Milegram 207a

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PERLIMINARY REPORT

OF

DURHAM UNIVERSITY EXPLORATION SOCIETY'S

EXPEDITION TO THE TUNGNAÁ REGION

JULY - AUGUST 1960

C O N T E N T S

RAFORKUMÁLASTJÓRI

-• INTRODUCTORY MAP •-

19°48' West of Greenwich

64° 12' North

Akureyri

REYKJAVIK

Vatnajökull

Myrdalsjökull

Field Area

Sandafell

Sultartangi

Tungnaá

Hald

Kaldakvísl

Hrauneyjafoss

Hrauneyjafell

Tungnaárkrókar

Blautakvísl

Pjórsá

Valafell

Malfell

Lambafjallahraun

Þjórsárdalur

Loðmundur

HEKLA

1:100,000.

0 1 2 3 4 5 6 7 8 9 10 km.

all heights in metres

KEY

Rivers and Streams.

Vehicle Tracks.

High ground with spot heights.

INTRODUCTION

The name of the Expedition was Durham University Iceland Expedition. It consisted of six male members all undergraduates of the above named University.

The members were:

R. A. SHAKESBY - Leader
J. L. GRIMSHAW - Hydrologist
J. EMBERTON - Geologist
D. J. SALT - Geologist
J. P. FREEMAN - Meterologist
N. H. CLEMINSON- Botanist

The area studied was part of the valley of the TUNGNAÁ between Tungnaákrókur and its confluence with Þjórsá. The total area covered was about 600 sq. km. The programme of work was drawn up by the State Electricity Authority who have great interest in the area as a possible site for the development of hydro-electricity. The S.E.A. kindly provided transport to the area and we were supervised by MR. SIGURJÓN RIST who was of invaluable help to us.
In addition to the help rendered by the S.E.A. we also were advised on botanical and meterorological proceduce by MR. I. ÓSKARSSON and MR. F. SIGURDSSON respectively. Their help was also of great value.
The work extended over a period of 7 weeks: from 1st July to 21st August. The remaining five days of our stay in Iceland were spent in the offices of the State Electricity Authority writing reports.

HYDROLOGY:- J. L. GRIMSHAW, R. A. SHAKESBY

There were two main object in this work:

(a) to take level recording of the Tungnaá, Kaldakvísl and carry out continuous level recordings at hourly intervals in both these rivers and Þjórsá simultaneously for 3 days. and (b) to take sediment samples from the Tungnaá at a number of places.

As far as (a) is concerned the work was carried out successfully. Two Lea level recorders enabled readings for the whole 7 weeks to be made for one, and 5 weeks for the other.

The second recorder was set up at Hald where the State Electricity Authority are installing a recorder.
All these results have been made available to the S.E.A. before the expedition left Iceland.
(b) No results could be left in Iceland as samples must be weighed in England.

GEOLOGY:- J. EMBERTON, D. J. SALT

The State Electricity Authority requested an area be mapped between Tungnaákrókur and the confluence of Tungnaá & Þjórsá (Sultartangi). Detailed mapping of 1:5,000 was to be done at Tungnaákrókur & Hrauneyjafoss (the two dam sites within the area).
The geological mapping was completed and copies as well as reports were left with the State Electricity Authority before the expedition left Iceland.

METEROLOGY :- J. P. FREEMAN

Prior to our arrival we informed the Icelandic Meterological Offices of our intentions and they kindly gave advice as well as the loan of some instruments.
Observations were carried out twice daily on temperature, humidity, wind speed and precipitation. In addition to this surface evaporation was also studied.
All results were given to the Meterological Office before the expedition left Iceland.

BOTANY:- N. H. CLEMINSON

Before the expedition went into the field a visit was paid to Mr. Óskarsson who gave advice on a programme of work and information on species which would probably be encountered. The work was composed of a collection and identification of species after which the variation of flora from the riverbank into the lava was studied. Variation of flora at different heights along the valley was investigated and finally some observations of two parallel tracts of vegetation at Hald were made.
No rare species of plants were found throughout the duration of the stay.

Summary

The above paragraphs contain the main details of field works carried out by the expedition. The only other item not mentioned above is GEOMORHOLOGY which was not a definite part of the work. Observations in this subject were made casually during the various traverses of the country and a small general summary will appear in the final report. The report proper will, of course, be made on the expeditions return to England. It is expected that this report will be published in November when two copies will be forwarded to the Icelandic National Research Council.

It remains only for me to express sincere thanks to the National Research Council for allowing the expedition to work in Iceland, to the State Electricity Authority, in particular Mr. Sigurjón Rist, for supplying us with a programme of work. Finally, we must thank the many other people whose kindness and hospitality made our stay in Iceland such an enjoyable and profitable one.

R. A. Shakesby

R. A. SHAKESBY
DURHAM UNIVERSITY EXPLORATION SOCIETY,
1/2 SYDENHAM TERRACE
NEWCASTLE - UPON - TYNE
ENGLAND

A PRELIMINARY REPORT OF THE GEOLOGY OF THE LOWER TUNGNAÁ REGION

The field area is shown on the introductory map. Work was concentrated on the south bank of the Tungnaá between Tungnaákrókur and Sultartangi. From this, four maps were prepared:-

(a) A general map of the whole area on the scale 1:50.000

(b) A more detailed map of part of the area from Tungnaákrókur to the confluence with Hrauneyjakvísl; 1:20.000.

(c) and (d) Finally two maps of 1:5.000 were drawn of the Tungnaákrókur gorge and the gorge below Hrauneyjafoss (These are areas in which the State Electricity Authority propose to build dams).

From the field relationship observed an approximate Geological Succession was drawn up. (This must, however, be modified in the detailed report).

POST-GLACIAL	RECENT DEPOSITS
	LAVA FROM HEKLA SERIES?
	ÞJÓRSÁ LAVA
	POST- GLACIAL PYROCLASTS
PRE-GLACIAL	PALAGONITE SERIES
	HREPPAR SERIES

No detailed description of the main rock groups will be given here, but will appear in the final report after a Petrological examination. This preliminary report will merely state the occurence, type and mutual relationship of the rocks.

HREPPAR SERIES:

This rock group was examined in only one place in the area. It was seen forming the small hill on the east bank of the Þjórsá at Sultartangi. This was a poor exposure but a few blocks of basalt were found "in situ ". A large block of sandstone was found at the bottom of the hill, but it could not be ascertained whether the rock was part of the series. The west bank of Þjórsá seems to be composed of alternating tuffs and basalts although no exposures could

be closely examined. The maximum observed thickness is 82 m., from the bottom of the gorge to the top of Sandfell.

PALAGONITE SERIES:

This might be generally described as an alternating series of bands of pillow lava (basalt) and tuff.

Succession:

PALAGONITE TUFF	(at least 260 m thick)
PILLOW LAVA	120 m
TUFF	4 m
PILLOW LAVA	4 m
TUFF	8 m
PILLOW LAVA	(at least 24 m thick).

This series was best seen in the river section in the Tungnaákrókur gorge and in the gorge below Hrauneyjafoss although it formed the majority of the hills of the area. Many other exposures were examined, particularly on Valafell and on the hills to the east of Hald, but these were less complete. The tuff shows current-bedding characteristic of a water-borne deposit. At the base of the Upper-most tuff, in at least three exposures, a series of pebble bands occurred which were probably formed of either water-worn pillow lava fragments or volcanic bombs. The series shows the effect of extensive glaciation. A small basalt lava-flow caps the hills to the south-west of the Tungnaákrókur gorge. This shows no direct evidence of glacial action and so may be post-glacial. The Palagonite series was not seen in contact with the Hreppar series.

POST-GLACIAL PYROCLASTS:-

These form a series of "ash-cones" composed of cinders and pumice. The cones follow a line north-east to south west about 2 km west of Hrauneyjafell and are surrounded by both Hekla Series lava and Þjórsá lava. They reach a maximum height of some 70 m but it is very likely that they extend many metres below the surface.

ÞJÓRSÁR LAVAS:-

These are definitely post-glacial in age, and cover the greater part of the field area. They appear to originate in Vatnaöldur, almost certainly from a fissure, flowing in a westerly direction to Þjórsá and then south west to the coast. In the Tungnaákrókur gorge three lava (basalt) flows occur, the lowest being 12 m thick, the middle one 15 m and the upper about 6 m. It is difficult to distinguish between the three flows in the unwæthered section due their similar characteristics. They are vesicular basalts with large phenocrysts of felspor and occasionally some idocrase. The actual flows show a strong columnar jointing towards their upper and lower surfaces but in the centre this jointing becomes contorted.

Resting on top of the lower two lava flows at Tungnaákrókur are a group of varved sediments, showing that at some time in this area a lake had been formed and has since drained.
Similar sediments were discovered in the depression below the Tungnaákrókur gorge.
They can be divided into two definite groups. The lower group is composed of very finely laminated clay varves with occasional bands of ash and vegetation. The upper varves are very much thicker and are made up of a coarser grained sediment. This change of varve type is very clear cut occupying a very short interval of time.
A different method of counting was used for each group. Samples of the lower fine varves were taken in tins and the individual varves counted at the base camp. From this an average thickness of varve was calculated and found to be approximately 1 • 7 mm. Taking the total thickness of these varves to bae400 cm (356 cm were definitely observed), the total number of fine varves was calulated as approximately 2, 350.

The method employed in measuring the coarse varves necessitated the excavation of a trench because these are unconsolitated and do not present a vertical face. The average thickness of the varves was found to be about 2 cm and the total section measured about 10.45 m. Thus over 500 varves are present. Adding the two ages together this

brings the total duration of the lake to approximately 3,000 years.
In the smaller lake below the gorge 18 years of fine sediment and 10 years of coarse sediments were found.

Clearly there must have been two periods of sedimentation with differant sources of material. It was, however, impossible to investigate this further in the time available.

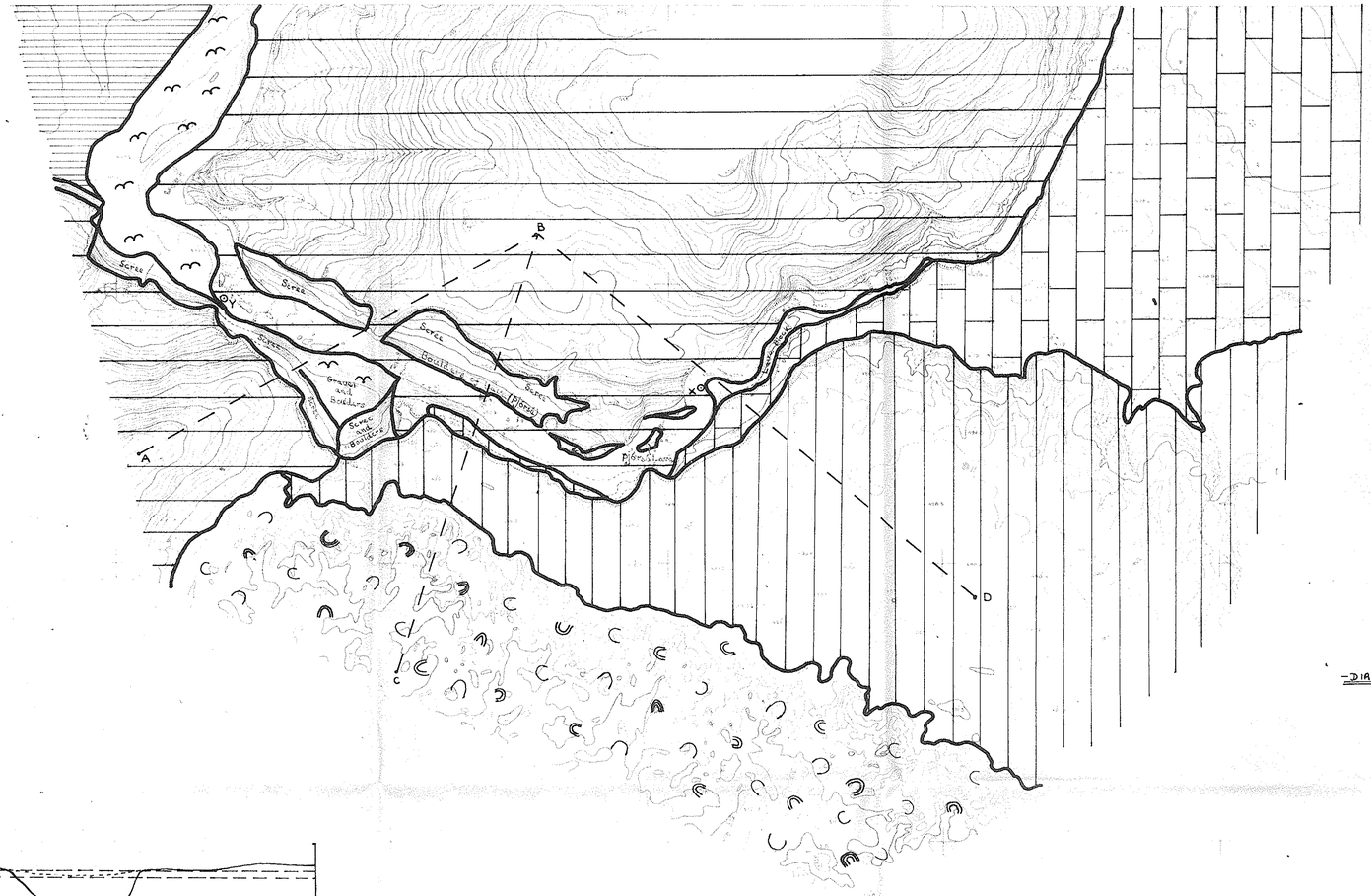
LAVA FROM HEKLA SERIES?

This lava is thought to belong to the Hekla series and if this is true it must be one of the earliest. The flow passes between Valafell and Hrafnabjarg, almost extending to the Tungnaá at Hald. It is a grey vesicular basalt like the Þjórsá lava but shows no columnar jointing and does not have the large phenocrysts. The lava lies on top of the Þjórsá lava.

RECENT DEPOSITS:-

This group includes alluvium, rivers gravel, ice transported river material and loess. The loess occurs at Hald in two parellel strips running north-east to south-west, 3 km in length and 200-300 m in breadth. This material is aeolian in origin.

The terms Hreppar, Palagonite and Þjórsá lava have been taken from a report to the State Electricity Authority by Guðmundur Kjartansson, geologist at the Museum of Natural History, Reykjavík.



KEY

RECENT DEPOSITS (Alluvium and River Gravel)

VARVED SEDIMENTS

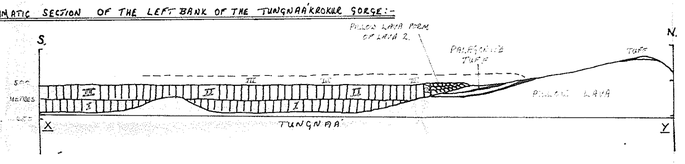
ÞJÓRSÁ LAVA 3

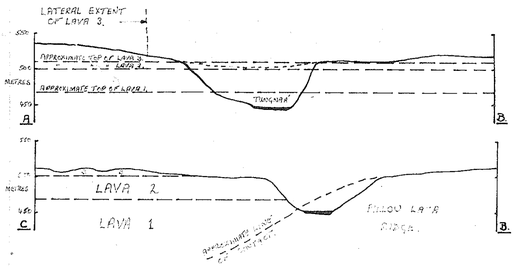
ÞJÓRSÁ LAVA 2

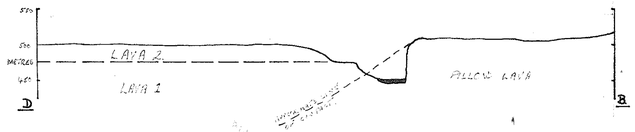
ÞJÓRSÁ LAVA 1

PALAGONITE SERIES

DIAGRAMATIC SECTION OF THE LEFT BANK OF THE TUNGNAÁ KRÓKUR GORGE:-



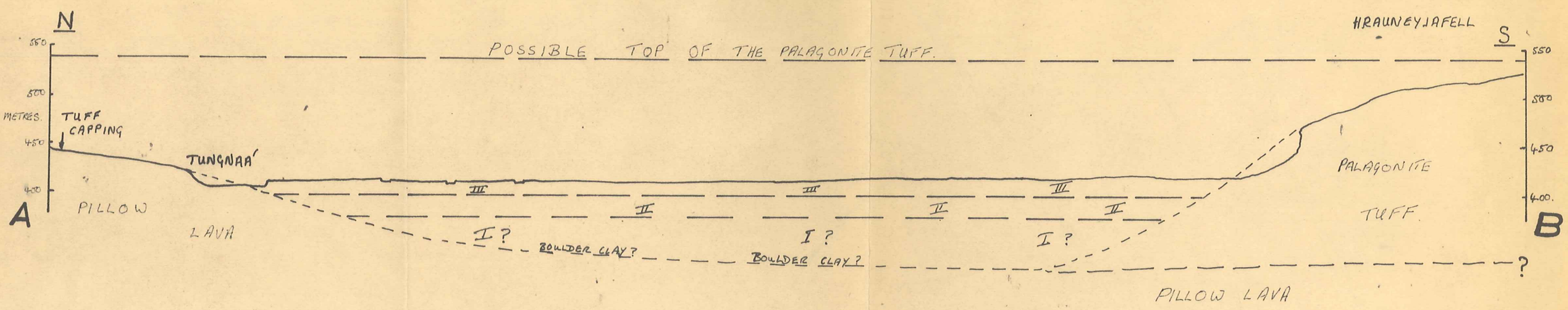




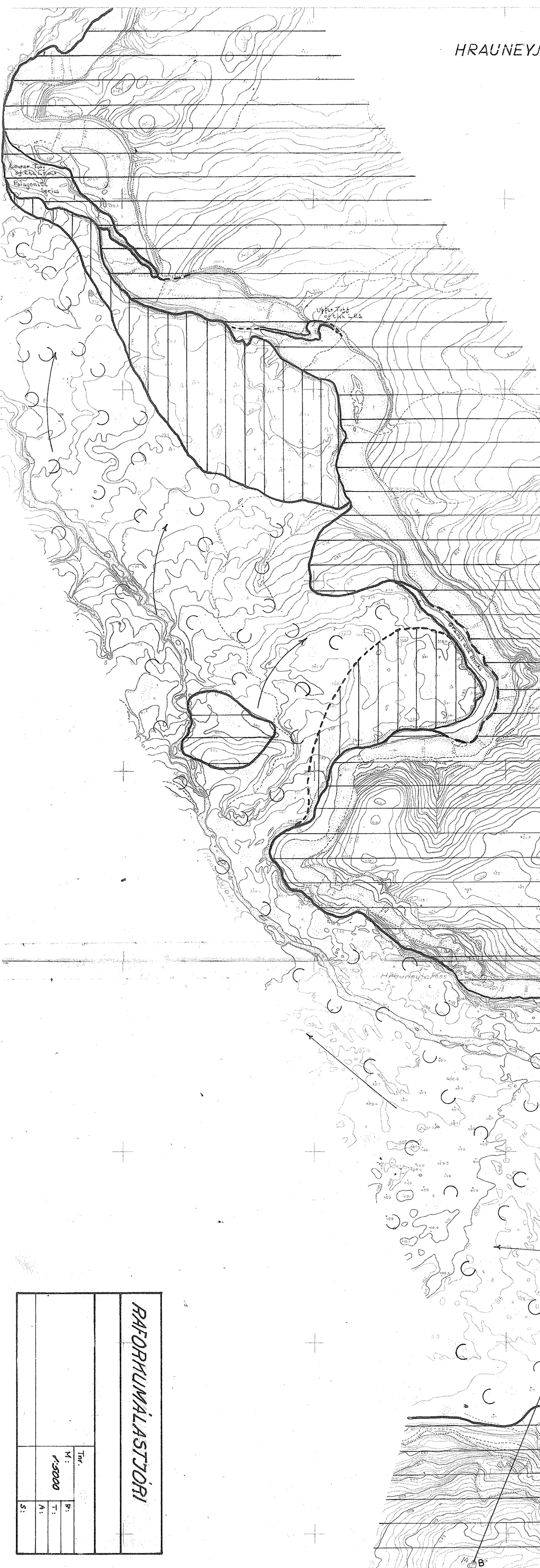
TUNGNAÁRKRÓKUR 1:5,000.

J.E.
D.J.S.

—DIAGRAMATIC SECTION FROM HRAUNEYJAFOSS TO HRAUNEYJAFELL—



HRAUNEYJAFOSS 1:5,000.



KEY

PJÓRSÁ LAVA 3

PJÓRSÁ LAVA 2

PALAGONITE SERIES

RAFORKUMÁLASTJÓRI

Tnr.

M: 1:5000

P:

T:

A:

S:

J.E.

D.J.S.

KEY

RECENT DEPOSITS

COARSE VARVED SEDIMENTS

FINE VARVED SEDIMENTS

ÞJÓRSÁ LAVA 3

ÞJÓRSÁ LAVA 2

ÞJÓRSÁ LAVA 1

POST-PALAGONITE LAVA

PALAGONITE SERIES

1:20,000

J.E.
D.J.S.

HYDROLOGY

J. L. GRIMSHAW
R. A. SHAKESBY

Introduction:

An outline of the hydrological work conducted by the expedition during its stay in Iceland is given here. Further work, in particular the examination of sediment samples taken from the rivers, has still to be completed.

Aspects Studied

(a) The continuous diurnal fluctuation in level of the Tungnaá and Hrauneyjakvísl over a two month period.

(b) The Correlation of the simultaneous levels in the Tungnaá, Kaldakvísl, Hrauneyjakvísl, Blautakvísl and Þjórsá.

(c) The diurnal variation in suspended sediment content of the Tungnaá and Kaldakvísl.

(d) The variation in suspended sediment content with location along the Tungnaá.

N.B. Only the results of aspects (a) and (b) are available to this report.

Blautakvísl refers to a branch of the Tungnaá at its confluence with Þjórsá.

Work Conducted

Upon the expedition's arrival in the field area two Lea level recorders were erected in the Tungnaá region. One was positioned on the Tungnaá at Hald and the second on the Hrauneyjakvísl near its junction with the Tungnaá. The curve obtained from the recorder at Hald is included in this report.

Simultaneous records were made of the water levels of the Tungnaá, Kaldakvísl, Hrauneyjakvísl, Blautakvísl and Þjórsá at selected points by means of staff gauge methods. Gauge readings were taken every hour for a period of three days.

Sediment samples of the Tungnaá water were obtained at Hrauneyjar, Hrauneyjafoss, Þóristungur and Hald.

Further samples were obtained at Hald at regular intervals of two hours and at Þóristungur at intervals of six hours for a period of three days. In each case the samples were taken at points where the river was turbulent in order to ensure that the sediment was distributed through the depth and breadth of the water. Vacuum filtration equipment was used.

Preliminary Discussion of Results

The water level curve from the Lea recorder at Hald (Figs. 1 and 2) displays the diurnal level fluctuations most clearly. There is seen to be a general decrease in level over the length of the curve due to the seasonal reduction in glacial melting. Deviations from the downward trend correspond with irregular rainfall as observed in meterological records.

Of the simultaneous water level curves of the Tungnaá, Kaldakvísl, Hrauneyjakvísl, Blautakvísl and Þjórsá (Fig. 3 - 7) three exhibit a gradual but definite decline in the mean daily level. These are the Tungnaá, Hrauneyjakvísl and Blautakvísl. Further more the diurnal fluctuations are less pronounced in these rivers. Hence it may be deduced that the decline is principally due to lack of rainfall.

The Kaldakvísl and Þjórsá are seen to have large diurnal level fluctuations and by the comparison of Fig. 3 and Fig. 6 it is observed that the fluctuations in the Blautakvísl are for the most part an influence of the Kaldakvísl.

Further Investigations

It is the intention the authors to further investigate the following aspects in preparation for a more detailed report:-

(a) The relationship between the water levels of the Tungnaá (at Hald), Hrauneyjakvísl and Kaldakvísl with the view of formulating the empirical discharge of the latter from the known discharges of the Tungnaá and Hrauneyjakvísl.

(b) The relationship between level and rainfall of the Tungnaá and Hrauneyjakvísl and from this the probable percentage of glacial water in these rivers.

(c) The variation in time of arrival of the maximum and minimum discharges at different points along the Tungnaá.

(d) The difference in suspended sediment content of the Tungnaá Hrauneyjakvísl and Kaldakvísl.

(e) The diurnal variation in sediment content of the Tungná and Kaldakvísl.

(f) The variation in sediment content of the Tungnaá with location along is length.

FIG 1

WATER LEVEL RECORD - TUNGNAÁ

LOCATION

RECORDER

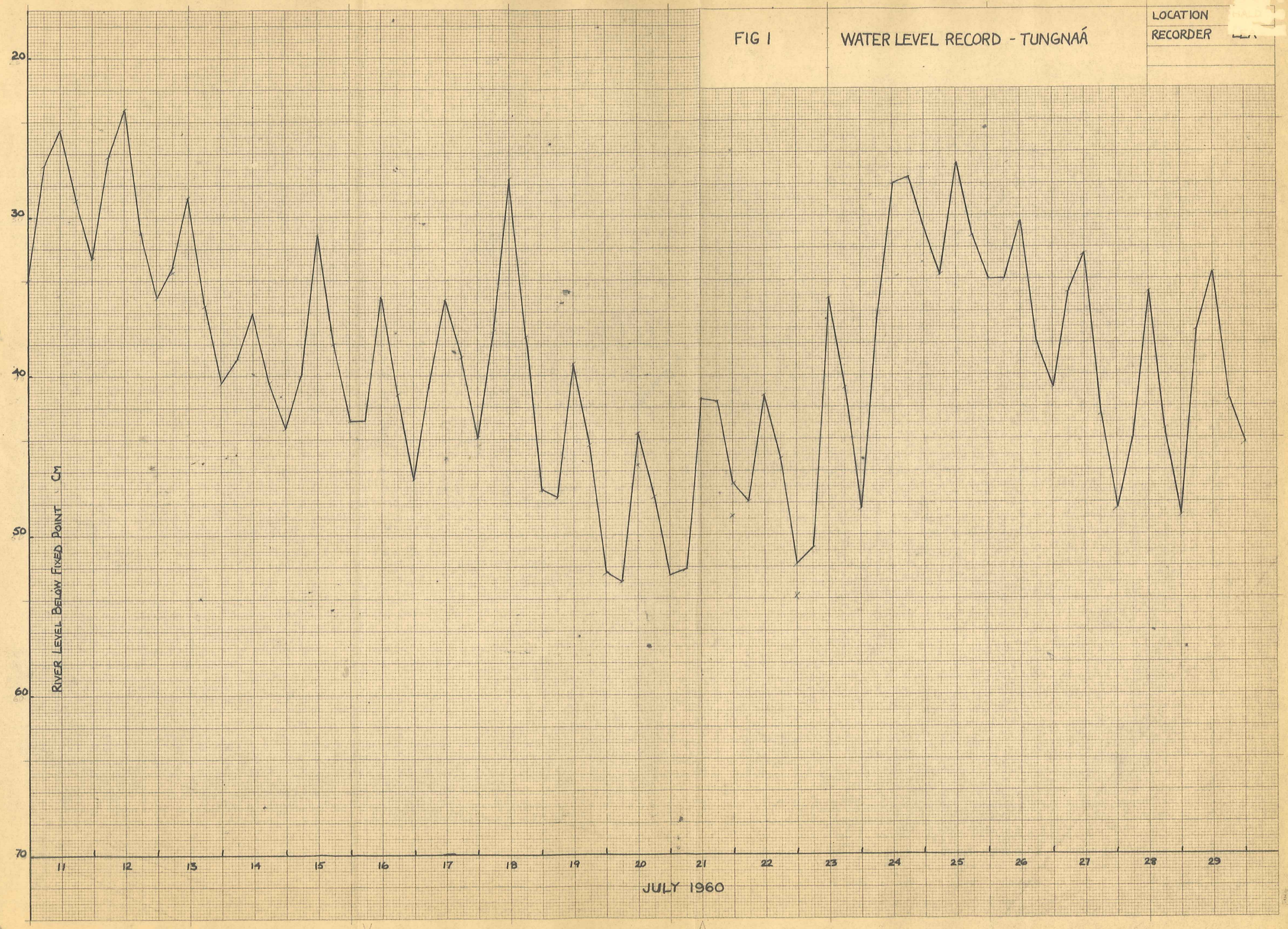
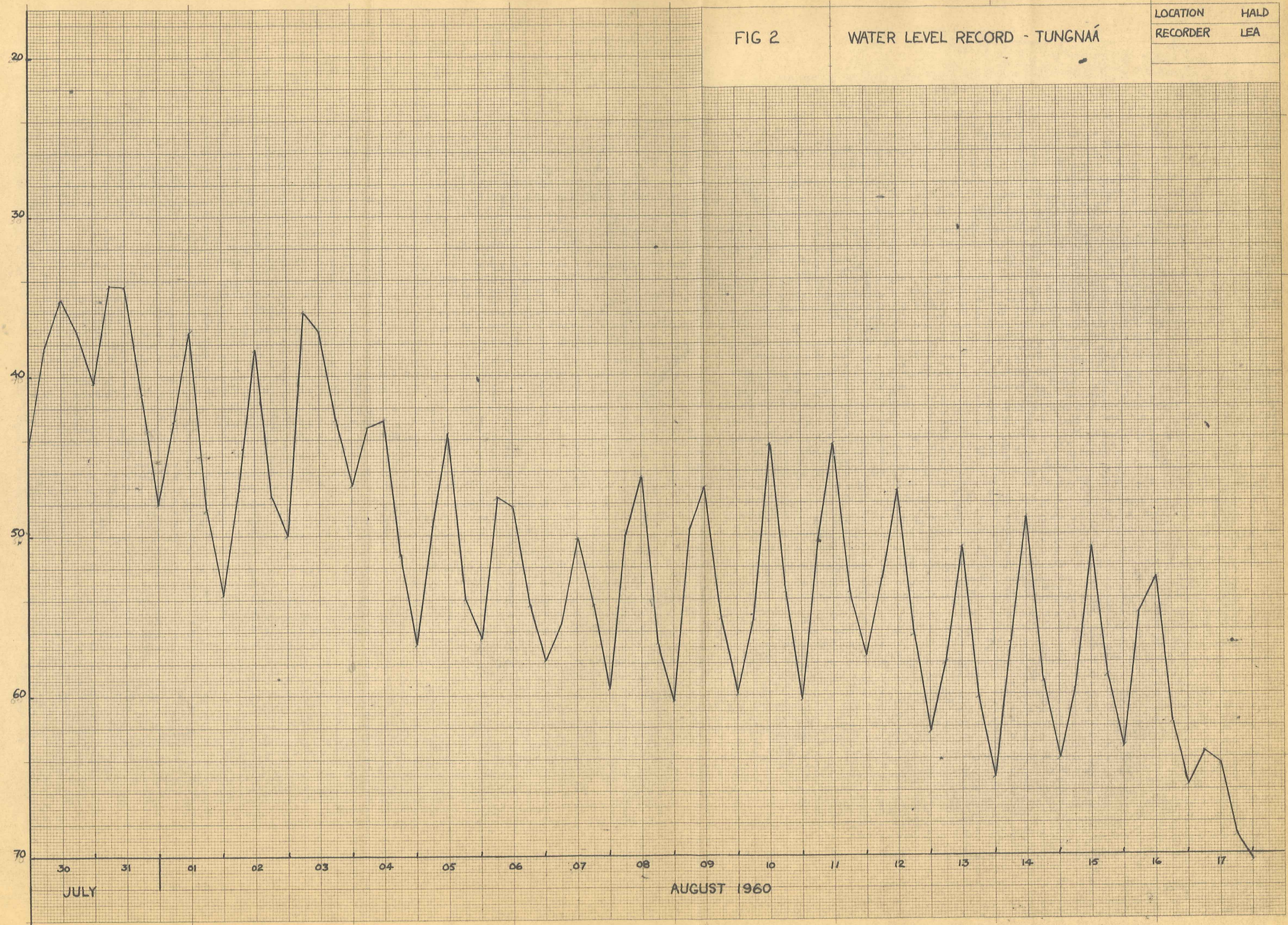


FIG 2

WATER LEVEL RECORD - TUNGNAÁ

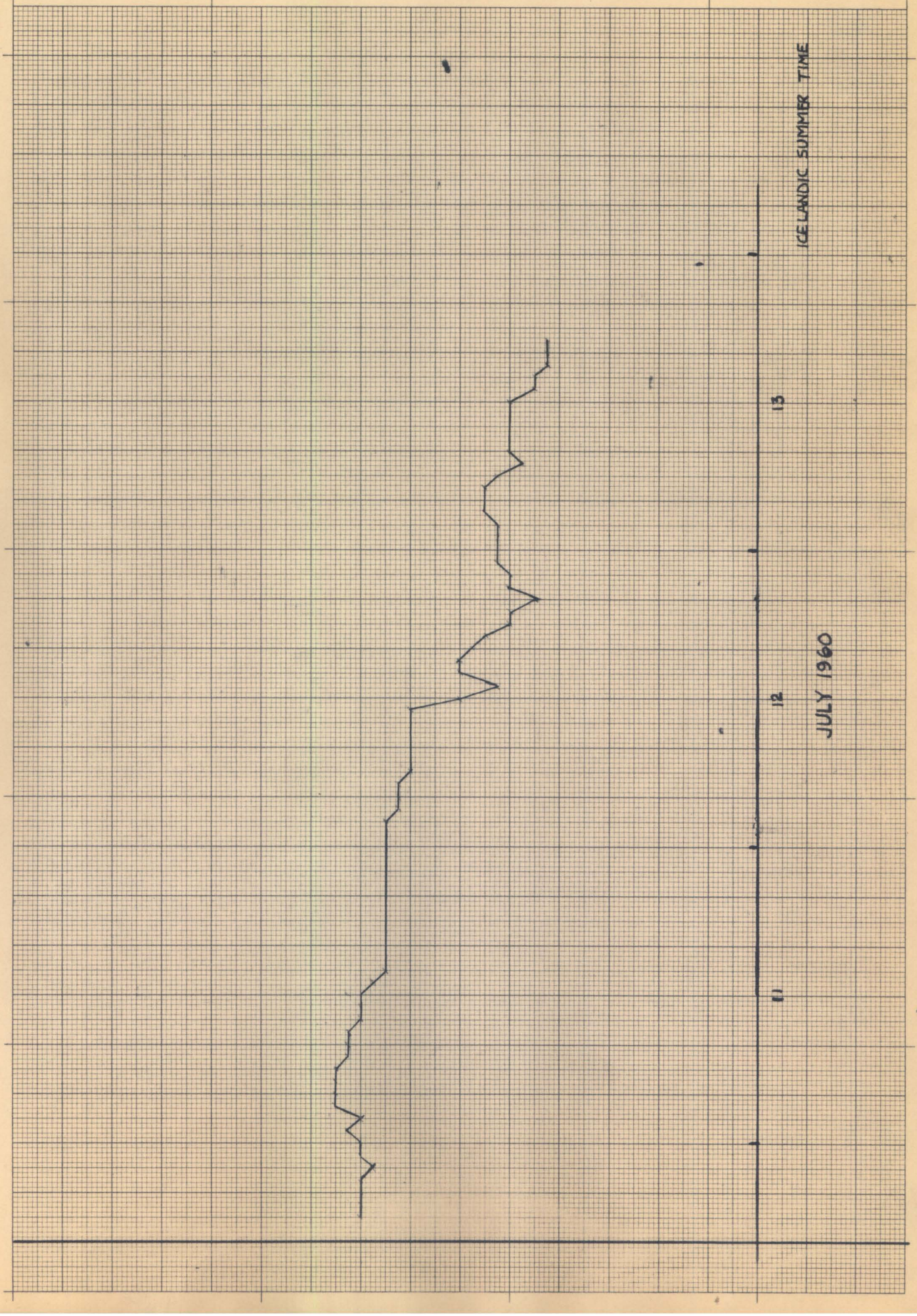
LOCATION	HALD
RECORDER	LEA



VERTICAL SCALE
1 CM REP. 2 CM

FIG 3 WATER LEVEL - TUNGNAÁ

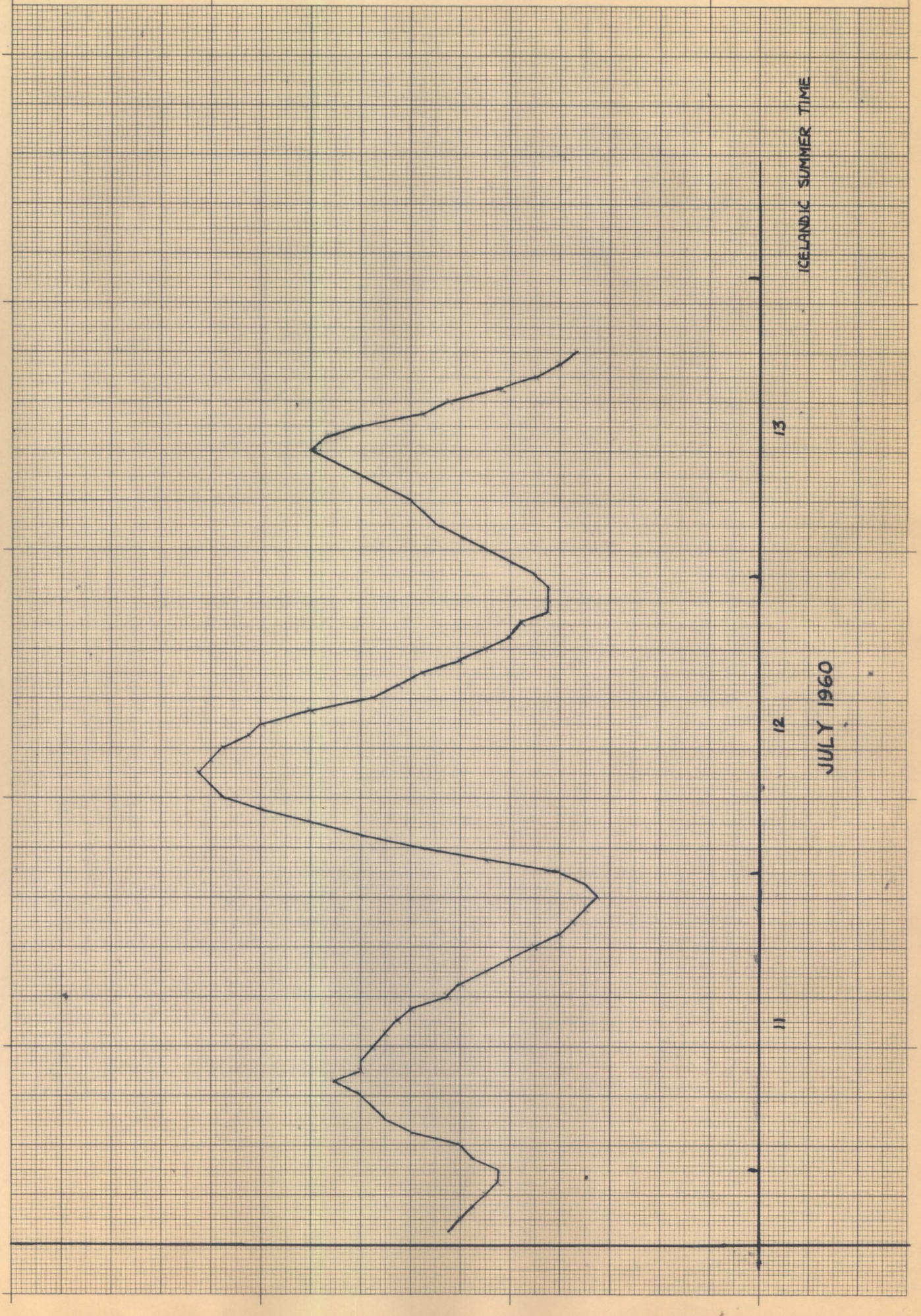
ÞORISTUNGUR



VERTICAL SCALE
1 CM REP. 2CM

FIG 4 WATER LEVEL - KALDAKVISL

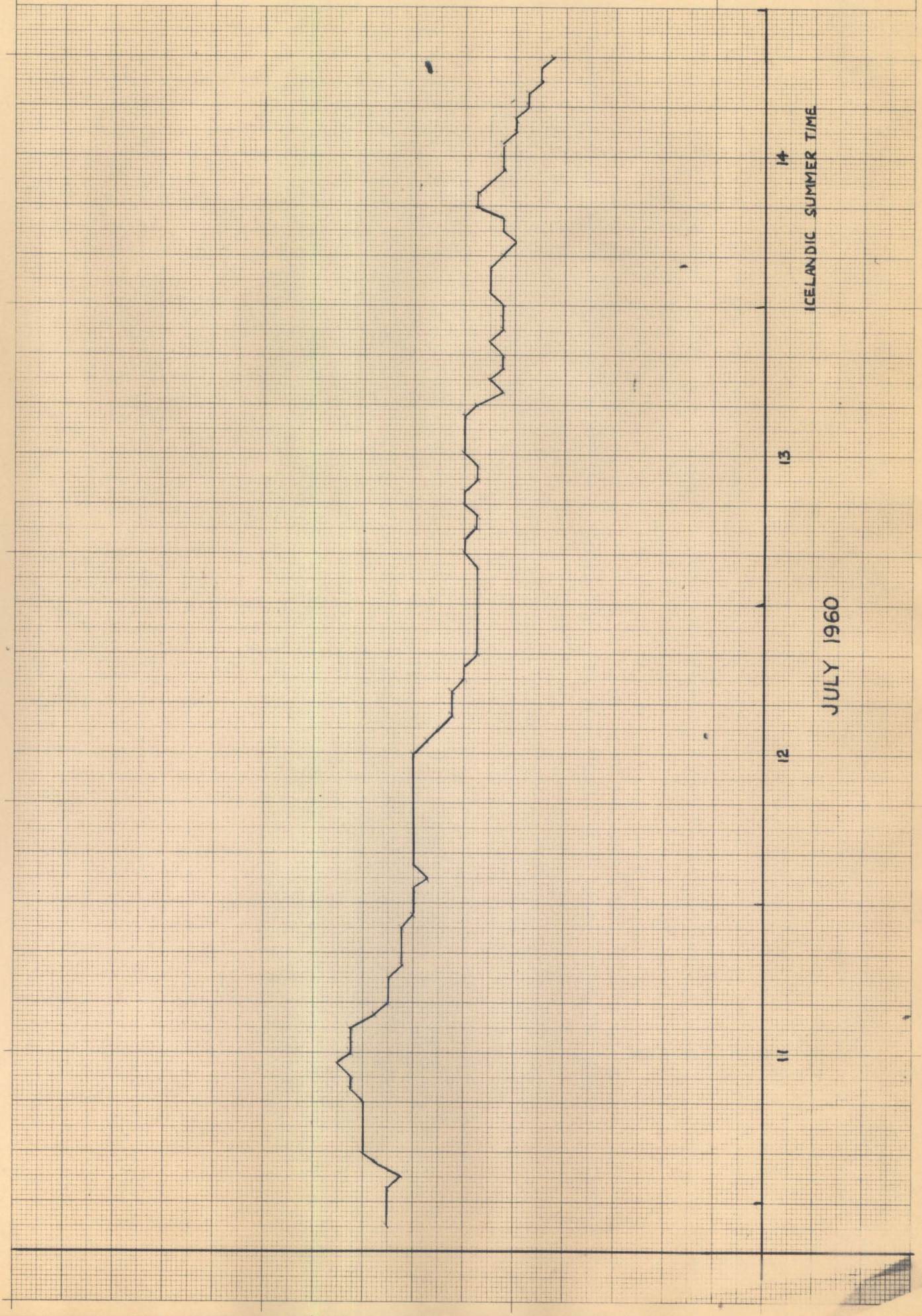
ÞÓRISTUNGUR



VERTICAL SCALE
1 CM REP. 2 CM

FIG 5 WATER LEVEL - HRAUNEYJAKVISL

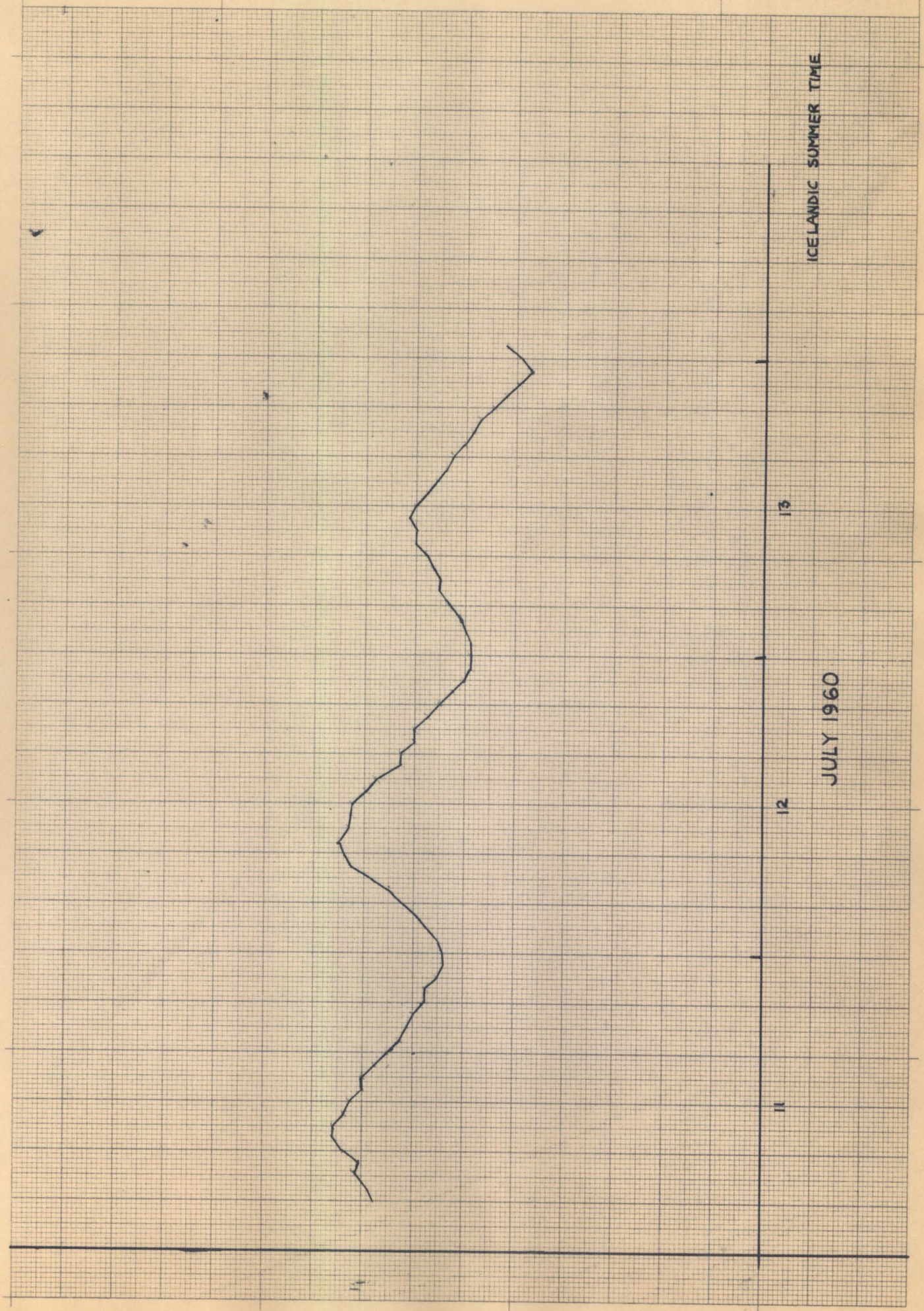
LOCATION TUNGNAÁ CONFLUENCE



VERTICAL SCALE
1CM REP. 2CM

FIG 6 WATER LEVEL - BLAUTAKVISL

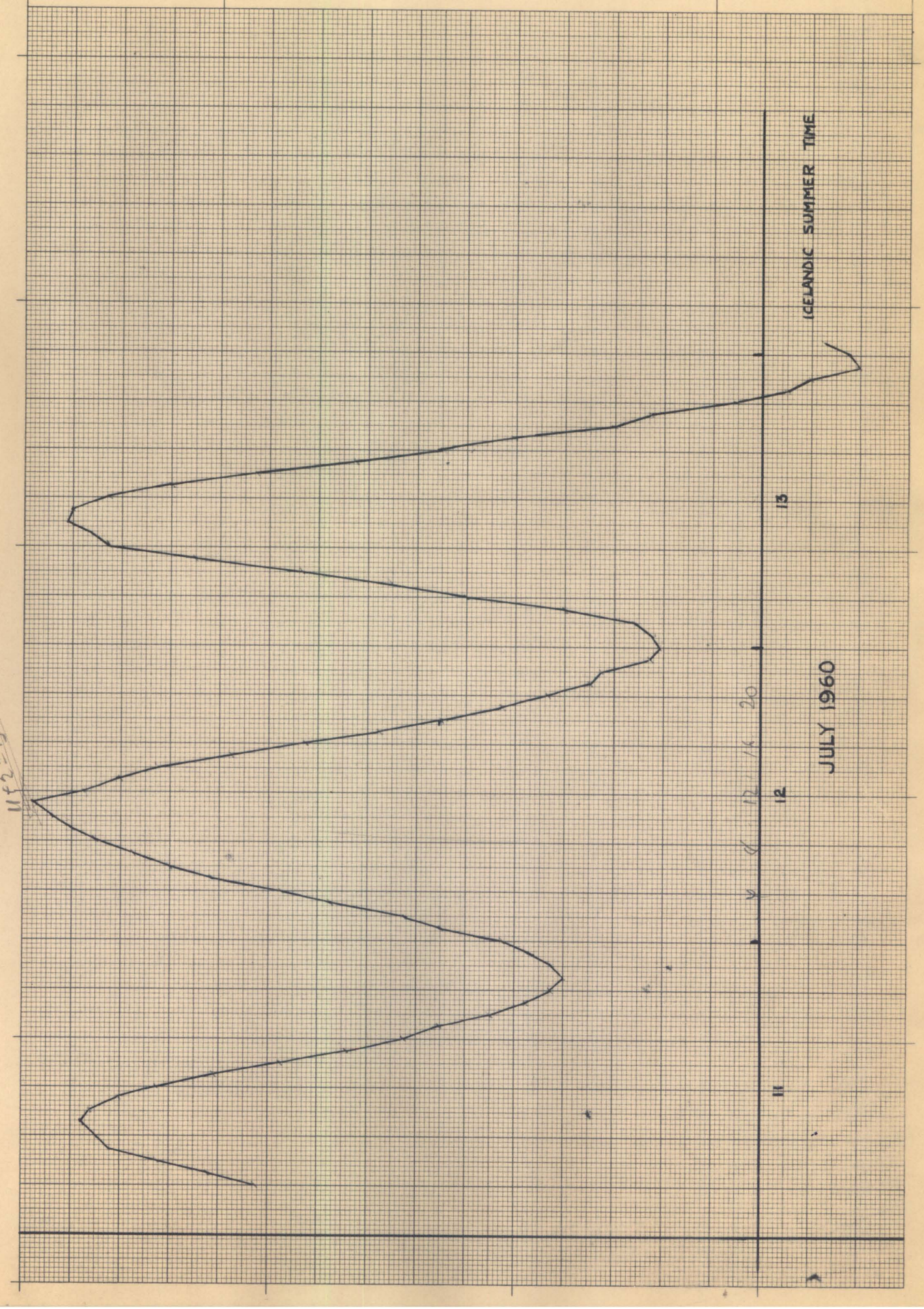
LOCATION PJORSÁ CONFLUENCE



VERTICAL SCALE
1CM REP. 2CM

FIG 7 WATER LEVEL - ÞJÓRSÁ
LOCATION

LOCATION TUNGNAÁ CONFLUENCE



11 f 2 = 13

METEOROLOGY. John P. Freeman.

Met. Station - Hrauneyjakvísl.

After base camp 1. had been established the Meteorological Station was erected on Sunday the 3rd July, at a point some 50 yards from the main camp and situated at the summit of a lava outcrop. The anemometer, recording wind speed in miles per hour, was attached to a 15 foot pole and guyed into place on a nearby lava hillock whilst two "Icelandic type" rain gauges were erected - one near the Met. Screen and the other on the relatively wide flood plain of the River Hrauneyjakvísl. The wind direction indicators were placed at intervals of approximately 20 yds. and with random distribution over the flood plain.

The instruments used at this station were, in the main part, supplied by the British Meteorological Office (M.O.4) but the actual Met. Screen of the snow screen design and along with the screen stand and rain gauges - belonged to the Icelandic Meteorological Office. These latter pieces of equipment were loaned to the Expedition by kind permission of Mr. F. Sigurðsson.

The thermometry instrument section included the following:-

a) 1 sheathed maximum thermometer (graduated in 1/5°F).
b) 2 sheathed minimum thermometers (graduated in °F)
c) 2 ordinary thermometers (- 20°F -(110°F))
d) A maximum and minimum thermometer (graduated in °F).
e) Thermograph - continuous readings for one week.

Other instruments included a hair hygrometer loaned by kind permission of Dr. H. Lister of Durham University.

Readings at this station were taken each day, beginning the 4th August, both at 0900 hrs. and 2100 hrs. and besides those in temperature, wind speed, precipitation, they included estimations of cloud base, state of ground, visibility and finally cloud formation and type. Each set of observations was concluded with a brief comment on the weather at that moment.

Readings of daily rainfall were also recorded for a short period of time at the S.E.A. Hut near Tungnaárkrókur - again using the Icelandic rain gauge. As all other instruments were in use during this time at Base Camp 1 - Hrauneyjafoss -

no other readings were possible although estimations as to the state of the ground and cloud formation and type as well as wind direction were recorded.

The Met. Station at Hrauneyjafoss was dismantled on the 1st August 1960 and re-erected at Base Camp 2. HALD on the 2nd August so that observations of conditions etc. could commence on the 3rd August. Due to air bubbles appearing in the minimum thermometers after transit to Base Camp 2. - minimum temperatures were read from the 3rd August onwards, directly from the Thermograph trace. Wind speed recordings were interrupted, for 1 1/2 days whilst repairs were effected to the anemometer cups and fastenings, damaged after the guy ropes had snapped in a strong wind. This second "location" of the Met. Station consisted of a relatively level site stretching for many 100's of metres on either side and having little in the way of lava hillocks and folds to obstruct air flow and cause false conditions.

Prior to the expedition leaving HALD various graphs of results and readings for each separate aspect of the subject were drawn up and can be seen with this report.
However conclusions from these results will not be available until further study of the latter has been carried out in Endland.

b). <u>Investigations into the value for the daily loss or gain ground water by direct evaporation</u>

This method of measuring the direct evaporation - ie, that due to Air temperature and wind only, was suggested by Dr. H. Lister of Durham University, England. The equipment needed to carry out these experiments was simple and for the most part, home made. It consisted basically of 10 cylindrical shaped water proofed cups of known depth and diameter. They were painted white in order to reduce, to a minimum, radiation factors within the soil and constructed of laminated cardboard to reduce conduction effects through the walls of the cup. The cylinders were filled with soil sections extracted from the ground with the aid of a strong steel tube having the same diameter as that of the cup itself.

Four or five cups containing soil sections were then placed overr an approximate area of 3 metres square, in circular holes cut into the ground, until their upper lips coincided with the ground level. Using an accurate pair of scales placed inside a box shaped windbreak, weighings of each labelled cup were taken at 0900 hrs. and 2100 hrs. each day. By simple subtraction of the daily readings and then taking an average of the results, I was able to obtain a value for the loss or gain in water-content of "n" square cm of ground surface.

The results of these evaporometer investigations will be published in the final report of the expedition.

Included with this report are DATA COLUMNS of temperature (max and min ^{o}C), precipitation and Relative Humidity taken at both camps. A complete synopsis of all weather readings in chart form also appears with this report although separate graphs of temp. ppt. and RH. plus those diagrams connected with the evaporation study will not be published until the final report is finished.

CHART A

METEOROLOGICAL READINGS OBSERVED AT BASE CAMP. 1.: HRAUNEYJAKVISL.

JULY 3rd. — 1960 — AUGUST 1st

READINGS TAKEN AT 0900hrs. AND 2100hrs.

MET. STATION AT APPROX. 3500 FEET ABOVE MEAN SEA LEVEL.

MAXIMUM AND MINIMUM °F

— RELATIVE HUMIDITY % —

— RAINFALL (mms)

CLOUD AMOUNT (⅛)

TYPE

DIRECTION WIND

SPEED (mph)

GROUND STATE

VISIBILITY

COMMENTS

HOURS

JULY

AUGUST

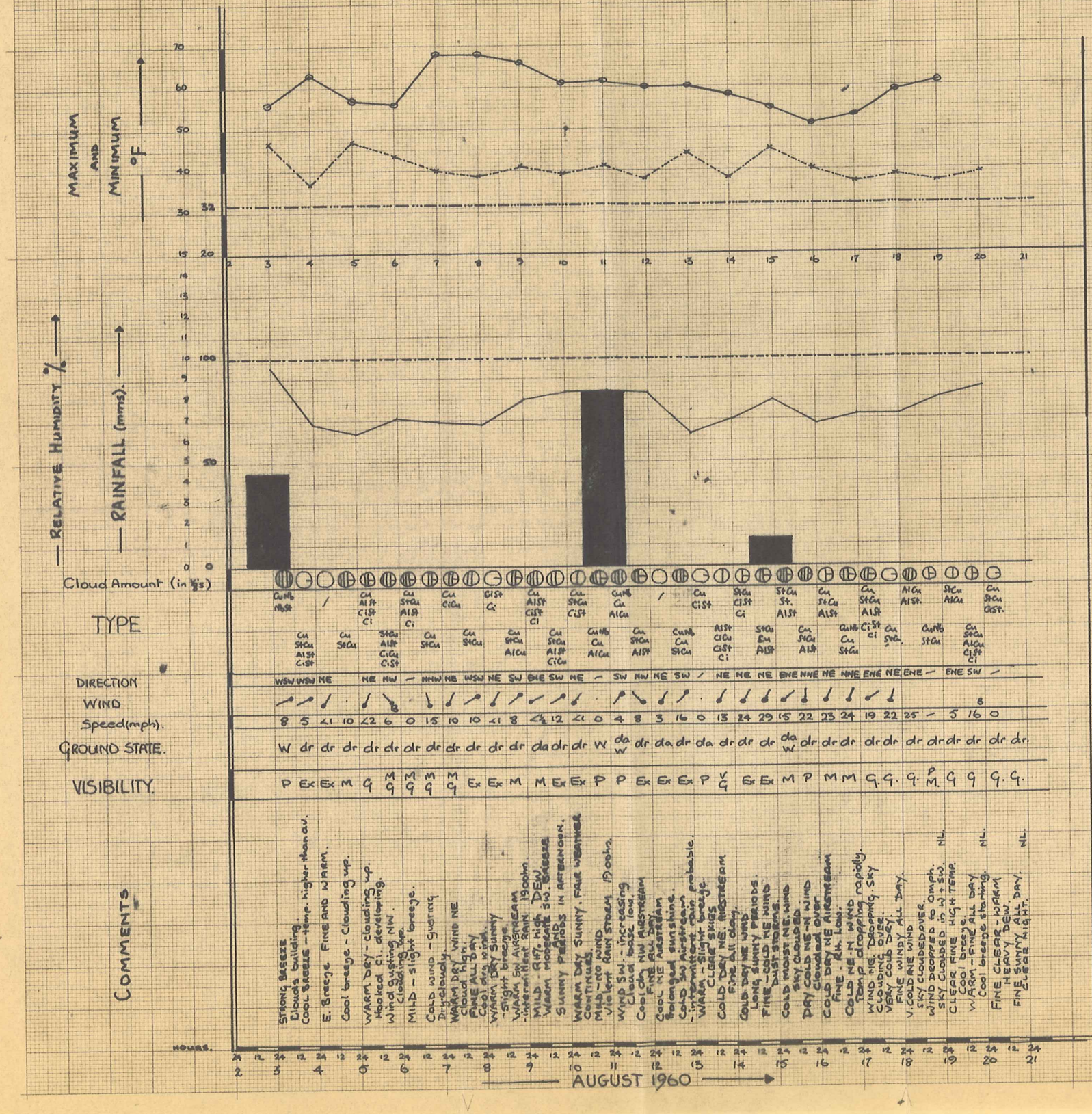
CHART B.

METEOROLOGICAL READINGS OBSERVED AT BASE CAMP 2 - HALD

August 3rd — 1960 — August 20th.

Station 300mtrs. above mean sea level.

READINGS TAKEN AT 0900hrs. AND 2100hrs.



SYMBOLIC INTERPRETATION.

MAXIMUM TEMPERATURE

MINIMUM TEMPERATURE

Relative Humidity in %

RAINFALL IN (mms). – in block diagram form over 24hrs from 0900hrs

Cloud Amount. ○ ◔ ◑ ◕ ◑ ◕ ◍ ◍ ◍
0/8 1/8 2/8 3/8 4/8 5/8 6/8 7/8 8/8.

WIND DIRECTION IN COMPASS POINTS AND 0–360°.

B = Backed. V = wind veered.

WIND SPEED IN MILES PER HOUR.

State of ground. W = wet: m. = moist.: da = damp: dr = dry.

VISIBILITY P = poor. M = Moderate. G = good. V.G. = very good. Ex = Excellent.

Comments – weather at 0900hrs or 2100hrs unless otherwise stated.

• HRAUNEYJAKVISL. •

DATA COLUMN 1.

READINGS IN °C TAKEN AT BASE CAMP 1
(READINGS FOR CHART A)

JULY	MAXIMUM + °C	MINIMUM + °C
3	—	—
4	12·22	8·61
5	11·67	6·67
6	11·11	4·72
7	18·33	4·72
8	18·33	7·78
9	20·00	6·67
10	13·89	8·33
11	13·33	7·50
12	13·89	7·22
13	13·61	8·06
14	14·44	3·89
15	16·11	1·39
16	15·00	3·33
17	17·78	7·78
18	17·78	6·67
19	12·22	4·44
20	11·67	7·22
21	15·00	7·22
22	14·44	4·44
23	10·56	8·33
24	13·89	8·33
25	11·11	6·67
26	12·78	6·67
27	14·44	5·28
28	13·61	7·78
29	13·33	7·78
30	12·78	8·33
31	15·56	5·56
AUGUST	+ °C Max	+ °C Min.
1	13·33	8·33

• HALD. •

DATA COLUMN 2.

READINGS IN °C TAKEN AT BASE CAMP 2.
(READINGS FOR CHART B.)

AUGUST	MAXIMUM + °C	MINIMUM + °C
3	13·33	8·33
4	17·22	2·78
5	13·89	8·33
6	13·33	6·39
7	20·00	4·44
8	20·00	3·61
9	18·89	5·00
10	16·11	3·89
11	16·39	5·00
12	15·56	3·33
13	15·56	6·67
14	14·44	3·33
15	12·78	7·22
16	10·56	4·44
17	11·67	2·78
18	15·00	3·61
19	16·11	2·78
20	—	3·89

· HRAUNEYJAKVISL ·

DATA COLUMN 3.

FROM READINGS TAKEN AT BASE CAMP 1.
(READINGS FOR CHART A.)

JULY	RAINFALL (mms)	R.H. %
3	—	—
4	5·8	89
5	0·2	79
6	—	66
7	—	65
8	—	69
9	—	97
10	3·95	86
11	—	84
12	—	76
13	—	65
14	—	67
15	—	96
16	13·75	80
17	0·6	90
18	0·7	73
19	—	77
20	4·2	80
21	1·0	69
22	—	90
23	9·05	89
24	—	90
25	5·8	97
26	5·7	78
27	0·1	63
28	3·35	75
29	—	73
30	—	77
31	1·0	86
1 Aug.	0·15	83

· HALD ·

DATA COLUMN 4.

FROM READINGS TAKEN AT BASE CAMP 2.
(READINGS FOR CHART B)

AUGUST	RAINFALL (mms)	RH. %
3	4·5	95
4	—	68
5	—	64
6	—	71
7	—	69
8	—	68
9	—	80
10	—	83
11	8·4	84
12	—	83
13	—	63
14	—	70
15	1·3	69.
16	—	68
17	—	72
18	—	72
19	—	72
20	—	80
21	—	—

DATA COLUMN 3. RAINFALL FOR TUNGNAARKROKUR. SEA. HUT.

JULY	RAINFALL (mms). from 0900hrs thro' 24hours.
14	—
15	—
16	7·6
17	—
18	0·85
19	—
20	2·1
21	0·35
22	—
23	—
24	2·2
25	9·0
26	8·1
27	0·4
28	3·7
29	—
30	—
31.	—

DURHAM UNIVERSITY ICELAND EXPEDITION 1960
BOTANY OF THE LOWER TUNGNAÁ

N.H. Cleminson - Botanist

PRELIMINARY REPORT

The work was carried out from June 30th. to August 21st 1960.

The work done may be roughly classified into three parts:-

1) Basic area survey.
2) Species list produced, with collections of all types of plant.
3) Quantitative work

However, before proceeding with this report I must first thank Ingimar Óskarsson of the Botany Department of Reykjavík University, for invaluable help which he gave me during a visit to him on June 29th.

Basic area survey

The area of work was on the south bank of the Tungnaá for a complete distance of 11 kilometres with quantitative work being centred in three positions in the area:-

1) Confluence of HRAUNEYJAKVÍSL and TUNGNAÁ.
2) Area between TUNGNAARKROKUR and HRAUNEYJAFOSS
3) HALD

a) Geology and Edaphic factors

The Tungnaa flows at the boundary of palagonite rock and Þjórsá lava, with the palogonite forming the northen bank, the Tungnaa flowing through a series of gorges with the palogonite reaching heights of 120 feet. Outcrops of palogonite do occur on the southern bank but these are usually quite some distance from the River, and do not, with few exceptions form the parent rock over which any quantitative work has been done.
The Hrauneyjakvísl leaves the Tungnaa just above the Hrauneyjafoss, and flows down through the lava rejoining the main river three miles down stream near the first base camp.

The Þjórsá lava is in general block lava, but areas of stratified lava are found between Hald and Tungnaárkrókur. This lava is extremely porous and is weathered to a large extent by the action of water on it, but temperature and wind, especially in the winter must have no small effect. The weathered lava is broken down into soils varying between almost a sandy consistvency, through a gravelly type, to a soil on top of the lava which is very thin and poor in humus, and which has lumps of comparatively unweathered lava protruding from it. Laval outcrops of about 20 feet in height are quite common in the lava field, and their vegetation consists almost exclusively of moss and lichen.

Nearer the river bank silt has been deposited in large amounts as the Tungnaá carries a high percentage of sediment, which is mainly rock flour from the base of the glaciers on the Vatnajökull. This rock flour suspended int the water is deposited in large amounts especially at confluences. As is typical with glacier fed rivers, the Tungnaá undergoes a daily fluctuation in level, and this coupled with the fast flow of the stream causes a considerable amount of erosion both in the gorges, and on the banks when the river flows more open country.

The soils which have been studied have varied from neutral to a slightly acid soil of a pH of 5-8. The A horizon is very thin if not nonexistent and the organic material in the soil is extremely small.

Drainage - as has been stated, the lava is extremely porous, and very little observable water is seen on the lava field. Water falling on this area, sinks very quickly, and comes to the surface very near to the River in the form of springs.

b) Climatic factors (during our expedition)

Wind - is consistently high. Over a period of two weeks the average wind speed was 17.2 M.P.H.

Relative humidity - is extremely low. Over a period of ten days the average was 69% and on several occasions it dropped below 40%.

Temperature - the area is more or less surrounded by ice caps and the temperature is not high and there is a considerable daily fluctuation. The highest during July was 66°F and the lowest was 34°F. (18.9 to 3.3°C)

Rainfall - this was not great, approximately 5,5 cms fell in July.

The general weather conditions were cold, dry, with winds and low relative humidity with the prevailing wind from the Vatnajökull which is due east from the area. These factors combine to climatic conditions which can only be overcome by plants which have xeromorphic features.

Biotic factors

The area is subjected to light grazing by sheep which are allowed to roam at will over a large area. The influence of man appears negligible in the area but the proposed dam to be built near Hrauneyjafoss will undoubtedly have an effect on the area in general as roads will have to be built across the area.

Birds:- Large flocks of geese are found near the rivers. Pink footed geese are most abundant but White fronted geese do occur with many other species

other species: - 1 Lesser black-backed gull
2 Arctic skua
3 Snipe
4 Curlew
5 Wheatear
6 Rock pippit
7 Golden Plover
8 Dipper
9 Pied wagtail
10 Raven
11 Falcon

Mammals:- A large number of foxes are to be found in the area but the smaller mammals do not seen to occur owing to the rigorous climate.

Insects - Large numbers occur which have not been identified. However many members of the Phalangida and Arachnida occur.

The Silver Y moth is abundant but the Lepidoptera in general are poorly represented.

PRIMARY WORK

Consisted of:-

1) observation of the flora in general
2) collection and identification
3) pressing
4) drawing up a species list

1) The observation of the flora was made on serveral walks in the area to be studied and merely consisted of attempting to find any ecosystems or related plants in communities, and in general the natural habit of growth and habitat of the varying species.

2) Collection of all types of the flora were made during excursions in the area, the plants being collected in polythene bags, and identied back at the camp.

The main book used in the identification was the "Flora of Iceland and the Faeroes" by C.H. Ostenfeld and Grontved, and published by Levin and Munksgaard, Copenhagen. Two other books were used which were unfortunately in Icelandic, but which were useful as they contained excellent drawings of many of the plants found in the area which were useful as checks for correct identification in the Flora.
These books were:- Flóra Íslands by Stefán Stefánsson
Íslenzkar Jurtir by Áskell Löve
The Latin names given in the books varied eg. GALIUM SILVESTRE and GALIUM PUMILUM ssp. ISLANDICUM
but unless otherwise stated, the specific names given here are those given by Ostenfeld and Grontved.

3) The pressing of the plants collected and idetified was done in a wire press, the specimens being placed between sheets of newspaper.

4) DRAWING UP OF A SPECIES LIST

Unfortunately none of the books which were available to me contained any information on the members of the Phyla Thallophyta and Bryophyta so until any positive identification can be made, I will refer to them in my notes as:-

Moss	1,2,3 ..... etc.
Lichen	1.2.3 ..... etc.
Liverwort	1.2.3 ..... etc.

These unidentified species were fixed in specimen tubes containing 3 parts of absolute alcohol to 1 part of glacial acetic acid.

I must also emphasise that in the following species list, as constant additions will be made during my stay that I cannot at the moment place the specimens in any botanical order, but this will be remedied later.

1. PHYLUM THALLOPHYTA

In general have been ignored owing to difficulty of presevation but:- Fungi

a) Two members of the Class Basidiomycete have been found in the heath near the base camp or Hrauneyjakvísl

Algae

In the small clear spring running into the Hrauneyjakvísl a Filamentous member of the Chlorophyceae has been found. This is possibly a Ulothrix species.

Other algal forms were common especially near Tungnaárkrókur

Lichens

a) Lichen 1 - very abundant in lava and found in heath.
b) Lichen 2 - on rock outcrops.

PHYLYM BRYOPHYTA

Again, owing to the difficulty of effective identification and preservation no special attempt was made to collect Bryophytes, and those listed below were ones that occurred in quadrats during quantitative work in the area, so these

species are by no means the only ones to be found in the Tungnaá region.

(unidentifiable at the present)

HEPATICAE 1) Liverwort 1 (thallose)
2) Leafy liverwort - Liverwort 2.

MUSCI

1) Moss 1 (Dicranum?)
2) Moss 2 (dominant on heath)
3) Moss 3 (pendulous capsules - on heath)
4) Moss 4 (reddish stems)
5) Moss 5 (globose capsuler-river bank Tungnaárkrókur)
6) Moss 6 (very thin leaves, lava outcrop)

PHYLUM PTERIDOPHYTA

SELAGINELLA SELAGINOIDES	~~TUNGLJURT~~ MOSAJAFNI
BOTRYCHIUM LUNARIA	TUNGLJURT
EQUISETUM VARIEGATUM	BEITIESKI
EQUISETUM ARVENSE	KLÓELFTING
EQUISETUM PRATENSE	VALLELFTING
WOODSIA ILVENSIS variety ALPINA	FJALLALIÐFÆTLA

PHYLUM SPERMATOPHYTA
CLASS ANGIOSPERMAE
1) SUB CLASS MONOCOTYLEDONS
a) GRAMINAE

1 POA ALPINA
2 POA GLAUCA
3 FESTUCA OVINA
4 FESTUCA RUBRA
5 ANTHOXANTHUM ODORATUM
6 NARDUS STRICTA
7 ELYMUS ARENARIUS
8 AGROSTIS STOLONIFERA
9 TRISETUM SPICATUM
10 DESCHAMPSIA ALPINA
11 PHIPPSIA ALGIDA
12 PHLEUM ALPINUM
13 CALAMAGROSTIS NEGLECTA
14 ACROSTIS TENUIS

b) CYDERACEAE

CAREX RIGIDA
CAREX GOODENOWII
CAREX CAPITATA
CAREX PULLA
ERIOPHORUM SCHEUCHZERI
KOBRESIA BELLANDI
CAREX MARITIMA (Gunn)
CAREX PANICEA
CAREX SHORDORRHIZA
CAREX SALINA VAR KATTEGATENSIS
ERIOPHORUM POLYSTACHYUM

c) JUNCACEAE

JUNCUS TRIFIDUS	MÓASEF
JUNCUS ARCTICUS	TYPPANÁL
JUNCUS BALTICUS	HROSSANÁL
LUZULA SPRICATA	AXHÆRA
LUZULA PALLESCENS	LJÓSHÆRA
LUZULA ARCUATA	FJALL HÆRA

d) COLCHICACEAE

TOFIELDIA PALUSTRIS	SÝKIGRAS

e) ORCHIDACEAE

HABENARIA HYDERBOREA	FRIGGJARGRAS

2) SUB-CLASS DICOTYLEDONS

SALIXGLAUCZ	GRÁVÍÐIR
SALIX LANATA	LOÐVÍÐIR
SALIX PHYLICIFOLIA	GULVÍÐIR
SALIX HERBACEA	GRASVÍÐIR
ARMERIA MARITINA	GELDINGAHNAPPUR
CERASTIUM ALPINUM	MÚSAREYRA
PINGUICULA VULGARIS	LYFJAGRAS
PARNASSIA PRLUSTRIS	MÝRASÓLEY
DRYAS OCTOPERALA	HOLTASÓLEY
POLYGONUM VIVIPARUM	KORNSÚRA
VISCARIA ALPINA	LIÐSBERI
CARDAMINE PRATENSIS	HRAFNAKLUKKA
CHAMAENERION LATIFOLIUM	EYRARÓS
RUMEX ACETOSA	TÚNSÚRA
RUMEX ACETOSELLA	HUNDASÚRA
EMPETRUM NIGRUM	KRÆKILYNG
BARTSCHIA ALPINA	LOKASJÓÐSBRÓÐIR
SILENE MARITINA	MELAPUNGUR
SILENE ACAULIS	LAMBAGRAS
SEDUM VILLOSUM	FLAGAHNOÐRI
THYMUS SERPYLLUM	BLÓÐBERG
SAXIFRAGA NIVALIS	SNÆSTEINBRJÓTUR
SAXIFRAGA GROENLANDIA	ÞÚFUSTEINBRJÓTUR
SAXIFRAGA DECIPIENS	TOPPASTEINBRJÓTUR
TARAXACUM FAROEËNSE	FÆREYJAFÍFILL
GENTIANA NIVALIS	DÝRAGRAS
POTENTILLA ANSERINA	TÁGAMURA

CARDAMINOPSIS PETRAEA	HELSKRIÐNABLÓM
THALICTRUM ALPINUM	BRJÓSTAGRAS
GALIUM SILVESTRE	HVÍTMAÐRA
RANUNCULUS REPENS	SKRIÐSÓLEY
RANUNCULUS ACER variety PUMILA	BRENNISÓLEY
RANUNCULUS AURICOMUS	SIFJARSÓLEY
HIERACIUM ALPINUM	FELLAFÍFILL
OXYRIA DIGYNA	ÓLAFSSÚRA
ARCHANGELICA OFFICINALIS	ÆTIHVÖNN
RHINANTHUS GROENLANDICUS	EGGJASJÓÐUR
ALCHEMILLA ALPINA	LJÓNSLAPPI
STELLARIA CRASSIFOLIA	STJÖRNUARFI
CERASTIUM CAESPITOSUM	VEGARFI
CNAPHALIUM SUPINUM	GRÁMULLA
ERIGERON BOREALIS	JAKOBSFÍFILL
GALIUM VERUM	GULMAÐRA
VACCINIUM ULIGINDSUM	BLÁBERJALYNG
GENTIANA AUREA	GULLVÖNDUR
EPILOBIUM PALUSTRE	MÝRADÚNURT
MINUARTIA VERNA variety RUBELLA	MELANÓRA
SAXIFRAGA HYPNOIDES	MOSASTEINBRJÓTUR
EUPHRASIA GRIGIDA	HLIÐAAUGNFRÓ
LOISELEURIA PROCUMBENS	SAUÐAMERGUR
EPILOBIUM HORNEMANNI	HEIÐADÚNURT
CERASTIUM TRIGYNUM	LÆKJAFRÆHYRNA
EPILOBIUM ALSINIFOLIUM	LINDADÚNURT
LEONTODON AUTUMNAUS	SKARIFÍFILL
SIBBALDIA DECUMBENS	FJALLASMÁRI
SAXIFRAGA OPPOSITIFOLIA	VETRARBLÓM
SEDUM ACRE	HELLUHNOÐRI
ALCHEMILLA MINOR	MARÍUSTAKKUR.
GENTIANA AMARELLA var. SUBARCTICA	GRÆNVÖNDUR
ANGELICA SILVESTRIS	GEITHVÖNN
VERONICA ALPINA	FJALLADEPLA
VERONICA ALPINA var AUSTRAUS Wg.	"
ALCHEMILLA FAERÖEENSIS	MARÍUVÖTTUR
SAXIFRAGA STELLARIS	STJÖRNUSTEINBRJÓTUR
SAXIFRAGA RIVULARIS	LÆKJASTEINBRJÓTUR
SAXIFRAGA CENUA	LAUKASTEINBRJÓTUR
MINUARTIA BIFLORA	FJALLANÓRA
SAGINA PROCUMBENS	SKAMMKRÆKILL
GENTIANA CAMPESTRIS	MARÍUVÖNDER

QUANTITATIVE WORK

This was by far the most important part of the work undertaken, and most of the time which was available was spent on it.

TYPE OF WORK:-

1. RANDOM QUADRATS
2. LINE TRANSECTS
3. BELT TRANSECTS

In every case the quadrat used was a one metre square, and the abundance of a species in the area enclosed was transferred to the DOMIN scale, the estimation being done by eye.

DOMIN SCALE:-

VEGETATION	COVER about 100%	- 10 units
	COVER greater than 75%	- 9 units
	COVER 50-75%	- 8 units
	COVER 33-50%	- 4 units
	COVER 25-33%	- 6 units
	Abundant COVER about 20%	- 5 units
	Abundant COVER about 5%	- 4 units
	Scattered, COVER small	- 3 units
	Very scattered COVER small	- 2 units
	Scarce, COVER small	- 1 units

At the confluence of Hrauneyjakvísl and Tungnaá and at Tungnaárkrókur random quadrats in

a) Heath
b) Lava
c) Riverbank

were taken, for a comparison between firstly, the three areas themselves and secondly, the two regions where the work was performed for an investigation of the change of flora with height along the Tungnaá.

In both of these areas, line transects were produced in which a line was taken from a point in the lava to the riverbank the species occurring at every metre along the line being noted, together with the slope of the line and the pH along it.

Belt transects were also produced in these areas, a metre quadrat being taken at every three metres along the line passing through lava, heath and riverbank. The advantage of this type of transect over the preceeding one is that as a larger area is taken in the transect, a more representative picture of the flora is obtained, with the transect being of greater value.

The quantitative work at Hald was confined solely to the investigation of two parelled tracts of vegetation occurring there, and a transect was taken between these areas which had a length of 800 metres. Metre quadrats were taken at 25 metre intervals along this line, and soil samples were taken at various parts which must be analysed later.

In all the three types of work, the results were placed in diagrammatic form on graph paper.

Special collection of varying species for research students in Botany at Durham Univerity were also made.

1) Dyas octopetala
   Twenty plants from different habitats were collected and pressed, and five soil samples from some of these habitats were taken. The seeds of this plant were collected, together with several live plants for attempted propagation in England.

2) Bartschia alpina
   Several specimens were collected and pressed, and soil samples from near the roots were taken. Five inflorescences were fixed in a mixture of 3 parts absolute alcohol and one part glacial acetic acid in specimen tubes. Live specimens were also taken for attempted propagation

3) Thalictram alpinum
   About 15 Herbarium specimens were collected and a small number of live plants were also collected.

4) Tofieldia palustris
   as for (3)

5) The preserving fluid (fixative) was used to fix the capsules of several species of genus Dicranum, in the stage where meiosis was occurring to produce spore tetrads. Live plants were also collected.
   Cytological work will be done on these fixed specimens.

In this preliminary report no results have been given and it is merely a statement of proceedure and methods adopted by me in the work which I carried out.

The conclusions from the results have also been omitted, as they are valueless and too lengthy without reference to the block histograms drawn up from the quadrat results.

The area as a whole, however, was extremely intersting from the botanical viewpoint, and much valuable work could be done in this area, particularly in relating the structural modifications of the plants to their extremely rigorous environment, where low transpiratory rates and water storage are essential factors.