IMPERIAL COLLEGE

OF SCIENCE & TECHNOLOGY

ICELAND

1958

THE EXPLORATION BOARD.

IMPERIAL COLLEGE ICELANDIC EXPEDITION

1958

FULL REPORT

The Expedition would like to acknowledge the help given by the numerous individuals and firms who made the Expedition possible. It is not practical to name all individuals, but our thanks are particularly due to Professor H. H. Read, F.R.S., Mr. A. Stephenson, O.B.E., The Royal Geographical Society, The Mount Everest Foundation, and the Imperial College Exploration Board. Also we would like to thank Miss R. Lawson for help in typing this report, and Mrs. P. Picton for some of the diagrams.

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SECTION I - GENERAL REPORT

1.1 PARTY

The following people were members of the party:

G. P. L. WALKER, Ph.D., F.G.S., Leader.

Dr. Walker is the lecturer in mineralogy in the Geology Department of Imperial College, and for the past five years has been working on the volcanic geology of Eastern Iceland. His previous experience of the area and seniority made him the obvious choice for leader of the Expedition. He was a member of the Leeds University Ruwenzori Expeditions 1951 and 1952.

D. BRIDGEWATER, B.Sc., A.R.C.S., Geologist.

Mr. Bridgewater had just completed his final year in the Geology Department at the time of the Expedition. He had been a member of a previous private Expedition to Norway in 1955 and he was the leader of the I.C. Norwegian Expedition of 1956. He is at present with the Greenland Geological Survey.

A. J. LEWIS, Surveyor.

Mr. Lewis had just completed his second year in the

Physics Department at the time of the Expedition. He had had some experience of skiing and dog-trekking in Norway.

I. M. PLUMMER, B.Sc.(Eng.)(Min.), A.R.S.M., Surveyor.

Mr. Plummer had just completed his final year studies in Mining at the time of the Expedition. This Mining course included an intensive course in all forms of surveying. He had general mountaineering experience and had spent the previous Summer Vacation in Canada. He is now doing research in the Mining Department.

P. SMITH, Surveyor.

Mr. Smith was, at the time of the Expedition, a second year student in Civil Engineering. He had had some general mountaineering experience.

P. F. TAYLOR, B.Sc., A.M.I.N.A., Surveyor.

Mr. Taylor is a research worker in the Civil Engineering Department. He was a member of the Durham University Expeditions to Iceland in 1949 and 1951 and leader of the Durham University Norwegian Expedition in 1950. He was a member of the British North Greenland Expedition 1952-54. At present he is the Secretary of the I.C. Exploration Board.

G. A. TOPPING, Surveyor.

At the time of the Expedition Mr. Topping was a first year student in the Civil Engineering Department. He had travelled in Norway previously and had general mountaineering experience.

R. F. WILSON, Geologist.

Mr. Wilson was, at the time of the Expedition, a second year geology student at I.C. He had had previous experience in geological mapping and field work.

R. G. WRIGHT, Geologist.

Mr. Wright was a second year student in the Geology Department. He had had good all round mountaineering experience, in both summer and winter. He is the present (1958-59) President of the Exploration Society.

I.2 PRELIMINARY ORGANIZATION AND SUPPORT

The Expedition was conceived in January 1958 and was supported by the Royal Geographical Society (£75, plus equipment), the Mount Everest Foundation (£50), and The Imperial College Exploration Board (£150). Personal contributions amounted to £280. Dr. Walker was financially independent of the Expedition, being the recipient of a grant from the Royal Society.

Most of the Expedition's food was supplied by a number of generous firms and was obtained through the good offices of Miss B. Falkingham of the I.C. Supplies Department. A large amount of this food was supplied free of charge or at reduced rates. An appendix listing the food and the suppliers will be found at the end of this report.

The Expedition was fortunate enough to be able to use the new dehydrated foods now being processed as a research product by the Ministry of Agriculture and Fisheries. An appendix as to the suitability of these foods for the Expedition's purposes will be found at the end of this report.

Cigarettes and tobacco were supplied to the Expedition free of charge by Players Limited. Very often these were useful as objects of remuneration to helpful Icelanders.

Surveying equipment was borrowed from the Mining Department of Imperial College and the Royal Geographical Society. A list of surveying equipment, with comments, will be found under surveying procedure in the Scientific Section.

The choice of clothing was left to the individual, although several members obtained Bally Boots at cost price through the Expedition. The boots gave excellent service.

Camping and cooking equipment were loaned to the Expedition by the I.C. Exploration Board. A list of this equipment with comments can be seen at the end of this report. Almost all the cooking at Base Camp was done in pressure cookers (supplied at reduced price by Prestige Ltd.) These proved to effect a great saving in fuel.

Fuel (paraffin) was obtained in Iceland. Not much difficulty was experienced in obtaining it, but usually it was not very clean, and the primuses needed cleaning frequently. The stoves were primed with Meta Fuel.

The roarer burner type of primus was found to be more satisfactory than the silent burner type as the vapourising system did not become blocked so quickly by the dirty fuel.

The Expedition's supplies and kit were packed in tea chests (18" x 18" x 24") and various assorted crates. Packing was done in the basement of the Garden Hostel, 12 Princes Gardens, by kind permission of the sub-warden, Mr. Minton. The total weight of the assorted crates (14 in all) was over half a ton. These were dispatched to Leith by British Road Services on June 15th. About half as much again had been sent direct to Leith by the suppliers.

Dr. Walker took with him a small 12 h.p. Austin Van. This gave him the necessary mobility to cover the large area of the country on which he was working. Dr. W[illegible] was accompanied by his wife for the duration of [illegible] Expedition.

I.3 THE EXPEDITION

I.3.1. Travelling

The whole party left from Leith (Scotland) at 7 p.m. on Monday, 23rd June, aboard the m.v. Gullfoss. The food and equipment were also aboard the same boat. Messrs. Wright, Wilson and Dr. Walker had 3rd class berths, and the rest of the party travelled 2nd class. Third class passages could not be obtained for the whole party.

Life on board the ship was restful and unenterprising, although the ornithologists gained useful experience in identifying the sea birds around the Icelandic coast. Most people were ill during the crossing, even though it was relatively calm.

The first view of Iceland, on June 25th, was of the magnificent southern coast with high ridges and sweeping glaciers. Further along the coast we came to the Vestmannaeyjar (Westerman Islands), a series of small volcanic islands which present themselves as a fantastic group of geometrical shapes. Great cliffs rise sheer from the sea at crazy angles, to be topped by steep green cones, or grassy hollows.

At last, early on the morning of 26th June, we docked at Reykjavik. The weather was dull, and, as seems usual in this city, it was raining. We were allowed to disembark at about 9 a.m. and immediately proceeded with the job of clearing our baggage and equipment through customs. We were made to pay import duty on the food of 2400 kronur (about £30). This sum was later reimbursed by the Icelandic authorities. Future expeditions are advised to get a clearance note from the Icelandic Government stating that they are a temporary scientific expedition, and that the food they have is for their own use only.

After the customs had been settled, money was obtained from the bank, and a lorry for transport of the equipment and one member of the party to Akureyri was arranged. The leader also visited the British Consulate.

The party, with the exception of the geologists, stayed at the Youth Hostel in Reykjavik, and then left for the East the next day by bus or lorry.

At this stage it is convenient to give a chart showing the movement of the various parties during the whole of their stay in Iceland:

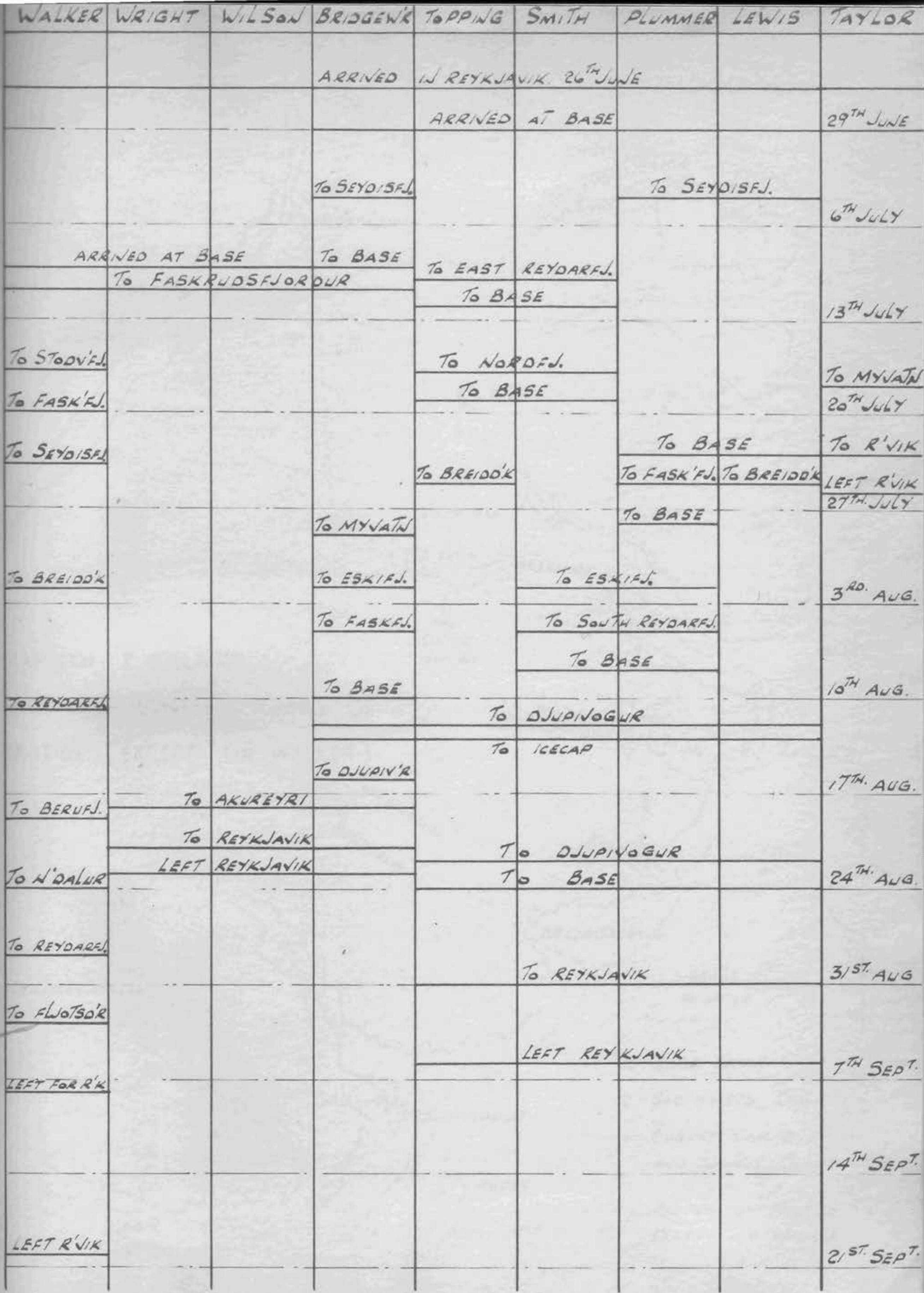
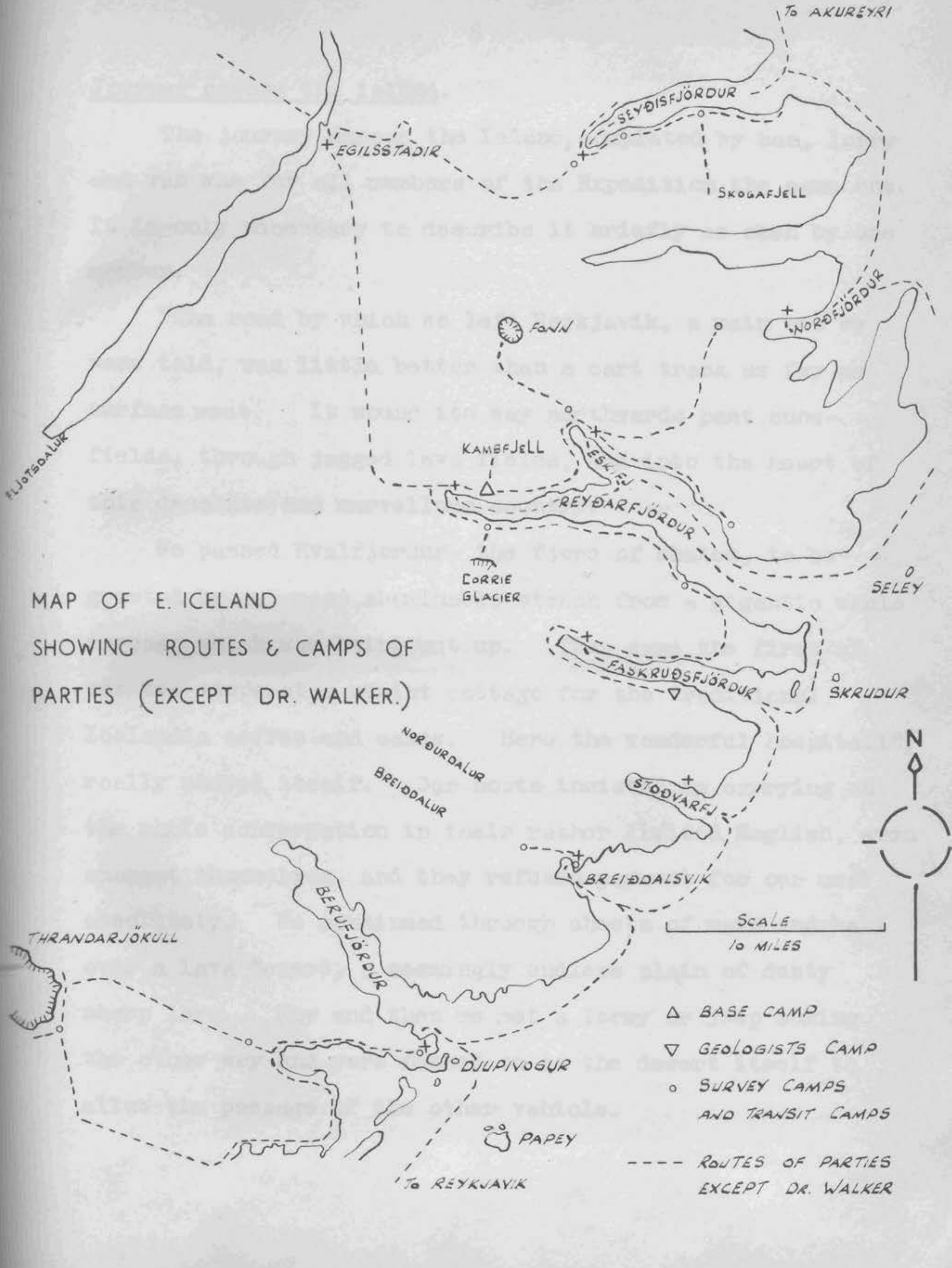


CHART SHOWING MOVEMENTS OF PERSONS.


To AKUREYRI
SEYÐISFJÖRÐUR
EGILSSTAÐIR
SKOGAFJELL
NORÐFJÖRÐUR
FONN
FLJOTSDALUR
KAMBFJELL
ESK. FJ.
REYÐARFJÖRÐUR
CORRIE GLACIER
SELEY
MAP OF E. ICELAND
SHOWING ROUTES & CAMPS OF
PARTIES (EXCEPT DR. WALKER.)
FASKRUÐSFJÖRÐUR
SKRUÐUR
NORÐURDALUR
BREIÐDALUR
STOÐVARFJ.
BREIÐDALSVIK
N
BERUFJÖRÐUR
THRANDARJÖKULL
SCALE
10 MILES
△ BASE CAMP
▽ GEOLOGISTS CAMP
o SURVEY CAMPS AND TRANSIT CAMPS
DJUPIVOGUR
PAPEY
---- ROUTES OF PARTIES EXCEPT DR. WALKER
To REYKJAVIK

Journey across the island.

The journey across the Island, completed by bus, lorry and van was for all members of the Expedition the same one. It is only necessary to describe it briefly as seen by one member.

"The road by which we left Reykjavik, a main one we were told, was little better than a cart track as far as surface went. It wound its way northwards past snow-fields, through jagged lava fields, and into the heart of this desolate and marvellous country.

We passed Hvalfjordur, the fjord of whales, to be greeted by a most abominable stench from a gigantic whale carcass which was being cut up. Then came the first of our two stops, at a quaint cottage for the traditional Icelandic coffee and cakes. Here the wonderful hospitality really showed itself. Our hosts insisted on carrying on the whole conversation in their rather limited English, even amongst themselves, and they refused payment for our meal absolutely. We continued through sheets of rain and hail over a lava desert, a seemingly endless plain of dusty sharp lava. Now and then we met a lorry or jeep coming the other way and were forced on to the desert itself to allow the passage of the other vehicle.

We stopped for another meal and continued onwards into the setting sun. The sun dipped for a few minutes below the horizon (for we were not north of the Arctic Circle), bathed everything in red light, and then rose again majestically to begin another day. Finally, we passed down a long green valley and could see a small white town at its far end. At either side were high rock walls, culminating in sharp jagged ridges, which reflected the red light of the rising sun on to the small town. This was Akureyi, the capital of the Northern province of Iceland.

Early next morning I contacted the others and we bundled half our kit on to the mail bus to the East. The other half was to follow about a week later. After crossing a huge glacial river with some magnificent falls (Godafoss) we struck out into the desert. Myvatn, a small hamlet by the side of a swampy lake, was the first place we came to. The lake is supplied partially with warm water from the hot-springs nearby and is the home of millions of midges (Myvatn means "lake of flies") and countless varieties of ducks and waterfowl. The lake also houses an abundant supply of large trout and a feast of these and skýr (sour milk) celebrated our arrival there.

The bus continued after lunch past a series of hot-springs, spouting steam and boiling water for many feet into the air. Near the springs were steaming pools of boiling mud which bubbled and frothed, and caked yellow sulphur could be seen in patches on the ground. Amongst the clouds of steam could be seen the ruins of a building. This, at one time, had been a sulphur extraction plant, but had exploded because of an irregular supply of steam.

Beyond the springs stretched a barren desert of lava. To the south-west could be seen the snowy peak of Herdubreid, a magnificent mountain, built of horizontal strata, capped with a snowy cone. Right in the south was the white ice-field of Vatnajokull and the snows of Snaefell in front of it.

After having crossed the desert, followed by a long trail of dust, we descended into the Egilsstadir valley and negotiated the longest bridge in Iceland. This is over three hundred yards long, and the piers are specially reinforced to withstand the pressure of the ice of the frozen river in winter. We were now approaching a more mountainous area, and our destination at Reydarfjordur. Up a short pass, a steep descent into a narrow fjord and we were there.

Base camp was pitched beside a turbulent stream some two miles from the small village of Reydarfjordur. Chaos reigned at first, but after a short while our supplies were neatly packed away, protected from the weather, and where they could easily be found."

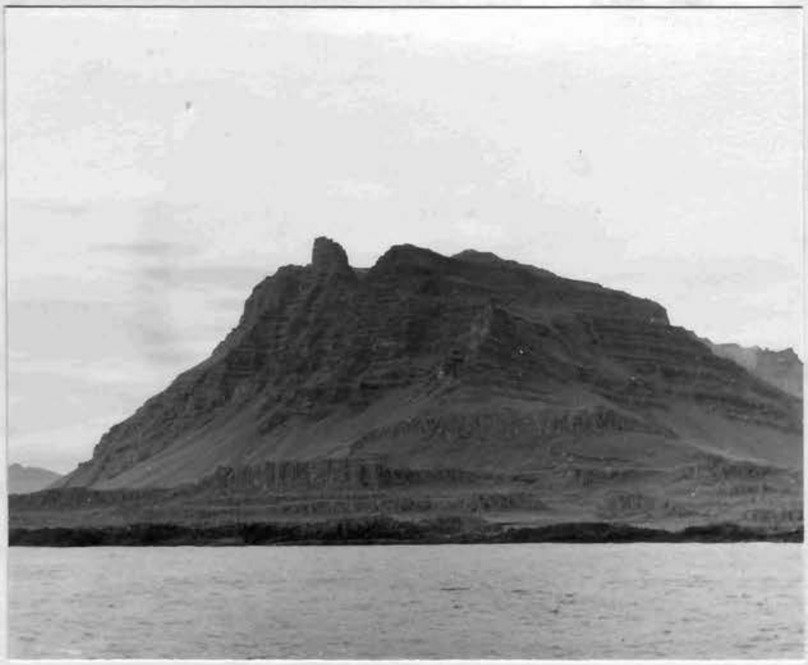
I.3.2. Base camp, Reydarfjordur, Eskifjordur, and Nordfjordur.

Once things were sorted out at Base camp we quickly settled to a routine and the tacheometric levelling began. For the first week the weather was very hot, and one member was severely burnt and blistered. Slowly our surveying improved, and by the end of the first week all the beaches around the head of Reydarfjordur had been completed. In addition, Taylor and Bridgewater were engaged in making a large scale plane-table map of the area in between the beach profiles G-G and F-F. This served as useful surveying practice and gave some idea to the party of the extent of the erosion of the beaches.

During this hot period, regularly, at about 6 p.m., a dense sea mist would drift into the fjord and envelope all of the lower slopes. Presumably this phenomenon was the result of the meeting of the hot air off the land and a cool sea current.

During the surveying of some of the beaches around

<u>Fig. 3</u>: View of Base Camp looking towards the fjord



<u>Fig. 4</u>: Typical Mountain scenery in Eastern Iceland

the head of the fjord difficulty was experienced in crossing the swollen rivers. These rivers, fed with melt water at that time of year, were very cold, and their depth and power were deceptive.

On Friday, 4th July, the Seydisfjordur party caught the bus for Egilsstadir, and the tidal staff was established on the jetty in Reydarfjordur village.

The tidal observations, described in the section on surveying techniques, were very tedious, but they allowed the observers to study the Icelandic way of life, and catch up on their letter writing and reading.

Just after the tidal observations had been completed the geologists arrived in Reydarfjordur by van, and after a day continued on to Faskrudsfjordur to start their project.

By this time the survey of the beaches in the western half of Reydarfjordur (with the exception of a few on the southern shore) had been completed, and a party left for the eastern end of the fjord near the Iceland Spar Mine, and later proceeded to Nordfjordur.

Taylor had to leave Base at about this time to travel back to Reykjavik via Myvatn, because of his commitments at College. This depleted the number of surveyors, and left the Base camp to its own inexperienced devices.

At this time Plummer and Lewis returned from Seydisfjordur, Bridgewater having returned some time earlier.

Difficulty was experienced in getting transport to Breiddalsvik, and after a long delay a party sailed by coastal vessel from Faskrudsfjordur on Saturday, 26th July.

Surveys of the beaches in Eskifjordur, and on the south side of Reydarfjordur were completed by 9th August. Another set of tidal observations were also carried out to correlate the Breiddalsvik results. Sufficient food was packed at Base for a party of five to spend eighteen days at the small ice-cap Thrandarjokull. The Reydarfjordur party finally took the boat south to Djupivogur, picking up the Breiddalsvik party on the way, and then travelled by vehicle and foot to the ice-edge.

I.3.3. Seydisfjordur.

A party of three, Lewis, Bridgewater and Plummer, went from Base Camp to Egilsstadir by bus, and then by hired jeep over the pass into the more northerly fjord, Seydisfjordur. It would have been impracticable to have marched over as they had six man-loads of equipment, and it would have taken four days to carry that amount in.

They set up a camp behind the town, and spent two days reconnoitering and bird watching. During this period they established contact with the local police-man, who later proved very helpful. The site of the Admiralty bench-mark was found at Imslandshus, although the bench-mark itself was not found, and the camp was transferred there whilst the initial tidal observations were made. When these observations were completed Bridgewater left, to return to Base, hitch-hiking most of the way.

After one day of surveying, in which the levels were transferred to Eyrar, the camp was moved up to Eyrar, a cache of food being left at Imslandshus. From this camp the levels were carried through to Skalanes, and the beach profiles made.

The children of the village were very friendly, as was the school-master. One of the local farmers supplied milk and eggs, and before the party left entertained them to coffee, having first invited his English-speaking nephews over from Egilsstadir.

An interesting method of drying fish was observed in the village. The fish, (gutted and cleaned), were spread on the stony beach to dry in the sun. They were picked up each evening, and stacked under tarpaulins, and respread the next morning by the children, under the direction of the school-master.

Faskrudsfjordur, only to find that the boat they then caught could just as easily have brought them right from Base Camp. After a rapid reconnoitre they pitched camp, and caught up with several hours of well needed sleep. This first camp was on the narrow neck of land which protects the haven nestling in the northern corner of this sweeping skerry-strewn bay.

As there was time to spare before starting the tidal observations they inspected the beaches in the valley behind the bay, in particular those near Heydalir. The main series of beaches form a huge horseshoe sweeping across the valley about three miles from the sea, the beaches at the ends being quite narrow but well defined. At Heydalir the flat top of the beach has been used to form the landing-strip.

The beaches have been badly eroded in places, especially where the river cuts through them. This river, once having cut through the beaches, spreads over a large flat area, giving rise to much damp, rough pasture, then joins up again to break through a narrow opening in the impressive storm beach which encircles the bay.

At the appointed time the tidal observations were made, the staff being lashed to the jetty. It was apparent that the results were following a much smoother curve than those

On 11th August the party returned to Breiddalsvik having done as much as they could of the profiling. They expected to be picked up the following day by the south-bound party travelling aboard the "Esja" on their way to Thrandarjokull. By this time they were running short of food, having underestimated the length of their stay, and having had to cut their stores before leaving Base. Consequently they were greatly relieved to see Smith, Plummer and Bridgewater waiting for them on the heaving deck.

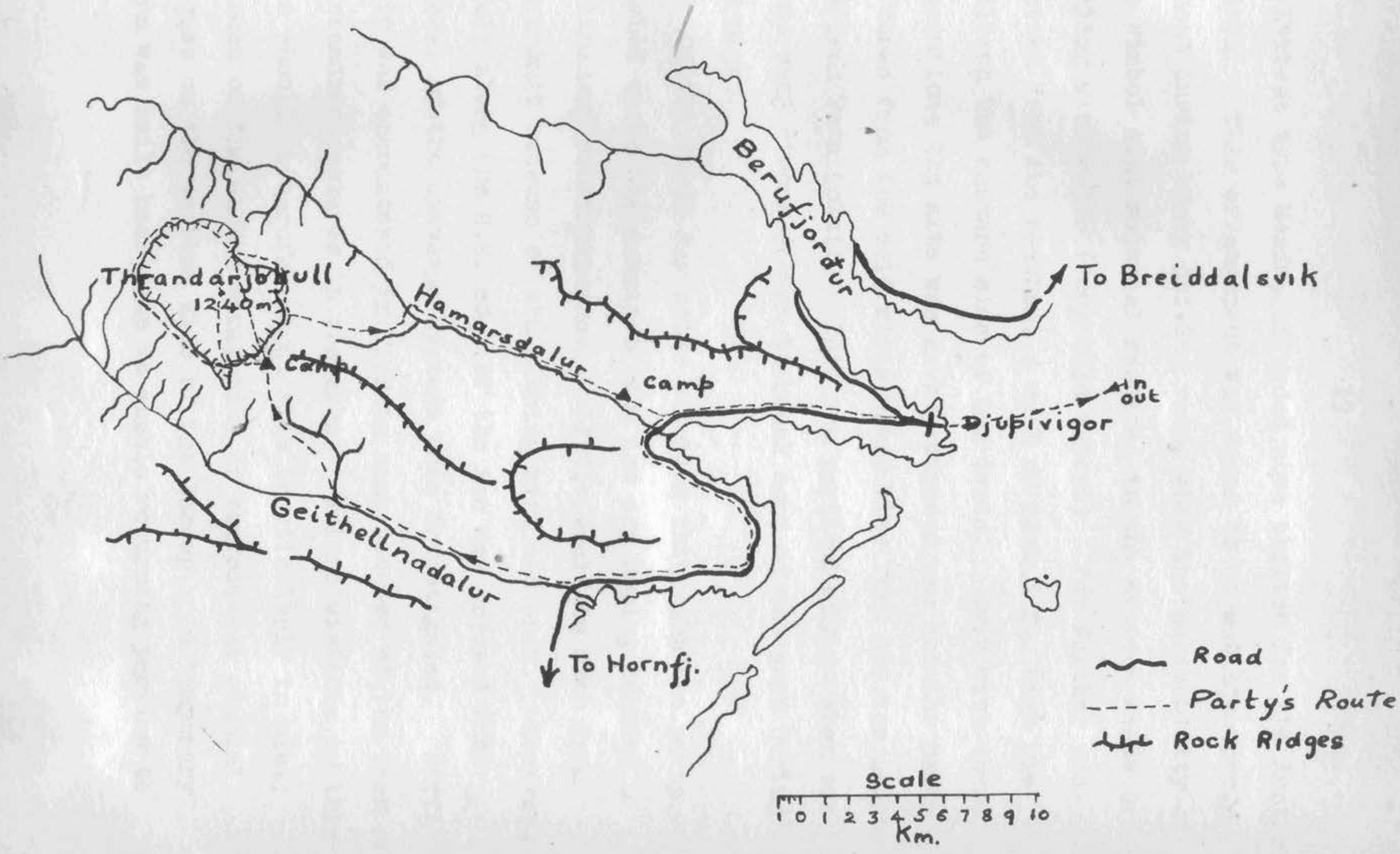
I.3.5. The Icecap Party Movements

Sufficient food and equipment were taken from Base to supply five men for 18 days. This included the extra clothing required for living at higher altitudes, and in all gave each man a load of about 70 lbs.

The party arrived at the small village of Djupivigor on 12th August and camped the night there. With the help of the Director of the village Co-op a jeep was hired to take the party and kit some 40 Km. into Geithellnadalur.

The party were deposited some 7 Km. from the ice edge, which was, at the time, in cloud. After climbing for four hours the party pitched camp on an exposed rocky shelf at about 900 m. (2900 ft.) The tents were so arranged, end to end and with their entrances together, that an easy distribution of food was possible, and the stronger tent,

GENERAL MAP OF ICE-CAP PARTY MOVEMENTS



an Everest type Meade, afforded some shelter for the Arctic Guinea. This arrangement was found to be satisfactory, except during heavy driving rain, when the permeability of the Wincol tent material resulted in the Everest Meade filling with water (very cold water!) For further protection from the weather, a wall of rock 3 ft. high was built on the eastern side of the tents. Even with these precautions the site was a very exposed one and the party suffered from the cold winds which blew from the ice nearby and from Vatnajokull. This was particularly so when the winds were strong enough to break some of the guys during the night.

On the first day after pitching this camp the party climbed up to the summit of the ice cap hoping to make a preliminary reconnaissence. Little could be seen from the summit because of the blowing mist and snow. However, a walk along the N.E. edge of the ice was enjoyed and several of the crevasse systems were investigated. Difficulty was encountered in finding camp because of the lack of outstanding features in the area. Future visitors to this area should be careful about this (particularly in mist) because of the marked similarity of the several glacial tongues on the eastern side of the Icecap. A temporary cairn was built near camp to enable returning parties to find their way more easily. Five cairns were built next day as part of the perimeter traverse and the party trekked their way back to camp right across the centre of the ice.

On 16th August Bridgewater left the party and walked the 22 miles back to Djupivigor to catch the coastal steamer, the m.v. "Esja", and join the geologists on their way to Reykjavik and home. No work was possible on that day because of the high wind and blowing rain.

Five more cairns were built on 17th August on the western side of the Icecap. By this time the weather seemed to be closing down and the rain became more frequent. Another day was lost because of bad weather on 18th August, and on 19th August came the first really good day (the only one) of the party's stay at the ice edge. On this day five more cairns were built and bearings were measured between all of the cairns. The distance of the ice edge from the cairns was measured and the distances between most of the cairns was paced.

The weather for the next two days was bad and the final pacing for the survey, between the last three cairns, was done in driving rain on compass bearings.

The last night at the ice cap was the most uncomfortable encountered on the Expedition. The wind was high and gusty, and the rain heavy; two side guys on the tents snapped in the middle of the night because of overstrain; the occupants of the tents became very wet, and four gallons of water were baled from one of the tents. It may confidently be stated that the "Wincol" tent material is definitely not waterproof. It was, perhaps, fortunate that the party was scheduled to leave next morning, and with the coming of daylight the camp was hurriedly vacated.

Difficulty was experienced in crossing the south-eastern tongue of the icecap. The incessant rain had washed away its surface snow and transformed it into a sheet of slippery blue ice, at an angle of about seven degrees. Good skating practice was enjoyed by the party.

After walking 12 miles, which included crossing the swollen river in Hamarsdalur at a narrow gorge, a transit camp was pitched 2 miles from the sea. Here the party dried out and continued on to Djupivigor next day. The party were fortunate enough to pass through the farmyard of a very kind gentleman, who offered them refreshment, and entertained them for several hours, before driving them the last few miles into Djupivigor.

One day was spent at Djupivigor drying out and rebuffing the curiosity of the local children. The party sailed for Base on 24th August.

Base Camp and Departure from Iceland

Base camp was packed up in a rainstorm and the party finally left the east coast aboard the m.v. "Esja" on 1st September.

Reykjavik was reached on 3rd September and the party took lodgings in the town until their embarkation for the United Kingdom on 6th September. During this period there were a series of anti-British demonstrations in the capital, over the fishing dispute. The party were grateful for the hospitality shown to them during this difficult period by the citizens of Reykjavik.

We must also record here the Expedition's gratitude to the many Icelanders whose patience and generosity were taxed so many times; it was largely due to these people that our stay in Iceland was such a pleasant one.

I.3.6. Activities of the Geologists

The geological party consisted of Dr. Walker (and his wife), R. F. Wilson, R. Wright and D. Bridgewater. This section of the report deals mainly with the activities of Wilson and Wright, and to a lesser extent to those of Bridgewater. Dr. Walker's travels are dealt with in the next section.

The party, with the exception of Bridgewater, left

Reykjavik by car late on the evening of the day of arrival, and after paying a visit to the home of the Professor of Physics at the University, motored some thirty miles out of the city before camping. While travelling north the following day, a stop was made at a whaling factory, the chief recollection of which was the powerful and repugnant smell.

Various detours were made to places of interest, and an attempt was made to get to the most westerly of the icecaps. This, however, proved to be impracticable in the short time available, but whilst on this detour they passed through the small thermal area of Reykholt, the steam from which had been utilised by the farmers for the heating of green-houses. On the farm visited citrous fruit and figs were being grown. With the vast reserves of hot water available it would seem possible that a major industry could be developed in these parts, with the result that Iceland might one day export tropical fruit to other countries.

Stops were made at the little towns and villages passed en route, and it was noticed that a generally high standard of living prevailed throughout the country. Of particular note was the great kindness and generosity with which the party were universally treated by the inhabitants.

After five days of travelling over apalling roads, the party had got to within thirty miles of Akureyri, when they had the misfortune to develop a petrol leak, and at the same time to lose some of the luggage. The former was temporarily repaired with the aid of chewing gum, but though they searched, there was not trace of the missing luggage. Luckily it was handed in to the police in Akureyri, and returned.

By this time they had become accustomed to the midnight sun and found it very useful, as their working days were often out of phase with normal routine by as much as six hours.

Just a week after leaving Reykjavik a major misfortune befell the party when bolts securing a back wheel of the van sheared. They came to an abrupt halt, and there being nothing else they could do, they pitched camp there. Soon a milk truck came along, and with the help of the driver, the van was moved on to the verge.

While the wheel was being repaired they took the opportunity of exploring the surrounding country. They were fortunate in being near to Myvatn, in an area reputed to be one of the most active, volcanically, in the world. The scenery was magnificent, with a ring of snow capped mountains making a background to the blue waters of the lake. The latter was fed by underground springs of pure water, and swarmed with both trout and duck.

During the week spent at Myvatn there was an average of twenty-two hours of sunshine per day, and the sky was continually cloudless.

When eventually the wheel was repaired, the party set off across the great northern desert, and reached the east coast after a two-day journey. Here they picked up the rest of their stores from the Base Camp, and carried on to Faskrudsfjordur. Camp was pitched about ten miles from the village, at a farmstead called Eyri. The farmer and his wife were most hospitable folk, and supplied them with fresh milk daily.

Some six weeks after arriving in Faskrudsfjordur, in which time a geological map of part of the peninsula had been constructed, the three of them, Wilson, Wright and Bridgewater, set sail aboard the m.v. "Esja" for Akureyri. After a three-day voyage, during which they crossed the Arctic Circle, they disembarked, and went by road to Reykjavik, where they boarded the m.v. "Gullfoss" bound for home.

I.3.7. Dr. Walker's Party

They left Reykjavik with Wilson and Wright at half past midnight of 27th June on the first stage of the car

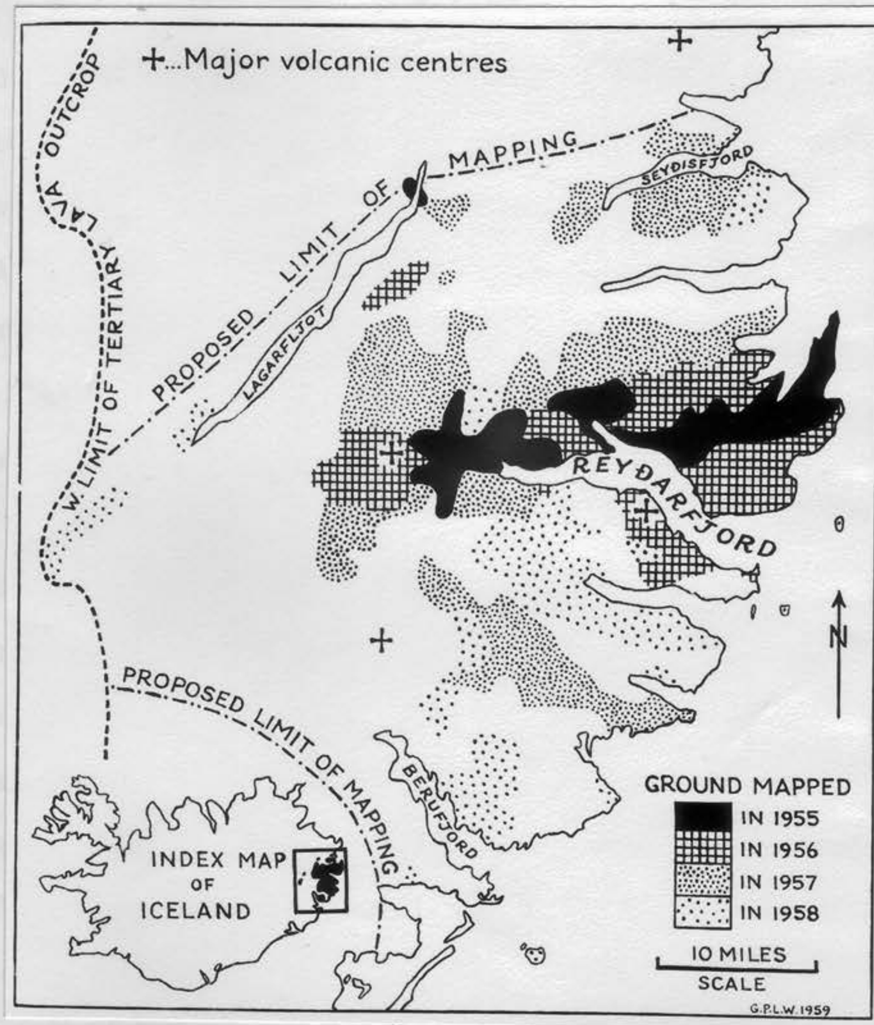


Fig. 6: Progress of Dr. Walker's geological mapping in Eastern Iceland since 1955

journey to eastern Iceland. Myvatn was reached on 30th June, after a journey which included a detour to the hot springs at Reykholt and an examination of the post-glacial lava and cinder cones of Bifröst. Advantage was taken of an enforced stay of a week at Myvatn (due to a breakdown mentioned in the previous section) to examine the fascinating volcanic geology of this region. Eastern Iceland was not reached until 8th July, and after a visit to Base Camp the van was driven over the ridge from Reydarfjördur to Faskrudsfjördur, by probably one of the most difficult roads in Iceland, and camp was established at the head of Faskrudsfjördur.

Soon after arrival at the head of Faskrudsfjördur, Wilson and Wright moved camp to Eyri to commence their own mapping. Dr. Walker then spent five days mapping near the head of Faskrudsfjördur, including three long 12-hour traverses into the mountains to the west, and then moved camp for a few days to Stödvarfjördur and then to near Hafranes. The brilliant and very warm sunshine experienced at Myvatn persisted, although a bank of low cloud out at sea often surged up the fjord during the daytime and at times reached the head of the valleys to the west. This low cloud is often encountered in the summer in the eastern fjordlands of Iceland and is a major handicap to geological mapping, although the peaks above 2000 feet usually rise above it and enjoy brilliant sunshine.

Although there was still much to do, Walker left on 23rd July to call at Egilsstadir for a fortnight's mail, and visit the bank at Eskifjordur for funds. On the rough crossing to Reydarfjordur a stone dislodged by one of the car's wheels struck the gearbox violently and broke off a large piece. The hole was successfully plugged, and the oil replenished. Camp was established near Hanefsstadir farm, south of Seydisfjordur, for the second stage of the planned programme.

Ten days were spent in Seydisfjordur to complete some mapping commenced in 1957. The weather had by now deteriorated, and most of the time they encountered cold northerly winds, with showers of rain that fell on the mountains as snow down to about 2500 feet. Much of the work had to be done at the eastern end of Seydisfjordur involving a 2 to 2½ hours walk every morning to reach the area of mapping and necessitating spending up to 14 hours in the field at a stretch. The work was, however, successfully accomplished.

After visiting Egilsstadir for mail, the difficult journey to Breiddalur was successfully accomplished and camp set up on August 3rd south of Breiddalur to examine the hitherto unmapped ground between there and Berufjordur. The scenery is dominated by a group of six spectacular rhyolite-capped peaks of which one, Slottur, is bounded on three sides by impressive cliffs up to 800 feet high. The ascent on the fourth side is quite easy. Another peak, Stong, is even more spectacular, and its ascent seems impracticable. These peaks prove to be a series of deeply dissected rhyolite domes that are exceptionally well-exposed.

On 11th August they returned to Reydarfjordur to visit Base Camp just before the departure of the party to Thrandarjokull, and then spent a few days checking doubtful points in the ground already mapped near there. They met Thorbjorn Sigurgeirsson, the Icelandic physicist, on 15th August; he was making observations on earth magnetism in the area, and they visited with him the offshore islands of Seley and Skrudur. Both proved to be composed of igneous intrusions, and the latter is interesting in being inhabited by an immense number of sea-birds, including puffins.

On 18th August they returned to Reydarfjordur after doing some mapping south of the fjord, and met the geologists, Wilson, Wright and Bridgewater on the m.v. "Esja", about to depart for Akureyri and thence Reykjavik. There followed a visit to Eskifjordur to collect funds from the bank there, and to visit the local Sheriff for Austur-Mula Sysla (County), a charming a very hospitable man.

It was, unfortunately, necessary to return to Breiddalur to complete some mapping started in 1957 north of the main valley of Breiddalur, but the difficult crossing from Egilsstadir was accomplished without incident. Before starting mapping, a visit was organised on 21st August to the island of Papey, six miles off-shore, near Djupivogur. Examination of aerial photographs of Papey had suggested the presence of ring-intrusions there, and it seemed extremely desirable to visit the island to study the geological structure. As luck would have it, the day chosen was one of the windiest of the summer, and the crossing, accomplished in a small fishing boat, was extremely rough. Had it not been an off-shore wind, conditions would have been impossible. The existence of arcuate intrusions on the island was established, but it was quite clear that the island is not a major volcanic centre, as had been hoped. Back on the mainland that night the gale was very severe and accompanied by heavy rain.

After a few days mapping in Berufjordur, a week was spent mapping in Nordurdalur north of the main valley of Breiddalur. Weather was poor, with cloud down to the valley floor on several days, making work on the mountains difficult, but the planned programme of mapping was completed. They then returned to Reydarfjordur to visit the surveying party about to dismantle base-camp and depart for Reykjavik.

That weekend was the wettest of the summer in eastern Iceland, with a fall of approximately three inches of rain. Following the rain the weather improved somewhat and several days were spent revisiting ground already mapped in 1955-57 along Reydarfjordur. They finally departed from the eastern fjordlands on September 3rd to make a study of the rocks at the top of the Tertiary succession some forty miles inland. From Egilsstadir the long, straight lake, Lagarfljot, was followed along a good road to its head, and camp established at the end of the motorable road, in Fljotsdalur. Five very successful days were spent there camped on the banks of the turbulent, milky waters of the Jokulsa river, and several long traverses were made, including one of 12 hours' duration to well beyond the furthest farm and to within 10 miles of the prominent volcanic mountain, Snaefell, and 15 miles from the northern edge of the ice-cap [illegible]jokull. On several days it was very warm and sunny, and on two days at least Thrandarjokull was seen to be completely clear of cloud.

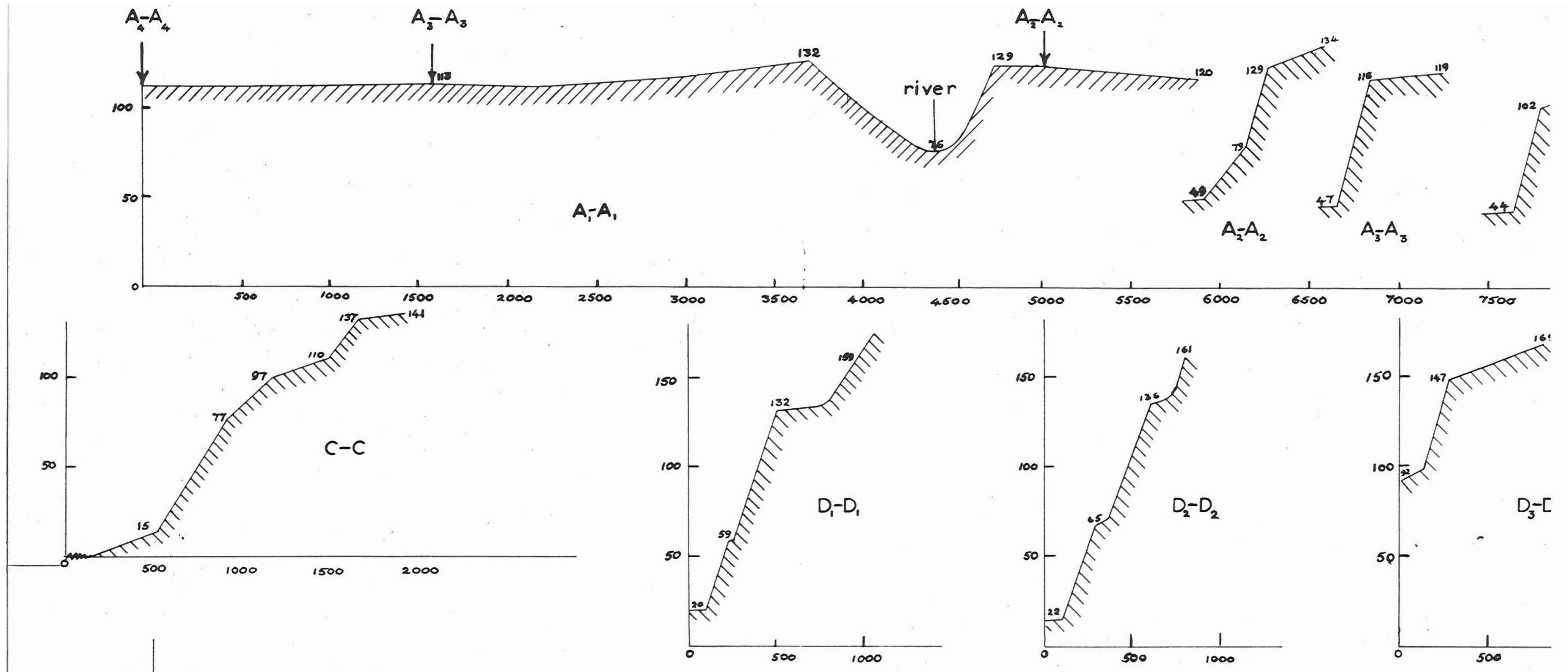
[illegible] Iceland was finally left on September 8th. [illegible] to spend a fortnight on the journey back to [illegible] enable some mapping to be undertaken at several [illegible] volcanic [illegible] of western Iceland [illegible] east. [illegible] the [illegible] of ash [illegible] had been planned was abandoned [illegible] fortnight was, geologically, a complete [illegible] the 500 mile journey to Reykjavik was [illegible], and they departed, aboard the [illegible] on the journey home.

RAISED BEACHES

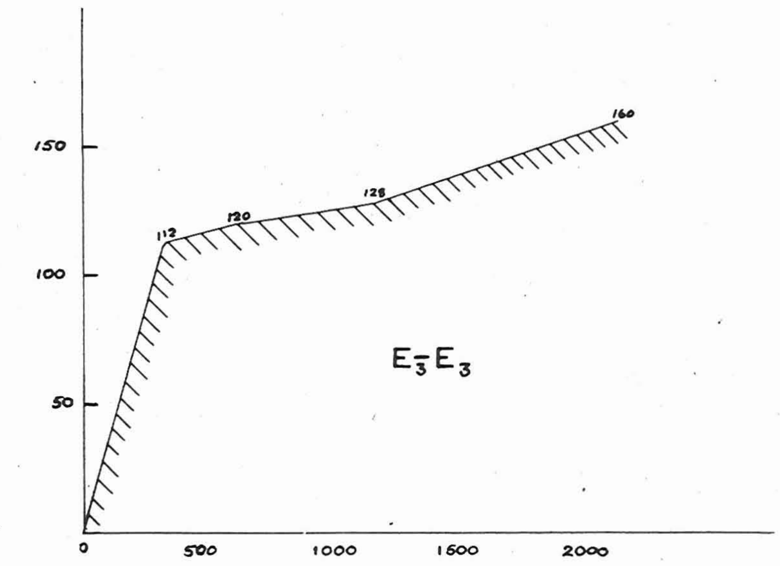
The survey of the beaches, although it covered three major areas, only yielded results for two of them namely Reydarfjordur, and Seydisfjordur. As recorded elsewhere the results from Breidalsvik were of no use because the theodolite used in the observations was damaged, and the errors introduced were not of a type which could easily be eliminated.

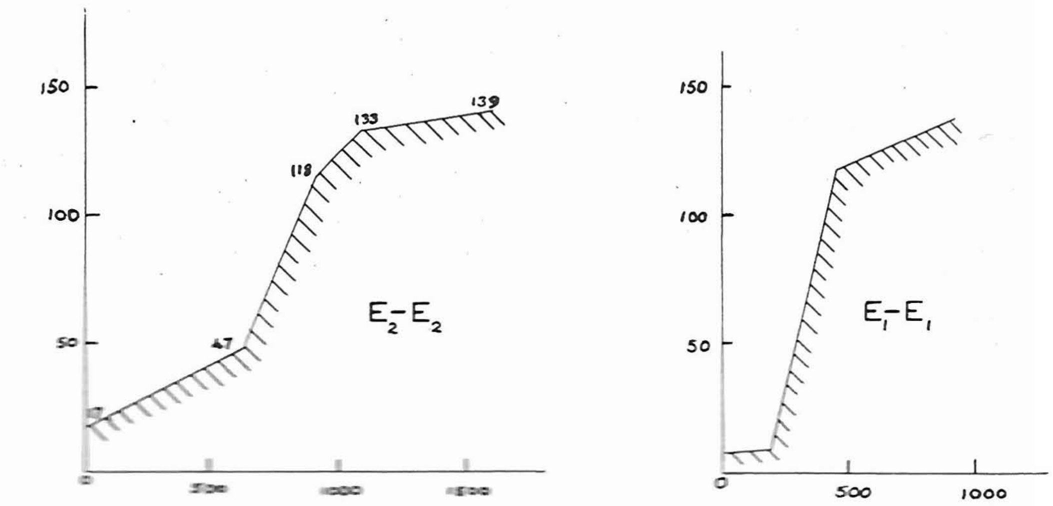
Cross-sections of each beach surveyed were drawn out (see attached prints), and from these an attempt was made to interpret the results. The first apparent feature is the lack of consistency in the heights of the beaches. The most obvious point to consider when a cursory examination is made, is the height of the point at the "front" of the beach (where it drops away rapidly). But as the beach would have sloped when originally formed, and the front of the beach has since been eroded, then the height of this point is of little use in the interpretation.

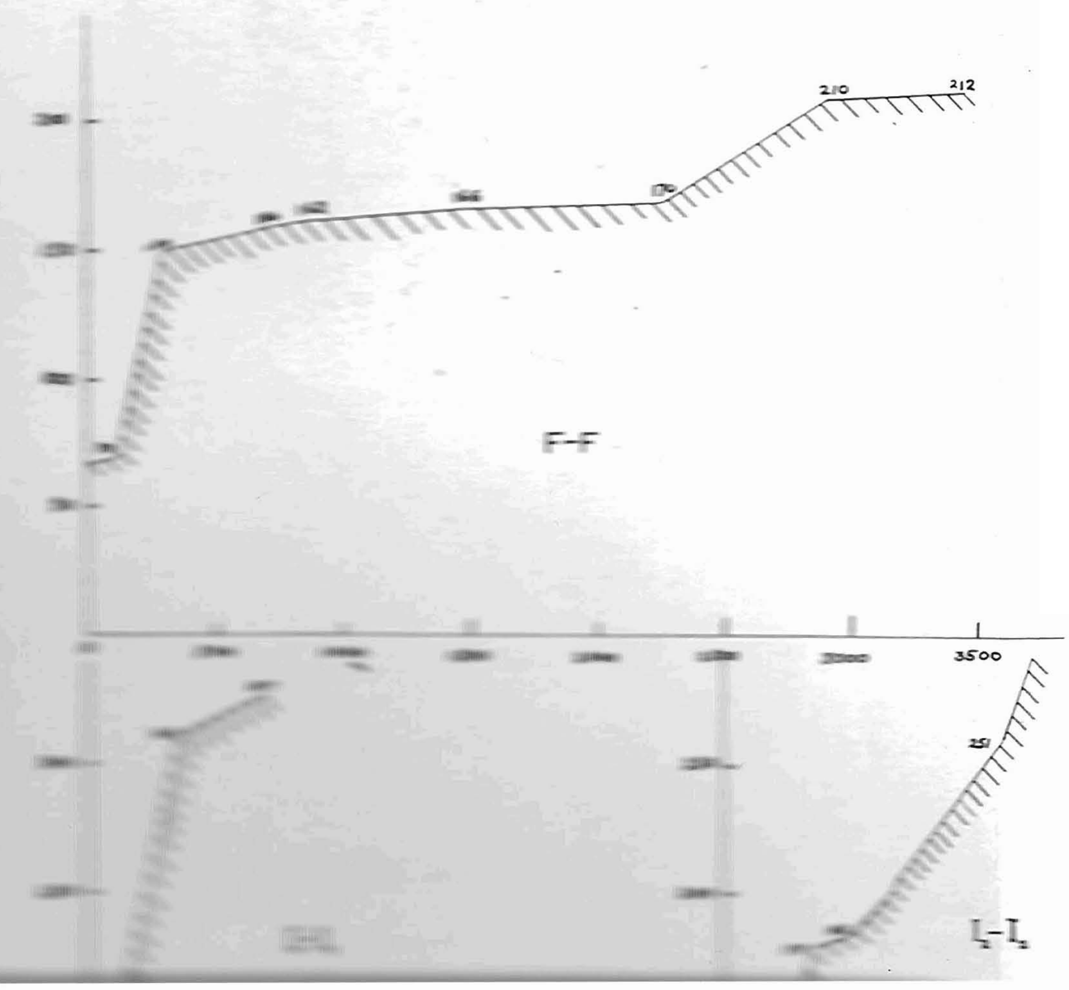
Another point which could be considered is the "nick" point, or the point where the beach abutted to the cliffs or other hinterland. In many of the profiles this point is difficult to define, but where the original cliffs can be detected this point is easily found. Here though there is again the problem of erosion. Not this time denuding the beach, but building it up at the foot of the "cliffs" with detritus from the cliff. In some cases, particularly in Seydisfjordur, the height of this point can give [illegible] f the level of the old beach

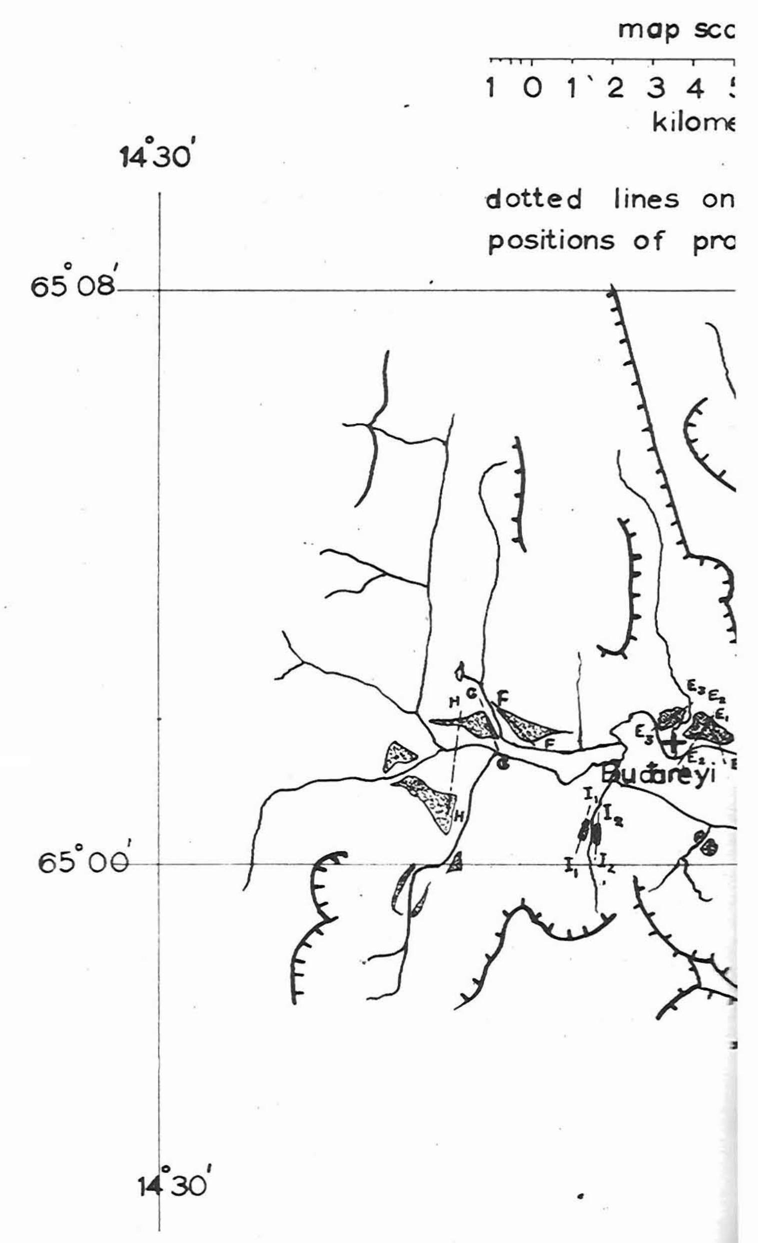


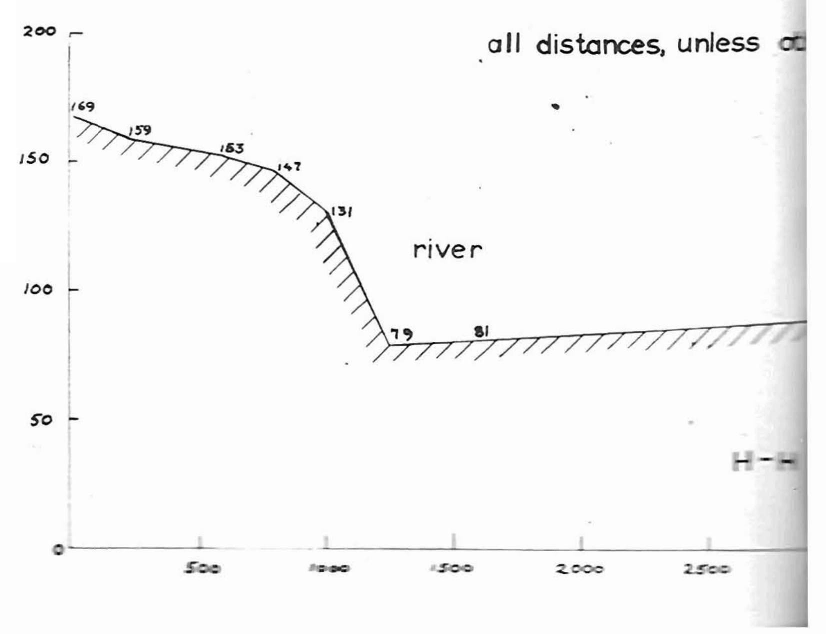
RAISED BEACHES IN THE REYÐAR
AREA

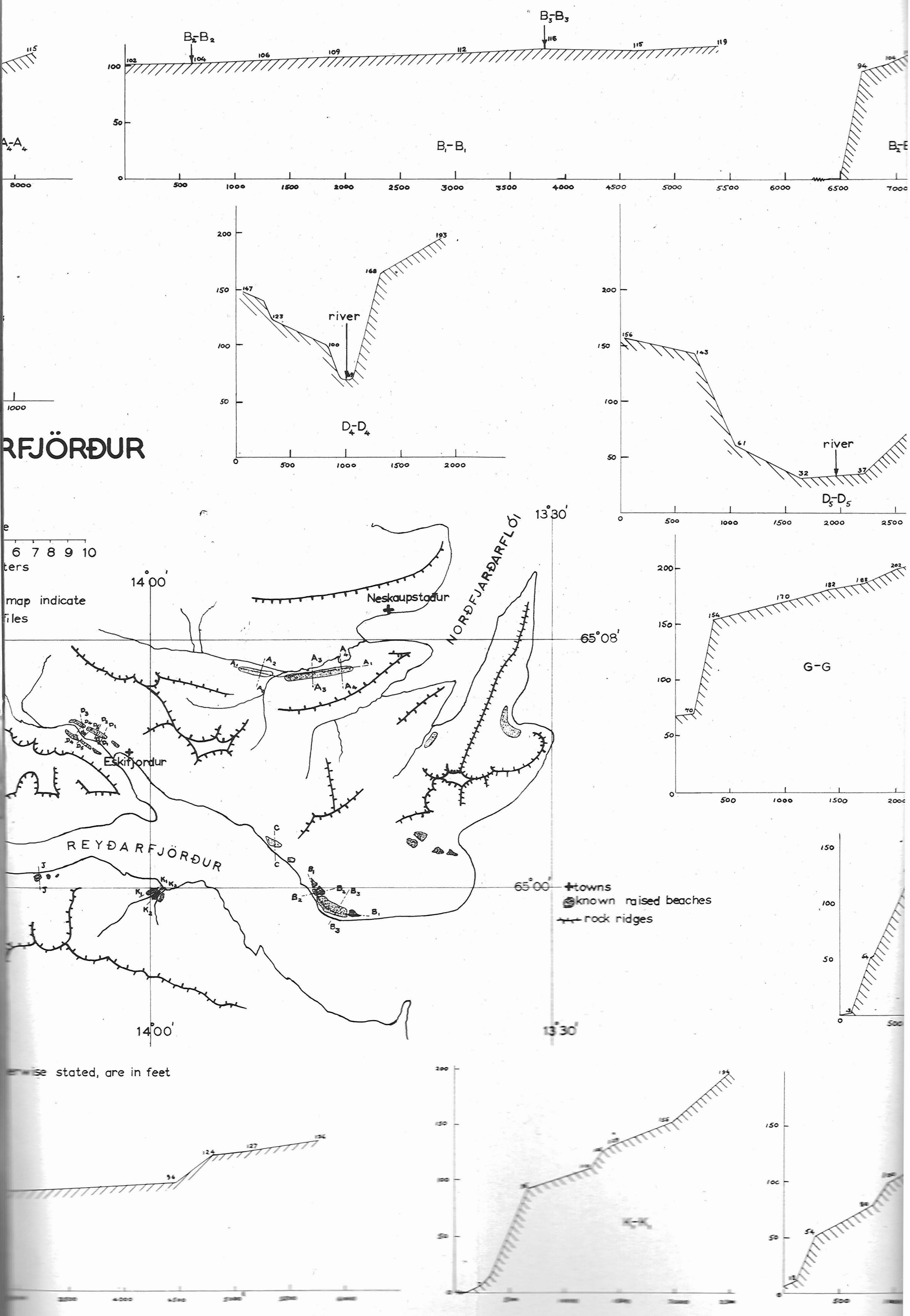




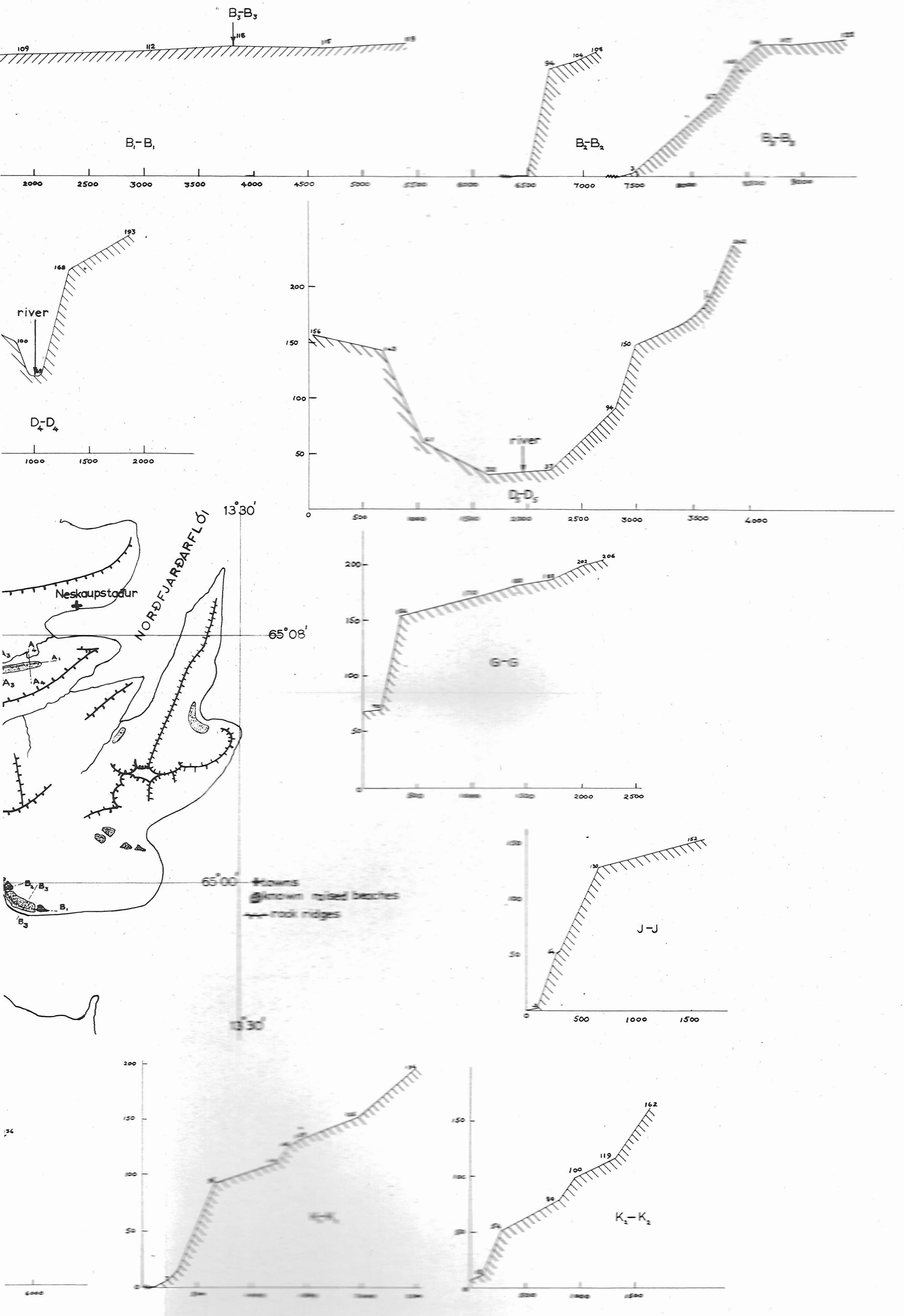


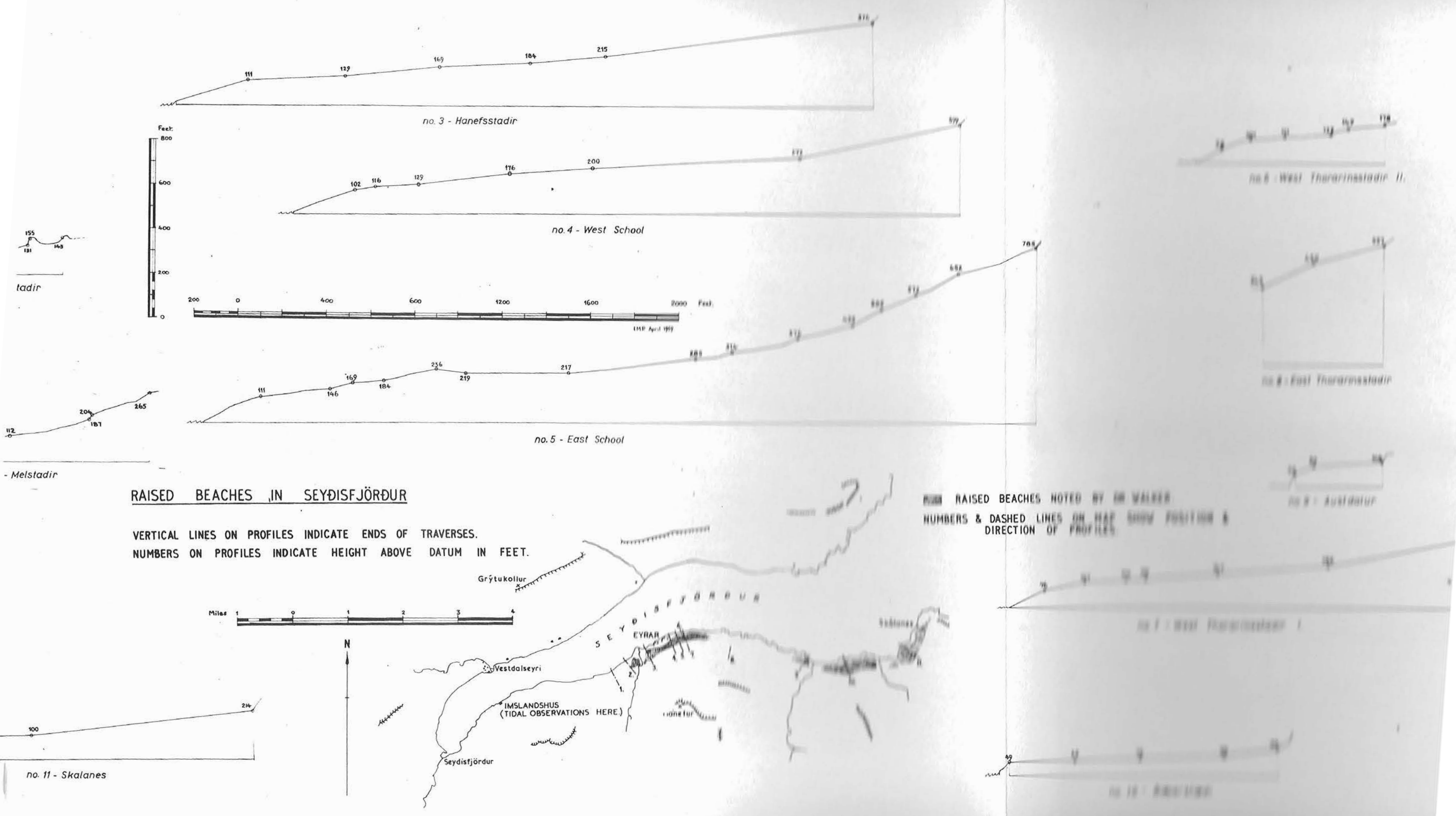




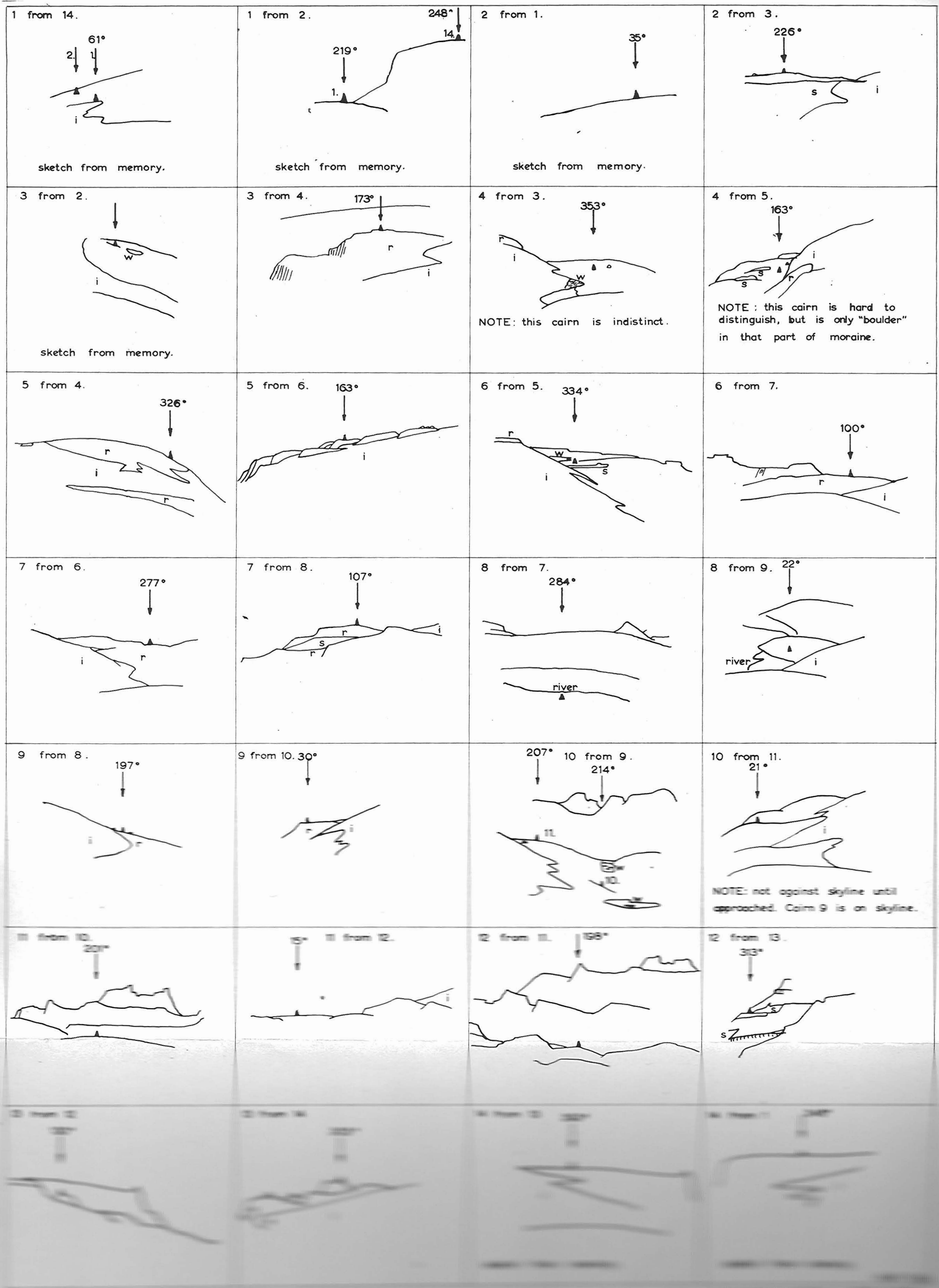


RFJÖRÐUR
B₂-B₂
B₃-B₃
B₁-B₁
A₄-A₄
D₄-D₄
D₅-D₅
G-G
river
e
6 7 8 9 10
ters
map indicate
files
NESKAUPSTAÐUR
NORÐFJARÐARFLÓI
Eskifjörður
REYÐARFJÖRÐUR
14°00'
13°30'
65°08'
65°00'
towns
known raised beaches
rock ridges
erwise stated, are in feet

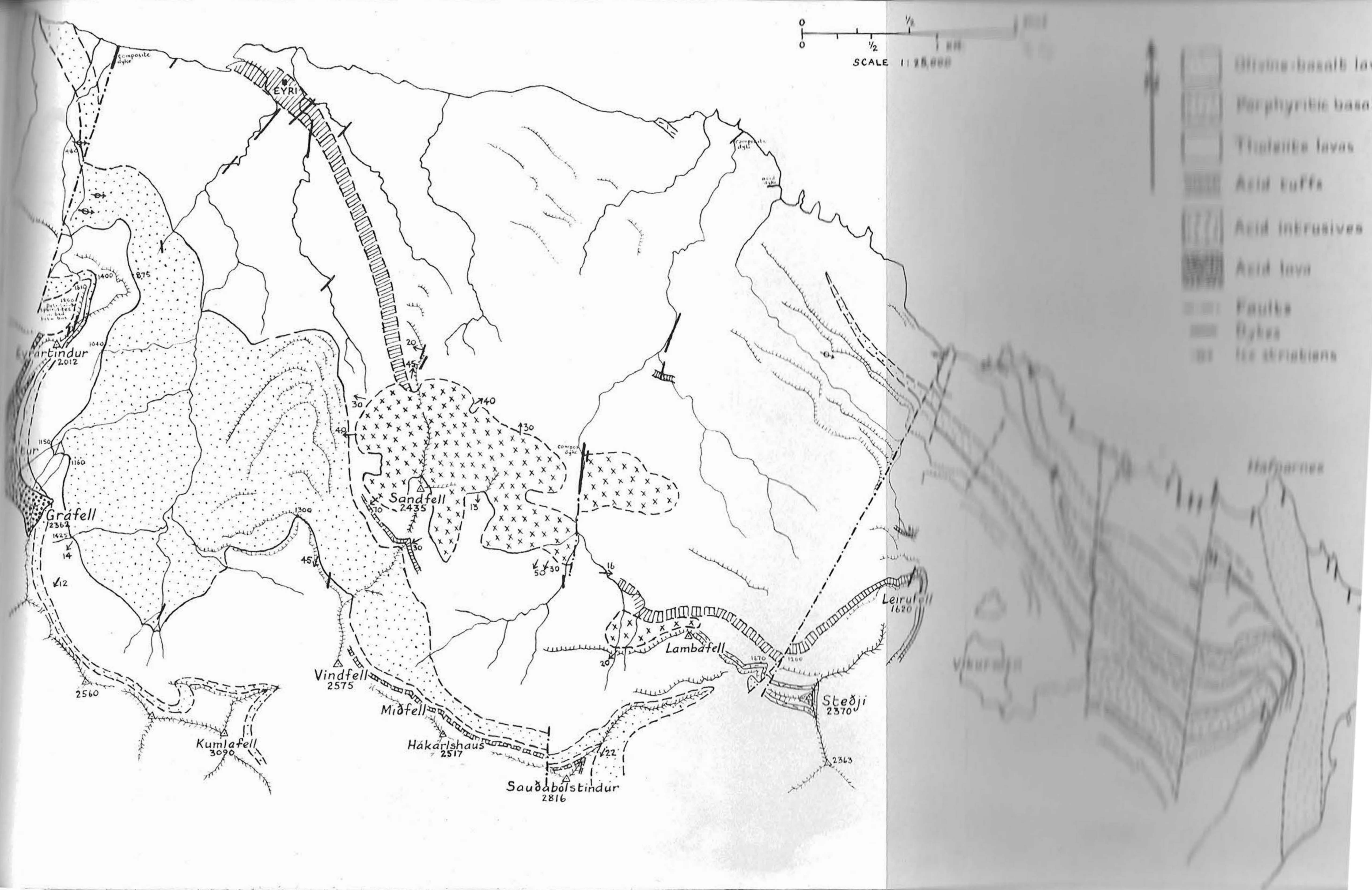

B3-B3
B1-B1
B2-B2
B3-B3
2000
2500
3000
3500
4000
4500
7000
7500
river
D4-D4
1000
1500
2000
200
150
100
50
river
D5-D5
0
500
2500
3000
3500
4000
NORÐFJARÐARFLÓI
13°30'
Neskaupstaður
65°08'
A1
A3
A4
B1
B2/B3
B3
65°00'
+towns
known raised beaches
rock ridges
G-G
2000
2500
J-J
0
500
1000
1500
13°30'
K1-K1
K2-K2
162
119
100



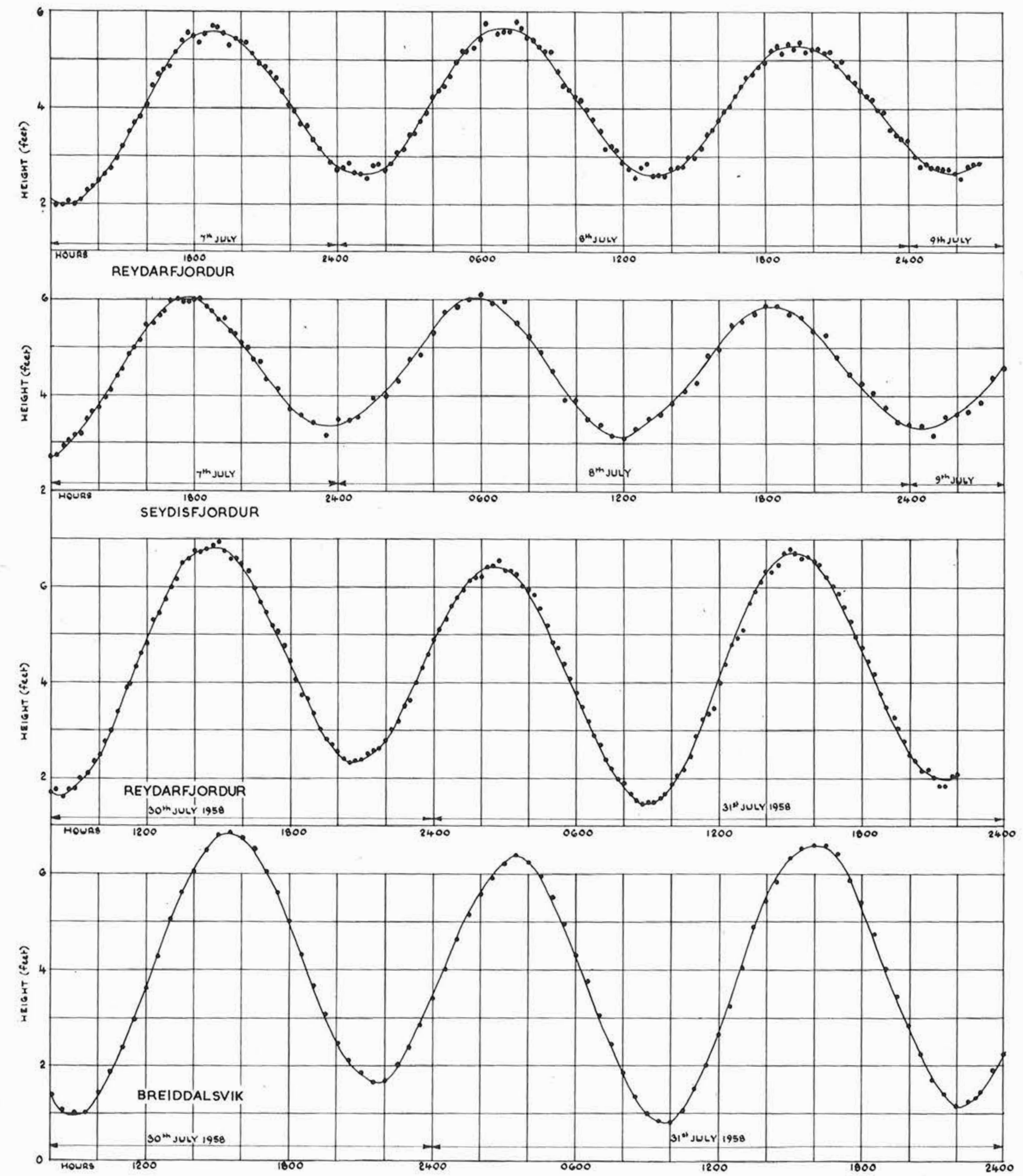
RAISED BEACHES IN SEYÐISFJÖRÐUR
VERTICAL LINES ON PROFILES INDICATE ENDS OF TRAVERSES.
NUMBERS ON PROFILES INDICATE HEIGHT ABOVE DATUM IN FEET.
RAISED BEACHES NOTED BY DR WALKER
NUMBERS & DASHED LINES ON MAP SHOW POSITION & DIRECTION OF PROFILES.
no. 3 - Hanefsstadir
no. 4 - West School
no. 5 - East School
- Melstadir
no. 11 - Skalanes
Feet
800
600
400
200
0
200
0
400
600
1200
1600
2000
Miles
N
Grýtukollur
SEYÐISFJÖRÐUR
EYRAR
Vestdalseyri
IMSLANDSHUS
(TIDAL OBSERVATIONS HERE)
Seydisfjördur
Skálanes



1 from 14.
61°
sketch from memory.
1 from 2.
248°
219°
sketch from memory.
2 from 1.
35°
sketch from memory.
2 from 3.
226°
3 from 2.
sketch from memory.
3 from 4.
173°
4 from 3.
353°
NOTE: this cairn is indistinct.
4 from 5.
163°
NOTE : this cairn is hard to distinguish, but is only "boulder" in that part of moraine.
5 from 4.
326°
5 from 6.
163°
6 from 5.
334°
6 from 7.
100°
7 from 6.
277°
7 from 8.
107°
8 from 7.
284°
river
8 from 9.
22°
river
9 from 8.
197°
9 from 10. 30°
207°
10 from 9.
214°
10 from 11.
21°
NOTE: not against skyline until approached. Cairn 9 is on skyline.
11 from 10.
201°
15°
11 from 12.
12 from 11.
198°
12 from 13.
313°



SCALE
EYRI
composite dyke
acid dyke
Eyrartindur
2012
Gráfell
2362
Sandfell
2435
Vindfell
2575
Miðfell
Hákarlshaus
2517
Sauðabólstindur
2816
Kumlafell
3090
2560
Lambafell
Leirufell
1620
Steðji
2370
2363
Tholeiite lavas
Acid tuffs
Acid intrusives
Acid lava
Faults
Dykes



PARTICULAR TIDAL CYCLES FOR VARIOUS PLACES IN EASTERN ICELAND DURING THE SUMMER OF 1958

Data are arbitrary
Time is G.M.T.

RECORDED BY IMPERIAL COLLEGE
ICELANDIC EXPEDITION 1958

It has been suggested by Dr. [illegible] that a [illegible]

[illegible]

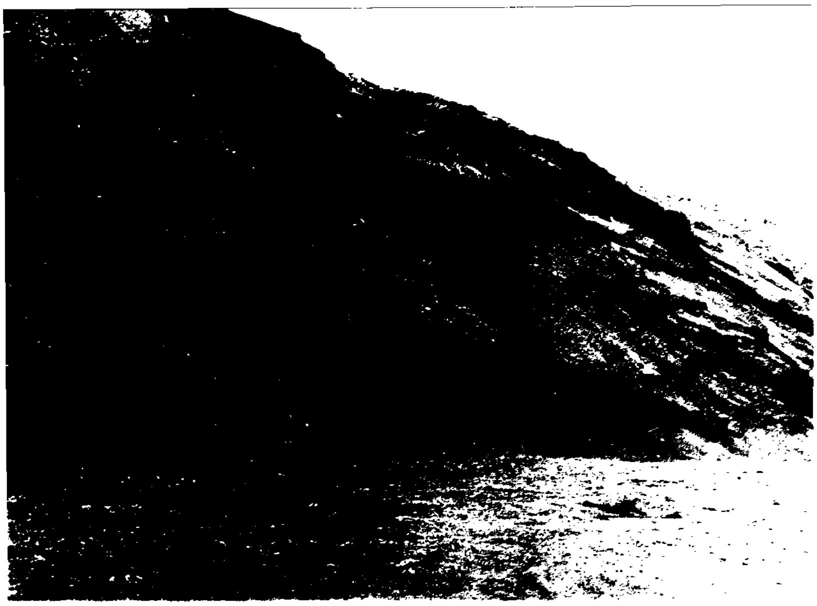


Fig. 15: Bedding of an eroded raised beach near Reydarfjordur

Fig. 16: Reydarfjordur and the raised beaches as seen from across the fjord

[illegible] ...ches

[illegible] benches in the two fjords [illegible] separate fjord [illegible] interpretation, and [illegible] deposits. [illegible] the height of the [illegible] such as the apparent [illegible] evacuation of [illegible]

[illegible] change in the [illegible] the [illegible] condition, [illegible] most dramatic explanation. The initial [illegible] have been that the whole island was covered with

[illegible]e and that it retreated towards the centre [illegible]

[illegible] of the inland [illegible]

[illegible]

[illegible] a difference [illegible] along the [illegible] 70°. There [illegible] such difference [illegible] here that along the west coast of [illegible]

[illegible] of the [illegible]

[illegible] in [illegible]

1:2400 in north Helgeland

1:1146 about Tromso.

Conditions during the Ice Age must have been similar in Eastern [illegible] difference between [illegible] as listed above [illegible]

[illegible] the Langmuir [illegible]

[illegible] as follows [illegible]

[illegible] the [illegible]

[illegible] of the [illegible] hypotheses.

[illegible] has not been considered [illegible]

[illegible] by Langmuir [illegible]

[illegible] may have [illegible]

[illegible] the [illegible]

[illegible] estimate [illegible]

[illegible] larger [illegible]

[illegible] saturation.

[illegible] would be [illegible] value by 250 instead of 21', then it would not be unreasonable to postulate that if all the Antarctic, Greenland, and other ice were to melt, the general sea-level would rise by about 130'. So if when the beaches we are considering were originally formed there was no ice on the surface of the earth, and then, due to some major climatic change the great ice-caps of the world were created, then the general sea level would have been lowered by some 130', thus forming the beaches [illegible]

[illegible] that [illegible] appeared, by [illegible] in other [illegible] are scattered, [illegible] developed [illegible] Gjordur and [illegible] (near [illegible]) 33 m.; [illegible] 41.5 m. In [illegible] the [illegible] in height with distance from [illegible]

2 BEACHES AND PLATFORMS IN SEYDISFJORDUR (see fig.6)

The main series of beaches lie on the southern side of the fjord, stretching almost continuously from a point about one mile west of Eyrar, near the ruined farm of Hrolfur, east to the farm of [illegible]. All of these beaches abut to the shore, and so their seaward faces are freshly eroded.

Above these [illegible]

[illegible] on the seaward side of this there [illegible] to be a nick point (just behind the un-named farm), but no profile was taken across it at the time (done later - [illegible] Vestdalur II) as it was thought to be an anomaly. However, on plotting the profiles in that area this appears to be a nick point more in keeping with the general series than the one we measured.

Behind Vestdalseyri there are two platforms. The lower [illegible] appears to correlate with the top of the bottom [illegible] on the Gundarstadir profile, the other is some 100-200' [illegible].

[illegible], on the north side of the fjord, [illegible]

[illegible] from the tidal graphs that [illegible] as well as [illegible] there is a secondary oscillation [illegible] curves. This is [illegible] harmonic oscillation of the [illegible] of [illegible] basin. Usually seiches are initiated [illegible] may sometimes be caused by an earth[illegible] observed here were almost certainly wind [illegible] they appear on both tidal cycles for [illegible] on the simultaneous Seydisfjordur observa[illegible] not apparent on the Breiddalsvik observa[illegible] expected, since Breiddalsvik is situated [illegible] is no fjord basin where an oscillation [illegible].

[illegible] can be analysed by normal harmonic methods, [illegible] assuming that the fjord basin is completely enclosed, [illegible] formula for their time of oscillation can be [illegible]

$$T = \frac{2 l}{n \sqrt{g . h}}$$

[illegible] of the [illegible] of oscillation)

[illegible]

Reydarfjordur, 1 hour; Seydisfjordur, $1\frac{1}{4}$ hours.

Hence, $\frac{T_r}{T_s} = \frac{1}{1\frac{1}{4}} = 0.8$

The fact that the values of T_r/T_s both for the observations and for the theoretical case are both 0.8 is largely fortuitous, since a great many interpretations of both λ and h could be made from the maps. However, the fact that the observed times and the calculated times are of the same order is to some degree a verification of the theory, and adds a little to the scanty knowledge relating to oscillations in fjord basins.

THE ICECAP OBSERVATIONS

A general description of the party's movements on and around the icecap has already been given.

The scientific work undertaken on Thrandarjokull may conveniently be divided into the following sections:

(a) The Survey of the Ice-Edge.

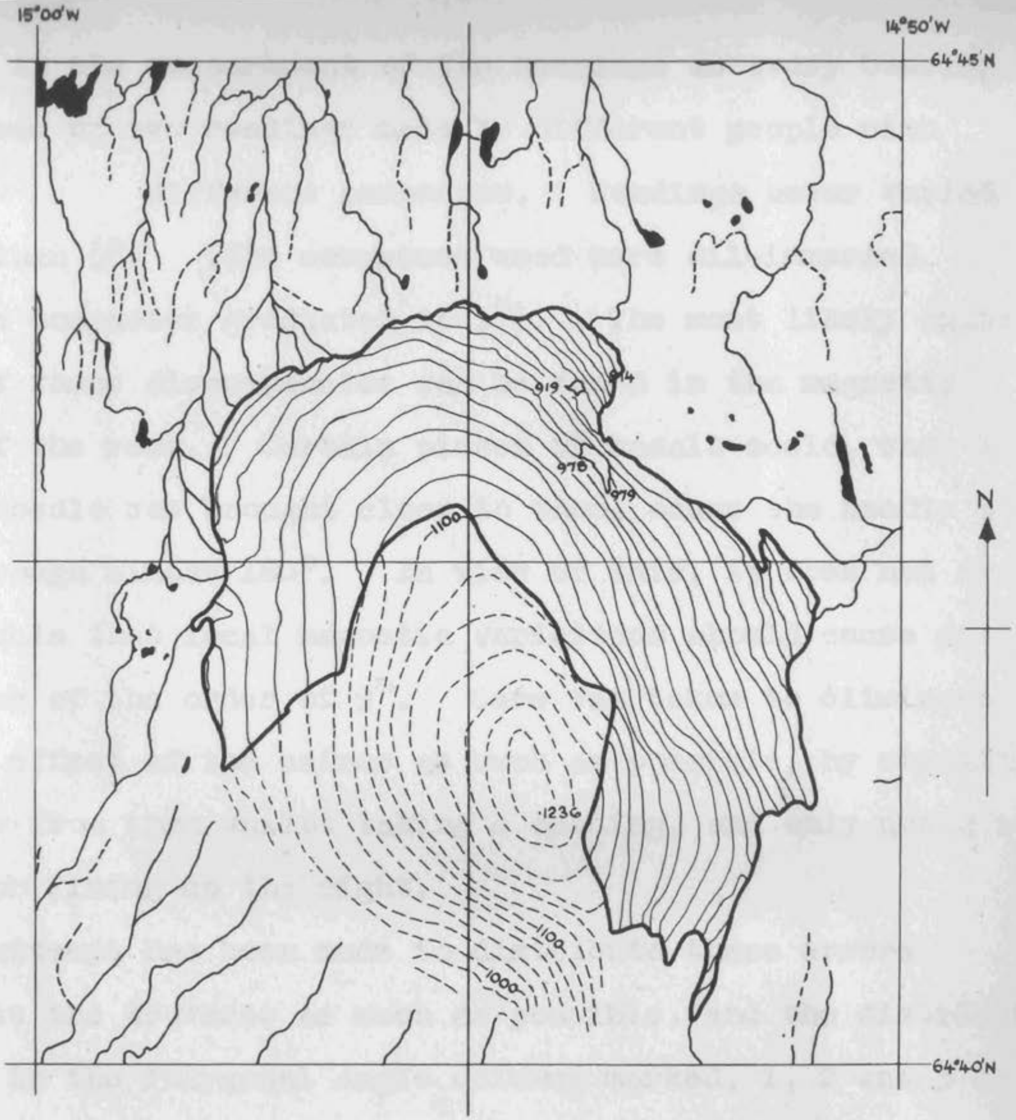
(b) General Features noted on and around the Icecap.

The Survey of the Ice-Edge

The basic object of this survey was to establish a number prominent cairns around the ice-edge and to measure the distance of the ice from the cairns along a measured magnetic bearing. This will enable a future party to make similar measurements, and so determine the rate of advance or retreat of the ice-edge.

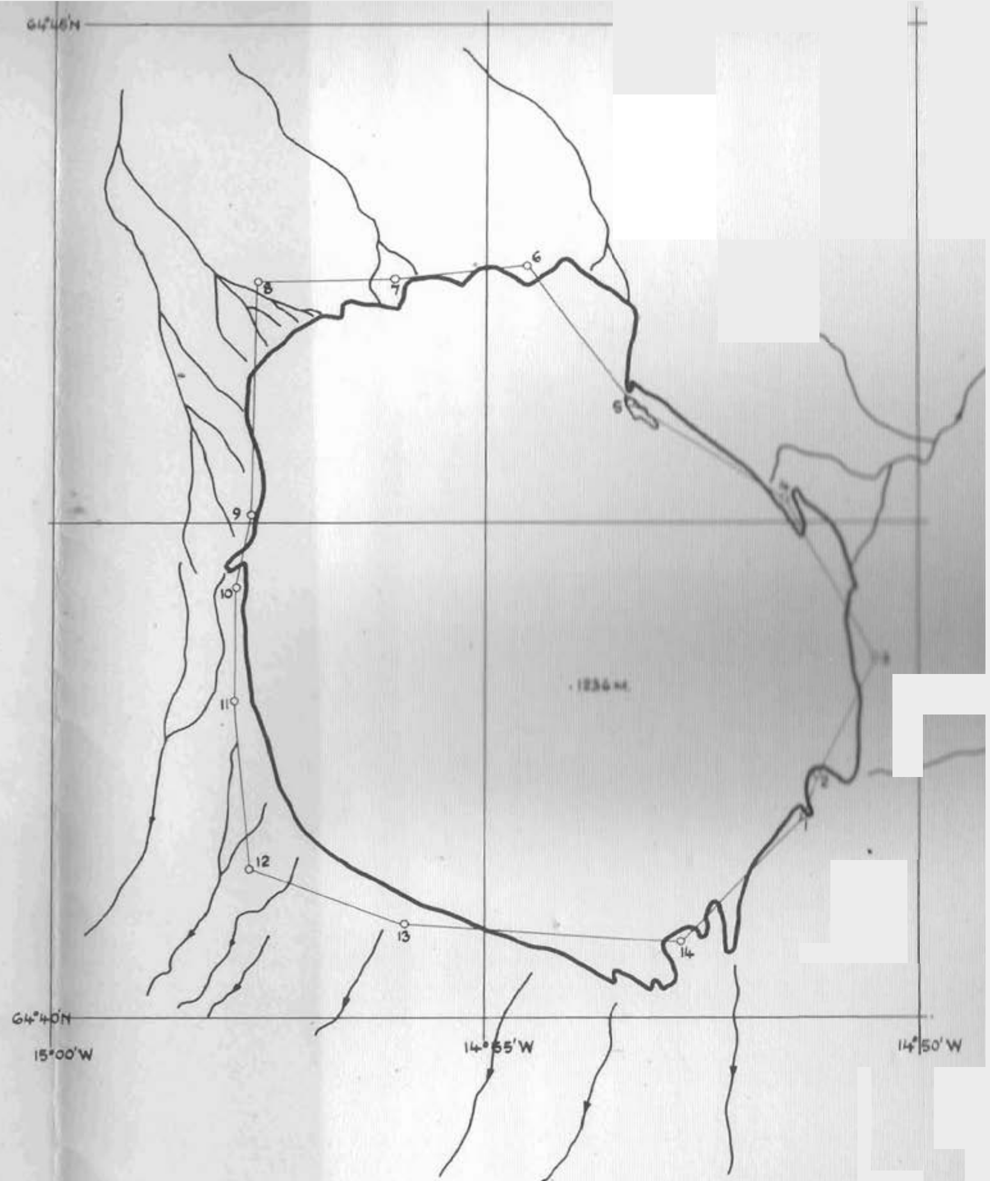
In all, fourteen large cairns (see Fig.   as a typical example) were built. The distance of the ice-edge from each cairn with the bearing along which the measurement was made, together with the bearings and distances of adjacent cairns, are shown in Table I.

From an examination of the table certain discrepencies are immediately obvious. Most important is that there appears to be a discrepency in the magnetic bearing when measured from say A to B, and then measured again from B to A. The value of this discrepency is recorded in column 4, and it can be seen to vary from zero to 9°. There is little possibility of there being



SKETCH MAP BASED ON U.S. MAPS PRODUCED BY AERIAL SURVEY (OCT. 1946)

(Note: dotted areas uncertain owing to obscurities on photographs)



SKETCH MAP SHOWING COMPASS & PACING TRAVERSE MADE BY IMPERIAL COLLEGE ICELANDIC EXPEDITION AUGUST 1958 WITH GENERAL DRAINAGE PATTERN

(Circles & numbers indicate cairns)

(Heights in metres)

Scale : kilometres
1 0 1 2 3 4

Scale: miles
0 1 2 3 4

ÞRÅNDARJÖKULL E. ICE NI

mistakes in the measurement of the bearings as every bearing is the mean of two readings made by different people with different compasses. Readings never varied by more than $\frac{1}{2}^{o}$. (The compasses used were oil-immersed prismatic compasses graduated to 1^{o}). The most likely explanation of these discrepencies can be found in the magnetic nature of the rock. Certain pieces of basalt could, when a compass needle was brought close to them, cause the needle to swing through almost 180^{o}. In view of this, it does not seem unreasonable that local magnetic variations should cause discrepencies of the order of 9^{o}. Care was taken to eliminate the magnetic effect of the cairns as much as possible, by standing well away from them whilst taking a reading, and only using the cairns for lining up the sight.

An attempt has been made to distribute these errors throughout the traverse as much as possible, and the distribution is shown in the Polygonal Angle columns marked, 1, 2 and 3 in Table I.

Column 1 is a straight back-sight/fore-sight tabulation, neglecting any magnetic discrepencies. It will be seen that the total of the internal angles as calculated by this method is only 15^{o} less than the sum for a 14-sided polygon. The expected error by the Gaussian laws is:

maxm. known error x $\sqrt{\text{no. of readings}}$

i.e. $9 \times \sqrt{14}$

$\approx 32^\circ$

As the error is only in fact 15° it may be concluded that the total error has been reduced by mutual cancellation.

Column 2 is a revised estimate, with the discrepencies distributed equally between the appropriate backsights and foresights. The sum of the angles is then 10° more than the sum for a 14-sided polygon.

If the error in both the backsight and the foresight had been the same, then by the Gaussian laws the error should not exceed

$4.5 \sqrt{14}$

i.e. $\pm 16^\circ$.

This is greater than the actual error, probably, again, because of the cancellation of errors.

Column 3 is the result of the final adjustment made to the angles to bring them to a total of 2160° (the sum of the angles of a fourteen sided polygon). This adjustment has been evenly applied wherever possible, but if this was not possible account was taken of the angles in which the original discrepency was greatest. This final adjustment can be little better than guesswork, but it is thought that no polygonal angle is in error by more than 2°.

No attempt has been made to correct the ice front direction

Fig. 23: Typical cairn as built during the Thrandarjokull ice cap survey

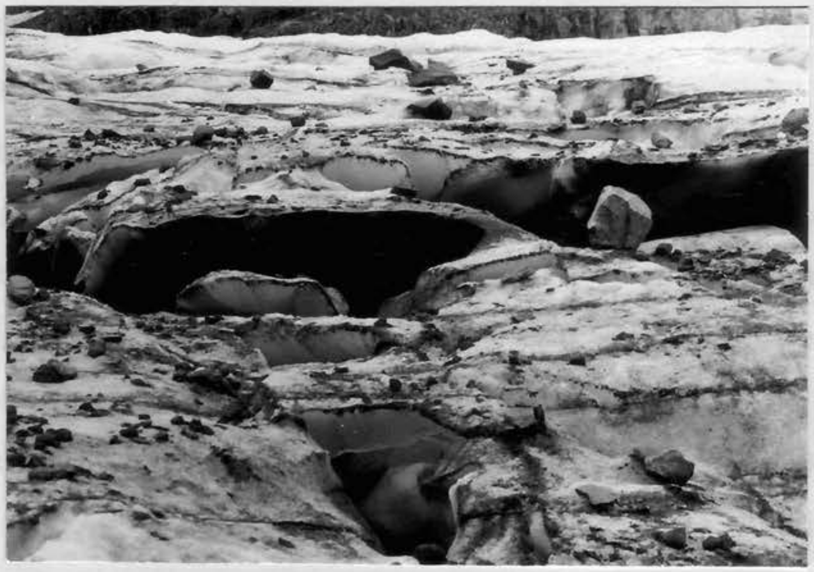


Fig. 24: Close up of edge of corrie glacier in Reydarfjordur

bearings, since it is these exact bearings which any party will need in the future, if they propose to resurvey the ice-edge. Similarly the actual observed magnetic bearings from one cairn to another have been included in Table I and on the sketches (Fig. 22) to help any future investigator wishing to locate one cairn from the next. For this purpose the sketches (Fig. 22) should be of great help. Most of them were made on the spot and show the prominent features near the cairns, and any boulders which may be confused with the cairns.

Distances to the ice-edge were measured with a linen tape, and the accuracy is probably not better than one foot. Account was only taken of steep slopes (greater than 30°) in these measurements.

Distances between cairns were paced. The distances are the mean of at least two persons' pacing. The pacing was standardised by finding the distances represented by 100 paces for each person. This was done back at Base camp, a tract of country being chosen for its similarity in conditions under foot to the terrain around the icecap. The error in the pacing is thought to be not greater than 1 in 30. As far as was possible pacing was checked, and indeed two of the legs were not paced, the distances being measured from aerial photographs, the three cairns in question having been fixed on the photographs. Aerial photographs are useful for this sort of work, but at times difficulty was experienced in fixing the position on them as the

Cairn	Back Sight °Magnetic	Fore Sight °Magnetic	Discrepancy between B.S & F.S.(°)	Distance to Ice Edge (ft.)	Bearing of Ice Edge (degrees)	Dist. between Cairns (ft.)	Polygon Angle 1	Polygon Angle 2	Polygon Angle 3	Adjustment (inches)
			7			5992				0.02
1	248	35		152	270		147	152	153	
			4			1322				0.08
2	219	46		363	270		187	189	188	
			0			3983				0.15
3	226	353		1014	288		127	127	126	
			0			5730				0.23
4	173	326		361	268		153	153	152	
			0			5560				0.31
5	136	334		58	334		198	203	201	
			9			5490				0.37
6	163	277		528	224		114	120	122	
			3			4083				0.44
7	100	284		834	206		184	187	186	
			3			4268				0.54
8	107	197		1992	153		90	94	93	
			5			7102				0.58
9	22	214		160	107		192	192	191	
			4			2230				0.63
10	30	201		214	121		171	169	168	
			0			3454				0.71
11	21	198		502	90		177	175	174	
			3			5090				0.78
12	15	130		2090	60		115	115	114	
			3			4842				0.90
13	313	116		767	50		162	164	163	
			3			8097				1.00
14	293	61		566	305		128	130	129	
			7			5292				

TABLE I

Fig. 25: Partially formed dirt cone Thrandarjokull

Fig. 26: "Crag's Tail" dirt accumulated in the lee of a rock; Thrandarjokull

farmer who said that the ice-cap had been rapidly decreasing in size from 1900 until about 1948, and then much more slowly until the present day.

Despite the fact that only a general recession in the ice may be deduced from this traverse at this moment, the most significant aspect of the survey is that fourteen cairns have been established around the perimeter and the distance of each one from the ice edge has been measured along a known bearing. This will enable a future party to make similar measurements and so determine the rate of advance or retreat of the ice-edge.

(b) General features noted on and around the icecap

At the time of year the party were at the icecap (mid-August) the firn line appeared to be quite high, at about 1150 m. Fixings were not taken because of the bad weather when the party were on the top of the icecap, and because of the extreme difficulty of finding any reliable known points for resection.

It may be seen from aerial photographs (taken 31st August 1945) that there is a transition zone (presumably the firn line) at an altitude of about 1100 m. This is a little lower than the firn line was presumed to be in 1958, but may be due to the photographs being taken a little later in the year, and to any reduction in the size of the icecap in the years between 1945 and 1958.

Fig. 27: Furrows made in moraine by the advance of the ice edge

On the eastern side of the ice, distinct furrows could be seen in the ground moraine (Fig.27.). It was thought that these were either gouged out by the winter advance of the ice and were then uncovered, or that they were recently unfrozen fossilised furrows of another age. Of the two, the former is the more likely explanation, since the furrows themselves were very soft and would not have lasted for any length of time (probably even when frozen). A possible explanation of their cause is as follows:

Owing to the stress distribution caused within the ice by its own weight, the cap is constantly flowing, plastically, outwards. In summer, this advance of the ice-edge is more than compensated by melting and ablation at the lower levels, but in winter there is a relative seasonal advance. During this advance boulders and stones are picked up by the ice front and these tend to mark and gouge everything in their path. The marks and striations are subsequently uncovered the following summer by melting.

A further theory on their formation is that the furrows are a result of a solifluction effect and are similar to stone stripes. In view of the large size (note the ice axe in the photograph) of the furrows this seems unlikely.

Abundant ice scratching of rocks around the ice-cap was noted, indicating that the whole of the area had, at one time, been under ice cover.

Dirt cones along the margins of the ice in the ablation zone were noticed. These seem common on the Icelandic ice-caps, and their possible origin is explained in "The Origin of Dirt Cones on Glaciers" by C. Swithinbank (Journal of Glaciology, vol. 1, no. 8, Oct. 1950).

Another feature which was noted towards the edge of the ice was a series of boulders with a dirt tail in their lee (see photographs fig.26. These were probably caused by the protection effect which the boulders give to any accumulated dirt in their vicinity. The dirt probably arose from wind blown dust or debris brought up along shear planes.

Roche moutonnées were observed at certain places around the cap, and were particularly prevelant on the lower levels.

The moraines which surrounded the cap showed no distinct orientation, or a tendency to any one type. They were without exception, very wet and stony. In most places a distinct series of moraines at intervals recorded the rapid retardation of the ice retreat during a certain period. In almost all places the state and position of the newest moraines indicated that the ice was still retreating slowly, but that its rate of retreat was decreasing. Only in a very few places was there any evidence of an advance, and then this proved to be very localised.

In areas where there was a sudden change in slope of the ice (not usually more than three or four degrees) a series of crevasses could be noted. These were usually not more than 18" across, but some were over 50' deep.

All over the icecap there seemed to be a distinct series of almost parallel narrow cracks (about ½" across) which seemed to run for many hundreds of yards. These were presumably small cracks indicating the general stress pattern within the ice. It is unfortunate that because of bad weather and insufficient time these were not further investigated, but a map of their distribution, direction, and spacing, should yield some interesting results.

In the ablation zone the ice was deeply cut by many melt water channels, some of which were 10' across. These could be very dangerous to an unroped party and were sometimes difficult to cross. It was interesting to note that in many instances these streams ended in moulins where the water cascaded into a hole 50' deep or more. The moulin was presumably initiated by the presence of a small crevasse or weakness in the ice, which the flowing water had gradually eroded into a deep hole.

Towards the edge of the ice melt streams often cut their way under the ice after disappearing down a "pothole", and so formed an ice-cave. Ice-caves could be useful for emergency shelter if it were found necessary.

In one place on the eastern side of the cap several melt streams had joined together and the force of the water had eroded a minor gorge, or escape channel, about 15' wide, and 15' deep, in the rock, just under the ice-edge. This was extremely difficult to cross.

Other more general things included the finding of several winged insects on the summit of the ice-cap. These had probably been blown up there by the wind. In a few places the tracks of an arctic fox were found, but the animal was never seen. The local farmers informed us that sheep were in the habit of walking on the ice, but we saw no sheep within about 2000' of the edge, and with the sparse vegetation on the peripheral moraines this would seem unlikely. The birds seen on the ice-cap are recorded elsewhere in this report.

5 GEOLOGY OF THE PENINSULA SOUTH OF FASKRUDSFJORDUR

The ground mapped lies in the Tertiary volcanic region of Eastern Iceland and is composed for the most part of basaltic laves which are dipping to the west at an average slope of 6-7°. In addition, there are two large bodies of acid rock. One, an intrusive laccolith of quartz-oligoclase porphyry, forms the prominent peak of Sandfjell in the middle of the area mapped. The other, a large mass of rhyolite capping the hills Kottur and Grafjell, forms a lava flow within the basalt succession. In addition, there are several beds of acid tuff.

The Sandfjell laccolith was mapped by L. Hawkes in the early 1930's and a detailed description published in the Quarterly Journal of the Geological Society for 1935. In this paper Hawkes mentioned the acid lava of Kottur. An acid dyke nearby was described by Hawkes in the Mineralogical Magazine for 1932. Apart from these papers nothing has hitherto been published on the geology of this part of Iceland, and the basalts have never been studied.

Geological succession and structure:

The main geological features of the peninsula are seen on the accompanying geological map (Fig.17). It can be seen that the geological succession is made up, essentially, of an alternation of three types of basalts - tholeiites, olivine-basalts, and feldspar-porphyritic basalts. Of these three, tholeiites are predominant, although there is a very prominent group of olivine-basalts exposed west of Sandfjell. Each of the groups shown on the map is made up of a number of individual lava flows, the average thickness of a flow being of the order of thirty feet.

The basalt lavas form tabular units, thin in relation to their lateral extent, piled on top of one another like a succession of sedimentary rocks; indeed mountains composed of lava are, from a distance, almost indistinguishable from mountains of sedimentary rock. Although individual lavas may thin out and disappear within a short distance when traced in the field, groups of flows often persist for many miles, hence their value for stratigraphic mapping.

Individual flows have chilled tops and bottoms, this being indicated by the finer grain in these areas. Towards the top of the flow, vesicles, or gas bubbles, which are sparse in the middle, become abundant. The vesicles commonly contain secondary minerals, such as members of the zeolite group which are common at Hafnarnes and in the olivine-basalts west of Sandfjell. The upper surface of the flow is often weathered and usually overlain by a thin layer of red earth.

Although columnar jointing is commonly regarded as characteristic of basalt lavas, and in fact many of the post-Tertiary lavas in Iceland exhibit it very well, no examples have been found in the area studied. Evidently the Tertiary volcanics of

Fig. 18: Glaciated Plain in Faskrudsjfordur

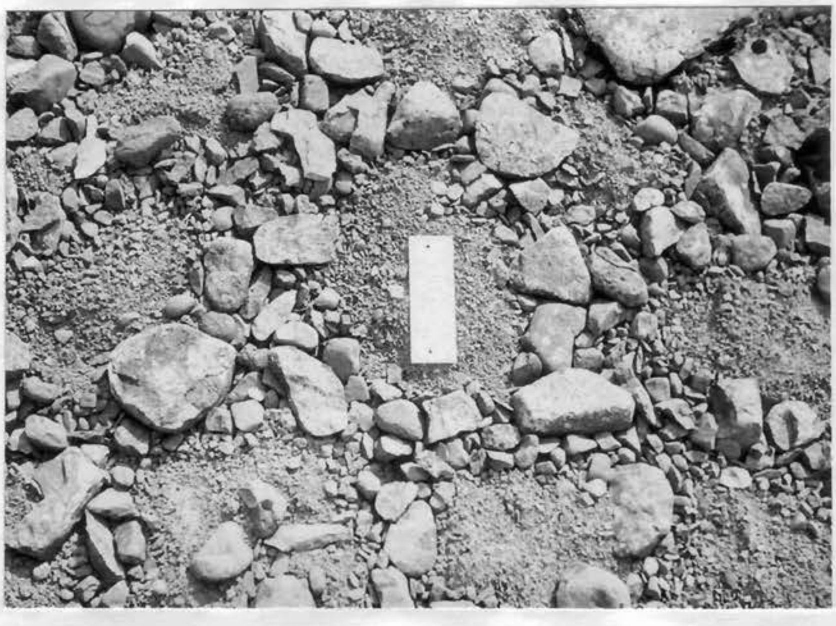


Fig. 19: Stone Polygons

Faskrudsfjordur were not erupted in a favourable environment for columnar jointing to result.

The structure of the area is very simple. The lavas in general are inclined at 6-7° dipping towards the west, although the dip decreases by 2-3° towards the tops of some of the mountains.

Petrology:

Tholeiites: These are the most abundant basalt lavas constituting 1750' of the lower part of the succession near Hafnarnes, and a further 600' near the top. The flows are usually thicker than those of olivine-basalt, 40-50' being typical. They are also distinctive in possessing a strong fluxion structure, usually approximately parallel to the base of the flow, and the tops of the flows are very rubbly, of typical aa type. Vesicles are fewer in the tholeiite flows than in the other types, and pipe-amygdules are absent.

In the field the tholeiites are very fine-grained, and even in thin section the grain size is so small that the constituent minerals are hard to identify. The rocks are composed of plagioclase, pyroxene, and magnetite, together with a certain amount of interstitial glass. The plagioclase is labradorite, and it is the parallel orientation of the tiny plagioclase crystals that gives it its fluxion structure.

Although usually non-porphyritic, it is not uncommon to find

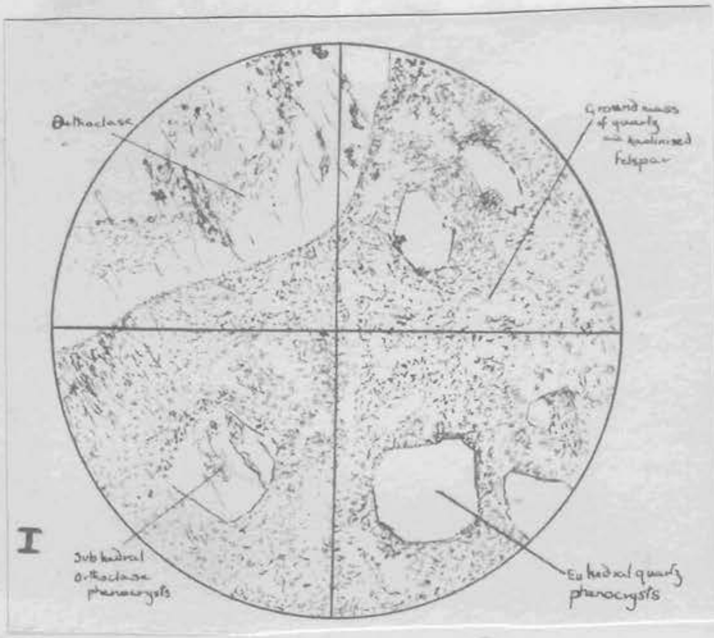
Fig. 20: Frost shattered boulder

occasional phenocrysts of plagioclase up to 1.5 mm. long, and of a composition more calcic than the plagioclase in the groundmass.

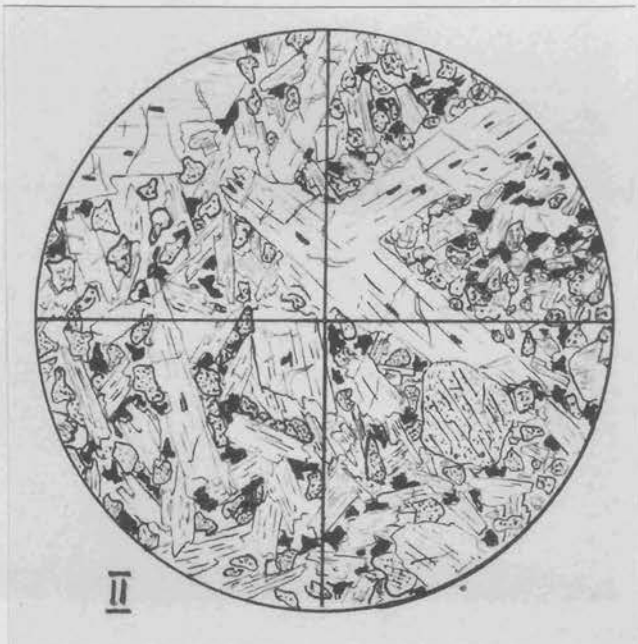
Porphyritic basalts: These are uncommon in the area. Their distinguishing feature is the abundance of phenocrysts of plagioclase feldspar. Sometimes these are quite large, and occasional crystals have been seen in the field as long as ¾". The phenocrysts have rounded, corroded outlines and show slight zoning. Associated with them are sparse phenocrysts of augite, much smaller than those of plagioclase. The groundmass of the porphyritic basalts is finegrained and similar in character to the tholeiites.

In most of the specimens examined, the rock has suffered considerable alteration, probably hydrothermal in origin, which has resulted, for instance, in the conversion of augite to chlorite. The alteration is most intense along the upper and more vesicular parts of the flows, and where most intense, the rock has a dark green colour. This alteration is found especially west of Leirufjell and may have been caused by the permeation of steam or hot solutions from the dykes, and, in the area of Sandfjell, from the laccolith itself.

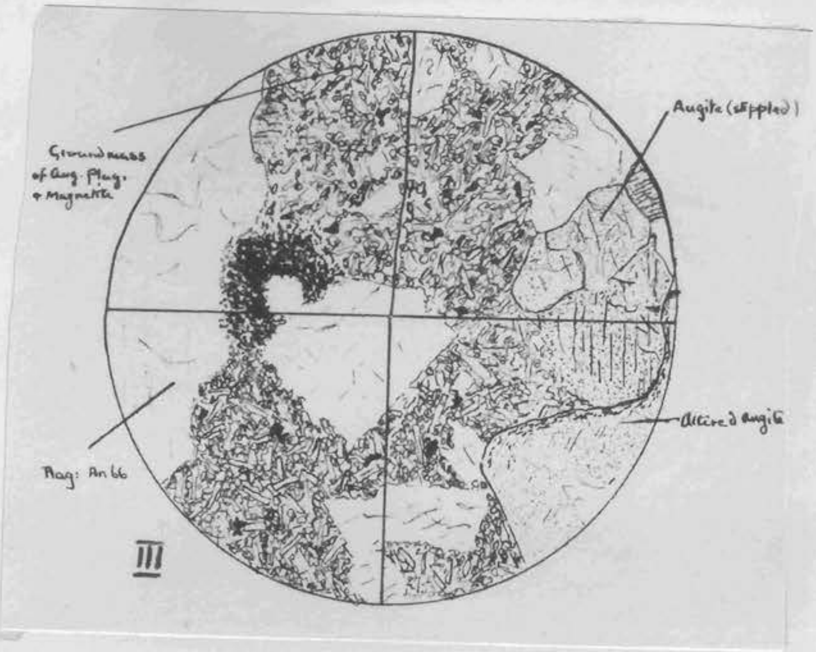
Olivine-basalts: These are distinguished by their relatively coarse grain, by the typical spheroidal weathering of the outcrops, by the possession of a pahoehoe type of top in contrast with the aa which is more characteristic of the tholeiites, by the common presence of pipe amygdules (these are peculiar to the olivine-



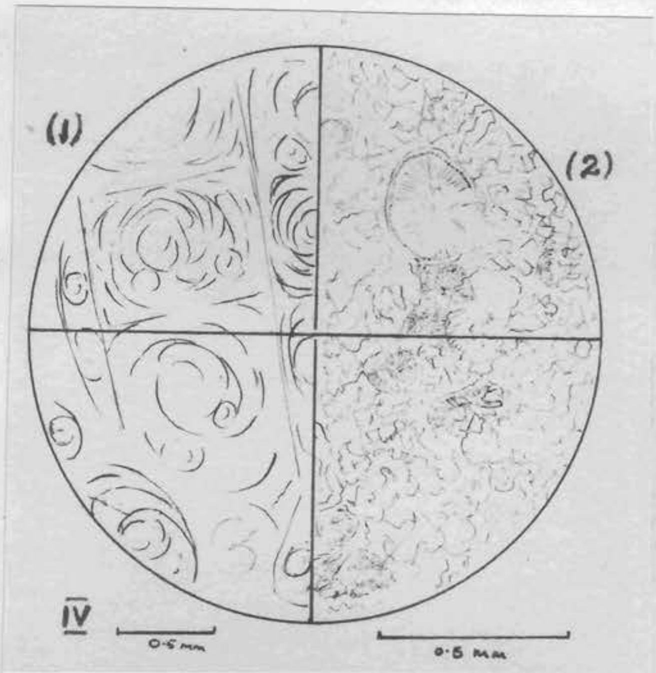
I. Microscope Slide of Dyke Rock of Quartz Porphyry



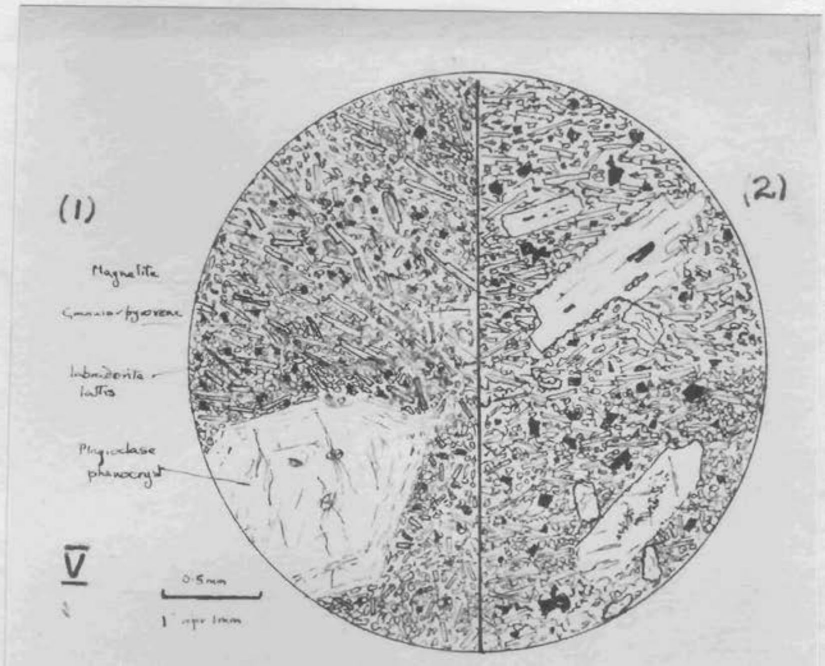
II. Microscope Slide of Coarse Grained Basalt



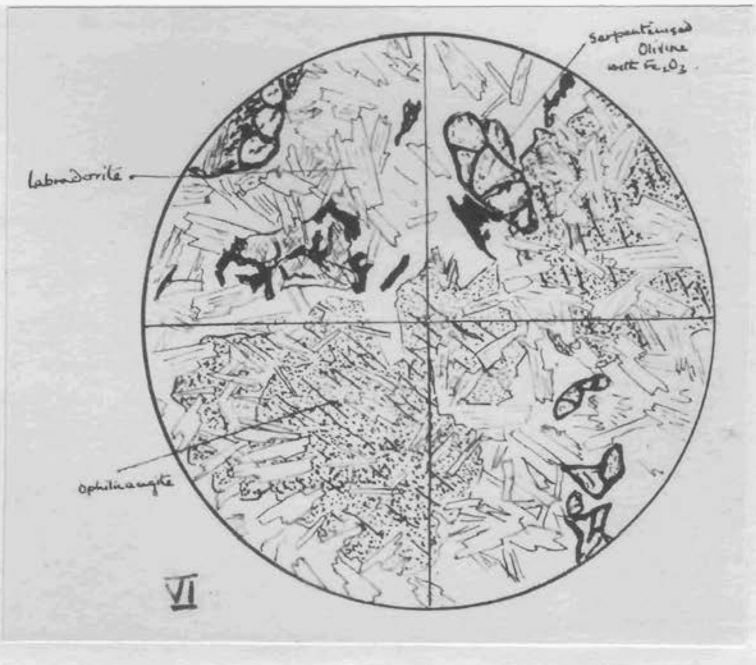
III. Microscope Slide of Porphyritic Basalt



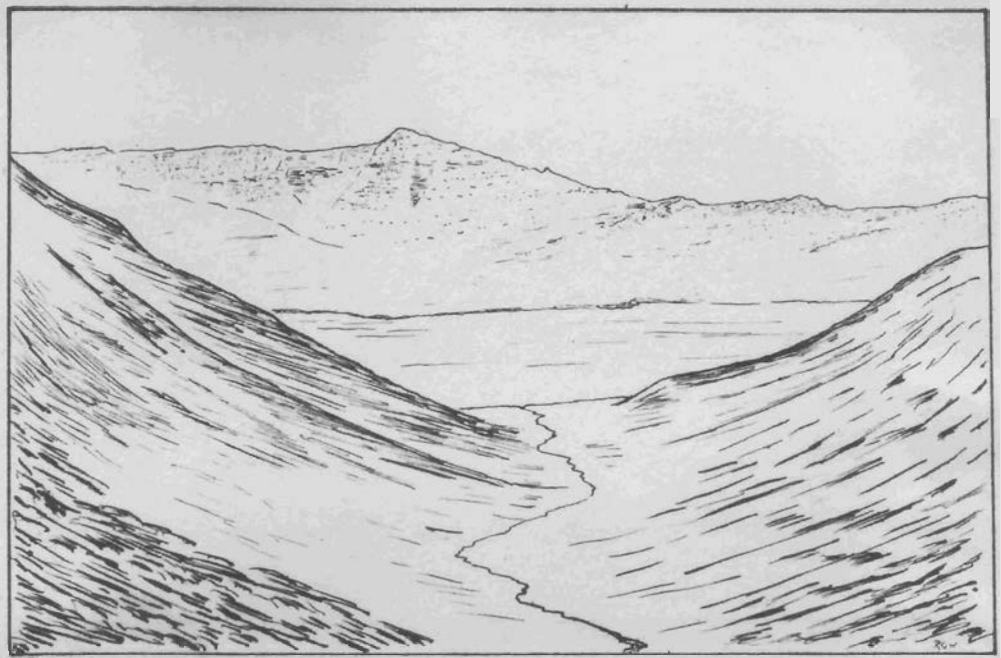
IV. Microscope Slide of (1) Porphyritic Obsidian
(2) Devitrified Rhyolite with Small
Spherulites



V. Microscope Slide of (1) Tholeiite with Accidental Pheonocryst, (2) Porphyritic Tholeiite.

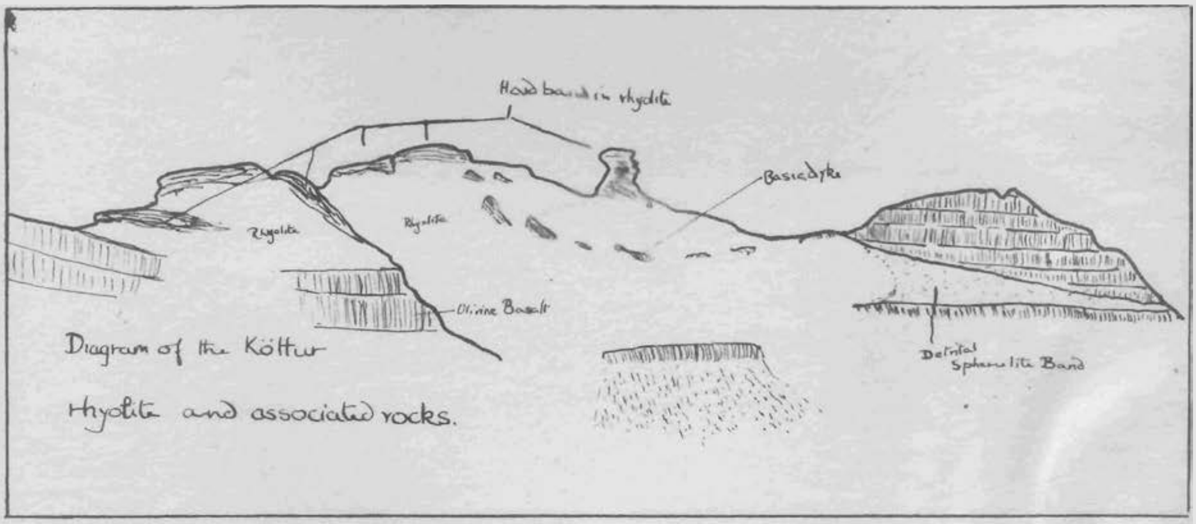


VI. Microscope Slide of Olivine Dolerite Dyke Rock



VII

VII. Field Sketch of Glaciated Valley with Typical
U-shaped Profile, W. side of Sandfell.



VII

VIII. Field Sketch of Köttur showing the Relationship
between the Basic Lavas and the Thick Acid Flow
from the North-East.

II. 6 ORNITHOLOGY

Several members of the expedition were interested in the birds of Iceland, and a certain amount of time was spent in this pursuit. Most of the birds listed in Table II are to be expected in the type of country we visited, and correspond closely with data given on Icelandic birds in "A Field Guide to the Birds of Britain and Europe" by Peterson, Mountford and Hollom.

The list of sightings in Table II has been roughly divided according to the fjords where the observations were made, with three additional columns; one for the period of travelling, (which includes the sea voyage from the time we lost sight of Scotland until the end of the bus journey across the island, and the return trip), one for the icecap, Thrandarjokull (this only including birds actually seen on the cap), and the other for birds seen at Myvatn.

Probably the commonest bird in the area was the Arctic Tern, many colonies occuring on each of the fjords. From the attitude of the terns towards intruders, especially ourselves, we are led to believe that the local population raid the colonies for eggs. On coming within say 30 yards of a colony certain of the birds would keep up a continuous attack, diving from all angles, and just pulling out before they hit the intruder's head. One member of the expedition was hit twice on the head by a very large tern, and on another occasion they attacked a theodolite as it stood on its tripod. Arctic Terns were seen to attack Arctic Skuas in Seydisfjordur, where the terns were feeding on floating waste from the fish gutting processes, and the skuas were trying their usual piratical tricks.

Another common bird was the Eider Duck, now protected under Icelandic law with regard to killing for the down. Heavy penalties are incurred for killing these birds. Many other ducks were present too, but they soon went into eclipse, and this made identification difficult.

In Seydisfjordur there were large flocks of gulls. These were mainly Herring Gull, and they fed from the fish wharves. Among these were a few black-backed gulls of both varieties, and some "albino" gulls which were rather difficult to identify. The only conclusion we could come to in the field was that they were Iceland Gulls, but that they had strayed from their usual breeding grounds in Greenland. The birds had pure white wing tips and were about the same size as the Herring Gulls. On consulting Dr. Finnur Gudmundsson, of the Natural History Museum in Reykjavik, it was decided that they might have been Glaucous Gulls just living with the Herring Gulls, but not breeding, or more likely they were Herring Gulls with faded wing tips.

On the island of Skrudur, between Reydarfjordur, and Faskrudsfjordur, there was a large colony of Kittiwake and Fulmar, with a few Gannets. This is a steep rocky island, 161 m. high, rising straight out of the sea. The local farmers-cum-fishermen visit this island periodically during the breeding season to collect young Kittiwake, which is apparently a local delicacy.

At Djupivogur there are many skerries, and small inlets on which many birds can be seen. Large flocks of duck were seen, but not identified. Also a Gyr Falcon, sitting on one of the skerries. A Red-throated Diver was seen fishing here too. By far the most important sighting of the whole trip occurred here. Only one day was spent watching in this locality, but in that day a group of 6 to 8 Swifts were seen several times by two members of the expedition. Previously (private communication - Gudmundsson) only a few odd pairs have been seen in Iceland. There is absolutely no doubt as to their identity, as they were viewed at only 20 yards, and with their distinctive colouring, shape, and general habits no mistake could have been made.

According to the distribution maps in Peterson, Mountford and Hollom, Oystercatchers do not breed on the eastern fjords of Iceland. At least one pair, and usually more, were seen on each fjord, and at Seydisfjordur several of the chicks from one nest were found. At the time three of the expedition were trying to find a Red-necked Phalarope's nest, but due to the insistent warnings of the Oystercatchers she would not lead us to her nest. However we did find three of the Oystercatcher's chicks.

An interesting sequence of events was observed with the Golden Plover. When the expedition first reached Reydarfjordur they were in the middle of the nesting season, our camp being surrounded by nesting birds, these giving us good warning of anyone approaching. This was at the end of June and the beginning of July. At the beginning of August the chicks had fledged, and the birds were collecting in flocks of 30-40, which were feeding on the newly mown hay fields. By 26th August, when we returned from the ice-cap, there were none of this species left. The Ringed Plover had not at this time migrated.

One member of the expedition spent a few days at Myvatn, the famous lake in central Iceland, on and near which there is a fantastic collection of birds. Unfortunately most of the ducks were in eclipse, thus making identification difficult.

TABLE II

Bird Check List

	Trav.	Seydis.	Reyd.	Fask.	Dj.	Ice.	Myvatn
Eider Duck	✓	✓	✓	✓	✓		
Mallard	✓	✓	✓	✓	✓		
Scaup	✓	✓					
Goosander				✓			
Teal							✓
Gadwall							✓
Widgeon							✓
Pintail							✓
Tufted Duck							✓
Barrows Goldeneye							✓
Longtailed Duck							✓
Scoter			✓				✓
Red Breasted Merganser				?			
Oystercatcher							
Ringed Plover	✓	✓	✓	✓	✓		
Golden Plover	✓	✓	✓	✓	✓		
Merlin	✓	✓	✓	✓			
Whimbrel	✓	✓	✓	✓	✓		
Purple Sandpiper			✓	✓		✓	
Redshank	✓	✓	✓	✓	✓		
Dunlin	✓		✓	✓	✓	✓	
Snipe	✓	✓	✓	✓			
Turnstone				✓			
Ptarmigan				✓			
Red-necked phalarope	✓	✓	✓	✓	✓		
Great Skua	✓				✓		
Artic Skua	✓	✓	✓	✓	✓		

	Trav.	Seydis.	Reyd.	Fask.	Dj.	Ice.	Myvatn
annet	✓		✓	✓			
lmar	✓	✓	✓	✓	✓		
erring Gull	✓	✓	✓	✓	✓		
lackheaded Gull	✓	✓	✓	✓	✓		
t. Black Backed Gull	✓	✓	✓	✓	✓		
l. " " "	✓	✓	✓	✓			
rctic Tern	✓	✓	✓	✓	✓		
ittiwake	✓	✓	✓	✓			
anx Shearwater	✓						
uillemot	✓		✓	✓	✓		
uffin	✓	✓	✓	✓			
lavonian Grebe							✓
t. Northern Diver	✓		?				
rnacle Goose			?				
reylag	✓						
hooper Swan	✓						
yr Falcon	✓				✓		✓
aven	✓	✓	✓	✓	✓		
heatear	✓	✓	✓	✓	✓	✓	
hite Wagtail	✓	✓	✓	✓			
eadow Pipit	✓	✓	✓	✓	✓		
edwing	✓	✓	✓	✓	✓		
nowbunting	✓	✓				✓	
wift					✓		
ectacled Guillemot			✓	✓			
lack Guillemot		✓	✓	✓			
d Throated Diver	✓				✓		

Seydis. - Seydisfjordur
Reyd. - Reydarfjordur
Fask. - Faskradsfjordur

Dj. - Djupivigor
Ice. - Icecap

III. APPENDICES

III. 1 SURVEYING TECHNIQUES USED ON THE RAISED BEACH PROJECT

The principal object of the surveying party was to find the heights of the raised beaches in the various fjords along the east coast of Iceland, and by relating these heights to a common datum, to find whether the island had tilted as a whole during the uplift process which led to the formation of the raised beaches.

The relating of the heights of the beaches to a local datum was thought to be a relatively easy task, but the correlation of these data was considered to be more of a problem. There were several possible methods available:

1) To select an arbitrary datum, and transfer this from one fjord to the next by spirit levelling round the coast, over the mountains, or over the road passes.

2) As (1) but to use tacheometric levelling techniques. This would be a far faster process on the whole, as, although the actual setting up of a theodolite takes longer than that of a level, far less set ups would be needed.

3) To select mean sea level as a datum (or some other datum which could be compared with mean sea level), and to relate the heights of the beaches to the observed mean sea level in each fjord.

After consultation with Dr. Walker, (the leader of the Expedition), who had been in the area several times before, and study of the maps available, it was decided that it was impracticable to carry the levels overland from one area to the next. This meant that mean sea level had to be determined in the relevant fjords.

Determination of mean sea level:

Commander Gordon of the Hydrographic Department of the Admiralty was consulted on this matter. From data supplied by him it was decided that the tidal range in the area did not exceed ten feet, and with this knowledge two twelve foot tidal staffs were made (Fig. 7). Each was made from two 6' x 6" x 1" lengths of teak, hinged together end to end, two brass rods attached by bolts and wing nuts being used to stiffen the staff when extended. On the faces of the staffs, one foot, and tenth foot markings were scribed, the staffs painted white, and alternate one-tenth sections painted black. The one foot markings were numbered from the bottom of the staff, with, contrary to the usual practice when marking staffs, the bottom of the number indicating the one foot interval. The numbers were six inches high, painted red, and the symbols V, N, O, and 1 were used to indicate five, nine, ten and eleven respectively. The

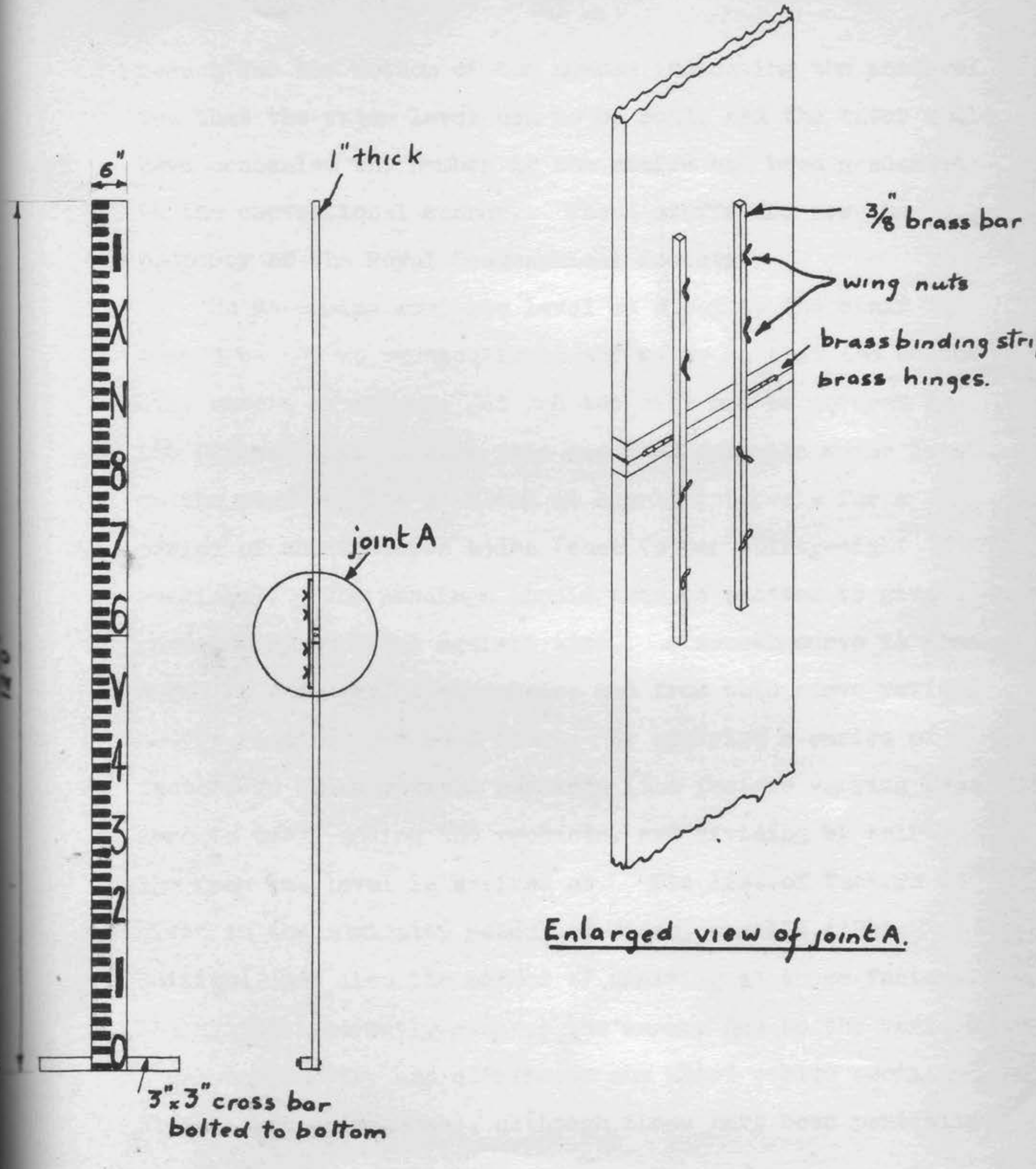


DIAGRAM OF TIDAL STAFF

reason for the bottom of the number indicating the interval was that the water level had to be read, and the water would have concealed the number if the staffs had been graduated in the conventional manner. These staffs are now the property of the Royal Geographical Society.

To determine mean sea level at a point, the staff should be set up vertically in the water so that the bottom will remain submerged, and the top will not be covered by the highest tide. When this has been done the water level on the staff should be noted at hourly intervals for a period of thirty-seven hours (that is for thirty-eight readings). The readings should then be plotted to give a curve of water level against time. A smooth curve is then drawn to this series of points, and from this curve revised hourly readings are read back. By applying a series of factors to these revised readings (the factors varying from zero to two), adding the products, and dividing by thirty, the mean sea level is arrived at. The list of factors is given in the Admiralty Manual of Tides, page 111 (1941 Edition), and also the method of arriving at these factors. The system apparently reduces the errors due to the various tidal components, and eliminates any short period oscillations (such as seiches), although these have been partially eliminated by the smoothing of the curve. It does not, however, exclude the long period oscillations (that is with periods of between six hours and a month or more) which may be due to meteorological disturbances.

In order to correlate the local data in two fjords, simultaneous mean sea level observations were made. A local datum was necessary as the surveying of the beaches was usually started before the tidal observations were made, and mean sea levels were not calculated until the Expedition returned to the United Kingdom. These local data were selected quite arbitrarily, for instance in Reydarfjordur a point on the upper surface of a certain slab of concrete was deemed to be ten feet above the local datum, and in Seydisfjordur, where the tidal observations were made before the surveying started, the datum was taken as the bottom of the tidal staff.

The actual procedure was to set up the staff, and, at an agreed time observers in the two fjords would start their series of observations. Readings were taken at quarter hour intervals, partly to give more points for drawing the curves, and partly to help keep the observer awake during the night watches. In Seydisfjordur quarter hourly readings taken initially, but after a few hours

Fig. 10: Tidal pole as established at Seydisfjordur

these were discontinued, and half hourly readings taken instead. The period of observation was extended to forty hours so that in case the observers on one fjord were not ready to start at the appointed time there was still a reasonable chance of getting thirty-seven hours of simultaneous observation. When the two parties of observers had been out of contact for some time, time synchronisation was achieved by checking watches at the local Post Offices.

It was decided that the tidal observations should be made in Reydarfjordur, Seydisfjordur and Breiddalsvik, these being the locations of the main groups of beaches (as observed on aerial photographs of the region by Dr. Walker). The Admiralty had established a bench-mark in Seydisfjordur and it was decided that this should be used to indicate our datum, (the mark being 10.76 feet above datum, which was defined as "a point seldom, if ever, uncovered by the tide"). The plan was therefore to carry out simultaneous observations in Seydisfjordur and Reydarfjordur, and then later in Seydisfjordur and Breiddalsvik.

Soon after setting up Base Camp a party left Reydarfjordur for Seydisfjordur, set up their staff, and at the agreed time started observations. Unfortunately the Admiralty bench-mark could not be found, even though detailed instructions had been given as to its location. After about two weeks surveying the beaches in Seydisfjordur this party then carried out their second series of observations, but because of transport difficulties the other party had not reached Breiddalsvik. The Seydisfjordur party did not discover this until they returned to Base Camp. This work was not entirely wasted since all the tidal observations were later supplied to the Admiralty to supplement their data on tides in Icelandic waters.

As the bench-mark in Seydisfjordur had not been found, it could not be used to indicate a datum, and so it was decided that the second correlation should be made between Reydarfjordur and Breiddalsvik. This was carried out without further difficulty.

The final datum for the whole survey was taken as the mean sea level in Reydarfjordur as calculated from the two sets of tidal observations.

When beaches were to be surveyed which were remote from the local datum standard one of three methods of transfer was used. Either (1) an observation of high tide was made at a point conveniently near the beaches, during the tidal observations, or (2) the water level at a specific time at a point conveniently near the beaches was observed during the tidal observations, or (3) the water level was noted simultaneously both at a point conveniently near the beaches, and another conveniently near the local datum standard (the height of the latter point being related to the local datum standard at a later date). These three methods were used in Reydarfjordur to transfer the local datum to Eskifjordur (method 1), to the beaches on the north side of the fjord at the eastern end, and to Seydisfjordur (method 3), and to the beaches along the south shore opposite base camp and Eskifjordur (method 2).

In Seydisfjordur levels were carried for some considerable distances by tacheometric levelling (about ten miles in all), and in order to check against gross errors this level was brought back to the local high tide mark. This was done three times during the traverse, and provided a useful check, revealing at least one major arithmetical blunder in the reduction of the readings. This method of checking was also used during the traverse round the head of Reydarfjordur to the beaches at the western end of the south side.

Levelling:

The tachometric levelling was carried out using two

Hilger and Watts Microptic No. 1 theodolites, with the circles graduated down to 20 minutes of arc, and an optical micrometer to subdivide these divisions down to 20 seconds of arc. One was loaned to the Expedition by the Royal Geographical Society, and the other by the Mining Department of the Imperial College. Though they were essentially the same, they differed in minor details, these differences making the "Mining" theodolite easier to use than the "R.G.S." It had a more powerful telescope, so allowing longer sights to be taken with the same accuracy, and was fitted with a telescope bubble which meant that it could be used as an ordinary level if necessary. The "Mining" theodolite was part of a "three tripod traverse" set, and so had a special tripod head, which though it made the tripod unduly heavy, and awkward, allowed the theodolite to be removed quickly and easily. The carrying systems for the two theodolites were different too, the "R.G.S." instrument being carried in a special leather case which could easily be slung on the back, whereas the other was in the standard waterproof metal case, in which it was clamped down.

The method of attachment of the "R.G.S." theodolite to the tripod was faulty. The instrument was secured by a screw through the head of the tripod into the base of the instrument. This screw was several threads too short, and soon after arriving at Breiddalsvik, the theodolite fell from the tripod, and was severely damaged. The survey team carried on with their work, not being able to ascertain the extent of the damage, and only when the results were plotted in England was it discovered that the errors were random, and large. It had been hoped that these errors could be eliminated, but this was found to be impossible.

The tripods used with the theodolites were of the standard collapseable type, and were not interchangeable, owing to the "fitting" having the special head. This head was protected in transit by a leather "bucket", to which was attached a carrying strap.

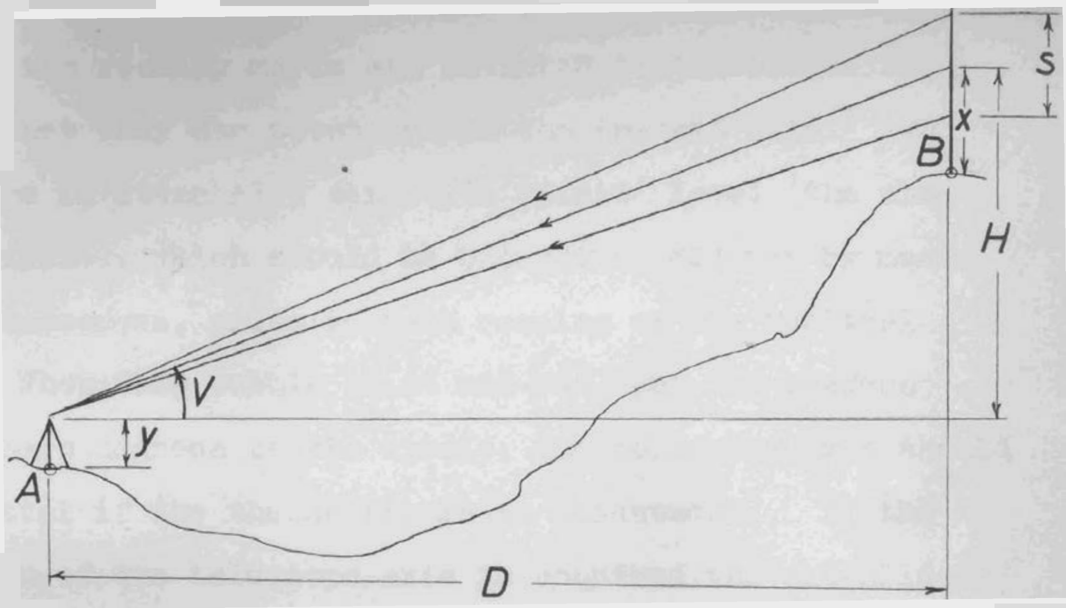
Two ten-foot Bannon, or folding, staffs were taken to be used in conjunction with the theodolites in the levelling, and two sets of Redmond's tables for reducing the readings to differences in height. These are standard tacheometric tables, but they are only calculated for a twenty minute of arc vertical angle interval. This reduces the bulk of the tables, and with the instruments used, aided the manipulation.

The basic principle of tacheometric levelling is to measure the inclined distance between two points (one of which is of known height, and the height of the other is wanted) and then to measure the inclination to the horizontal of the line along which the distance was measured. Then by simple trigonometry the difference in height, and so the height of the second point, can be found.

Built into the telescope is a graticule in which are two crosswires (horizontal and vertical), and across the vertical wire are two short "stadia" lines, one a certain distance above the horizontal wire, and the other the same distance below. This graticule can be brought into focus at the same time as the field of view. The angle subtended at the eye by the stadia wires is constant, and so if a graduated staff is held in a vertical plane, but perpendicular to the axis of the telescope, the length of the graduated staff seen between the stadia lines varies proportionally with the distance away of the staff (see figure). If the staff is held vertically, and the telescope axis is not horizontal then this is not true, but by multiplying the reading by the cosine of the angle of inclination of the telescope axis to the horizontal, this can be accounted for. In the instruments used the stadia constant was 100, as with most modern theodolites. So, by noting the stadia readings, the vertical angle, and knowing the stadia constant, the distance of the staff from the theodolite can be calculated.

Built into the theodolite is a graduated circle, by means of which the inclination of the telescope axis to the horizontal can be measured. The circle is rigidly attached to the teles-

TACHEOMETRIC LEVELLING



for Microptic no. 1 theodolite:

$$D = k_1 s \cos^2 V$$

$$H = \frac{1}{2} k_1 s \sin 2V$$

difference in height between points A and B

$$= H - x + y .$$

values of D and H were obtained from Redmond's Tacheometric Tables.

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cope, and the reading marks are attached to the theodolite frame so that they can pivot around the transit axis. To the readers is attached a sensitive spirit level (the alt-alidade bubble), which should be brought to mid-run by means of the thumbscrews, prior to each reading of the vertical circle. When this bubble is at mid-run, and the readers indicate zero degrees on the circle, the telescope axis should be horizontal if the theodolite is in adjustment. If the inclination of the telescope axis is required the alt-alidade bubble is brought to mid-run, and the vertical circle reading taken. The reading may be in any of the four quadrants depending on whether the telescope is depressed or elevated, and whether the vertical circle is to the left or the right of the telescope as viewed from the eyepiece.

When this angle is measured the difference in height between the transit axis of the theodolite and the point indicated on the staff by the horizontal cross-wire can be calculated by a formula (see figure). If the height of the transit axis is measured above the point of known height, or the unknown point, (vertically below the centre of the theodolite), and the staff is on the other point, and the horizontal cross-wire reading is noted, the difference in height between the two points can be calculated. To simplify these calculations tables have been compiled giving the

EXAMPLE OF BOOKING

1	2	3	4	5	6	7	8	9	10	11	12	13
B.S. /F.S.	T.A. hght.	stadia 1	stadia 2	horiz. crosswire	circle left		circle right		mean intercept	height diff.	reduced height	Remarks
					vert. ∠	crosswire	vert. ∠	crosswire				
		Date : 9th July 1958				weather: mod. breeze, cloudy, showery						
											32.86	
B.S.		3.00	8.19	5.59	358 00	5.75	182 00	5.15	5.45	+18.10		
F.S.		3.00	8.40	5.70	359 20	4.46	180 40	3.84	4.15	−6.28	45.98	B.M. 107
											122.33	
B.S.				7.61		Level	Shot		7.61			
F.S.				1.82		Level	Shot		1.82		128.12	

columns 10, 11, 12 were completed in camp

column 10 is the mean of 7 & 9.

11 is the value of H from Redmond

12 is the reduced height of the point sighted

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horizontal distance, and the height difference between the transit axis and the cross-wire reading point on the staff, for given distances and vertical angles.

The tables used (Redmond - Tacheometric Tables - Technical Press) give these values for distances up to 850 feet, and vertical angles which are multiples of twenty minutes of arc up to 29° 40'. In order to use them to full advantage the stadia readings were taken in the usual manner (that is placing the upper stadia wire on a convenient mark on the staff before reading the other wire), and then changing the inclination of the telescope axis to the nearest 20' interval before noting the horizontal cross-wire reading and the vertical angle reading.

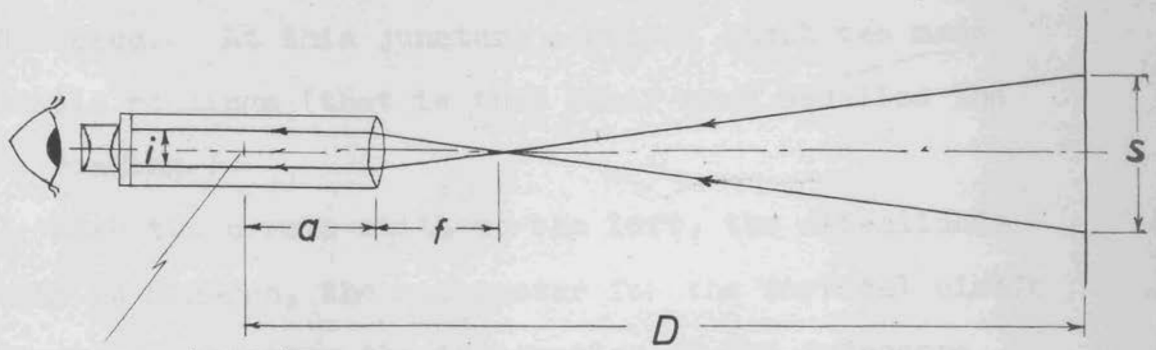
The actual manipulations carried out in the field were as follows:

(1) The tripod was set up about 150 yards from the staff (100 yards for the "R.G.S." theodolite), and roughly levelled, all the screws then being tightened.

(2) The theodolite was then attached to the tripod, and levelled. With the "R.G.S." theodolite the three levelling screws were on the instrument, while on the other they were on the tripod head.

(3) With the vertical circle to the left of the telescope the staff was sighted and the stadia line intercept read

DISTANCE MEASUREMENT



f = focal length of objective
i = separation of stadia lines
s = intercept on staff

$$\frac{i}{s} = \frac{f}{D-a-f}$$

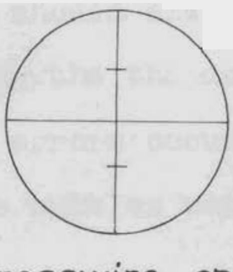
$$D = \frac{sf}{i} + f + a$$

$$= k_1 s + k_2$$

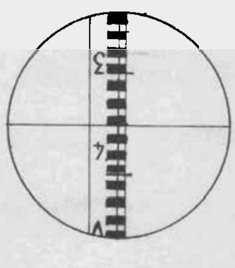
where k_1 is the stadia constant
and k_2 is the additive constant
with the Microptic no.1 Theodolite

$$k_1 = 100$$

k_2 is very small



crosswire only



view through telescope

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off, and booked. At this juncture a mental check was made of the stadia readings (that is that their mean equalled the crosswire reading.)

(4) With the circle still to the left, the alt-alidade was brought to mid-run, the micrometer for the vertical circle brought to zero, and then the inclination of the telescope adjusted so that the vertical circle reading was the nearest exact multiple of 20', and the horizontal crosswire still cut the image of the staff. The reading of the circle was noted, and also the horizontal crosswire reading.

(5) Operation (4) was repeated with the circle to the right.

(6) The staffman was signalled to proceed to the next station, about 150 yards ahead of the theodolite, and operations (3) - (5) repeated.

(7) Having checked that all the relevant data had been noted, the theodolite was removed from the tripod, put in its case for carrying to the next set-up, and the tripod collapsed.

(8) Operations (1) - (7) were repeated et cetera.

The staffman should always have been holding the staff upright, and facing the theodolite. If the staff was not held upright then errors occurred, and to help prevent this from happening rob bubbles were taken and used.

If it was apparent that a "level shot" could be taken, that is, with the telescope axis level the image of the staff through the telescope was still seen to be cut by the horizontal crosswire, then with the "Mining" theodolite the following procedure was adhered to:

(1) Operations (1) and (2) were carried out as above, except in that if both of the shots from that particular station were to be level shots then the levelling only need to be very rough.

(2) If a cross-section were being done on a beach, then the stadia readings were taken to give an indication of the length of the shot, but if it were just a matter of carrying a level through then this was ignored.

(3) The telescope was carefully levelled using the telescope bubble, and whilst it was level the reading of the horizontal crosswire on the staff was noted.

Care had to be taken whenever a bubble was being adjusted because of the strong sun, the heat from which distorted the glass of the bubble, and so caused erroneous readings. It became a standard practice to shield the bubble being adjusted from the direct sunlight during the adjustment, but even so difficulty was experienced in centralising the bubble.

During the actual cross-sectioning of the beaches the height of the transit axis of the theodolite above the ground was measured either with a steel tape, or with the staff.

During some of the cross-sectioning it was necessary to deviate quite considerably from the straight line of the traverse. In this case the horizontal angle swept out was noted too (to the nearest twenty minutes of arc), and the plan of the profile later plotted. In order to increase the number of heights determined on a profile and yet not increase the number of set-ups necessary, intermediate shots were sometimes taken, only the circle left reading being taken.

In some cases it was found that shots with depressions or elevations of greater than 20° were needed. In Redmond there are abbreviated tables up to 29°40'. Readings were reduced each evening when the party returned to camp, and the heights checked.

During the carrying through of levels, bench-marks were cut in suitable places, usually on horizontal surfaces. This would have proved useful for checking if it had been necessary, or time had allowed. It was also essential when a long traverse was being carried through, and the cross-sectioning was to be done on the return journey. An attempt was made to bring each cross-sectioning traverse back to a bench-mark as a check. Near the site of each set of tidal observations a bench-mark was established, and the relationship between some relevant mark on the staff and this bench-mark determined using the theodolite and the survey staff.

III. 2 SCIENTIFIC EQUIPMENT

2 theodolites, Hilger & Watts, Microptic No. 1

4 liquid filled prismatic compasses

3 aneroid barometers

1 18" x 18" plane table

1 boxwood alidade

1 100' linen measuring tape

2 tidal measuring staffs

2 tacheometric staffs

1 pair binoculars

3 rod bubbles

2 sets tacheometric tables

2 field notebooks

6 sheets drawing paper

Comments on this equipment can be found under the appendix on survey techniques.

III. 3 GENERAL EQUIPMENT

Of the equipment taken only the tents call for comment. The tents which were taken fall into the following categories:-

Meades

The "B" Meade

The design of these tents is excellent. They are strong and roomy and are easy to erect. The only feature which is to their detriment is their weight: they are made of an unnecessarily heavy material and their poles are stronger than they need to be. Thus they are only really useful as a basecamp tent.

The "C" Meade

The "C" Meade is not so heavy as the "B" Meade, but its design is not so sound. The side flaps for holding the walls out tend to tear the wall, as there is an uneven stress distribution in the wall. Another disadvantage is that a fly sheet could not be fitted to the ones which the Expedition had, and rain came very easily through the Egyptian cotton material.

The "Everest" Meade

This tent is of very sound design and is undoubtedly the best tent that the Expedition took. The only criticism was not of the tent but of the tent material: as already explained in the general section "Wincol" material is not waterproof.

The Arctic Guinea

The tent is of sound design but is a little light for prolonged expedition use. The material of which the tent is made is of excellent quality, and tent and flysheet were really waterproof even in the heaviest rain. The tent is a little complicated for quick erection.

The Pyramid Tent

This tent, made for Arctic Sledging, was of pyramid shape, supported by 4 poles running to the apex. The tent material was heavy Ventile. The tent was ideal as a messing tent at base camp, and was capable of standing up to very high winds. It was very easy to erect.

Other equipment taken included:

7 primus stoves

3 pressure cookers

6 sets of cooking pots

2 pairs crampons

3 climbing ropes

6 ice axes

3 large polythene bottles (for kerosene)

2 tent repair outfits

9 sleeping bags (various kinds)

9 air beds (rubber)

1 entrenching tool

6 waterproof capes

some repair kit.

Comments on this equipment will be found in the appropriate places in the introduction and in the general section.

III. 4 LIST OF FOODSTUFFS

Food	Quantity	Comments
Margarine (tinned)	50 lb	Very good, packing excellent
Cooking fat (tinned)	30 lb	" " " " , about 20 lb. too much was taken
Tea	7 lb	Very good, needed packing in tins
Drinking Choc.	18 lb	" "
Nescafe	5½lb	" "
Salt (Cerebos)	9 lb	" " , packing good
Porage Oats	65 lb	" " , tinned
Lemonade Crystals	9 lb	Quite useful, could have easily managed with 4 lb
Ovaltine	4½lb	Good, lids tend to come off tins easily
Sugar	120 lb	Should have been packed in tins
Soup (Normal)	95 pkts	Excellent, needed 20% more
" (Bouillon)	44 pkts	Quite useful as a drink
Raisins	12 lb	Good in curries, needed packing in polythene bags or tins
Sweets	28 lb	20 lb would have been enough
Lifeboat Biscuits	112 lb	Excellent
Chocolate	160 lb	Very good, in damp conditions needs sealing hermetically
Nespray (dried milk)	48 lb	Very good, difficult to mix in hot water
Sweet Biscuits	50 lb	Too many, 30 lb would have been enough
Oatmeal blocks	24 lb	Excellent, needed another 30 lb

Food	Quantity	Comments
Tinned cake	30 lb	Good for an occasional treat
Mint cake	18 lb	Good in cold conditions
Dried Egg	20 lb	10 lb would have been quite ample, needed packing in 1 lb tins
Oxo	3 lb	Good for flavouring stews
Jam	36 lb	Too much, total should have been about 40 lb
Marmalade	24 lb	
Honey	12 lb	
Tinned fruit	20 lb	Made a pleasant change
Cheese	80 lb	Excellent, a staple part of our diet
Dried potato (powder)	8 lb	Useful for thickening soups
Luncheon meat	12 lb	Useful in scrambled egg
Dehydrated meat	60 lb	See M. of A.F.F. report
" veg.	70 lb	
" fruit	30 lb	

More curry powder would have been useful.

III. 5 DEHYDRATED FOODSTUFFS

REPORT SUBMITTED TO THE MINISTRY OF AGRICULTURE, FISHERIES AND FOOD ON THE SUITABILITY OF THEIR DEHYDRATED FOOD FOR THE PURPOSES OF THE EXPEDITION.

I. Objects of the Expedition

(a) To carry out a survey of a series of raised beaches on the east coast of Iceland.

(b) To carry out a geological survey and make a geological map of the Kirkjubol Peninsula, Eastern Iceland.

(c) To make a sketch map by compass and pacing traverse of the small ice-cap Thrandarjokull, Eastern Iceland.

I. Duration of the Expedition

(a) Raised beach survey: 7 weeks.

(b) Geology: 6 weeks.

(c) Ice-cap survey: 2 weeks.

III. Members

As in the front of the main report.

IV. Living Conditions

For the whole duration of the expedition, entirely under canvas.

V. Cooking facilities and availability of fuel

Cooking was done throughout the expedition on kerosene Primus stoves. Liberal supplies of fuel were available, except at the ice-cap. Usually, dehydrated food was first soaked and then pressure cooked.

VI. Climatic conditions

In general, the weather was good. Towards the end, however, it degenerated and high winds with driving rain were encountered (particularly at the ice-cap).

VII. Degree and duration of daily activities

For the most part, seven hours surveying in the field was usual, although on certain days, when transferring camp, etc., up to ten hours was spent in marching.

VIII. Suitability of dehydrated foods

The one pound tins of cooked minced meats were ideal for this type of expedition, where mobility is a prime factor. The larger cans were not found to be so convenient, since they usually contained more food than was necessary for the duration of one trip from Base camp. Also, in the case of meat, the larger cans were found to have a greater bulk/unit weight. A can of $\frac{1}{2}$ the large size would have been more convenient.

The labelling on some of the larger cans could have been better, since some were only labelled by number (we suggest: potato; carrot; peas; as the marking). This was most unsatisfactory to a man without the relevent list of numbers. Also, the writing on some of the can labels which appears to have been done in ball-pen, becomes erased when exposed to the weather.

It is suggested that, in all cases, it would be helpful to stamp, into the metal of the can, a description of its contents and their weight.

IX. Deterioration of dehydrated foods

After about two weeks of exposure to the air, the vegetables tended to become a little soft, but this did not seem to affect the flavour. The sugared apple very quickly absorbed moisture from the atmosphere and became sticky.

At base camp, most of the food was left in its opened can until used. On trips from base, food was usually packed either in polythene bags or in airtight tins.

X. Recipes

In general, the suggested recipes were not used, as it was considered that they were too complicated for camp use. The basic meal at camp was usually a stew composed of dehydrated vegetables and meat. Sometimes this was followed by a stew of dehydrated fruit.

When the weather became colder, or at higher altitudes, it became necessary to add more fat to these stews (as much as ¼lb. of margarine for four people).

Occasionally, by way of a change, dehydrated beef steaks were pressure cooked and then fried. Sometimes, lamb cubes or minced cooked pork were made into a sweet curry, using raisins and curry powder.

XI. Acceptability

Dehydrated potato strip was generally thought to be better than dehydrated potato powder.

Although opinion differed as to the relative palatability of canned and dehydrated fruit, it was generally thought that the dehydrated fruit tasted more like fresh fruit than the canned fruit in syrup which the expedition took.

The dried meat was thought to be better and more suitable for expedition purposes than luncheon meat, corned beef, etc.

XII. General comments on individual items

MINCED COOKED BEEF

Flavour improved by adding Oxo or soup powder.

MINCED COOKED HAM

Too salty by itself, but ideal in a stew, with vegetables. Very good in scrambled egg.

MINCED COOKED PORK

Very satisfactory. Most people thought it was improved by curry.

RAW LAMB CUBES

Very good curried.

RAW BEEF CUBES

Rather tough, needed pressure cooking.

STEAKS - GRADE I

Excellent when properly cooked.

BEEF STEAKS - GRADE II

These seemed to vary according to cut. Sometimes rather tough.

POTATO STRIP

Very satisfactory. Smaller strips were found to cook more quickly. Flavour improved by adding margarine.

CABBAGE

When pressure cooked it must be completely immersed - otherwise it turns brown. Flavour improved by the addition of cheese when cooked.

CARROT

- Satisfactory.

PEAS

Very good. Tend to lose their skins when pressure cooked.

SPROUTS

Sometimes turn brown in the middle when pressure cooked. Not very good for stews.

APPLE AND SUGAR

When mixed with raspberries it was found to produce a very satisfactory sweet.

RASPBERRIES

Satisfacbory. Need a lot of sugar.

BLACKCURRENTS

Excellent. Need a lot of sugar.

PLUMS

Very good, need a lot of sugar.

It should be noted that all the above fruits need a large amount of sugar, and due allowance should be made for this when planning the expedition.

PLACE IN THE DIETARY

Dehydrated products were always used as a basis for the main meal in the evening. Sometimes minced cooked ham was included in scrambled egg as a breakfast food. The diet was almost entirely of dried food; a typical day's menus were as follows:

BREAKFAST

Porridge, sugar, milk (from milk powder), tea or coffee.

LUNCH

4 oz. of chocolate, 2 oz. of cheese, 2 oz. of Lifeboat biscuits and several sweets, to be eaten at intervals during the day.

SUPPER

Soup or omelette (soup from soup powder, omelette from dried egg). Main course - usually a stew from dehydrated vegetables and meat, either a sweet of dehydrated stewed fruit, or cheese or jam and biscuits, tea or drinking chocolate.

About 75% of our diet was dehydrated food.

LIST OF OTHER SUPPLIES TAKEN BY THE EXPEDITION

In large quantities:-

Porridge

Sugar

Cheese

Chocolate

Milk, (Nespray, dried)

Dry biscuits

Dried soups

Tea

Drinking chocolate

Margarine

In small quantities:-

Sweet biscuits

Tinned cake

Oatmeal blocks

Luncheon meat

Oxo

Kendal mint cake

Jam

Honey

Cooking fat

Dried egg

Canned fruit

Coffee

Ovaltine

Powdered potato

Sweets

LOCAL FOODS

Small quantities of local foods were obtained:-

Fish

Milk

Bread

Eggs

APPROXIMATE TIMES OF EATING

Breakfast: 09.00

Lunch : At intervals throughout the day

Supper : 19.00 - 21.00

HEALTH AND WELL BEING

Losses in weight

I. M. Plummer : 16 lb.

P. Smith : 6 lb.

G. A. Topping : 9 lb.

Other people remained substantially constant in weight.

Satisfaction of hunger

All agree that dehydrated foods satisfy hunger quite adequately.

Thirst

The party generally agree that properly prepared dehydrated foods did not make them more thirsty than usual.

Sleep

On the whole the party slept well.

III. 6 BALANCE SHEET

INCOME

	£	s	d
Personal contributions from Members	250	0	0
Donations:			
Mount Everest Foundation £50 Royal Geographical Society 75	125	0	0
* I.C. Exploration Board	150	0	0
Sale of Newspaper Articles	8	0	0
Sale of Tidal Staffs	7	10	0
	£540.	10.	0

EXPENDITURE

	£	s	d
Boat Passages	228	14	4
Other Travelling Expenses	6	15	0
Freight	12	2	9
Food	110	1	8
Equipment	23	0	2
Other Expenses	8	13	2
Expenses in Iceland (travel etc.)	130	0	0
	£519.	7.	1

Excess of income over expenditure £21. 2.11

* In addition, the Exploration Board paid the insurance premiums of £33. 10. 11, so that the total cost of the Expedition to the Board amounted to £183. 10. 11.

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The Origin of Dust Cones on Glaciers, Charles Swithinbank, Journal of Glaciology, Volume I, No. 8, October 1950, pp. 439 and 461-465.

Admiralty Manual of Tides (1941 Edition) p. 111.

Venture to the Arctic, ed. R. A. Hamilton, p. 119.

The Geology of the Sandfell Laccolith, Hawkes, Quarterly Journal of the Geological Society, 1935.

Two books of photographs proved to be very interesting, and gave a good idea of the scenery, and the conditions which will be met during any trip to the island. The books were:-

Hekla on Fire, by Sigurdur Thorarinsson, and

Island I Myndum (Icelandic pictures).