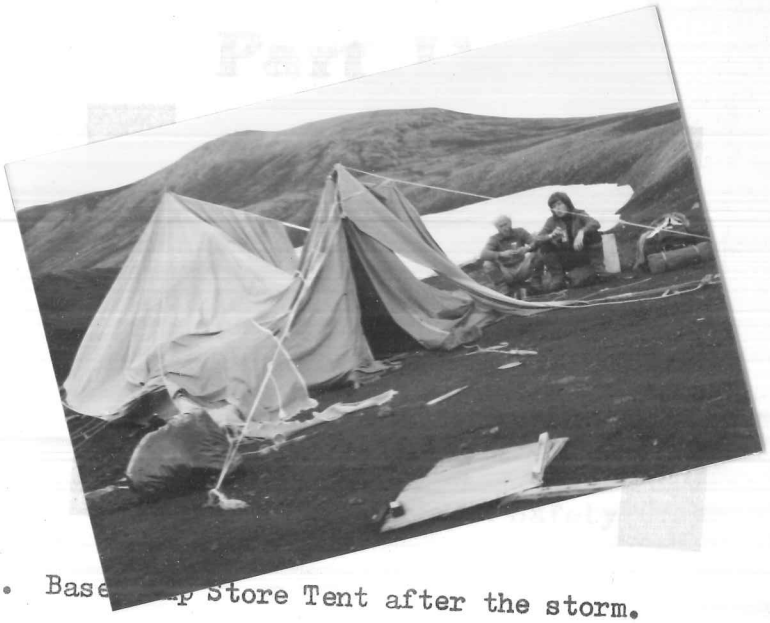


Photo. 4. Base [illegible] Store Tent after the storm.

Part II
Organization

a) Finance
b) Travel and Route
c) Food
d) Bread Making
e) Shipping
f) Equipment
g) Planning and Safety

a) Finance.

Income.

		£
17 members at £195 each		3315 - 00
4 leaders at £100 each		400 - 00
Grants:	Young Explorers'Trust	300 - 00
	Scott Polar Research Institute	100 - 00
	Johanna Scott Foundation	1000 - 00
	Churchill Trust	600 - 00
Donations		335 - 00
Fund Raising:	Sir Vivian Fuchs Lecture	210 - 00
	Paper collection, raffles, food sale	240 - 00
	Sale of photographs	52 - 65
	Sponsored abseil	30 - 00
	Street collection for abseil	22 - 79
	Lectures on 1978 Expedition	15 - 00
Surcharge £15 x 21		315 - 00
Golden Circle £15 x 21		315 - 00
Interest		164 - 00
Sale of first day cover envelopes		15 - 00
		£7429 - 44.

Guy Hawkins was awarded a Churchill Travelling Fellowship and was able to contribute towards the cost of equipment for this and future expeditions.

Expenditure.

	£
1. Transport	
a) to London	50 - 00
b) Flight to Iceland and Accomodation in school and tour, tax and transfer	3421 - 50
c) Bus charter to Laufafell return	261 - 00
d) Collection and return of equipment	60 - 00
2. Food	
a) Bulk purchases	385 - 55
b) Evening meals (Raven)	228 - 30
c) Extras	105 - 30
3. Equipment	
Purchase of tents, rucksacks, ice axes, crampons, sleeping bags, duvets etc.	2180 - 60
4. Administration	
Paper	16 - 00
Crates	50 - 00
YET sub.	6 - 00
Report	96 - 98
Film	120 - 00
Campsites	35 - 00
Insurance	15 - 00
Printing (maps, raffle tickets, etc)	145 - 00
Group Passport	11 - 00
5. Shipping	
a) Felixstowe - Reykjavik	196 - 65
b) Reykjavik - Felixstowe	80 - 84
c) Dock fees (both ends)	72 - 45

Brought forward: £7222-17

6. Miscellaneous.

Paint	12 - 00
Zip	3 - 50
Medical	12 - 95
Tools	44 - 20
Cooking	3 - 10
Toilet	2 - 50
Tent repair kit	14 - 25
Rope	15 - 00
Crampon straps	10 - 95
Abseil gloves	8 - 90
Material for rock flaps	47 - 63
Petrol for van to Felixstowe	25 - 68
Batteries for tape and tapes	5 - 00
Cotton	3 - 20
Postage	11 - 72
Paraffin.	28 - 00
	£7470 - 75

Balance £-41-31

We hope to raise the balance by selling copies of the report and other fund raising activities.

b) Travel and Route

Our flights were arranged through Twickenham Travel. All these arrangements were excellent and we would like to extend our thanks to TT. for their efforts.

Owen flew out three days before the main party to sort out the freight which had been sent out four weeks previously. This proved to be a great benefit as we were able to get into the field almost immediately.

From Reykjavik we travelled to Laufafell base camp by chartered bus. The excellent arrangements for this were made by Dick Phillips and we are most grateful to him for all his advice and help with this.

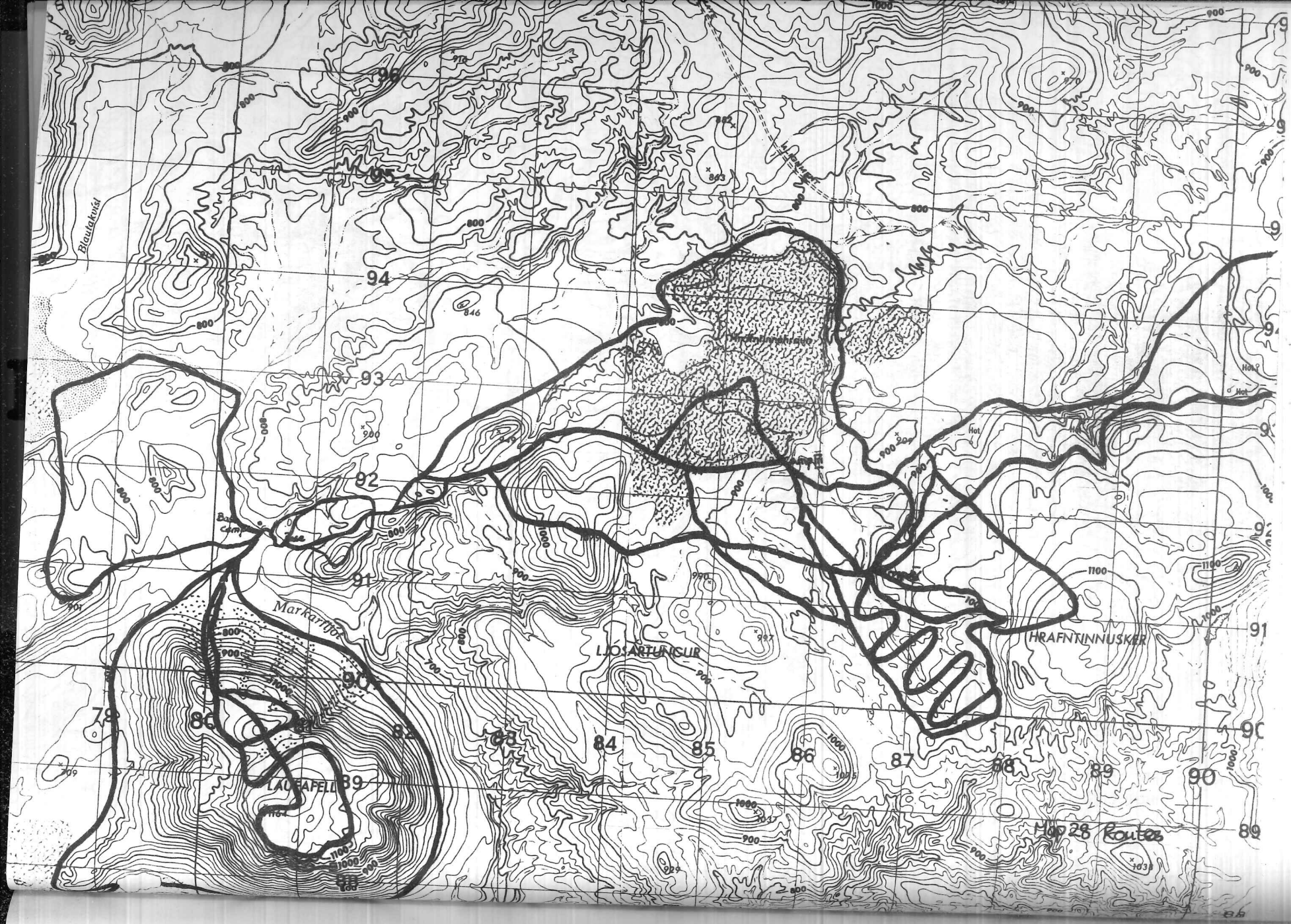
The route from Reykjavik to Laufafell begins on tarmac road which after Hella deteriorates to lava track. This track has been much improved in the last ten years.

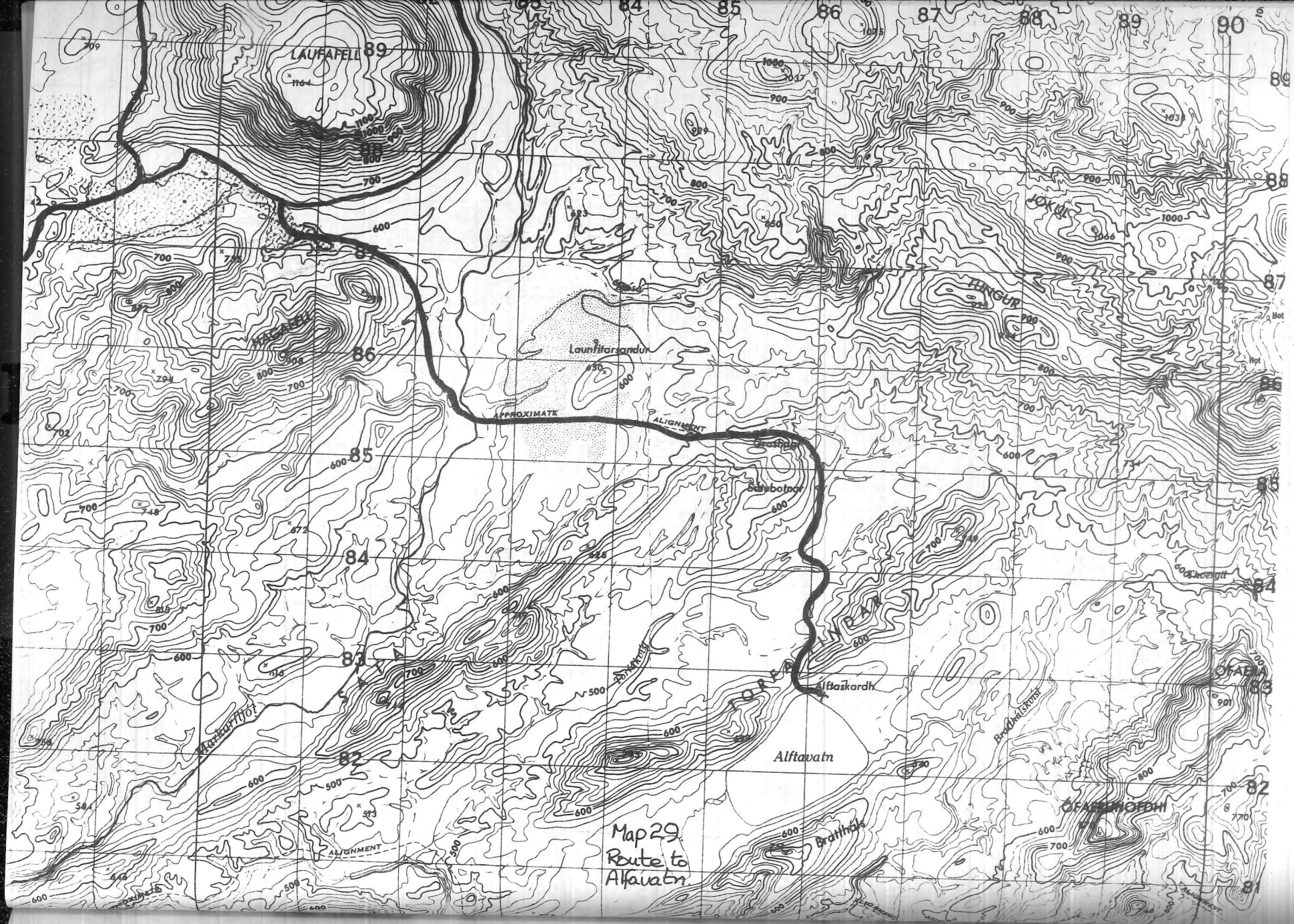
The campsite is not very suitable. When we arrived most of the valley was under snow and we had to squash all the tents into the lower part of the valley. Drinking water was obtained from the meltwater stream.

Camp IV was much smaller than in 1978 due to the large amount of snow still unmelted. It was also very wet under foot.

We also hired a bus on the second to last day in Iceland and visited Thingvellir, Geysir and Gullfoss. A very worthwhile trip.

On arrival back in England Mick McCord was waiting for us. We are very grateful to him for giving up his time to take us back to Norwich.


Blautakvísl
Markarfljót
LÓSÁRTUNGUR
HRAFNTINNUSKER
LAUGAFELL
Map 28 Routes


LAUFAFELL
HRAFNAFELL
Laufafarsandur
APPROXIMATE
ALIGNMENT
Sandbotnar
HRINGUR
JÖKULL
Alftaskardh
Alftavatn
Brattháls
Map 29
Route to
Alftavatn.

Map 30
Route to
Landmannalaugar
TORFAJÖK

c) Food.

We took with us food for 21 people for 28 days. In addition we took Bread flour for baking and Soya scone and Cake mix. The scone and cake mix were excellent but needed some experimenting with to get right.

Breakfast.

This consisted of Porridge or Crunchy or Muesli, with tea or coffee

Lunch

This consisted of sardines or cheese spread with bread or compo biscuits, Yorkie or Rolo or Kit-Kat, Fox's Glacier Fruits, peanuts and sultanas, and a packet soup.

Supper

This consisted of a Raven Meal plus Soya Mince or Tinned Meat or Soya Beefburgers or Soya Sausageburgers with potato or rice, baked beans, tinned fruit and milk pudding.

In addition to this basic menu we also took quantities of the following:

Coca Cola
Raisins
St.Ivel 5 Pints
Tea bags
Spaghetti
Meat pastes
Fish Pastes
Digestive biscuits
Tuna fish
Rise and Shine
Hot Dog Sausages
Honey and Peanut Butter
Jam
marmite
coffee
Real Coffee Bags
Oxo Cubes
Carnation Milk
Carnation Build Up
Coffee Mate
Syrup and sugar
Horlicks
Colmans Sauce mixes
Assorted Soya Mixes.

d) Bread Making

After our attempts in 1978 at bread making we decided to spend more time and to experiment more. The result was that we had fresh bread every day and also scones and fruit cake of sorts once a week. The many variations of the bread made a welcome change to our dehydrated diet and the experiments with the many recipes used provided an entertaining sideline to the expedition. Below is one such recipe.

Jerry and David's Final Solution

Heaven help us!

Pour mettre le bread vous takez les ingredients à follows

uno) 2 bags de Reads fleur brun et blanc
duez) 1½ oz de margèrine
trez) 1 level tablespoon of salt
quatro) 2 pints de fairly chaud aqua
chinque) Owen's tea et moi Cherry Brandy.

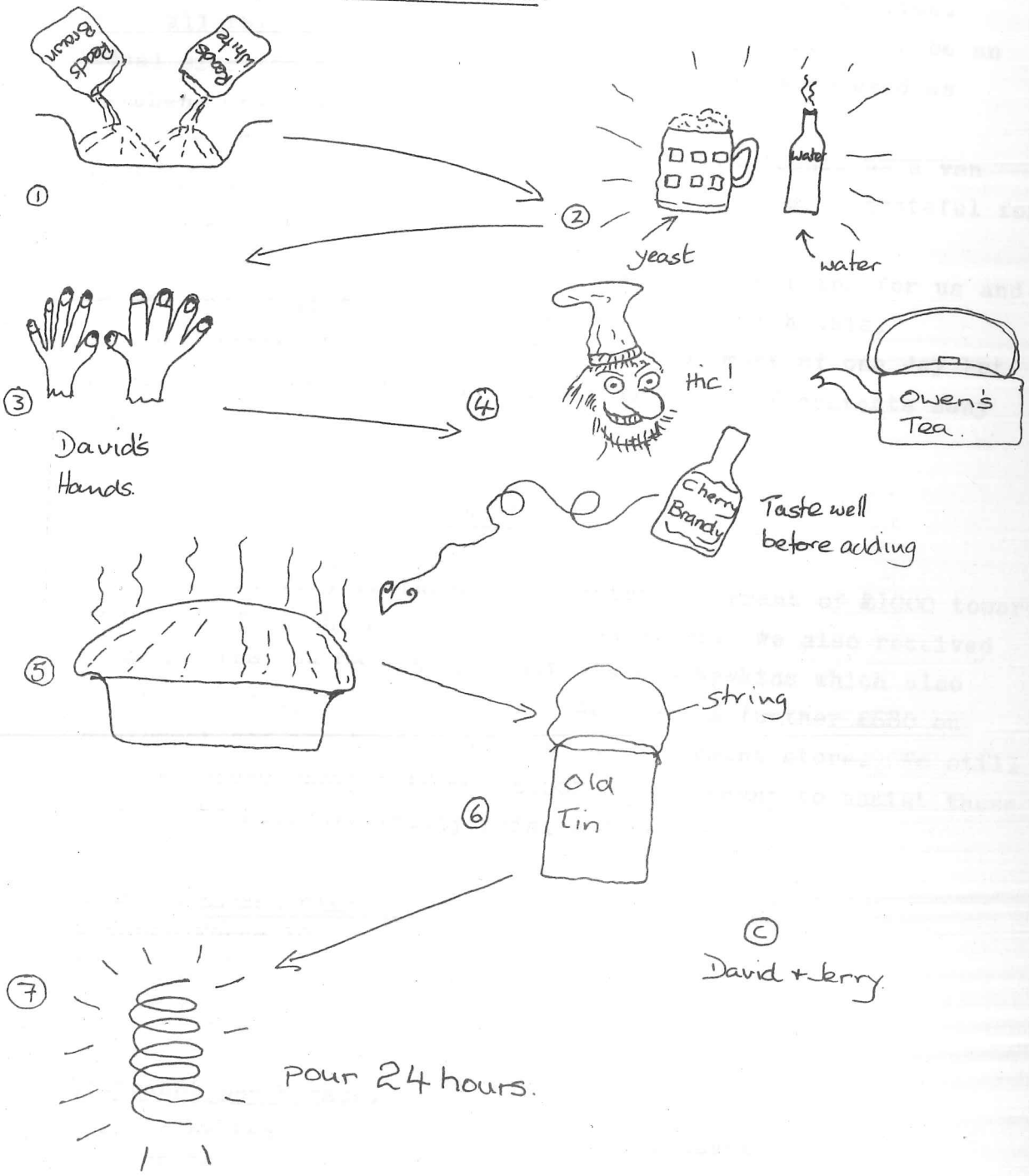
Aussi 12 level teaspoons de dried yeast a mixé avec un pint de fairly chaud water and leave à froth pour 10 minutes.

Le way a mettre le Grand Mixture

1) vous pretté le fleur dans le bowl et mixé le margèrine et le salt avec il.
2) Mettre le yeast concoction into le mixture avec le rest de la water.
3) Mixe le mixture et knead like mad
4) Addez le Cherry Brandy (taste before hand to make sure it has not gone off) and Owen's tea if it will dare leave the kettle.
5) Finding what un bloody mess you've made add extra fleur and get un bon dough
6) Leavez le deux loaves at least 2 hours and then allez à le

chaud spring et cook pour 24 hours.
Eat it if you dare! They did.

Illustrations.



e) Shipping.

All our food and a large proportion of our equipment was sent out by ship four weeks before the main party arrived.

All this fitted into 21 tea chests which proved to be an ideal size for this job. The tea chests were also used as kitchens when we were at base camp.

Mr. Stevens of Mann Egerton in Norwich loaned us a van to transport the stores to Felixstowe. We are most grateful for his assistance.

McGregor, Gow and Holland arranged the shipping for us and we are very grateful to them for their help with this.

Collecting the crates in Iceland took most of one day but there were no problems. Go armed with lists of contents many times duplicated!

f) Equipment.

We were very fortunate in receiving a grant of £1000 towards equipment from the Joanna Scott Foundation. We also received a grant from the Churchill Trust via Guy Hawkins which also helped to equip the expedition. We spent a further £680 on equipment and now have a substantial equipment store. We still need to spend another £800 - £1000 on equipment to assist those pupils who have difficulty raising funds.

Equipment per pair.

1 Vango Force 10
1 primus stove
1 bivi bag

Equipment per Person.

1 sleeping bag
1 pr boots
1 duvet
1 set waterproofs

4 prs socks
2prs. Trousers
2 pullovers
2 shirts
1 pr training shoes
1 hat
1 pr gloves
1 pr gaiters
1 set mess tins
1 kfs
1 rucksack

1 compass
1 map case
pencil and pen
1 karrimat
1 camera
1 ice axe
1 pr crampons
washing kit
1 pr sunglasses
1 mug
1 water bottle

General Equipment.

1 Icelandic store tent and flysheet
1 bucket
1 washing bowl
1 jug
2 funnels
1 double burner primus
6 helmets
3 safety ropes
4 climbing ropes
25 karabiners
6 belts
10 slings
1 tent repair kit
3 medical kits
1 large medical kit
100 toilet rolls
1 box washing powder
1 gallon washing up liquid
meta fuel

3 tea towels
shovel
string
rope
snappie bags (wrong size!)
Tilley lamp (didn't work!)
string bag.

Scientific Equipment

Max-min thermometer
4 thermometers
barometer
hygrometer
3 Quadrats
sample net
specimen tubes
tape measures
clinometer
agar plates
range poles
stakes

g) Planning and Safety

March 1979	Idea broached to headmaster
May 1979	Members chosen
June 1979	Flight provisionally booked
	Sponsor letters sent out
November 1979	Application for grants and Research Permit
February 1980	Purchase of some food and equipment
May 1980	All food purchased. Passport application sent off
June 1980	Food packed and sent off.
July 1980	Expedition.

On an expedition to a remote area safety is of prime importance. In this area if there had been a serious accident we would have had to walk to Landmannalaugar to radio for help. This would have take about 6 hours.

Part III

Diary

1. Diary.

15th. July
Owen flies to Iceland in advance of the main party.

17th. July.
Iceland: Owen retrieves the crates from Sundahofn. Crates taken to campsite and sorted.
England: A large farewell committee waved goodbye. At last we were off to Iceland. We arrived at the airport in plenty of time for our flight. Mick McCord, who had kindly driven us to Heathrow, left us waiting to be weighed in. Noone was overweight and we proceeded through customs and passport with no difficulties. As expected our flight was delayed by half an hour but there was plenty to talk about. Guy Hawkins and his crowd from Canterbury had arrived just in time to be weighed in and were now introducing themselves to the rest of the party.

To get a good seat on the plane we walked/ran along the corridors to be first in the queue for boarding, the official in charge obviously deleighted by our enthusiasm. Some of us had not flown before and found the take of and landing an amazing experience. It was an easy flight with very little turbulence, we saw the sun set/rise over the thick clouds below and enjoyed a superb meal. The majority of the passengers were English, we were travelling with two other expeditions, both of which were male only.

At midnight we landed at Keflavik, Icelands only international airport. Once through customs and having found our luggage we loaded onto one of several coaches taking people to Reykjavik. The coach driver sped down the middle of the road through an extremely barren landscape.

18th. July.
Owen met us at the campsite and brewed tea while we pitched tents in the cool and misty early morning light.

Four hours later we were up again. A quick breakfast before laarning to light primus stoves. Everyone then went into Reykjavik to send off arrival messages and examine a provincial capital. Everything was very expensive because of the high importation costs, but there was a fascinating collection of European and American goods.

After the tents had dried, everything was packed ready for the bus. It was a lovely clear sunny day so we sunbathed until the bus arrived. As with everything in Iceland, the bus was meticulously clean. The crates were loaded inside and the rest went on the roof.

The main road of Iceland is tarmaced for most of the way to Hella so the first couple of hours were comfortable. Crossing a large flat plain we saw what little farming goes on and a few of the larger towns. The last outpost of civilization was a cafe,

shop and garage. After that the road became a track marked by posts across black barren ash. The scenery was awe inspiring. It began to rain for a little while. The bus crossed the Mrkarfljot safely but found no exit point. The driver then reversed back into the river river and drove along the river until a suitable place was found. We unloaded the bus and said goodbye to an excellent driver.

The store tent was first to go up then our tents. The pegs were easily pushed into the soft ash. Large stones were placed all round the tents before supper. Rice and Risotto cooked on dirty primuses which tend to blow out, flame or fume is very filling but not too wonderfull.

A meltwater stream served our water needs, very delicious but rather chill for washing. Our first night was clear and cold.

19th. July.

A cool crisp morning and hot porridge for breakfast. For the first and last time we washed up straight after the meal. A seemingly large amount of food was distributed and we attended a talk on general behaviour and safety. It took 1½ hours to pack our day sacks and rations before Dr. Clarke (Dave, Doc or Capt.Caveman) led us out for our first walk. It was up the hill at the back of camp the loose rock was rather hard to walk on but the view was tremendous. We visited a large waterfall on the Markarfljot before finding the local hot-spring. In a hot vent we cooked our soup by dangling our water bottles in the swirling water. After lunch we went northwards rejoining the Markarfljot and going upstream where we saw a mountain hut and some large volcanic plugs. Once back at the camp everyone bathed their feet in the cold stream and an inspection noted the beginning of several blisters.

Jo and Joelle made the first batch of bread and left it in the hot ash at the hot spring for 24 hours.

Spaghetti Bolognese cooked to perfection over a now clean primus tasted delicious. Jerry managed to heat up his Angel Delight forming a sticky strawberry liquid plus lumps.

Evenings are non-existant. They are as light as day so we practised crawling crab fashion up snow faces - the new art of cramponing met with unanimous enthusiasm.

20th. July

'Wakey Wakey!' and much clamouring aroused the camp and much bad language rose from several tents. Only an hour overdue we were ready with ice axes and waterproofs. Guy was in charge. To be told to go and stand on top of a snow hill then throw yourself down it is not the pleasantist of ideas. But once used to the idea of glissading-a posh word for sliding down a slope on the behind is tremendous fun. The main problem is how to stop. Guy had the answer to this as well - ice axes! We practised stopping with ice axes for most of the morning. Abseiling next.

Lunch was at the hot spring, the duration of which was spent drying off. This exercise proved useless since most got wet again clambering around the river bank.

Snow bollards were dug on a suitable bank of snow and then we tried abseiling down a sheer snow wall. Very good.

The bread was dug out after supper - it was good although a bit yeasty. The ladies then had a wash having the hot spring to themselves for the evening.

21st. July

After reconstituted stuff the bread was superb, a welcome addition to our diet. As usual Jo was last ready. Today was our first survey day. We split into several groups and went to the hot spring to carry out transect surveys, temperature mapping, flora and fauna collecting and mapping.

We used the snow tunnel to get to the spring. It was beautiful, a natural vaulted crypt although rather damp. A faint blue light showed where the roof was thinnest and the warmer spring water flowed through the centre.

In the evening Guy took some on a walk to the watershed and back. Walking in the evening is cool and pleasant.

22nd. July

A second day of surveys was going to complete the base camp hot spring study. It was cloudy but quite mild. Breakfast was Jordan's Original Crunch - delicious.

We finished most of the surveys after lunch. Siobhan dug out the next batch of bread and then returned to base to write up some of the results of the surveys.

Before supper Guy organised some more difficult glissading over a vertical drop. We also practised cramponing up the slope!

23rd. July

It was raining when we woke up but everyone was ready almost on time. Guy led the party while Owen brought up the rear. We made our slow way to Austur Reykjadalir. We were carrying 2 days food with us to stash near our new camp - Camp IV.

After a kilometre we dropped our packs to adjust our clothing. It was essential to be comfortable for walking. It was drizzling but finer weather was coming. For the longer walks across snow we used crampons.

The region of snow ended and the block lava began. It was rugged and hard to negotiate. Austur-Reykjadalir was an impressive area. Hundreds of hot springs and brightly coloured rocks.

We stopped for dinner by the river, made memorable by Jerry's stepping stone dances. He got soaked but looked very funny trying to balance on a rocking stone. Doc got soaked by a well placed boulder - courtesy Guy.

Lunch over we then set about exploring the crater of Hrafntinnahraun, a fantastic place. Jerry's rucksack somehow obtained some rocks which were not discovered for some time! Out of the crater we reached the edge of the block lava and waited for Owen and Guy to return from inspecting camp IV.

Back at camp we had a good supper and spent the evening

making steam puddings and chatting.

24th. July.

The rucksacks yesterday were nothing compared to the weight we had today. They were difficult to lift straight up but once properly adjusted it was not too bad. The worst part of the walk was at the beginning - uphill. The sun came through and made the snow brilliant Rob led us at a good pace and we did not stop too often.

Lunch break at the river again and then on again to Camp IV. The leaders left us in the hands of Rob and Jasper to find the camp. The river wasn't much fun with the heavy packs and we had to negotiate some very muddy slopes.

Finally we reached the camp site and hurredly pitched our tents while the rain had stopped. Rucksacks and other equipment were stored in the snow tunnel, out of which flowed our fresh water supply. The ground was soft and warm. Once settled in the ladies demanded a hot shower. It was lovely, like a shower at home although a trifle draughty once out of the water. The shower in fact, was a hot waterfall. Unfortunately, it started to snow and we narrowly missed an embarassment as a group of Icelandic walkers came over the brow of the hill. Owen and Guy returned to base and we all crowded into the largest tent.

25th. July.

Away from the early morning enthusiasm of Owen and Guy we slept in late, until they arrived half way through the morning with 80 lb. packs. It had been a warm night compared with the below freezing temperature of base camp. Just before noon we set off to explore the hot spring area. It was fantastic. There were so many different shapes, colours and sounds. We had lunch at the only geyser in the area. There was one large pool with irregular eruptions and a small pool which erupted twice and never again while we were there.

Supper was an incredibly hot curry. Guy and Owen returned to base.

26th. July

The weather was damp and cold. Siobhan came up in a large rash over her hands due to the sulphur in the water. The wind was strong and cold so people wrapped up well to start with, then had to reduce layers as we walked. We went to the top of Hrafntinnusker via the geyser and had a superb view over to Myrdalsjokull and Tindfallajokull. We did not stay long as the weather started to deteriorate. It started to snow as we made our way to the enormous ice hole. This was magnificent. Owen approached the hot spring area he fell down a crevasse and had to do it twice more for the camera.

27th. July

A clear blue sky awaited us. Hot sun so on with trunks and shades. The camp became a giant washing line! Owen and Guy arrived with heavy packs having taken a long cut over the tops of three mountains to get some photographs. Jo broke a tent pole which was eventually mended. Andy and Jasper immersed themselves in the

and were reading books. Owen then showered the sunbathers with cold water.

Up to the ice hole for a bit of abseiling and some studies. Guy and Owen set up an abseil over the sheer wall of the ice hole. A better spot was found for this and Jerry managed to turn upside down during his descent.

Hubbard and Pinnock returned to base with Owen and Guy.

28th. July.

The Davids arrived at camp with a load of supplies. The snow toilet was suffering badly due to the melt!

Off to the geyser for a session of mapping and measuring, collecting and recording. Rain descended in the evening but everyone was kept amused by Jerry!

29th. July.

Everyone up early and packing equipment for our walk t o Landmannalaugar. Owen and Guy arrived from Base and we set off due east and into the cloud. It was wet and cold and the compasses were not much use with all the iron deposits around. Eventually we managed to find the route but not after some time wandering in thick fog over loose scree slopes and very rough terrain. Lunch was eaten sitting huddled in a gulley out of the worst of the wind and rain.

We found the well trodden route into Landmannalaugar and had the block lava to negotiate. Finally we arrived and put up our tents.

As soon as this was done we all went into the hot pool for an hour long soak. A late night.

30th. July

After a restless very windy night the tents were very smelly with so many people squashed into them. Some managed to post cards and others went into the hot pool again. We all tried the mud pool which was very invigorating. Pilch took the idea of getting clean to the extreme - he stayed in for8 hours setting a new record. He emerged as a very clean white prune!

31st. July.

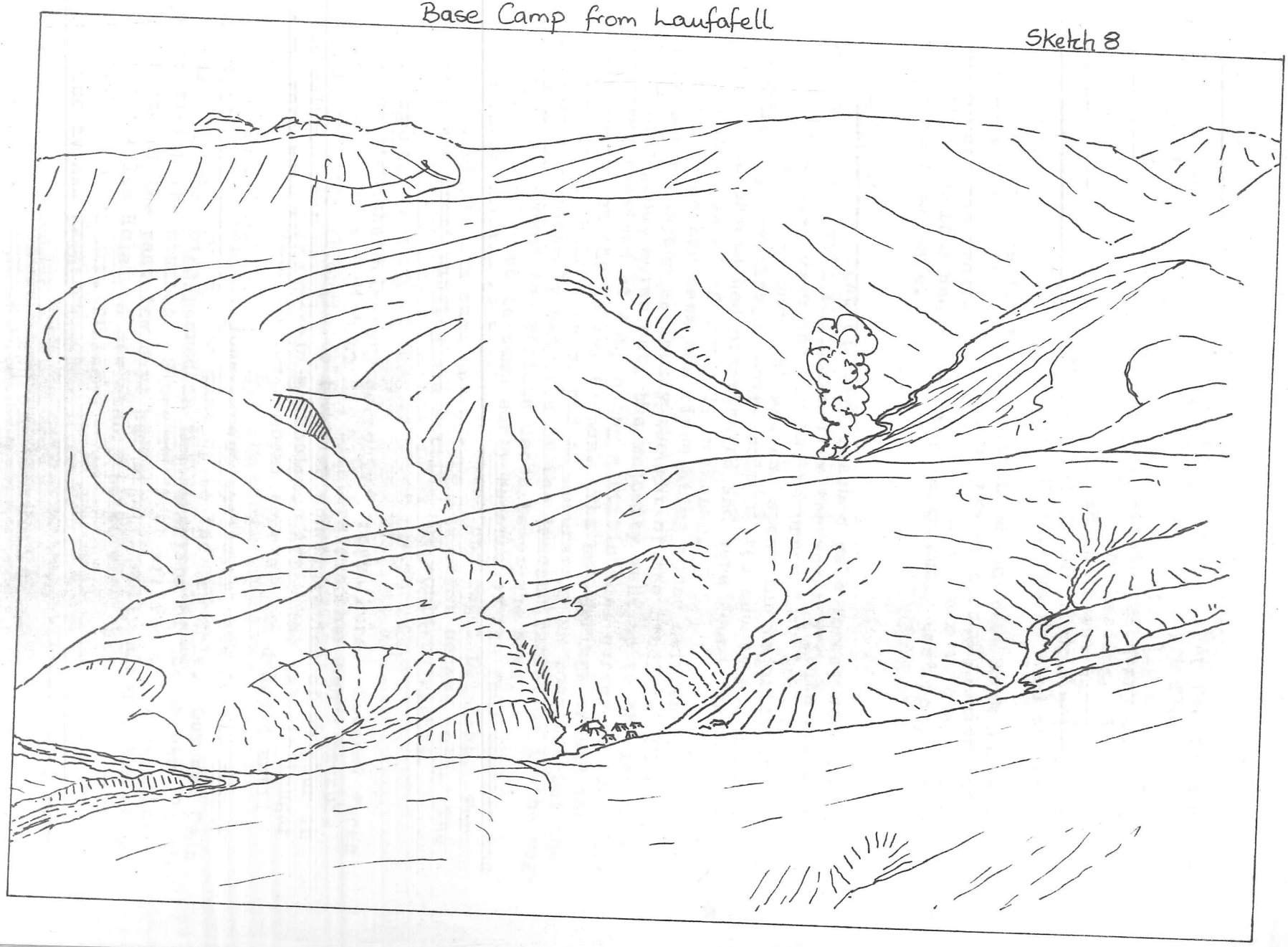
The weather was all wrong for our walk back. In the valley it felt hot and sultry. Just before departing we managed one last superb dip in the hot pool.

After the incoming walk the scenery was magnificent as it was revealled in its true colours. The moss was bright green and covered richly coloured rocks. In the distance a brightly coloured green lake sprkled like a jewel. For the first hour the going was hard. It then became easier.

No problems with navigation. This time we ate our dinner in a pretty meltwater stream valley, covered with moss and littered with hot springs. For valley walking adjustable limbs are essen-

Base Camp from Laufafell

Sketch 8



tial, one leg needs to be shorter than the other for the whole length. An added attraction is always the swift flowing stream waiting for a side to collapse or someone to slip or trip. We followed the stream round until a certain tributary cascading down from the lava plain for which we are heading. It fell through a small steep gulley at the top of which it was narrow enough to cross. Several people came near to grief at this point. At the top and reorientated, Owen and Guy left us to find our own way and disappeared.

Just in time for tea we descended our snow bank and examined a very wet campsite, the small meltwater stream flowing through the middle was swollen and had burst its banks at one place. The toilet had melted and was rather dangerously unsteady, otherwise everything was safe.

1st. August.

During the night the wind reached gale force, down in our small valley we were well sheltered from the worst effects but base suffered badly. Owen and Guy had returned late last night to find the store tent smashed flat and had spent the majority of the night clearing up, erecting a centre pole of tea chests and milk bottles. Several tea chests had disappeared and were found further down stream either as firewood or severely weakened.

While the bad news was circulating noone stirred and lunch was eaten before anyone seriously thought of the studies. Straight after the geyser group moved out, the majority went up to the ice hole and Jerry remained at camp doing a statistical survey of the stone distribution on the valley slopes. The hot springs around the geyser and ice hole were mapped as accurately as possible but the accuracy was severely hampered by the immense variation in the magnetic field around the various deposits of the area.

People returned to camp early because of the foul weather and ate a large helping of bolognese sauce and Angel Deleight. For half an hour the sun came out before the night became cold. The evening was spent singing and setting the world to rights.

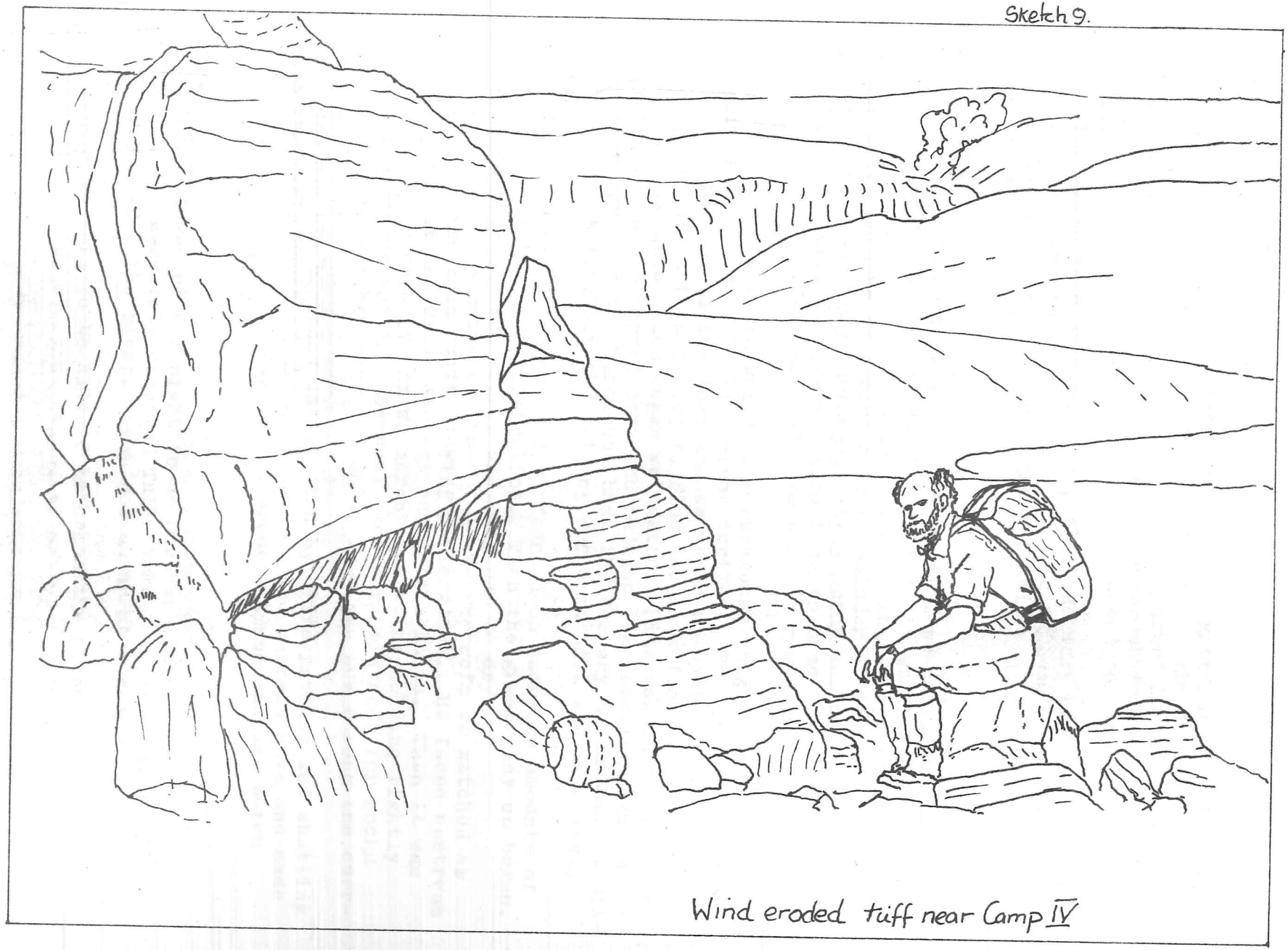
2nd. August.

The atmosphere is very corrosive around here. Several faces were rather raw and Siobhan had blisters over her hands because she is probably allergic to the high concentration of sulphur in the water. Feet are always a problem. After the walk to Laugar some were very tender so the removal to base was delayed until Sunday.

By mid morning everyone except the swamp rats (alias Jasper and Rob) were ready for the hike up to the Ice Hole. Guy and Owen led the way then disappeared in the direction of the shower leaving us to finish the studies. Since we first arrived the fantastic melt rate of the past few days had significantly altered the structure of the Ice Hole. A new abseil point was found and prepared while the studies were finished.

One by one people descended the abseil. At first faces were

Sketch 9.



Wind eroded tuff near Camp IV

tight and concentrated but by the end were grinning with the sense of satisfaction. Jerry made it all the way - the correct way up and unlike several others did not come to grief in the muddy stream at the bottom. The girls went for a shower while the abseil was cleared away and everyone eventually returned to camp for our last evening.

The swamp rats beer was foul, flat and very weak but sophisticated in comparison to the melee for the raisons and peanut butter. Our entertainment was of the highest possible standard - really mad games in the mud and snow.

3rd. August.

We had packed the night before so that we could lie in but we were not allowed to for long. Weatherwise it was an ideal day for walking but it was a sad business packing everything including razor sharp chuncks of obsidian as a reminder of the area. The litter parade was very thorough. Every scrap was collected and burnt, then packed for transporting back to base. Nothing can be buried in the loose ash soils because it takes such a long time to rot.

With all the extra weight the rucksacks hung uncomfortably on our backs and we felt like drunk turtles. The valley side gave way under the repetitive load and we ended up wading through the stream. It did not take long to find the lava flow and where it ended and the snow patch began we rested. Mike was suffering from a broken toe so we slowed down and enjoyed the dazzling snow and pure blue sky. As we approached base the scenery became more starkly black and white, but the walking was down hill and relatively easy.

It was early afternoon and we feasted on enormous amounts of rations as a late lunch celebration. Then the great tidy up began. Everything possible was washed and hung out to dry.

Dressed in swimming costumes and waterproofs we watched as Owen crossed the cold swift flowing Markarfljot. He faced upstream so the force of the water did not buckle his knees. Then it was our turn. In groups of six we marched crabwise holding tightly round each others waists. Several feet were mistaken for rocks but it was amazing how warm the water felt and how strong the current was.

Rob had his birthday anticipated by extra rations and chatting into the early hours of the morning. Jo had a brain wave and made some superb drop scones out of the scone mix and another batch of bread was buried.

4th. August.

Jerry stayed up all night to do another set of river survey readings. He certainly deserved full marks for perseverance and certainly needed the sleep. Owen got us up at a reasonable time with a fresh kettle of tea.

Today we were to be allowed to cross the river the dry way. During the morning everyone helped to set up the rope bridge. All

the tension possible was essential because of the amazing amount of stretch in the rope. Owen tried it out first. The pulley made the first half of the crossing easy but the climb upwards took a lot of strength.

Disaster! Owen got stuck half way across because the rope had slipped onto the spindle of the pulley. He tried to free himself but slipped of a stone and was ducked. Guy was amazingly agile as he crawled along the rope to Owen and painfully slowly wheeled him back. Meanwhile the effects of the wind, water and pressure were wearing Owen out. Suffering from hypothermia and two cracked ribs he was dragged out and resuscitated by steaming in as hot an atmosphere as possible. Everyone crammed into the store tent and primus stoves were lit to form a tropical heat. Everyone pulled together really well.

Hubbard's bread was excellent refreshment when the worst was over and the Kenco Coffee superb!

As a form of exercise and escape Guy took everyone except Jo Darts and Pilch on a very wet walk along the river up to the gorge. And that was not the end. A couple of young Icelanders had a large red car stuck half in and half out of the Markarfljot so all turned out to push and pull including Owen, much against everyones advice. After stalling the car once they made it across and everyone returned for a hot drink and dry set of clothes.

5th. August.

Just the same as yesterday finished we woke to the constant patter of rain. Jo and Siobhan arrived for breakfast after a sleepless night. Owen had fainted again and had to be watched carefully. Today was therefore declared one of rest and recovery. Most people remained inside their tents reading and eating the vast supply of goodies rationed out to keep them quiet. Jonathan had a very quiet and sleepy birthday.

A continuous session of people moved into the store tent for social chatter and so the day continued. Late in the evening Owen

and Guy discussed the mini expeditions with Rob and Darts, the two appointed leaders.

6th. 7th. and 8th. August. Mini Expeditions to the west of Laufafell and the lakes there; and to Alfavatn. Owen and Guy completed the surveys of Austur Reykjadalir and climbed Laufafell.

9th. August.

Owen and Guy did there 'Wakey! Wakey! - Tea' early morning call. It was a windy drizzly morning, not the pleasantest of prospects viewed from a warm sleeping bag. As a superb way to start the day we all crossed the rope bridge using the tried and tested descender method. It was great fun especially to look down on the swirling waters suspended by nothing but one rope. The method is rather slow and laborious for a whole team. It took a good hour for everyone to cross.

By twelve we were cold and wet but finally moved out across the plain towards the red hill in the distance. Passing Laufafell was a hard struggle against a heavy wind but fun! The redness was caused by iron oxide in the ash spewed from a volcano. Large globular masses had landed as bombs with flanges due to their spinning motion. A surprisingly easy climb over the trecherous loose rubble was helped by the wind pushing up from behind. The view from the top of the hill was mervellous and abruptly halted by the low cloud chopping the summits off all the highest peaks. Once over the ridge we dropped out of the wind and marched across a very flat black lava plain. Up and over a small ridge via a steep gulley we were in the middle of a range of volcanic hills. Then sheltered behind a large rock outcrop we ate well before setting off again.

After crossing a snow face we had to cross a large flat ash plain. Poor Marco was suffering from a bad ankle and had to be sheltered and relieved of his pack. The wind was amazing. The strong gusts blew you backwards and dust was a severe problem. Across the plain were several valleys all leading towards the Markarfljot and we had to pick the wrong one. After a short rest we followed the tributary round until our way was blocked. There was then no alternative but to go up. Marco was suffering and it was still windy. The triangle of the mountain hut came into view and we walked round the gulley towards it. A stable solid building which was musty but very cosy.

Already well outside our E.T.A. Guy hurried us onwards walking along the upper edges of the river bank. Gradually the camp came into view. On until we stopped by an Icelandic four wheel drive car, the occupants came out and chatted and we heard the latest Olympic Games results.

Disaster! Two tents had collapsed and the rope bridge was fraying. Everyone crossed the river as befor but in larger teams of 8, fully clad and soaked to the skin. Rob and Jasper had their tent

re-erected within minutes. The girls tent was harder and ended up suspended in muddy drapes between jury rigged poles. Everything was soaked.

10th. August.

The clouds cleared to reveal a beautiful day, absolutely ideal for drying off after yesterdays escapades. Base blossomed with drying lines and mats drying in the new heat. As a finale to our expedition we were to climb Laufafell. An excellent day. Not everyone went but it was fantastic. A hard climb of 1½ hours was rewarded with an unparalled view and the promenade around the top revealed a large trecherous gulley around which the wind whistled. It would not have been right to clamber down when an alternative faster method was available. Glissading down a snow slope was an amazing experience, immensly thrilling - it took 1½ minutes to descend!

During the evening people cleared up before the sad celebrations began in earnest. By some feat we all managed to squeeze into the store tent around a large table of upturned tea chests. We ate to our hearts content feasting on such delicacies as jam, tinned fruit and beefburgers. The tent was stifling so for the remainder of the evening people chatted and sang around a large fire. Nature gave a grand finale of a clear, bright sky and a few minutes of the Aurora Borealis.

11th. August.

A madness overtook the camp this morning as we packed to leave the area. It had a horrible finality about it. Every rucksack was filled and the remaining tea chests packed. At mid morning the bus arrived, an hour early which sent everyone into a flurry of activity. We combed the valley and river banks for any small scrap of litter, and collected our burnt rubbish in two tea chests. At noon everyone boarded the bus and we left. For three hours we bumped across the rough Icelandic tracks. Most people slept, exhausted.

Arrived at Reykjavik in time for tea. The school was very clean and neat with excellent lighting and toilet facilities. Beds were polythene covered mattresses which felt quite luxurious. As happens at every convenient washing place all spare clothes were washed and dried, only then could we explore Reykjavik.

12th. August.

First several items of business had to be attended to. The removal and passage of the crates had to be checked and then thank you letters to all the firms who had so generously helped us, had to be written. The rest of the day was ours.

As a group we wandered down to the swimming pool where we sampled more of Iceland's energy. The pools were beautifully warm with no chlorine because they are flowing outlets of hot springs

2. Acknowledgements.

The success of a trip such as this is due not to one individual but to all those who helped in the organization, fund raising and the actual expedition itself.

We are very gratefull to all those people and firms who contributed time, money and products to our venture.

We wish to thank the following for their generous assistance:

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C & A
W.Jordan & Son Ltd.
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McGregor, Gow and Holland

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Last but not least a very special thank you to Sir Vivian Fuchs who helped us to raise money for the expedition by giving a talk on the'Trans Antarctic Expedition'. We are most grateful for his support.

3. Conclusion.

Our second expedition to Austur Reykjadalir was a great success despite one or two mishaps!

We managed to further our knowledge of the area and we plan to use this knowledge on the next expedion to the same area in 1982.

The success of the trip was due to many people. Tony Escritt of the Iceland Unit made the organization a great deal easier than it would have been. The advice and help we received from the Young Explorers' Trust was invaluable.

This year, though,we were unable to carry out some of the exploration side of the expedition. We had planned to visit Hekla and Myrdalsjokull but time ran out. We hope to explore these areas in 1982.

In 1982 we also plan to carry out a magnetometer survey of Austur Reykjadalir and produce a map showing the magnetic anomaly pattern in the area.

Owen J.Hunt
March 1981

Appendix I

Zone C

Hot Spring No.	Temp °C	Area sq. m.	Depth m.	pH.	Number of vents	Deposit	Type of Deposit	Notes.
33	87	5	?	5.5	2	✓	Blue/grey mud	Grey mud obscured bottom
34	31	8	0.05	4	6	✓	Small amount of sulphur	Large amount of vegetation
35	78	6	0.2 max	4	6	✓	Grey mud Sulphur	Some pools, small bubblers
36	97	0.5	0.05	7	2	✓	Yellow Sulphur	Bubbly growths. Gas vent
37	16	1	0.15	6	0	✓	Sulphur Silica	Almost extinct. No vents clear.
38	38	12	0.5 max	5.5	13	—	—	Bottom covered in green slime.
39	16	0.5	0.05	5	0	—	—	Mossy. Almost extinct.
78	14	0.5	1	4	1	✓	Red mud	Dying
79	15	0.2	0.1	5	1	✓	Red deposits	Dying
80	17	1	0.75	5	1	✓	Grey silt	Dying
81	33	4	0.4	5	0	✓	White mud	Still.
82	69	6	1	7	1	✓	Red mud	Continuous bubbles
83	25	4	0.4	4	1	✓	mud	
84	17	1	4	3.5	1	✓	mud	Slime inside deep hole
85	54	0.5	0.1	7	1	—	—	Slimy growth.
86	72	0.3	1	7	1	✓	White clay	disappears underground.
106	61	0.2	0.5	7	1	✓	White clay	disappears underground.
107	23	1	2	7	1	✓	clay	disappears underground.
108	40	0.5	0.5	6	3	✓	Kaolin	slimy growth.
109	42	0.7	0.5	6	1	—	—	—
110	50	0.5	1.2	7	1	—	—	Violent + noisy
111	91	0.1	1.0	7	1	—	—	quiet.
112	92	1	1.0	7	2	✓	Red mud	Much steam
113	91	1	1.2	6	1	✓	Red mud	Dry vent Noisy
114	85	1.5	1.5	6	1	✓	Sulphur clay	Very smelly
115	88	1.6	0.2	5	2	—	—	Some vegetation
116	91	1.4	0.3	7	1	—	—	Smelly.

Appendix II.

Tot Detergent.

We used this product for washing up and for washing our clothes in. It is a biodegradeable detergent and very concentrated. It proved excellent for both purposes.

Debba and Mitzi Cream.

We used these products because of the acid waters which caused the skin on fingers to crack. In 1978 this was so serious that one or two members of the expedition were unable to write. Both products were again excellent and there was only one case of split fingers. (due to the fact that the individual had not used either product).

All these products were supplied by Deb Chemicals Limited.

Arkady Soya.

We used a number of products made from Soya by Arkady Soya Mills. All the products were excellent but some experimenting was needed with the cooking times of the Scone and Cake mixes.