THE VATNAJÖKULL

By ANDREA DE POLLITZER-POLLENGHI

General

In the very remote times of the tertiary, a vast land between N. Europe and N. America united the basalts of Scotland and Greenland. Afterwards in consequence of great tectonical movements this land disappeared under the sea, and Iceland, the Faroe and Shetland Isles are all that remain of that continent at the present time.

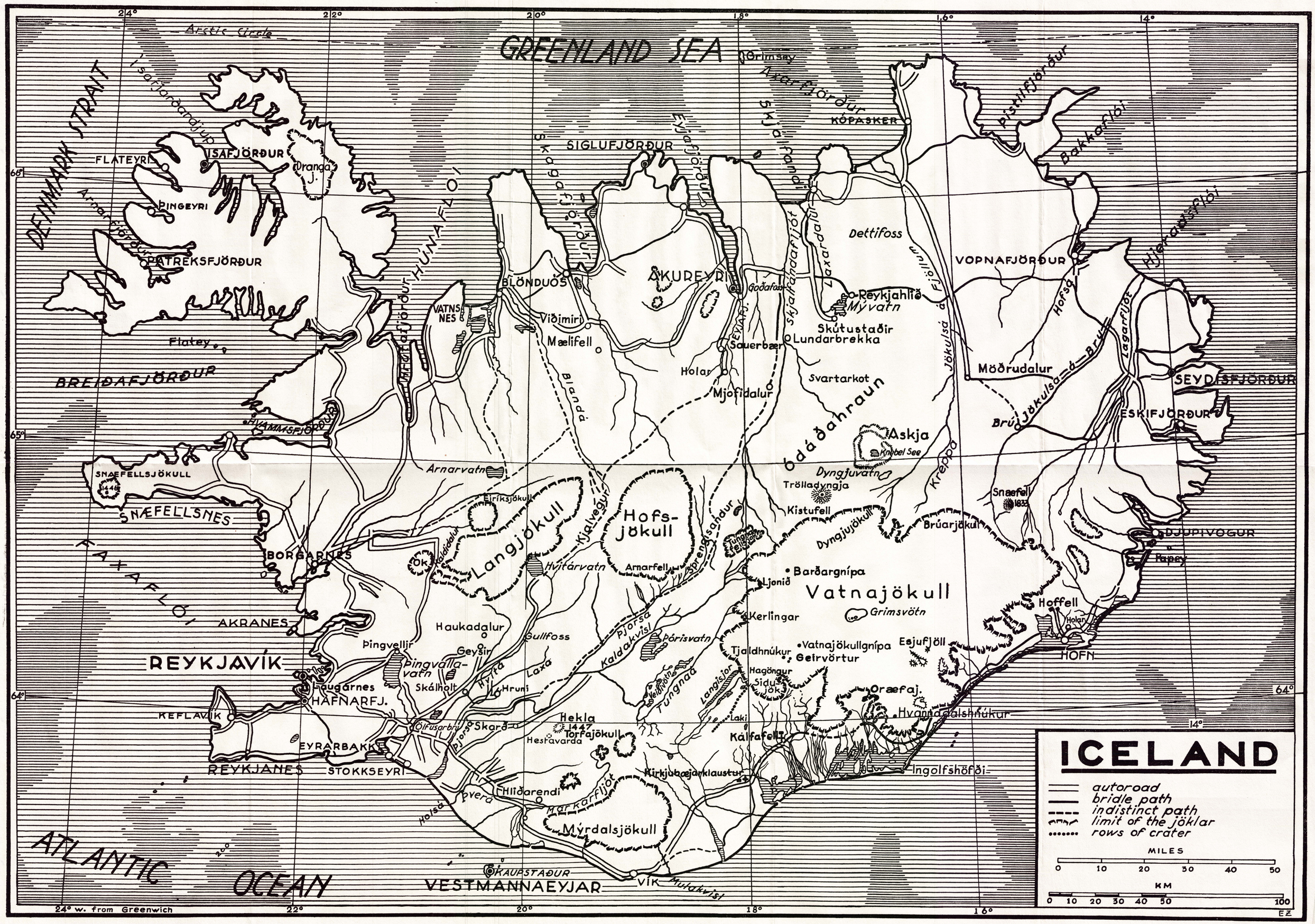
Nowadays the aspect of the surface of Iceland is based above all on the prevailing rule of two factors which, in a continuous mutual struggle in the past and present, constructed and destroyed the island : volcanism and ice.

The geological formation of Iceland is completely volcanic. Of the 103,000 sq. km. (greater than Ireland), 13,000 sq. km., *i.e.* more than one-eighth, are covered with glaciers. Of these the Vatnajökull alone has 8,500 sq. km. (to compare : the Gross Aletschgletscher, the greatest glacier of the Alps, has 115 sq. km. All the 2000 glaciers of the Alps put together have a surface of only 4000 sq. km.). Iceland is a plateau or tableland built of volcanic rocks, composed of basalts, tuff, liparite and mostly of recent lava. This lava varies from resistent rocks to the last stage of corrosion—fine sand. In consequence vast regions are covered with deserts of sand, pumice-stone and hard lava, often incised by profound volcanic fissures. One of them, Eldgjá (Icelandish : fire-fissure), is 35 km. long and the greatest volcanic fissure of the world.

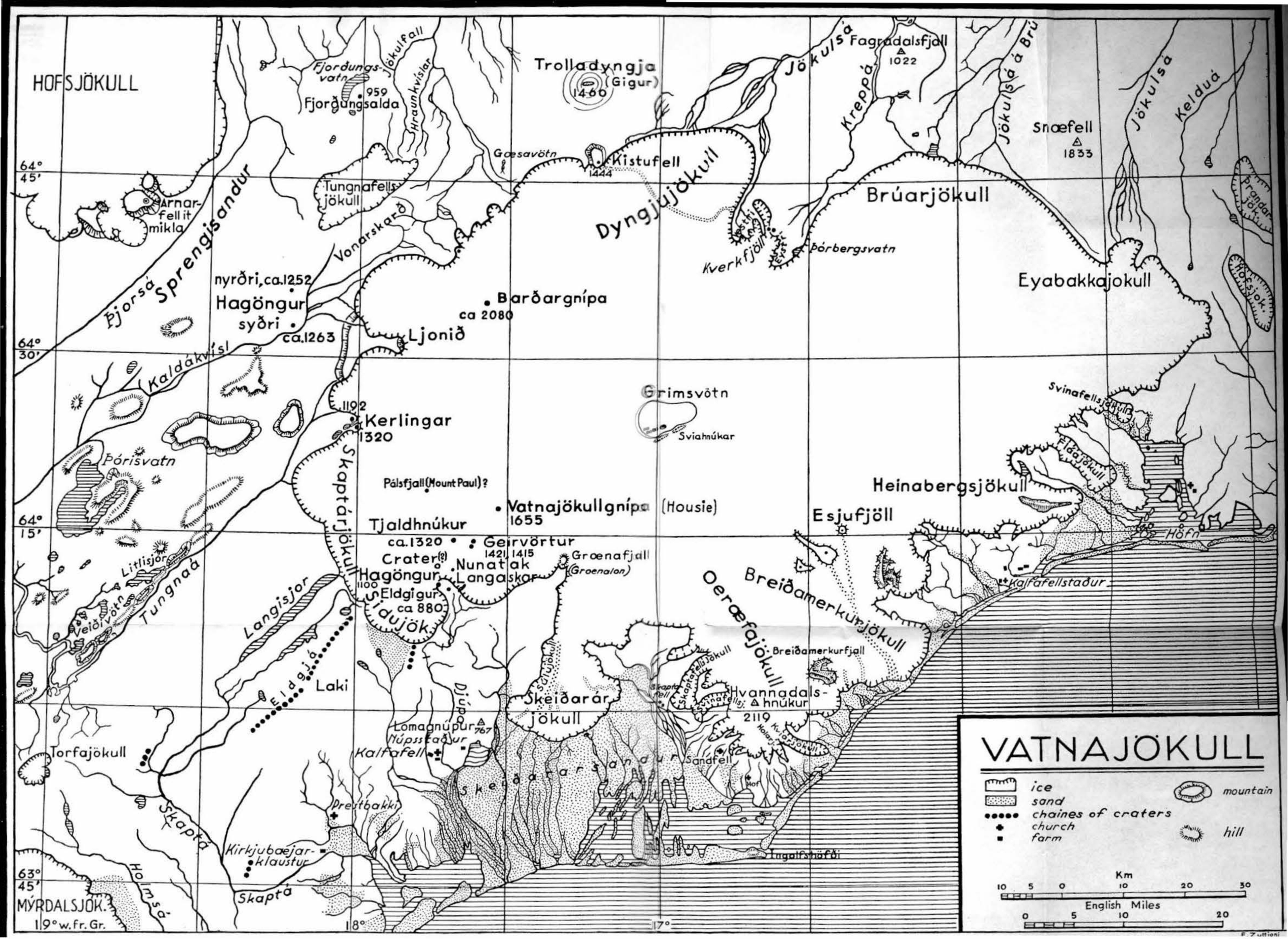
Though Iceland is almost 1000 km. distant from Norway and but 260 km. from Greenland, it has a much milder climate than the latter, because the S. coast is washed by the Gulf Stream. Thus at Reykjavík, the capital, the winter temperature corresponds to that of Berlin, and there is hardly ever any snow. In the N. instead, the ice-carrying current causes a colder and dryer climate. Owing to this position, between fresh polar atmosphere and warm maritime air, the weather is very unsteady and it often rains.

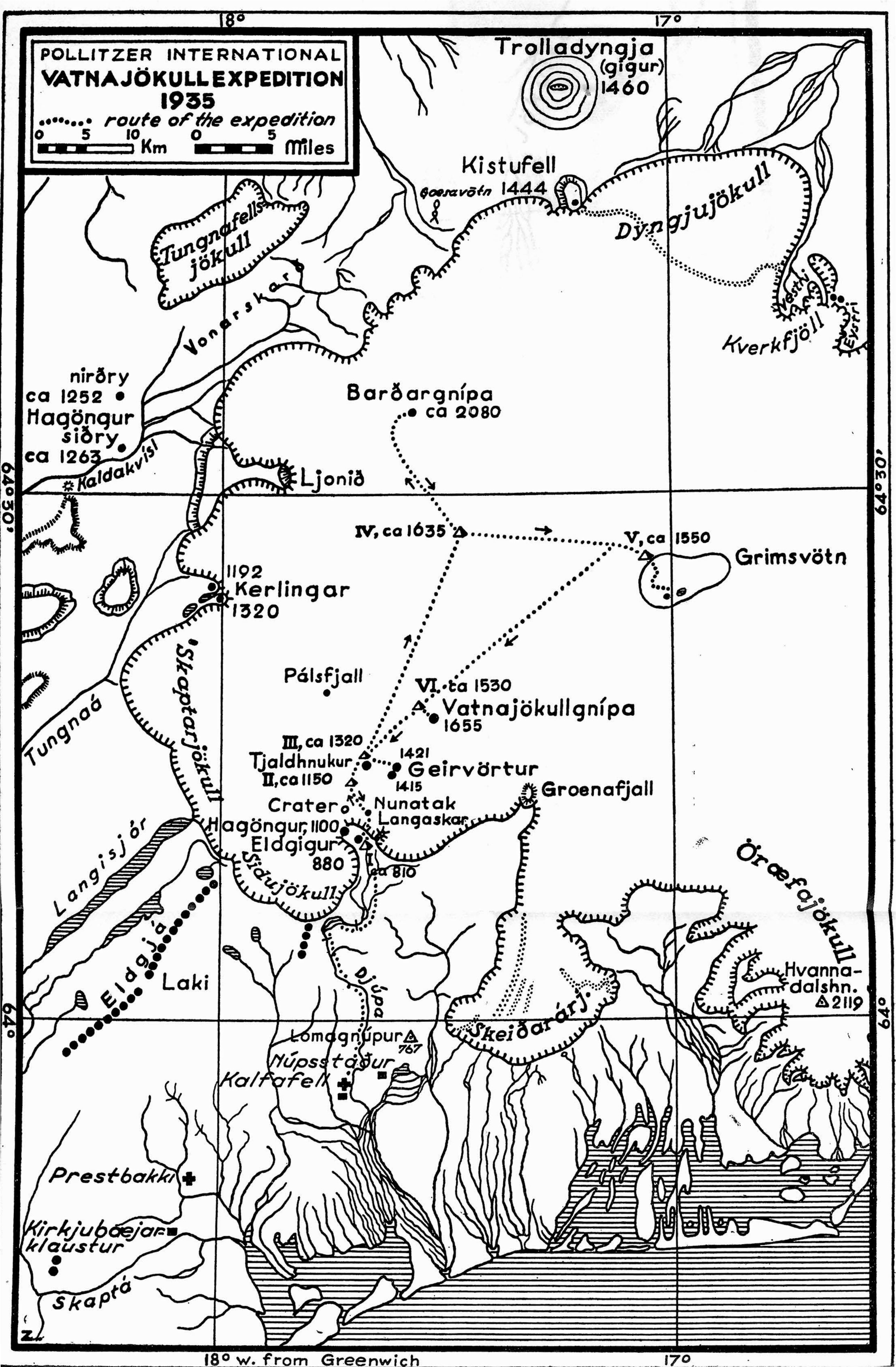
Iceland has about 113,000 inhabitants, of whom 30,000 live in Reykjavík, another 20,000 in little towns and commercial centres on the coast, the rest in farms scattered about on the sea-shore.

Innumerable hot-water springs exist everywhere. When they spout, as a rule, with intermittence, they are called geysers. This hot water is used not only by farmers for the cultivation of vegetables and for the heating of their houses, but also for the swimming-pool near Reykjavík (Laugarnes) fed by a hot-spring and where one can bathe all the year round in the open air.


GREENLAND SEA
DENMARK STRAIT
Arctic Circle
Ísafjarðardjúp
Arnarfjörður
FLATEYRI
ÍSAFJÖRÐUR
Drangajökull
ÞINGEYRI
PATREKSFJÖRÐUR
Flatey
BREIÐAFJÖRÐUR
HVAMMSFJÖRÐUR
SNÆFELLSJÖKULL
1446
SNÆFELLSNES
BORGARNES
AKRANES
REYKJAVÍK
Laugarnes
HAFNARFJ.
KEFLAVÍK
EYRARBAKKI
REYKJANES
STOKKSEYRI
ATLANTIC
OCEAN
200
Húnaflói
Húnafjörður
VATNSNES
Skagafjörður
SIGLUFJÖRÐUR
Eyjafjörður
Skjálfandaflói
Öxarfjörður
KÖPASKER
Þistilfjörður
Bakkaflói
Hjeraðsflói
BLÖNDUÓS
Víðimiri
Mælifell
Blanda
AKUREYRI
Goðafoss
EYJAFJ.
Skjálfandafljót
Laxardalur
Dettifoss
Reykjahlíð
Mývatn
Skútustaðir
Lundarbrekka
Sauðbær
Holar
Mjóafjallaá
Svartarkot
Jökulsá á Fjöllum
VOPNAFJÖRÐUR
Hofsá
Möðrudalur
Jökulsá á Brú
Lagarfljót
SEYÐISFJÖRÐUR
ESKIFJÖRÐUR
Brú
Askja
Knebel See
Ódáðahraun
Krepja
Dyngjuvatn
Trölladyngja
Kistufell
Dyngjujökull
Snæfell
1833
Brúarjökull
DJÚPIVOGUR
Papey
Arnarvatn
Eiríksjökull
Langjökull
Kjalvegur
Hofsjökull
Kaldadalur
Ok
Hvítárvatn
Arnarfell
Tungnafellsjökull
Sprengisandur
Baðargnípa
Ljónið
Vatnajökull
Grímsvötn
Kerlingar
Hoffell
Hólar
HOFN
Haukadalur
Gullfoss
Pjórsá
Kaldakvísl
Þórisvatn
Þingvellir
Geysir
Þingvallavatn
Skálholt
Hvítá
Hruni
Laxá
Tjaldhnúkur
Vatnajökullgnípa
Eyjafjöll
Geirvörtur
Hagöngur
Sjónjökull
Langisjór
Veiðivötn
Tungnaá
Öræfaj.
Hvannadalshnúkur
Hekla
1447
Torfajökull
Hestavarða
Skaftá
Ölfusá
Laki
Kálfafell
Ingólfshöfði
Kirkjubæjarklaustur
Hliðarendi
Markarfljót
Þverá
Hólsá
Mýrdalsjökull
KAUPSTAÐUR
VESTMANNAEYJAR
VÍK
Múlakvísl
24° W. from Greenwich
22°
20°
18°
16°
14°
66°
65°
64°
ICELAND
autoroad
bridle path
indistinct path
limit of the jöklar
rows of crater
MILES
0 10 20 30 40 50
KM
0 10 20 30 40 50 100
E Ž

[To face p. 257.


VATNAJÖKULL
ice
sand
chaines of craters
church
farm
mountain
hill
Km
10 5 0 10 20 30
English Miles
0 5 10 20
HOFSJÖKULL
Fjorðungsvatn
Fjorðungsalda
959
Jökulfall
Hraunkvíslar
Trolladyngja
(Gigur)
1460
Jökulsá
Fagradalsfjall
1022
Krepp á
Jökulsá á Brú
Snæfell
1833
Jökulsá
Kelduá
Gæsavötn
Kistufell
1444
Dyngjujökull
Tungnafellsjökull
Arnarfell it mikla
Sprengisandur
Þjórsá
Vonarskarð
Brúarjökull
Kverkfjöll
Þórbergsvatn
Eyabakkajökull
Brandarjök.
Hofsjök.
nyrðri, ca.1252
Hagöngur
syðri
ca.1263
Barðargnípa
ca 2080
Ljonið
Kaldakvísl
Grimsvötn
Svinafellsjökull
Sviahnúkar
1192
Kerlingar
1320
Eldajökull
Þórisvatn
Skaptárjökull
Pálsfjall (Mount Paul)?
Vatnajökullgnípa
1655
(Housie)
Heinabergsjökull
Esjufjöll
Höfn
Tjaldhnúkur
ca.1320
Geirvörtur
1421, 1415
Crater(?)
Nunatak
Langaskar
Grœnafjall
(Grœnalon)
Hagöngur
1100
Eldgigur
ca 880
Litlisjór
Veiðivötn
Tungnaá
Langisjór
Eldgjá
Laki
Sídujök.
Oræfajökull
Breiðamerkurjökull
Breiðamerkurfjall
Kalfafellstaður
Skeiðarárjökull
Skaptafellsjökull
Hvannadalshnúkur
2119
Skeiðarársandur
Lómagnúpur
767
Núpsstaðir
Kalfafell
Sandfell
Torfajökull
Skaptá
Prestbakki
Kirkjubæjarklaustur
Holmsá
Tungafellshöfði
MÝRDALSJÖK.
63° 45'
64° 45'
64° 30'
64° 15'
19° w. fr. Gr.
18°
17°


POLLITZER INTERNATIONAL
VATNAJÖKULL EXPEDITION
1935
route of the expedition
0 5 10 Km
0 5 Miles
18°
17°
Trolladyngja
(gigur)
1460
Kistufell
Goðavötn 1444
Dyngjujökull
Tungnafellsjökull
Vonarskarð
Kverkfjöll
Austri
Eystri
niðry
ca 1252
Hagöngur
siðry
ca 1263
Kaldakvísl
Barðargnípa
ca 2080
Ljonið
64°30'
IV, ca 1635
V, ca 1550
Grimsvötn
1192
Kerlingar
1320
Skaftarjökull
Pálsfjall
VI, ca 1530
Vatnajökullgnípa
1655
Tungnaá
III, ca 1320
Tjaldhnukur
1421
Geirvörtur
II, ca 1150
1415
Groenafjall
Crater
Nunatak
Langaskarð
Hagöngur, 1100
Eldgigur
880
I, ca 810
Sídujökull
Langisjór
Öræfajökull
Eldgjá
Laki
Djúpá
Hvanna-
dalshn.
2119
Skeiðarárj.
Lómagnúpur
767
Núpsstaður
Kalfafell
Prestbakki
Kirkjubæjar-
klaustur
Skaftá
64°
18° w. from Greenwich
17°

Mountaineering in Iceland

It is difficult to relate the story of mountaineering in Iceland, since such in its true sense cannot exist in Iceland. With the exception of the southern part only of the Vatnajökull (Oeræfajökull), very high mountains, where one can find technical difficulties comparable to those of the Alps, these do not exist. Instead there are in the central part of the country vast uninhabited regions without any resources, where impervious lava deserts, impetuous rivers without bridges and vast ice-caps make the crossing extremely difficult for travellers. If therefore I am attempting to relate a tale of mountaineering in Iceland, it will principally be a history of the journeys made in the central part of the country and of the great crossings. These were undertaken for two different purposes: at an early time to find ways of communication, then later for scientific exploration. Great journeys were always made by the first settlers, who in the tenth century wanted to go from the boundary regions to the Thing.[1] In that first century of settlement the first crossings had also taken place. The Lándnáma Bóc [2] (publ. 1 and publ. 99, book III, 17, 1, p. 163 [3]) thus relates the tale:

'Barðr, the son of Björn of Heyang, came in his ship to the mouth of Skiálfanda fljótz-ós, where he founded settlements in all Bárðar-dal up from Kálfborgará and Eyadals-áo and dwelt at Lundarbrecko for some while. He noted that the land-winds (his dwelling was near the N. coast, therefore the land-winds came from the S.) were warmer than the sea-winds; he thereby thought that there must be a better choice of land to the south of the heaths. He sent his son south to Goe (February 10–March 10). They found Goe-beytla (*Almeria vulgaris* or *Equisetum variegatum*) and other growth.

'But the second spring Barðr gave a sledge to every living thing that could walk, and made each drag his own fodder and all his chattels.

'He went by a path that was afterwards called Bárðar-gaoto, over the Vonarskarð, and then he took into settlement Fliotz-hverfe and dwelt at Gnúpom. This place is on the S.W. of the Vatnajökull, near to Kalfafell. He was called Gnúpa-Barðr (Bard of the Peak).'

It seems that the central part was well known to the inhabitants by the end of the tenth century.[4] But if we may be sure about this knowledge of Central Iceland in that epoch, very little on the other hand is known of what people knew at that time of the jöklar (plur. of jökull), especially of the Vatnajökull, and also that little is wrapped in the most nebulous legends. The early history of the Vatnajökull is concerned

[1] The first parliament of the world was held at Þhingvellir in A.D. 930.

[2] Ari's Lándnáma Bóc (the book of settlements) gives the history of the settlements of Iceland. This book is the fountain-head of Icelandic history. It was inscribed by the historian Ari (1067–1148) and his contemporaries from oral tradition.

[3] See numbered index of publications (books, journals, papers and maps) concerning the Vatnajökull at the end of this paper.

[4] Also Erkes (publ. 27, p. 4) is of the same opinion.

chiefly with legendary routes across the ice. The Saga of Grettir the Strong (1010–1031) speaks of a warm lake in the centre of the Vatnajökull. Various other old chronicles relate of a warm lake, 'Grimsvötn,' in the centre of the glacier.

How was this legend born? Who saw the mysterious lake or lakes? It appears that farmers coming with their cattle from the N. to the S., instead of passing by the Sprengisandur of the Route of Barðar (the Vonarskarð), crossed the jökull, or from the Kverkfjöll to Skaptafell, or from Brúarjökull to Kalfafellstaður. Whether this was possible, or, to be more exact, whether that was *then* possible, because the jökull was then less extensive than nowadays,[5] or whether the vast ice-cap was then easier to cross with cattle or even with sheep only, has been the subject of various discussions. Be that as it may, we find no further mention of Central Iceland until it was discovered for the second time by scientists later than the seventeenth century. The first person whom we know for certain as having crossed the central part is Arni Oddsson, who in 1618, as Bruun says (publ. 14, 15), accomplished the so-called Vatnajökullsvegur.

But the first scientist who really contributed much to science was Eggert Ólafsson. Halldór Hermannsson speaks of him in his fine article (publ. 39).

Travel in the inner part of Iceland, especially the ascent of mountains, was then a novel thing. People had a superstitious fear of the mountains, believing that unknown dangers awaited them there and that supernatural beings would threaten anyone daring to disturb them. The first object at that time was to ascend the volcano Hekla. People thought it impossible on account of the terrible sulphur-reek, mud pools, hot-water springs and a large crater, the latter continuously emitting fire and smoke. It was rumoured, moreover, that raven-like birds with sharp iron beaks would give a very unpleasant reception to anyone daring to go there. All these were sufficient deterrents. After many inquiries Ólafsson at last succeeded in finding a farmer willing to accompany his party. But on arriving at the spot, now called Hestavarda (horse enclosure), where one can go on horseback, the farmer refused to continue. Ólafsson and Pálsson continued the ascent, and not only reached the top but also returned. So for the first time the volcano Hekla was scaled on June 19, 1750.

In 1754, encouraged by this first success, Ólafsson wished to ascend the Snæfellsjökull, 1446 m. (in the W. of Iceland, not to be confused with Snæfell, 1833 m., to the N.E. of the Vatnajökull), the mountain then believed to be the highest of the island. The neighbouring population considered any attempt at scaling the mountain as pure madness. One might lose one's eyesight from the glare of the snow: a story was also told of two English sailors who dared this attempt. They reached the top but one only returned with his eye badly injured. Ólafsson and Pálsson left on July 1, 1774, with a thermometer, a compass, a

[5] For the change in the dimensions of the Jöklar see also Barðarson (publ. 7, p. 13).

mercurial barometer of a very primitive kind and some veils to protect their eyes. They reached the top and returned without any damage.

Then came the geodesist and astronomer, Björn Gunnlaugsson, to whom we owe the first great work of triangulation. He travelled for a long time in Iceland and left but one work, which, however, is of great value: the first good map, the 'Uppdrottur Islands,' published in 1849, at a scale of 1 : 960,000 (publ. 34). For many years the exploration and cartography of Central Iceland made no progress until the coming of Thorvaldur Thoroddsen, the greatest, most energetic and most cultured of Icelandic travellers, who accomplished his memorable journeys from 1881 to 1898. During all his journeys, as Thoroddsen himself says, he had explored Iceland completely with the solitary exception of the central part of the Vatnajökull.[6] At the time of Thoroddsen the inner part of the Vatnajökull was little known. For the history of its knowledge I should advise consultation of Brian Roberts (publ. 67), where all the expeditions are listed exactly and with great care and where there is a map with the exact routes of all up to 1932. Of course short ascents to the margins of the glaciers and mountains, such as the Hvannadalshnúkur, are omitted. To give a rapid sketch of these expeditions to the reader, I will summarize them as follows:

1. British Expedition (June 24–July 6, 1875).—Crossing of W. L. Watts, accompanied by 5 Icelanders. From Núpsstaður to the Kistufell. First crossing of the Vatnajökull. Discovery of the Vatnajökull Housie and of Mount Paul. (Publ. 101–103.) (Itinerary 1 on the map of Roberts.)
2. Danish Expedition (August 3, 1901).—Journey of Daniel Bruun with an Icelander in the N.E. corner of the Jökull. Ponies were used for the first time. (Publ. 11.) (Itinerary 2 on the map of Roberts.)
3. British Expedition (August 13–September 2, 1904).—Crossing by J. H. Wigner and T. S. Muir from the S. of the Snæfell to the Groenalon. They verified that there do not exist any volcanoes near the Groenalon and made meteorological observations. (Publ. 55, 104.) (Itinerary 3 on the map of Roberts.)
4. British Expedition (1912).—Rev. Athole Murray. (*A.J.* 40. 85 *sqq.*)
5. Danish Expedition (June 21–24, 1912).—Captain J. P. Koch and Prof. A. Wegener with three colleagues executed the double traverse from the Kverkfjöll to Breiðamerkurjökull. They made various glaciological observations. (Publ. 48–51.) (Itinerary 4 on the map of Roberts.)
6. Swedish Expedition (August 27–September 5, 1918).—H. Wadell and E. Igberg. They crossed the Vatnajökull from

[6] 'With exception of the central part of the Vatnajökull, there is not in the whole of Iceland one large stretch of country on which I have not at least looked from some high mountain-top' (publ. 86, p. 52).

Kalfafell to Heinabergsjökull, to which they give the name of Sviagigur. Glaciological volcanological studies. Observations on the causes of the jökulhlaup (glacier leap). Publication of map. (Publ. 100.) (Itinerary 5 on the map of Roberts.)

The phenomenon of the jökulhlaup is one of the most interesting things of Iceland. Many Icelandic volcanoes are covered with ice. When sudden eruptions take place, the ice and snow are melted. This often causes serious catastrophes, since vast regions are flooded in a very short time by great impetuous rivers which bear enormous masses of ice floating on their surface. That conflict between lava at a temperature of 1400° meeting with the thick ice shell, making it 'rise and go down and toss and roll like a stormy sea' (publ. 86), must be one of the most terrific phenomena that Nature can offer to human eye.

(Literature concerning jökulhlaup: Thoroddsen 86, pp. 210–212—very detailed; Thoroddsen 86, pp. 187 and foll., then Barðarson 8, p. 13, v. Knebel and Reck 47, chap. XIV.)

7. British Expedition (1925).—Rev. Athole and Mrs. Murray. (*A.J.* 40. 85 *sqq.*)
8. Icelandic Expedition (July 15–18, 1926).—Helgi Guðmundsson, Sigurbergur Árnarson and Unnar Benediktsson traversed the Vatnajökull from Svinafellsjökull to Dyngjujökull. (Publ. 28, p. 116.) (Itinerary not designed in the map of Roberts.)
9. British Expedition (1927).—Rev. Athole and Mrs. Murray. (*A.J.* 40. 85 *sqq.*)
10. British Expedition (June 28–July 31, 1932).—Cambridge Expedition composed of F. W. Anderson (geologist and zoologist), University College, Southampton; J. A. Beckett (surveyor), Sidney Sussex College, Cambridge; P. Falk (botanist), King's; W. L. S. Fleming (geologist), Trinity Hall; W. V. Lewis (seismologist and surveyor), Caius; and B. B. Roberts (ornithologist), Emmanuel, leader. Double crossing from Stadardalur to the Kverkfjöll. Surveys, geological, geomorphological, botanical, zoological and meteorological observations, partly on the ice-cap and partly in the region of Þórbergsvatn. (Publ. 9, 66, 67.) (Itinerary 6 on the map of Roberts.)
11. German Expedition (June 19–July 2, 1932).—Dr. Helmut Verleger and Dr. Max Keil, from Hoffell as far as 4 km. before coming to the Kverkfjöll and back. (Publ. 96.) (Itinerary 7 on the map of Roberts.)
12. German Expedition (July 1–26, 1932).—Second Journey of Dr. Verleger with two Icelanders, from the S.E. margin (near Hoffel) to the moraine between the Brúarjökull and the Eyabakkajökull, ascent of the Snæfell and back. (Itinerary 7 on the map of Roberts.)

Here ends the report of B. B. Roberts. (Publ. 67.) I will now continue this list, reporting the successive journeys as far as I know them.

13. Icelandic Expedition (April 4–8, 1934).—Immediately after a great eruption of the Grimsvötn: Guðmundur Einarsson, Jóhannes Áskelsson, Lydia Zeitner and Sveinn Einarsson, from Núpsstaður to the Grimsvötn and back. The first expedition in spring and the first observation of the crater in partial activity. (Publ. 5, 23.)
14. Jóhannes Áskelsson of Reykjavík and Dr. Niels Nielsen of Copenhagen, accompanied by farmers, from Hagöngur to the Grimsvötn (April–May, 1934).—Various scientific observations were made. (See 'The Polar Record' of the Scottish Polar Research Institute, Cambridge, no. 9, pp. 37–39.)
15. July 1934.—Dr. Ernst Hermann of Berlin, Dr. Rudolf Jonas, M.D., and Prof. Dr. Herbert Lager of Vienna, together with the two Swedes, Bertil Liljöhöök and G. Haselius. They started from Hagöngur, aiming for the Grimsvötn, which they did not reach on account of bad weather.
16. German Expedition (summer, 1934).—Dr. Ernst Hermann, Karl Schmid and Wilhelm Schneiderhahn. (Publ. 70, and *Mitteilungen*, D. u. Oe. A.V., 1936, pp. 67–71.)
17. Pollitzer International Expedition (May 23–June 8, 1935).—Dr. Rudolf Leutelt (glaciologist and morphologist), Dr. Andrea de Pollitzer-Pollenghi (leader, surveyor and photographer), and Karl Schmid (geographer). Of this expedition the present article is going to speak. (See also the publication by Pollitzer in the 'Bollettino' of the Reale Società Geografica Italiana, no. 10, 1935, and 'The Polar Record,' no. 11, 1936, pp. 50–52.)
18. Icelandish Expedition (May 23–June 1935).—Jóhannes Áskelsson and Dr. Traustí Einarsson of Reykjavík. From Kalfafell to the Grimsvötn. The area round the craters was surveyed and mapped. (Publ. 5 and 6, pp. 45–47.)
19. Triggvi Magnússon's Icelandish Expedition (June 16–July 1935). —Jóhannes Áskelsson, Kristian Ó. Skagfjörð, and Triggvi Magnússon, all of Reykjavík. From Kverkfjöll to Grimsvötn, return to Núpsstaður. The craters in the Grimsvötn were surveyed and mapped. (Publ. 6, p. 45.)
20. Austrian Expedition (June–July 1935).—Dr. Rudolf Jonas, Prof. Franz Nusser, Dr. Franz Stefan, all of Vienna. From the Kistufell to the Grimsvötn, then to the western end of the Jökull and then to the Hagöngur and Kalfafell. Many important observations were made. (Publ. 6, pp. 47–50.)

Space restriction prevents me from speaking of the ascents of other Icelandic mountains. Above all they concern the other three big jöklar; the Myrdalsjökull, of about 1000 sq. km., greatest height 1705 m.:

the Langsjökull, 1300 sq. km., greatest height about 1400 m.; the Hofsjökull, about 1350 sq. km., greatest height about 1700 m.; and twenty other smaller jöklar. A list is given in Thoroddsen. (Publ. 86.)

In Iceland there are many snow-capped mountains (*e.g.* the volcano Hekla). To the S. of the Ódáðahraun there is also a vast and wild mountain region with the Askja and other smaller volcanoes (about which there exists a rich literature). Finally, many smaller, lower mountains of about 1000 m.: *e.g.* in the region of the Veiðivötn (Fiskivötn) and the Laki, the mountains of Skarðsheidi (Borgarfjörður), of the Oexnadalur (between Viðimiri and Akureyri), all the mountains with sharp and savage and, I dare say, Dolomitic peaks, where one should be able to make difficult climbs. In general, steep ramparts, serrated if not very high, are not wanting in Iceland.

In the last few years, sportsmen, especially Mr. Triggvi Magnússon and Mr. Kristian Ó. Skagfjörð of Reykjavík, have repeatedly ascended and traversed with sledges and on skis the Langsjökull and the Hofsjökull in spring and in summer. I do not know of any big mountain or jökull that has been ascended in winter. Exceptionally, in January 1930, Mrs. H. C. Bryan and Miss E. Pirie, accompanied by the Norwegian Sverrir, all with ski ascended the Ók (1198 m.) (see *British Ski Year Book*, 1930, pp. 398–406).

Mountaineering, still a new thing for the Icelanders, is not generally very popular so far. A purely climbing Association does not exist. But there is a Tourist Association, the 'Ferðafjelag Islands,' with over a thousand members, which has two huts, Hvitarness at the Hvitárvatn and the other at the Snæfellsjökull. There is also a Ski Club, 'Skidafjelag Reykjavikur,' founded on February 26, 1914, by the Norwegian L. H. Müller of Reykjavík, which has now about 250 members.

Our Journey through the Vatnajökull

All journeys and crossings of the Vatnajökull are concerned with the central and eastern parts. Little was known of the western part, traversed but once, by Watts in 1875, in very bad atmospherical conditions with continuous fog and snow-storms. Accordingly I considered this part to be the more interesting. The aim of the expedition was to study the W. portions of the jökull, to make a summary survey, a morphological, volcanological and glaciological study and to ascend the principal mountains, especially the Barðargnípa. In the summer of 1934 I went to Iceland for a preliminary visit and, for ten months, organized our journey with great care. I arrived at Reykjavík on May 16, 1935. The Icelandic mountain-painter, sculptor and climber, Guðmundur Einarsson, should have accompanied us, but at the last moment was prevented by illness. A young German, Karl Schmid, offered himself in his place. Our party accordingly consisted of three: Dr. Rudolf Leutelt of Innsbruck, glaciologist and geomorphologist; myself, as leader, surveyor and photographer; and Karl

Schmid of Laupheim, geographer. Guðmundur Einarsson made all arrangements for us, and lent us saddles and other things. As there was still very much snow in the northern regions and at the Veiðivötn, and as the most rapid, convenient and economical way of getting to the margin of the jökull was to use motor cars as far as Kalfafell, we decided on that means of transport. We left Reykjavík in a 'bus. In the evening we reached Vík, the most southerly village of Iceland.

Early the next morning we started in the same 'bus, which, as a special favour, took us to the Mulakvisl. On the other side there was to be a lorry waiting, ordered by telephone by Guðmundur Einarsson, driven by a capable driver, which for an Icelandic chauffeur means one capable of fording rivers and knowing the dangers of quicksands. I really cannot imagine a worse road than the one we were to be driven over. We were proceeding along a track ; every moment we had to stop and make a fresh start. We had to get down and push the car, run after it, perspiring in our heavy black oilskins and rubber boots. In this fashion we crossed streams, torrents and lakes—all in the sandur.

At last we arrived at the banks of a shallow river, divided into several arms and about a kilometre wide. It was 10 A.M. and there punctually were the farmers arriving with a cart and ponies. On the other side of the river the lorry was waiting for us. We had to carry our things over in several trips, the lorry being a Ford. Two spare springs were tied on in front—a good sign. We started at once at 40 km. an hour. It was quite useless to speak of a road or a track : neither existed. We seemed to be on a wet Sahara ; we crossed rivers and lakes, just as if travelling in a racing motor-boat. Soon we entered the Hraun, the lava-desert. This was an 'apalhraun,' *i.e.* a desert of block-lava, to be distinguished from the 'helluhraun' or the stratified lava-desert. At 16.00 we arrived at the farm of Kirkjubæjarklaustur. The farmer, Laurus Helgason, had been informed of our arrival and had invited us —naturally on payment—to lunch. It was the first farm after Vík, some 70 km. distant. We left in the same lorry, and in the evening were at Kalfafell, the end of our car journey. An interesting little church secured by four chains, two farms and a school make up Kalfafell. We lodged at the school, which consisted of one room only. Guðmundur Einarsson had ordered the ponies by telephone and tomorrow we should be able to start.

On the 23rd, early in the morning, we packed everything on the eight ponies, there being a riding pony for each of us, besides the four ponies of the farmers who accompanied us. Finally, at 09.00, everything was ready, tied on to pack-saddles with ropes made of plaited horsehair and sheepswool. The proprietor of the farm, Stefán Jonsson, known to all as Stefán, led the caravan. He was 70 years old, but quite active and healthy in mind and body. At 300 m. above sea-level the grass disappeared. The bridle-path could no longer be recognized. We were going along the true right bank of the Djúpa (the 'profound') which flows between basalt walls. After a ride of 4 hours we arrived at the only point where one can attain the river on horseback. In the

preceding years many expeditions had tried in vain to ford it in summer. The Djúpa was roaring and dirty ; at the bottom we could hear the rumbling of stones violently dislodged by the current. Stefán, who knows the region very well, had never heard of anyone having passed here. But in this season the crossing was possible and there we were on the other side. Now we were going along the left bank. The wind had blown away the clouds and a magnificently imposing panorama appeared before our eyes. Below us there was a vast moraine and beyond it the Sidujökull, one of the forty-two tongues of the Vatnajökull, was glowing in the sun. It seemed like a big, flattened cake without limits. It is different from Alpine glaciers, being full of the most irregular crevasses ; the ice is black with the pumice of past eruptions and it was a splendid sight. We went up the snow-covered moraine. From the N. an icy wind was blowing : it was the blast of the Vatnajökull greeting us. Far away a typical volcanic cone of red colour, the Eldgigur (or Randigigur), rose up. We found increasing snow in the midst of which were often torrents, through which we had to wade. Finally, late in the evening, we arrived at the foot of the red volcano. We dug a kind of hole in the snow with an aluminium shovel and there we put up our tent. (Camp I or the Base Camp : about 810 m.) In the morning of May 24 we put together a sledge. We decided to take but one and to haul it in relays of three. Experience has shown that this was the best system. We took with us one Primus, numerous repairing tools and victuals. During the entire expedition we always used skis. The sledging was very fatiguing. After 3 hours' hauling we arrived at a little nunatak. In the distance we saw towards the N. a very marked elevation, the Tjaldhnúkur, *i.e.* ' mountain of the tent.' Our intention was to form a provision depot there, as it was impossible to continue with that burden. To the N.N.E. rose the double summit of the Geirvörtur. On trying by compass to fix the N., we saw that it was impossible to do so, on account of the influence of iron in the lava. It refused to give the right direction. We proceeded towards the crest of the Tjaldhnúkur, where some black rocks emerged. At 20.00 we attained the rocks of the crest and at about 1150 m. pitched Camp II. We had had fine weather for the whole day, but the next, May 25, was very foggy and we had to remain in our tent, or, to be more exact, in our sleeping-bags. The next morning, May 26, at 11.00, the weather cleared up and we began preparations to go down and fetch up more provisions. In an hour and a half, without the sledge, but on our skis and with the empty rucksacks, we were back again at Base Camp. We filled our sacks and remounted the glacier. In 2 hours we were back at the tent and, with our rucksacks only, continued towards the summit of the Tjaldhnúkur, where we dumped all the food into a case we had brought with us and buried it in the snow. Before our eyes lay a fantastic and magnificent view : one could see almost all the W. part of the glacier, the Kerlingar, the Ljonið and the Hofsjökull appearing in the midst of the sea of fog. It was late and the névé was frozen. In 15 minutes we were down at our tent : it was

23.30 and the light was still so strong that I had not even noticed that I was still wearing my dark goggles. After a well-earned rest, May 27, we left at 12.30, pulling the sledge. To render haulage easier on the steep slopes we put skins on our skis. At 15.00 without the least fatigue we attained the Tjaldhnúkur. On the spacious summit wide and flat slabs of black rock were to be seen. We dug a hole to fix up our tent. (Camp III, about 1320 m.) During the whole night the wind blew so strongly that we could hardly sleep. The next morning, May 28, everything was covered with icicles. It was intensely cold. We reckoned up the result of these first four days: we had made but 5 km. horizontally and gained 510 m. in height. Nevertheless one important achievement had been made: a provision depot had been formed high up on the ice-cap in an easily distinguishable spot. So, if necessary, we were not obliged to go down to the base for replenishment. The provisions we had would permit us to live well for three weeks and, with economy, longer still. We took with us food for ten days and 5 litres of paraffin and tried to reduce the remainder to what was indispensable. But as usual, after having loaded everything, we still had a heavy burden: that is the fate of all mountaineers, I think.

We left at 10.00. The air was of such astounding clearness that we could see for dozens of kilometres. Looking N., the whole Vatnajökull appeared as a vast white plain, slightly undulating, almost without any crevasses or marked elevations. It was therefore very different from the zone we had seen until now. Whilst the one had a broken surface and somewhat the characteristics of Alpine glaciers, the other resembled Arctic inland ice. Having hauled the sledge some kilometres towards the N., we could see by looking attentively in the W. at a distance of some kilometres a characteristic formation until then hidden by a kind of undulation of the ice. We could distinguish a group of various cones, covered with snow and surrounded by several concentric rings of dark rocks. Between us and that formation there opened several big crevasses preventing any close approach.

We continued dragging the sledge. Every 2 hours we had a rest of 15 minutes. At each rest we ate something, but by 16.00 we were completely exhausted. It was necessary, however, to arrive the same day as near as possible to the Barðargnípa. It was 23.00; the snow was completely frozen, every inequality was sharp like cut-glass. The seal-skins, owing to the continuous strain, had become simply rags. To the N. we saw an enormous flat hill. It seemed very little higher than where we stood. The sky was azure, full of light so bright that we could easily read a newspaper. We continued hauling, but it was very cold. At 00.30 daybreak began: the clouds were first dyed pink, then scarlet. A fresh impulse pushed us on, although our shoulders were hurting terribly. At 01.00 we stopped and I jumped on to the sledge-metre: to-day we had made 26 km. and had gained considerably in height. We pitched the tent (Camp IV, about 1635 m.) with two pairs of gloves on our hands. We had understood that it was necessary to march during the night when everything was frozen, as the sledge

ran much easier on the hard surface : during the day we could sleep or at least try to do so.

On May 29 the weather was beautiful again as we awoke. In front of us, the Barðargnípa, some 12 km. long, resembled a lengthened, shield-shaped cupola that rose from the Kverkfjöll in a W.S.W. direction culminating in the N. before us. It had the shape of a big Hawaiian volcano. Thus that mountain appeared before us—the desired aim of many—covered with an everlasting mantle of ice, glistening in the sunshine of the limpid Polar atmosphere.

We left without the sledge, with only skis and rucksacks. After a long march on flat ground we began slowly to ascend. After 4 hours (about 12 km.) we did not yet know where the culminating point stood. We proceeded in a N.W. direction to examine the landscape of the other declivity. We gained no height but began to see the ' novum mundum,' the world on the other side. Now the terrain seemed to descend, the most glorious marvel was presented to my eyes : as long as I live I shall never forget this sight, I shall carry the memory of it closed up in my heart like a precious treasure that nobody can tear away from me, as a comfort and viaticum for sad days.

The landscape, spread below my eyes, was so savage that human mind could never imagine it. Towards the S., fearful and gloomy, rose the volcanic cones of the Laki, the longest crater chain of the world, every top in a mantle of snow. I had already seen them in a painting by Guðmundur Einarsson, but had thought they had been more or less the fruits of the Viking fancy of his Scandinavian soul ! Now I had to admit that in reality they appeared just like what I had seen on the canvas.

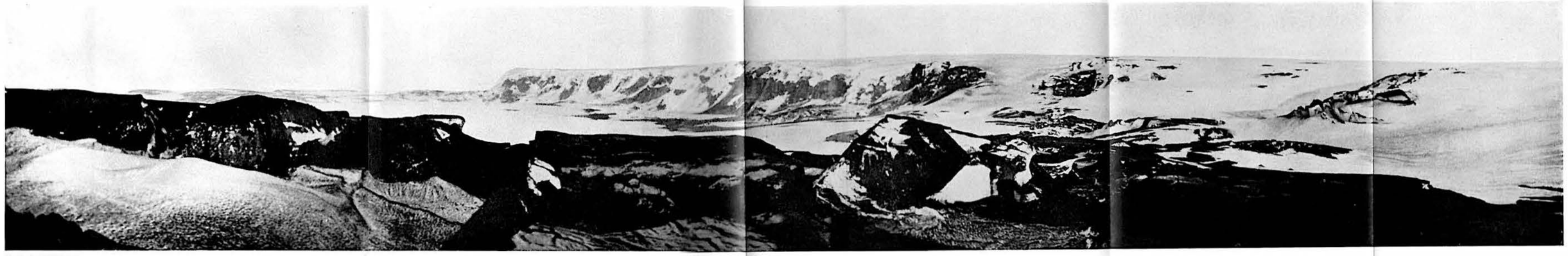
A little beyond lay the region of the Veiðivötn (the lakes of fishes), a series of silvery tarns amongst solemn, dark mountains. Below us lay the Vatnajökull, the boundless cupola sloping down towards the Veiðivötn into which the tongues of its glaciers calve. There was the Sprengisandur, the great sandur without an oasis, without a blade of grass, which one can traverse on horseback only, riding for 18 hours. There was the river þjorsá springing forth from the Hofsjökull and flowing S. in silvery serpentines. The Hofsjökull, the second biggest glacier of Iceland, was lying at our feet like a relief in this immense museum of Nature. Far away to S.W. the þórisvatn, then the volcano Hekla, then the river Oelfusá and finally, almost on the horizon, we caught a glimpse of the þingvallavatn, the biggest lake of Iceland. It was a landscape without trees, without colour and with lines tortured by those big stone blocks accumulated by the numerous eruptions in the region of the Veiðivötn.

I was dreaming, enjoying and forgetting everything. ' There is the summit,' screamed my companions. Their call brought me back to reality : it was true. Now we could plainly see the highest point. We went up for yet another hour, and at last arrived on the top. The flat summit is 500 m. wide and about 1000 m. long. It was 20.30, the aneroid indicated 591 mm., which, considering the temperature, the

pressure of the next meteorological station and the due corrections, corresponds to about 2080 m. We unroped ourselves to behold the panorama and walk around the summit. The eye wanders over the whole Vatnajökull. Towards the S.E. at the other margin, S. of this sea of ice, dyed to a pale violet colour, lay the imposing group of the Oeræfajökull, a formidable basalt massif of Alpine character; clearly visible, a peak rose above all to the sky: it was the Hvannadalshnúkur, the highest point of Iceland (2119 m.). It was about 60 km. distant from us but, on account of the quite extraordinary limpidness and clarity of the air, seemed much nearer. Towards the N.E. two wild volcanic cones rose above the white mass. They were the Kverkfjöll, still active volcanoes. In the N., in a kind of golden dust spread the Ódáðahraun, the 'desert of the Evil Dead.' Below us towards the W. was the very small Tungnafellsjökull, the Hofsjökull and the lakes sparkling in the false light. Now we could see the þingvallavatn, distant about 150 km., even better. We could encompass with our eyes more than half of Iceland. Terribly beautiful was this furious battlefield between Fire and Ice. It was 22.30 and we were 15 km. away from our tent. We had to return. At 01.45 we reached the tent. At 03.00 I was in my sleeping-bag with the sun shining red on the canvas of the tent.

For the return we decided not to take the same itinerary, but to go to the Grimsvötn. On May 30 we left at 18.00. As we proceeded a strange wall seemed to rise in the distance. The jökull showed always more crevasses, completely covered by snow-bridges. Fortunately the temperature was very low. One could smell the odour of sulphuretted hydrogen. (Icelandish, *Brennisteinssilu*, i.e. Sulphur stink—see publ. 66, p. 297.) At 24.00 we arrived at the N.E. corner of the Grimsvötn (Camp V, about 1550 m.). Before us the ground sloped down into a bowl-shaped cavity, closed to the S. by a long, vertical, terribly black wall. From our standpoint we could not see its whole height.

May 31 was the sixth sunny day, the warmest of our whole journey. At 12.00 the shade temperature was 8° (C.), in the sun 24°. The sun had a very strong actinic force, perhaps also because there was a very fine mist. At 13.30 we began to descend to the Grimsvötn on skis. At the beginning of the cavity, although snow-covered, we could guess the presence of big crevasses. We proceeded with caution, duly roped. After a few minutes the eye could already overlook the whole cavity. It must have a length of about 9 km. and a breadth of 5·5 km. The margin and still more the bottom were covered with many big spots appearing to be sand. On approaching, we saw that it was dark volcanic ash (pumice), gray-brown, almost black. It hindered progress very much, as the skis would not slide on it. In many parts we saw a long series of typical melting cones. The march was rather dangerous. We passed séracs covered with snow-bridges till we arrived on a kind of promontory, a dozen metres high, a magnificent observation post. We were only about 150 m. higher than the warm lake at the bottom of



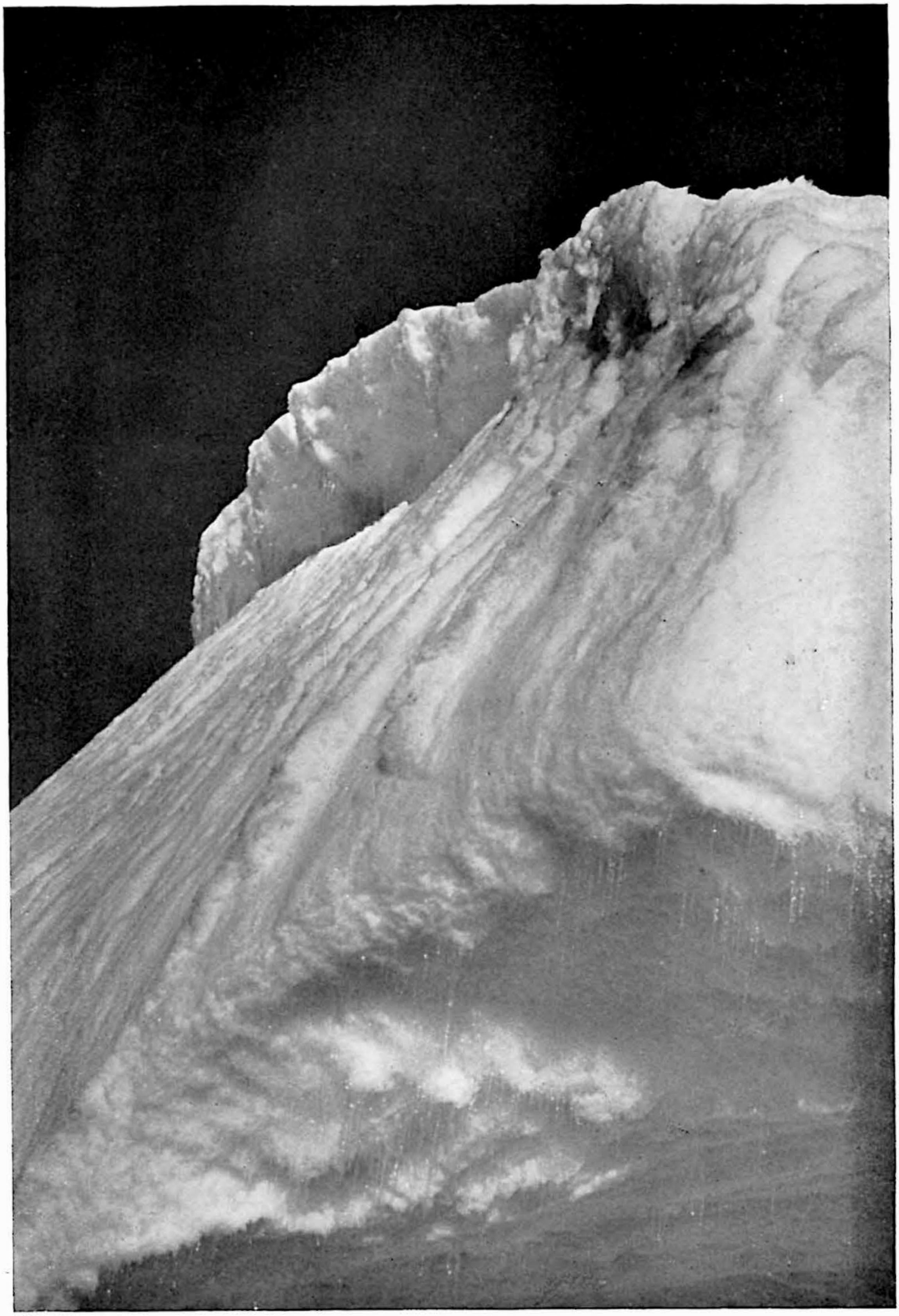
Photo, A. de Pollitzer.]

PANORAMA OF THE GRIMSVÖTN (TAKEN FROM N.W.).

In the foreground enormous séracs, partially covered with pumice. After the séracs the glacier slopes to the bottom with great crevasses not visible on the photo. In the centre is the lake covered with ice-cakes. Near the lake the cloud of smoke, due to volcanic activity. In the background the black basalt wall rises perpendicularly some 400 m.

(This is the first panorama of this mysterious place.)

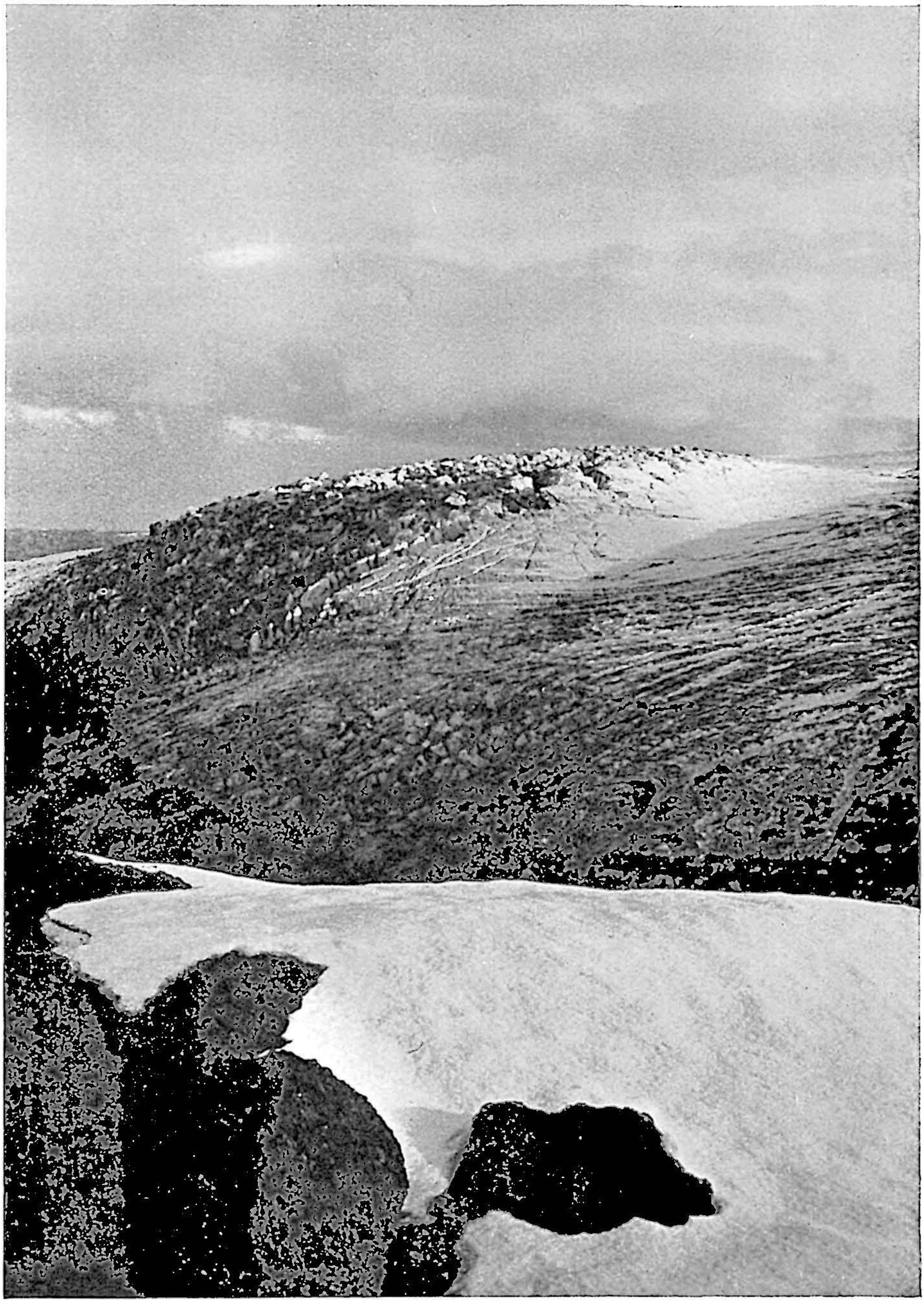
[*To face p.* 268.



Photo, A. de Pollitzer.]

THE SUMMIT OF THE VATNAJÖKULLGNÍPA.
(Taken with infra-red screen.)

[*To face p.* 268A.



Photo, A. de Pollitzer.]

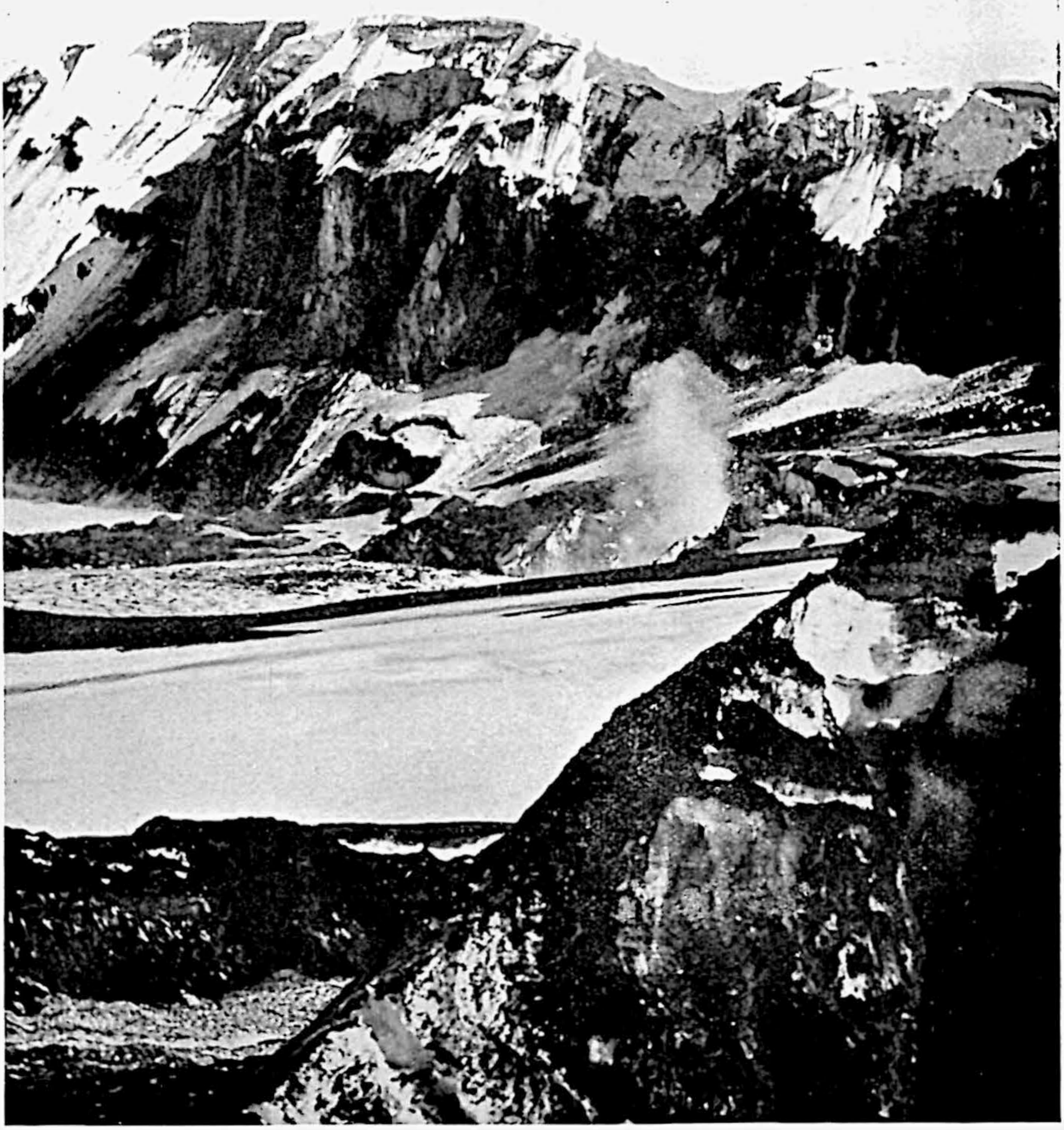
THE SIDUJÖKULL FROM THE ELDGIGUR.

The glacier is terribly crevassed and the crevasses are covered with black pumice.

Photo, A. de Pollitzer.]

FORMATIONS NORTH OF HAGÖNGUR.

Cones surrounded by concentric rings. All covered with névé. Probably of volcanic origin.



Photo, A. de Pollitzer.]

THE CENTRAL PART OF THE GRIMSVÖTN.

(This photo is taken from the same point as the panorama. Here the telelens *Elmar* 10, 5 has been used.)

In the foreground are séracs covered with pumice. At the bottom one can clearly see the lake covered with ice-cakes. In the middle the cloud of smoke is visible. In the background is the imposing black basalt wall, from which masses of ice fall continuously.

Photo, A. de Pollitzer.]

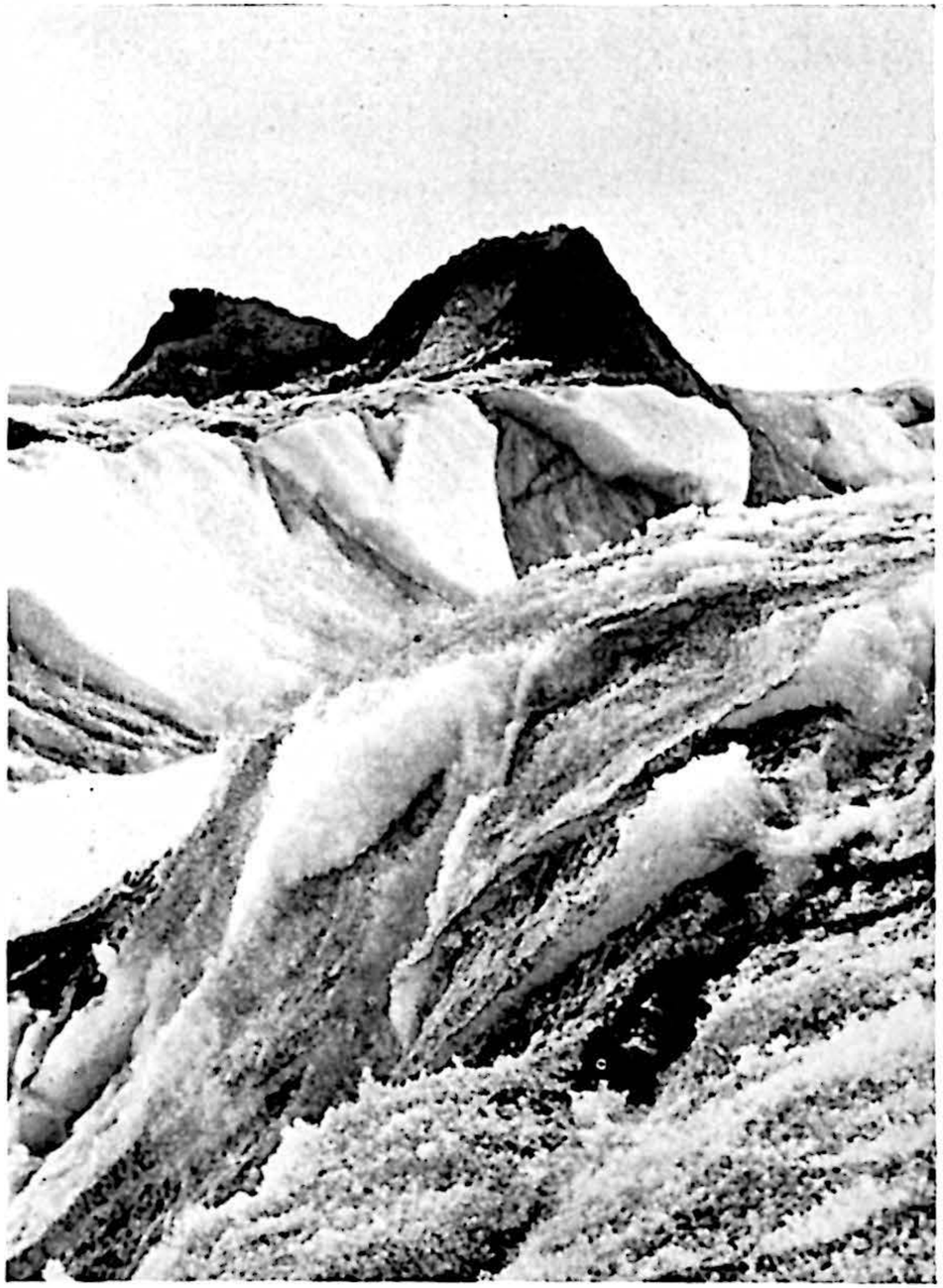
THE ASCENT OF THE VATNAJÖKULLGNÍPA.

Below the summit can be seen a profound incision, produced in consequence of a recent avalanche or wind-slab.

Photo, A. de Pollitzer.]

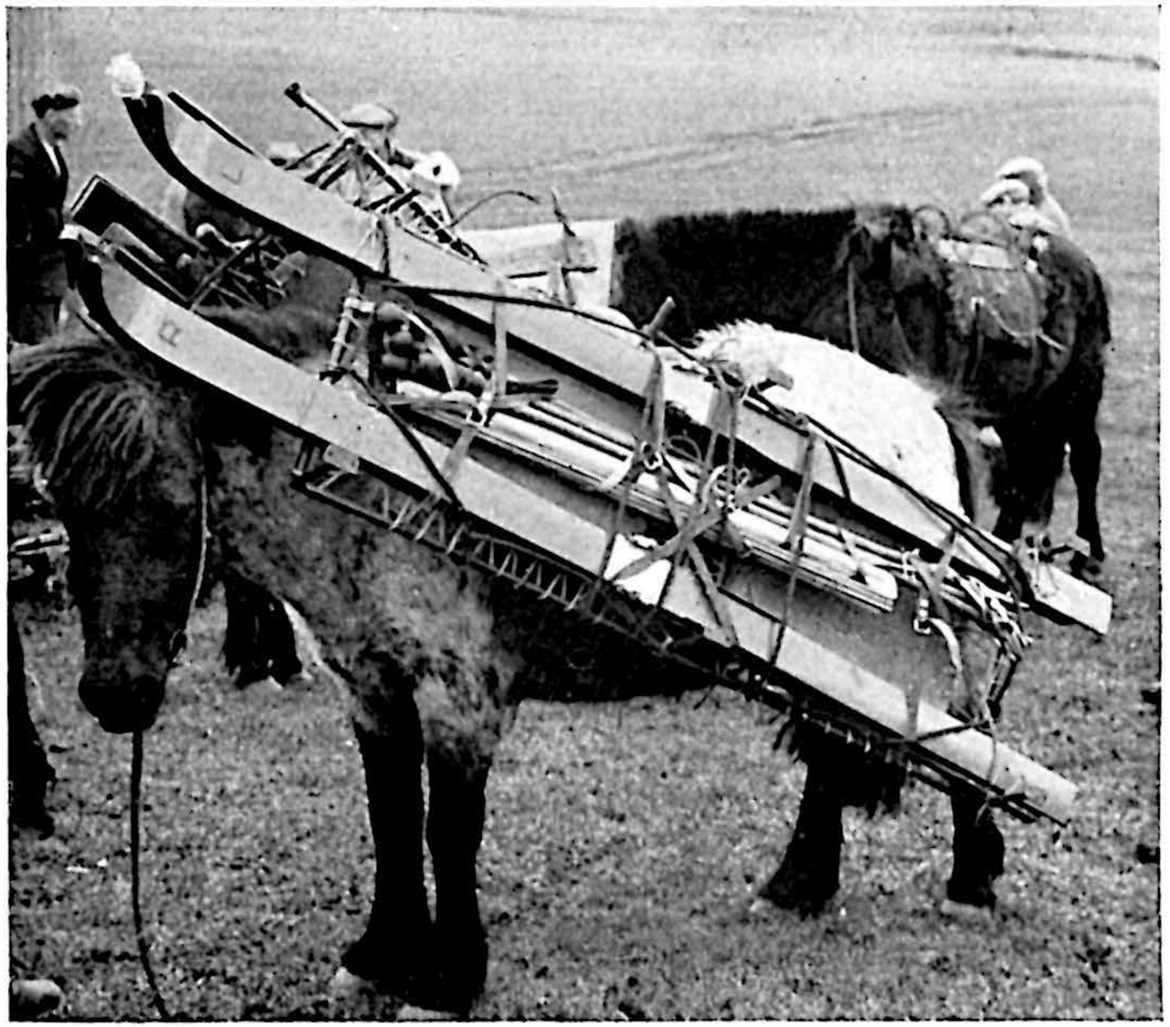
PHASE OF THE FORMATION OF MELTING CONES.

(In the Grimvötn.)



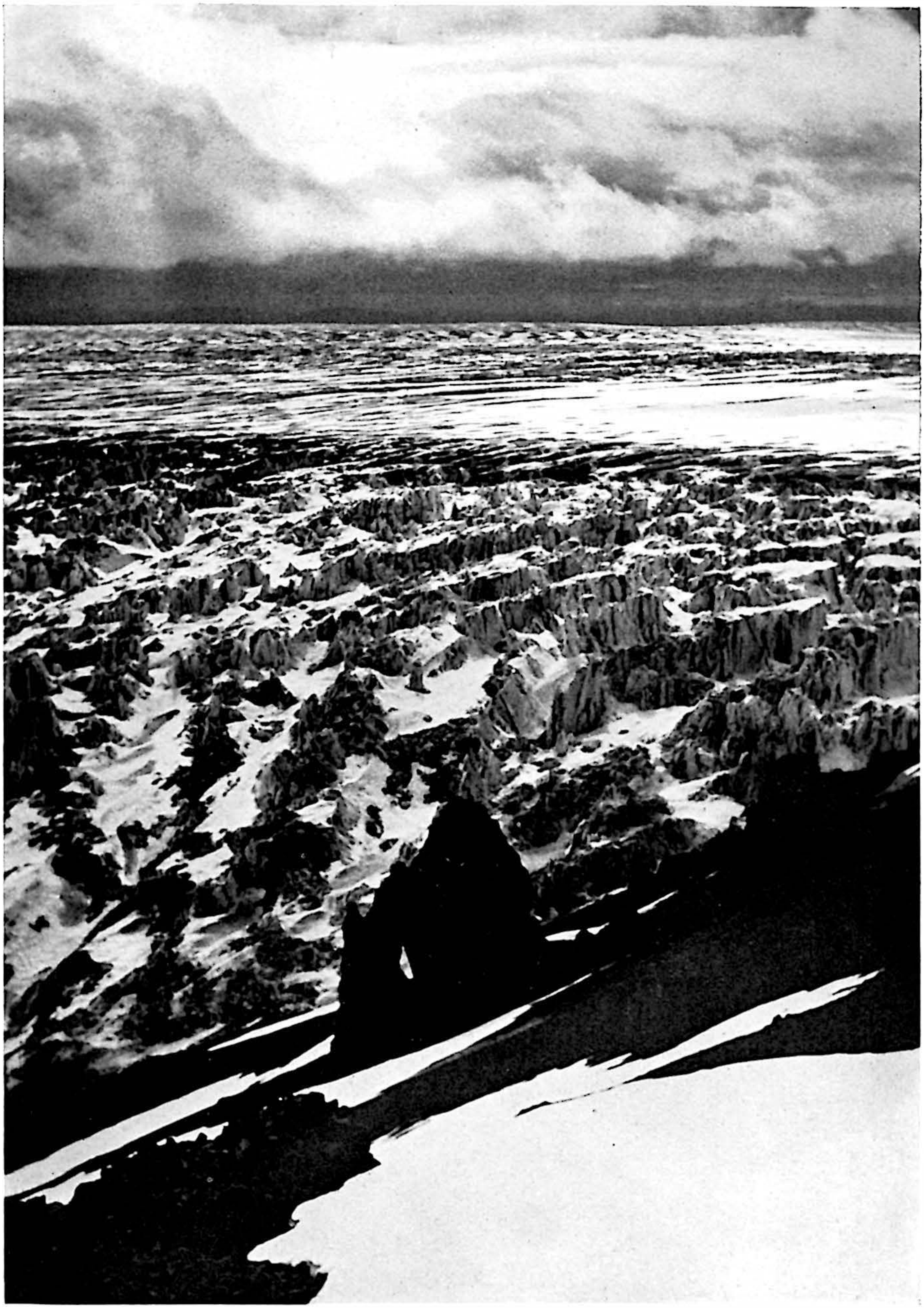
Photo, A. de Pollitzer.]

SÉRACS AND MELTING CONES ON THE SIDUJÖKULL.



Photo, A. de Pollitzer.]

PACK-PONY WITH SKIS AND SLEDGE AT KALFAFELL.



Photo, A. de Pollitzer.]

THE SIDUJÖKULL FROM THE HAGÖNGUR.

Photo, Gumundur Einarsson.]

MELTING CONES. (On the Torfajökull.)

Photo, A. de Pollitzer.]

ASPECT OF THE SURFACE OF ICE IN THE GRIMSVÖTN.

Vast parts of the bottom are covered with pumice. Everywhere crevasses and open holes.

[*To face p.* 269.

the cavity. My two companions had decided to start at once and try to approach as near as possible to the mysterious lake, but I preferred to remain and enjoy the sun that still illuminated the landscape, and try to take some photographs and make a short survey.

From a crater a column of smoke was rising. That smoke explained the strong smell of sulphur. The whole gigantic basin was a *caldera*. Was it due to the tectonical movements or to plutonic forces? The black basalt wall plunges down precipitously for about 400 m., but it seemed not to be real. Wadell (publ. 100), however, affirms that it is warm in addition! The ice that reaches the brink of the wall in a thickness of about 20 m. hangs over it in many parts; it is pushed by a slow movement, forming corniches. Finally it breaks off and, with a thundering noise, avalanches and blocks of ice crash down to the bottom, covering the lake in great part, forming a mass of more or less compact ice-cakes (see illustrations). On the other hand the water of the lake, warmed by volcanic phenomena (presence of magma hearth in the neighbourhood), and probably also by the sun, slowly melts the continuously falling ice. On account of the strong evaporation the air is always very damp near the Grimsvötn. We had observed that during the night everything was covered with hoar-frost. From my point of observation I could obtain but a partial view of the lake, which I suppose to be 600 m. in diameter and of oval shape. Besides that lake there may probably exist two smaller ones. The W. part of the jökull plunges steeply to the cavity in two enormous séracs. On the E. it slopes more gently but is always much crevassed. The bottom is covered with névé, but one can guess the presence of wide crevasses and formidable séracs, partially covered with volcanic ash (see illustration). Thus Nature, jealous of the secret of her mysterious lake, has surrounded it on three sides with enormous crevasses and on the fourth by a wall that continually hurls down avalanches of ice, forming a formidable bulwark against mankind.

My companions came back and told me that they had not reached the lake. 'We arrived lower down, nearer the lake. There were enormous crevasses: avalanches simply seemed to rain: it would have been madness to go on.'

June 1 was the seventh sunny day. At 18.00 it was cold like the previous days and at 18.45 we left. Until 21.00 the sky was serene and we could see Venus for the first time. Then suddenly dense fog appeared. After a long march we arrived at 00.45 at the foot of the Vatnajökullgnípa (Camp VI, about 1530 m.).

The next day, June 2, at 14.30 we ascended the Vatnajökullgnípa. The weather was marvellous and on the mountains was little new snow. The summit held a characteristic pyramid-shaped peak. On the northern rampart all the snow had come down in an avalanche and had left a small but picturesque white wall. Wind-slab had also made a horizontal incision under the summit (see illustration). We easily reached the summit (1655 m.) at 15.15, the Vatnajökullgnípa having been ascended several times. The view was magnificent, from the

Oeræfajökull to the Barðargnípa, from one end of the Vatnajökull to the other. Pleasure would have been perfect, had our feet not been wet!

We descended again. At 22.00 we left Camp VI, and at 24.00 reached the Tjaldhnúkur (Camp VII, about 1320 m.), where we found our depot.

During the morning of June 3 and at 14.00 it was foggy, so we put off our ascent of the Geirvörtur till the next day. In the meantime we started an opulent lunch, food being now abundant. Then I took a look around. Only the double summit of the Geirvörtur, the top of the Vatnajökullgnípa and our own location (Tjaldhnúkur) emerged from a sea of milky fog which was slowly rising. In a short time we too would be swallowed up by the wet and damp element. There was nothing to be done except return to our sleeping-bags to warm ourselves. When I awoke at 03.00 the sun was shining on the canvas. Snow had fallen to a depth of half a metre. Icicles were hanging from the pole, the tent and the cords; it was very cold but marvellous.

At 05.20, June 4, we were on the higher peak of the Geirvörtur, 1421 m. A grand view: no clouds in the sky, with the sun beginning to warm. From this side I could see a new and diverse panorama. The immense jökull flows steeply towards the S. with frightful crevasses; seen thus from the top, they appear like real abysses. The stream of ice calves into the ice-dammed lake Groenalon,[7] the 'green lake' of ice. Ecstatically I admired the panorama with my field-glasses. It simply gave me the impression that I could touch everything with my fingers. On the horizon, of almost azure, indescribably serene and transparent colour, like that of Copenhagen porcelain, rose the majestic summit of the Hvannadalshnúkur. From the N.E. shoulder we could easily get to the top on our skis. The ascent from the S.W. shoulder seemed to be more difficult. Towards the N.W. the Geirvörtur falls downwards in a steep wall. Towards the S.E. it is still steeper and ends in a rampart with formidable crevasses. The route we had taken was the easiest one. On the top of the Geirvörtur we saw a cairn. My companions went up to Geirvörtur II also while I took some photographs and measurements. At 11.00 we were back to Camp VII, and at 16.00 to Base Camp (810 m.).

On June 5 we had a rest and took some walks to the Eldgigur (about 880 m.), a little volcano with red lava. On June 6 I went up to Hagöngur alone. First one goes northward along the wide sandy plain furrowed by numerous streams, then up by a broad and easy ravine between the lower and the great Hagöngur that penetrates deep into the Vatnajökull surrounding it in the W., N. and E. From the top I had a wonderful view on to the Sidujökull, all broken up by thousands of crevasses (see illustration). Under the top were strange formations of tuff, amongst others a block with a big hole. I made the ascent and the descent all on ski. At 18.00 I was back at the Camp.

[7] This lake, 20 km. long and 200 m. deep, has now disappeared. In its place a profound valley with big ice-blocks has opened (*Neue Freie Presse*, September 29, 1935, publ. 5, p. 52).

On June 7 I went to photograph the crevasses of the Sidujökull. By 11.15 I was at the foot of the Hagöngur in splendid sunshine. I reached the pass between the lower and the great Hagöngur with a magnificent view on to the glacier at my feet. I came down by a couloir in stem-christianias, thus reaching the margin of the Sidujökull. Here, between the glacier and the mountains, lies a small ice-dammed lake of a few hundred square metres, bright green in colour with white pieces of ice floating on its surface. Between the mountains and the ice there ought to be a bergschrund, so I took off my skis. I should really have stopped here, but my enthusiasm was too great. The steep brink of the jökull, a few metres high, had to be crossed. With great caution, sounding every step with my ski-sticks, I climbed up and was on the Sidujökull. It was fantastic: a system of wide crevasses, dirty and black, following no precise direction, with many melting cones (see illustration). I proceeded with care, passing continuously over snow-bridges. At 16.30 I was back at the tent. To-morrow Stefán would come and fetch us, and in three days we should be back in Reykjavík.

Our expedition was at an end. Every expedition needs luck and good weather, and we could be grateful to the Providence which had enabled us to make a long journey on the Vatnajökull, the ascent of the Barðargnípa, the second summit of Iceland, and the descent to the Grimsvötn, all in 17 days, including a most interesting exploration.

Practical Hints

An adapted equipment, carefully prepared beforehand at home, as well as ordering everything one wants to get in Iceland by letter, will make the journey agreeable, interesting and not expensive.

Best Season for the Vatnajökull.—In contrast to what one was used to, we have found out in these last two years that the best season is spring or the beginning of summer. Also according to our experience I think the months of May–June to be the best time. During that season only can one find during the day powder-snow, instead of 'streams draining the ice which cut deep channels' or 'slushes' or even thaw-pools (see publ. 66, p. 298). In May–June the surface is always crisp and hard by night, and only on such a surface is hauling possible with a certain facility. The weather, too, is generally better at this time, and the snow covers a great many crevasses.

Composition of the Party.—Two persons are too few, three are the best or perhaps a multiple of three.

Communications with Iceland.—There are two lines from England to Iceland: the 'Eimskipafjelag Island' (the Iceland Steamship Company, Reykjavík) from Hull to Reykjavík (transit 4 days), or from Leith to Reykjavík (transit 3 days), and the 'Det Forenede Damskibbs-Selskab' (the United Danish Steamship Company, Copenhagen), from Leith to Reykjavík (transit 4 days). Passage 1st class £6 10*s.*, 2nd class £4 10*s.* Food extra, 8*s.* or 5*s.* per day.

Language.—In the towns people speak mostly Danish, many of them English, and some German. In the country are always to be found clergymen or farmers who know English. One can risk travelling in Iceland without knowing a word of Icelandic.

Guides.—Farmers generally do not go mountaineering, and those of the south of Vatnajökull (in contrast to those of the zone of the Myvatn, in the north) not only ignore the use of skis but do not even wear common boots with a sewn sole, but the antique sheep-skin shoes, the 'Leðurskor,' made of one piece of sheep-skin: and the older ones at least refuse to wear ski-boots. Alpine guides do not exist in Iceland.

Information.—Those who possess the best knowledge of the Vatnajökull are, as far as I know, Jóhannes Áskelsson (address : Mentaskool) and Guðmundur Einarsson (address : Listvinahus), both of Reykjavík. For meteorological and astronomical information apply to Mr. J. Eythorsson, director of the Veðurstofa (Meteorological Observatory of Iceland) in Reykjavík.

All these gentlemen have been extremely kind to me and I express my gratitude to them. At Reykjavík there is a British Consul, and at Akureyri a Vice-Consul. To hire ponies, motor cars, etc., apply to Mr. Stefán Stefánsson, or to Mr. Ingolfur Guðmundsson of the Icelandic Tourist Office, or to someone you have been recommended to in Iceland ; or—finally—do it all by yourself.

Survey

Besides the morphological, glaciological and volcanological studies our expedition had also aimed at making a survey of the zone we intended to cross. Besides the importance a map has in itself, any study one wants to make in an almost unknown zone needs at least an approximate map. The best map of the Vatnajökull has been up till now the one by Wadell (publ. 100). But especially in the western part it is completely inaccurate and even wrong. And, of course, having to go a long way in a short time the survey would have to be hurried, limiting oneself to fixing the position of the principal summits. Therefore we decided to use very light instruments like the box sextant Salmoiraghi, no. 84, for reading the horizontal angles, and the Indian clinometer (Livelletto 'Abney,' Salmoiraghi, no. 158 ter) for the vertical angles, a dioptre, a Bezard compass, big model, and three aneroids (two Lufft and one Tycho).[8]

The use of these light instruments reduces very much the accuracy of the survey, but it would permit us to make difficult and valuable observations even under unfortunate conditions. I still want to mention that the use of instruments of high precision has only sense if all the means, time and atmospheric conditions permit of taking care of all other details, the most important feature of which is the construction of survey-cairns. We used three aneroids, checked at the Veðurstofa in Reykjavík, before leaving, and again on our return. The differences we have—of course—taken into consideration. At every important point we took the reading of all three aneroids, and where it was possible, for instance at the camps, we did the same morning and evening. For those readings we took the times from the nearest meteorological stations : Akureyri, Westmannaeyjar and Hólar, which are the points of a triangle in which lies the zone we have crossed. As we could not get all the times from Hólar we took in some cases those of Seydisfjörður. I am greatly indebted to Mr. J. Eythorsson for the times furnished and his kindness towards us.

All along our route to the jökull, from Camp Base to our return, at the time of our journey, there was no point whose co-ordinate had been fixed. But now, by indications kindly given to me from the Danish Geodetic Institute, I have got the co-ordinates of three mountains, of which I had also made measurements—Vatnajökullgnípa, Geirvörtur and Hagöngur—and of other peaks I had observed, namely, the two Kerlingar and the two Hagöngur (on the S. of the Tungnafellsjökull). So the principal points on which my measurements were based have been fixed. I am greatly indebted to Col. F. J. Jensen of the Danish Geodetic Institute for his courtesy.

Equipment

It is really a problem to know what to take with you, when going for the first time. Only in the appendices of the book by Beckett (publ. 9) did I find good article by Brian Roberts on 'Provision and Equipment.'

I must state that the zone in question has all the characteristics of the Polar landscape. If, therefore, it is necessary on the one hand to stick to a Polar equipment, on the other hand one has to consider that the distances between inhabited regions are not to be compared with those in Greenland or in the Antarctic,

[8] It is a pity that the Paulin Altimeter (*A.J.* 40. 360–2) and Hymans' Pocket Rangefinder can no longer be obtained; two very good instruments for similar hurried work.

and that the sojourn is a relatively short one. I think that to go to the Vatnajökull one should provide for at least 3–4 days' provisions in excess, and have, besides a good tent, a large equipment of tools for repairs. The employment of a sledge seems to be quite indispensable. It is the best means of transport, enabling three persons to haul 60–80 kg. on level ground. On steep ground it has no advantage over the rucksack: in this case it might be better to make several trips with the rucksack. It was only during the first stage of the journey that we encountered some very steep gradients.

If ponies have been seldom employed and dogs have never been used this may be attributed to the fact that the expeditions wanted to stay for some time on the ice-caps to make observations. For this purpose horses are still less convenient, as they would have to be fed. Secondly, all the expeditions have had small means and the employment of ponies is very expensive. Dogs would cost still more; sledging dogs are unobtainable in Iceland.

I now want to give some advice as to equipment. Generally speaking it will be the same as used for high mountain ski-ing in winter or during springtime in the Alps. The temperature to be found on the Vatnajökull will always be less extreme than, for example, in the Alpes Valaisannes. From spring to autumn the temperature on the Vatnajökull is rarely lower than $-5°$ (C.).

Sledge.—The ideal sledge for all Arctic countries is the Nansen sledge. It is based on great experience. It was perfected by Nansen, and I think will never be surpassed. It is constructed to be drawn only by dogs and it is too heavy for two or three men, so I tried to build a model with a frame of steel tubes taken from a bicycle. Only steel tubes of the best quality, $\frac{3}{4}$ of an inch in diameter, can be used, and the welding must be done with the utmost care. The three empty spaces at the top are covered with very strong canvas, fixed with a cord that runs spiral fashion. Our sledge was mounted upon a pair of Persenico skis, 220 cm. long, exceptionally strong, and the gliding surface was completely fitted with a steel sheath, 1 mm. thick. I have been very content with this kind of sledge.

Harness.—The best type of harness is one that can be regulated.

Skis.—On account of the great wear they should be of hickory and rather long so as to offer the greatest security in passing the snow-bridges. In May–June the short summer type of skis are of no use. For hauling a sledge sealskins are indispensable and for two persons it is better to take an extra pair.

Tent.—The tent is a vital part of the equipment. One has to choose a tent in which all the members of the expedition can easily find room enough, or at least one tent for two or three persons. The ground-sheet must be of rubber-canvas, sewn to the tent with the edge turned up about 10 cm. The ordinary tent-poles as used for camping are useless on névé. I had some tent-poles specially made of duralumin and I have been very satisfied with them. A very light tent-sack, type Sohm, as reserve for short excursions will always be of great utility.

Sleeping-bags.—On the ground-sheet of the tent it is always advisable to place first a good pneumatic mattress (very good is the Czecoslovak 'Optimit'), and on top of that the sleeping-bag of eiderdown. The sleeping-bag has to be very warm and have a waterproof cover. (I recommend a thin tent canvas.)

Clothing.—To reach the jökull ponies are necessary. Here rubber boots, and coat and trousers of oilskin are indicated. If the ride is short, a long waterproof oilskin would suffice. As head-cover a sou'wester is the best. All these things can be bought of very good quality and comparatively cheaply in Reykjavík (O. Ellingsen, L. H. Müller, Haraldar Árnarson). On the Vatnajökull clothes are needed that protect sufficiently against the cold and above all against the wind which is frequent and strong. Therefore I recommend a mountain-suit, two or three pullovers of soft and warm wool, or one or two pullovers of thick sheepswool (to be obtained at low prices in Reykjavík), also woollen shirts and long woollen drawers. For protection against the intense sun a large hat is required. Unfortunately the question of a perfect waterproof which one can wear without perspiring has not yet been solved. I think the best dress when it is snowing is a windproof suit 'Protector' (Swiss) composed of an anorak and trousers: against water it is always best to wear oilskin.

Bootgear.—Only one pair of nailed boots. In midsummer, when skis cannot

always be used, I found it convenient to have a pair of rubber boots, so as to be able to wade through the thaw-pools that are found on the surface of the ice.

Ice axe.—One for each person for every eventuality.

Crampons.—Useless.

Provisions.—In contradiction to others I do not find a special choice of food necessary, as is the case with other Polar expeditions. For example, take pemmican : if anybody is not used to eating pemmican he will never like it. I prefer the ordinary mountaineer's food.

Paraffin.—One can obtain water—except on warm days in summer—only by melting the snow. At Reykjavík tins of 2–5 litres of paraffin may be obtained and these are very practical. It is important to see that they are well fitted with good corks. Three persons will have sufficient paraffin, if taking 10 litres for a fortnight.

Packing.—It is indispensable to have everything well packed in such a way that it is easily loaded on a car, on ponies or on the sledge. Consequently it is inconvenient if the equipment is packed into rucksacks or other sacks and, to avoid this, I ordered some cases of ply-wood in Reykjavík, 65·5 cm. long, 32·5 cm. wide, 46 cm. high. All corners were covered with zinc. They are rather costly but of small weight and absolutely waterproof, at least for one encampment. They proved to be very practical, especially on the sledge.

Saddles.—Normally the farmers who hire the ponies have got their riding saddles, but it is always necessary to get information beforehand. They always have a sufficient number of pack-saddles.

I am very willing to give to anyone interested in the matter a detailed list of all things I took with me on my expedition.

Photographic Equipment.—I do not think there exists a better camera for an expedition than the Leica, being the quickest in use, which is very important. I also think that with any other camera you would never obtain as many good photos as I did with the Leica, because the films weigh less than those for other cameras. It is necessary to carry it round the neck in an Ever-Ready case. On the ice there is always much light. Therefore the Elmar lens 5 cm. f/3·5 is sufficient for the Leica. For telephotographs the Elmar lens 10·5 cm. f/6·3 can be used. Whoever goes to Iceland for the first time has, as a rule, a tendency to over expose because of the clearness of the air. *Information :* on the jökull during the day, with sun, I normally used f/12, exposure $\frac{1}{200}$ second, with 16 Din panchromatic film. One must bear in mind that the light changes frequently, and it is useful to take an exposure meter. I had very good results with the Electro-Bewi. For distant panoramas one generally gets more details with a yellow screen. If it is foggy the red screen is useful. For panoramas and scientific work take a folding camera 6 × 9 with film-pack and tripod. With this camera you can also take interesting photos in natural colour (with Dufaycolor films).

Cartography and Notes on the Maps

The first complete map of the Vatnajökull that contains some details is the one by Wadell (publ. 100) at a scale of 1 : 600,000, published in 1920. As the author informs us in the appendix, it is based on the map by Thoroddsen (in publ. 86) and partially on the one by Bruun (publ. 16) published 1935. Those maps have been useful only in so far as they give, very approximately, the contours of the glacier. For the details of the interior Wadell had at his disposition for the south margin the fine and precise map made by the Geodetic Institute (1 : 50,000, publ. 18) ; for the north margin the one by Trautz (in publ. 95) at 1 : 110,000 and, for the zone, between the Tungnafellsjökull and the Vatnajökull a sketch by Reck at 1 : 150,000 (in publ. 65). In this manner Wadell made his map, collecting all the cartographical material existing at that time. He had the advantage of being the first man to explore the Grimsvötn, and so he was able to determine their approximate position. All the sketch-maps and maps printed afterwards were based on the map by Wadell. The following maps are now available :—

1. The map of Iceland by Bruun (publ. 16) in a new, third edition in 1935 (a reliable map, the only one for travelling in the interior of Iceland).
2. A sketch by the Marquise de Fontenay of the extreme west zone (in publ. 30).

3. The map by Sigurðsson of the west zone and the west margin of the Vatnajökull, drawn at 1 : 200,000, and reproduced at 1 : 400,000 (in publ. 57).
4. For the central part of the Vatnajökull twice traversed (there and back) by the Cambridge Expedition, the two surveyors of the expedition, J. A. Beckett and W. V. Lewis, have given us more knowledge by their more exact contours, which are missing on the map by Wadell. The map was published at 1 : 1,000,000 and has a feet interval of 500 feet. In addition they have drawn a map of the Þórbergsvatn zone at 1 : 60,000, and a detailed survey at 1 : 10,000 of the lake itself (publ. 9, 66).
5. Almost the whole north margin has been surveyed by the Geodetic Institute, assuredly a most important contribution. The maps are not yet on sale, but they already exist in blue counterdrawings at 1 : 200,000 (publ. 19).

As will be seen, the efforts of the cartographers are rapidly conquering the whole of the unknown part of the Vatnajökull. I understand it is the intention of the Danish Geodetic Institute and the Icelandic Government to survey the whole surface of the Vatnajökull systematically in the next few years.[9]

All the cartography (maps, sketch-maps, etc.) is mentioned in the 'Index of Publications (Books, Journals, Papers and Maps) about the Vatnajökull.' Anyone wishing to order maps from the Danish Geodetic Institute should write direct to the 'Geodaetisk Institut, København,' for the catalogue. Every question will receive an immediate and kind reply. Here I must point out that the glacier S. of the Skaptarjökull, W. of Hagöngur, has been called Sidujökull, according to indications by Guðmundur Einarsson, whilst Wadell and the Cambridge Expedition call the glacier between Hagöngur and Groenalon the Sidujökull.

Bibliography

There is a very extensive bibliography on Iceland. The Landsbókasafn Islands (National Library) in Reykjavík (Director, Dr. Guðmundur Finnbogason) contains altogether about 132,000 works. There are some ten thousand publications which in one way or the other refer to Iceland. The first book which might form the basis of information for any mountaineering or scientific journey is, so far as geography and geology are concerned, that by Thoroddsen (publ. 86), which still remains the standard work. For the bibliography there is the publication 46 by Olaf Klose, a catalogue of books and maps, where 6967 publications are systematically quoted. Whoever requires the most useful and practical hints on Iceland, which might interest a tourist or a traveller in general, ought to buy the little guide by Stefán Stefánsson (publ. 75). There is still a Baedeker, useful as always (Norway, Denmark, Iceland, Spitzbergen, 1931, RM.14). A very good and quite modern study of the geography of Iceland (scientific) is the recently published book by Iwan (publ. 43). Finally I have still to mention the book of illustrations 'Das unbekannte Island' by Dr. Heering (publ. 35), which illustrates the Icelandic landscape.

Fortunately the number of publications regarding the Vatnajökull is restricted. The following is a list which I have tried to make as complete as possible. I want to say that I do not intend to adorn myself with the merits of others. In fact the merit of having already compiled a list of nearly all the publications regarding the Vatnajökull belongs to Brian Roberts, in a very diligent work (publ. 67) where he summarizes 52 publications.

Index of Publications (Books, Journals, Papers and Maps) about the Vatnajökull

(1) Ari : 'Lándnáma Bóc.'
*(2) Anderson, Tempest : 'The Skaptar Jökull' (*A.J.* 18. 212–21).
*(3) —— 'Volcanic Studies' (London, 1903, pp. 123–35).
(4) Áskelsson, Jóhannes : A Report in 'Nátturfraðingurinn' 4 (1934), pp. 61–84 (Icelandic scientific journal).
(5) —— 'On the Last Eruptions in Vatnajökull,' Collection Visindafélag Islendinga (Societas Scientiarum Islandica). XVIII.—Reykjavík Isafoldarprentsmiðja H. F., 1936.

[9] The map of the Vatnajökull together with that illustrating the route of the 1935 party will be found at the end of this number.

(6) ÁSKELSSON, JÓHANNES: 'Results of scientific observations at Grimsvötn,' Iceland, 1934–1935. (*The Polar Record.* Printed in Great Britain for the Scott Polar Research Institute, Cambridge: At the University Press.)

(7) BARÐARSON, GUÐMUNDUR: 'Vulkanausbrüche in Island' (*Visindafélag Islendinga*, Reykjavík, 1930, 6).

(8) ——'Islands Gletscher' (*Visindafélag Islendinga*, Reykjavík, 1934, pp. 1–60).

(9) BECKETT, J. ANGUS: 'Iceland Adventure—The double traverse of Vatnajökull by the Cambridge University Expedition' (H. F. & G. Witherby, London, 1934).

(10) BIRKELAND & FÖYN: 'Handbuch der Klimatologie' in fünf Bänden, Band III, Teil I 'Klima von Nordwesteuropa u. den Inseln von Island bis Franz-Josef-Land' (W. Köppen, Graz & R. Geiger, München; Det Norske Meteorologiske Institut, Oslo).

*(11) BRUUN, DANIEL: 'Ved Vatnajökulls Nordrand, Undersögelser foretagne i Sommeren 1901 paa Islands østland' (*G. Tidsk.*, 16 (1902), pp. 155–172 (Map and Illust.)).

*(12) ——'Sprengisandur og Egnene mellen Hofs- og Vatnajökull, Undersogelser foretagne i Sommeren, 1902' (*G. Tidsk.*, 16 (1902), pp. 219–242 (Map and Illust.)).

*(13) ——'Islandfaerder til Hest over Vatnajökull i aeldre Tider' (*G. Tidsk.*, 22 (1913), pp. 4–13 (Sketch-map and Illust.)).

*(14) ——'Vatnajökullsvegur, samt Undersogelser ved Vatnajökulls Nord og Vestrand' (*G. Tidsk.*, 28 (1925), pp. 181–7).

*(15) ——'De ede Igne Nord for Vatnajökull' (Copenhagen, 1927).

(16) ——'Island'—Oversiktskarta, 1 : 850,000 (Gyldendal, Copenhagen, 1935).

(17) DANISH GEODETIC INSTITUTE, COPENHAGEN (Geodaetisk Institut, København): 'Yfirlitskort met bilvegum' (motor-map 1 : 1,000,000, Copenhagen, 1933).

(18) —— Maps 1 : 50,000 of the S. part of the Vatnajökull Kvartbladene 77 S.A., 78 N.A. og S.A., 87 S.V., 87 S.A., 96 S.A., 97 N.V., 97 S.V.

(19) —— Counterdrawings . . . not yet on sale of the north margin of the Vatnajökull, nos. 74, 75, 84, 85, 94, 95.

*(20) EBELING, MAX: 'Eine Reise durch das isländische Südland' (*Zeitschr. d. Gesell. f. Erdk. zu Berlin*, 45 (1910), pp. 361–82).

(21) ——'Isländische Bergfahrten' (*Zeitschr. d. Deutschen u. Oest. Alpen-Vereins*, 57 (1926), pp. 94–113 (Illust.)).

(22) EGGERTSSON, SAMUEL: 'Iceland' 1 : 500,000, Copenhagen (1928).

(23) EINARSSON, GUÐMUNDUR: Report in 'Eimreiðin' (Icelandic magazine), 2 (1935).

*(24) EIRIKSSON, H. H.: 'Observations and Measurements of some Glaciers in Austur-Skaftafellsysla in the Summer of 1930,' Publication Nro 12 Soc. Scient. Islandica Reykjavík (Map and Photographs).

*(25) ERKES, HEINRICH: 'Das isländische Hochland zwischen Hofsjökull und Vatnajökull' (*Petermanns Mitteil.*, 57 (1911), pp. 140–3).

*(26) ——'Fra Islands Indre' (*G. Tidsk.*, 21 (1912), pp. 233–8).

(27) ——'Neuerforschtes Land im innern Islands,' Deutsche Islandforschung 1930, vol. II, 'Natur' (W. H. Vogt, H. Spethmann, Breslau, 1930).

(28) ——'Nye Rejser paa Island 1926' (*G. Tidsk.*, 1927, pp. 114–16).

*(29) EYTHORSSON, J.: 'On the present position of the glaciers in Iceland.'—Some preliminary studies and investigations in the summer 1930 (*Visindafélag Islendinga*, x. 1931, Reykjavík).

*(30) FONTENAY, F. DE: 'Ferð til Vatnajökuls og Hofsjökuls, sumarið 1925' (*Andvari*, pp. 99–144 (Reykjavík, 1926)).

(31) GAIMARD, PAUL: 'Voyage en Islande et au Groenland' publie par ordre du Roi sous la direction de M. Paul Gaimard, Atlas historique bibliographié d'après les dessins de M. A. Mayer. Arthur Bertrand, éditeur, Paris. Tome deuxième.

(32) GROSSMANN, KARL: 'Notes on the less-known interior of Iceland' (Report of the Sixty-sixth Meeting of the British Association for the Advancement of Science (p. 859), London: J. Murray, Albemarle Street, 1896).

(33) —— 'Observations on the Glaciation of Iceland' (*The Glacialist's Magazine*, reprint, pp. 33–44; London: F. H. Butler, 158 Brompton Road, S.W. Sept. 1893, vol. I, No. 2).

(34) GUNNLAUGSSON, BJÖRN: 'Uppdrottur Islands' 1 : 960,000 (edited by La Société Littéraire d'Islande, Copenhagen, 1849).

(35) HEERING, WALTHER: 'Das unbekannte Island'—Ein Führer in das Land der Edda mit einem Beitrag 'Geist und Geschichte des isländischen Volkes' von Reinhard Prinz. Dr. Walther Heering Verlag in Harzburg, 1935.

*(36) HELLAND, A.: 'Om Islands Jøkler og om Jøkelvenies Vandmaendge og Slamgehalt' (*Arch. f. Math. og Natur.*, Christiania, 7 (1882), pp. 200–232).

*(37) —— 'Om Vulkaner i og under Jøkler på Island og om Jøkuhlaup' (*Nord. Tidsk. Vitenskap, Konst och Industri*, Stockholm, 6 (1883), pp. 368–87).

(38) HERMANNSSON, HALLDÓR: 'Catalogue of the Icelandic Collection' bequeathed by Willard Fisk (Ithaca, N.Y., 1914).

(39) —— 'Eggert Ólafsson, a biographical sketch' (*Islandica*, 16 (1922), pp. 19–27 (Issued by Cornell University Lib.)).

(40) —— 'The Cartography of Iceland' (*Islandica*, 21 (1931) (Issued by Cornell University Lib.)).

*(41) HOWELL, F. W. W.: 'Icelandic Pictures drawn with Pen and Pencil' (London, 1893, pp. 62–72).

*(42) —— 'The Northern Glaciers of the Vatnajökull, Iceland' (Report of the 66th Meeting of the British Association for the Advancement of Science at Liverpool, 1896, p. 859).

(43) IWAN, WALTER: 'Island—Studien zu einer Landeskunde' mit 56 Abbildungen auf Tafeln, 52 Textfiguren und einem Plan. Kommissionsverlag von I. Engelhorns Nachf. Stuttgart, 1935. Berliner Geographische Arbeiten herausgegeben v. geogr. Institut d. Univ. Berlin durch Prof. Dr. Norbert Krebs u. Priv. Doz. Dr. H. Luis.

(44) KEINDL, JOSEPH: 'Ueber einige Vulkane und Plateauberge in Innerisland' (*Mitteil. d. Geograph. Gesell. in Wien*, 75 (1932), pp. 28–52).

(45) —— 'Untersuchungen über den Hofs- und Langjökull in Island' (*Zeitschr. f. Gletscherk.*, 20 (1932), pp. 1–28).

(46) KLOSE, OLAF: 'Islandkatalog,' Kiel, Universitätsbibl., 1931.

(47) v. KNEBEL, W., and RECK, H.: 'Island—Eine naturwissenschaftliche Studie' (Stuttgart, 1912 (Maps and Illust.)).

*(48) KOCH, J. P.: 'Fra Generalstabens topografiske Afdelings Virksomed paa Island' (*G. Tidsk.*, 18 (1905), pp. 1–14 (Map)).

*(49) —— 'Rejsen tvaersover Island, Juni 1912' (*G. Tidsk.*, 21 (1912), pp. 254–64 (Map and Illust.)).

(50) —— 'Die dänische Expedition nach Königin Luise Land und quer über das nordgrönländische Inlandeis, 1912–13' (*Petermanns Mitteil.*, 58 (1912), Oktoberheft, pp. 185–9).

*(51) KOCH, J. P., and WEGENER, Prof. A,: 'Glaziologische Beobachtungen am Vatna-jökull auf Island' (*Meddel. om Grønland*, Copenhagen, 75 (1930), p. 676).

(52) KONGELIGE SØKORT ARCHIV, Copenhagen: 'The Danish Sea-charts, VII, Island.'

(53) 'L.': 'Une visite au Vatnajökull et au Myrdal Jökull' (*L'Explorateur*, 2 (1875), p. 631).

(54) MERCALLI, G.: 'I vulcani attivi della terra—Morfologia—Dinamismo—Prodotti—Distribuzione geografica—Cause' (Illust.), U. Hoepli Edit. Milano, 1907.

*(55) MUIR, T. S.: 'Notes on the Weather on the Vatnajökull during August and September, 1904' (*Journ. Scott. Meteorolog. Soc.*, 13 (1905), pp. 33–7).

(55A) MURRAY, ATHOLE: 'Some Journeys through the Mountains of Iceland' (*A.J.* 40. 85–99, illustrated).

*(56) NIELSEN, NIELS: 'Contribution to the Physiography of Iceland with particular reference to the Highlands west of Vatnajökull' (*D. Kgl. Danske Vidensk. Selsk. Skrift. Naturvidensk. og Mathem.*, Afd. 9, Række IV, 5 (1933), pp. 183–287 (Maps and Photographs)).

*(57) —— 'L'Exploration de l'Islande Centrale' (*La Géographie*, 49 (1928), pp. 408–22 (Map)).

(58) —— 'Tektonik und Vulkanismus Islands unter Berücksichtigung der Wegener-Hypothese' (*Geologische Rundschau*, Leipzig, 1930).

(59) ÓLAFSSON, EGGERT: 'De ortu et progresso superstitionis circa ignem Islandiae subterraneum.'

(60) —— 'Rejse igiennem Island' (Iter per patriam), 1772.

*(61) PAIJKULL, C. W.: 'A Summer in Iceland' (London, 1868).

(62) PÁLSSON, SVEINN: 'Forsog til en Physik, Geographisk og Historik Beskvikelse over de Islandske Isbiairge' (1794). (Extracts by A. Helland are reprinted in *Den Norsk. Turist.*, Aarborg, 1882.)

*(63) PJETURSSON, HELGI: 'Reise in Süd-Island im Sommer 1906' (*Zeitschr. d. Gesell. f. Erdk. zu Berlin*, 42 (1907), pp. 597–621).

*(64) RABOT, CHARLES: 'Les Variations des Glaciers de l'Islande méridionale de 1893–4 à 1903–4 d'après la nouvelle carte d'Islande' (*Zeitschr. f. Gletscherk.*, 1 (1906), pp. 132–8).

*(65) RECK, HANS: 'Glaziologische Studien über die rezenten und diluvialen Gletschergebiete Islands' (*Zeitschrift f. Gletscherk.*, 5 (1911), pp. 241–297).

*(66) ROBERTS, B. BRIAN: 'The Cambridge Expedition to the Vatnajökull, 1932' (*Geogr. Journal*, 81 (1933), pp. 289–313 (Maps and Photographs)).

(67) —— 'Vatnajökull, Iceland: The History of its Explorations' (*The Scottish Geographical Magazine*, 50 (1934), pp. 64–76 (Sketch-maps)).

(68) SAEMUNDSSON, BJARNI: 'Die isländische Seefischerei' (*Handbuch der Seefischerei Nordeuropas*, VII, 4, Stuttgart, 1930).

(69) SAPPER, KARL: 'Vulkankunde' (*Verlag Engelhorns Nachf.*, Stuttgart, 1927).

(70) SCHMID, KARL: 'Der Vatnajökullausbruch, 1934' (in *Island*, published by Verein der Islandsfreunde, January–March, 1935, pp. 181–8).

*(71) SKÚLASON, SKÚLI: 'Ferðir yfir Vatnajökull' (*Falkinn*, December 16, 1933 (Reykjavík), pp. 40–44).

*(72) SPETHMANN, HANS: 'Der Nordrand des isländischen Inlandeises Vatnajökull' (*Zeitschrift f. Gletscherk.*, 3 (1908), pp. 36–43 (Sections and Illust.)).

*(73) —— 'Forschungen am Vatnajökull auf Island und Studien über seine Bedeutung für die Vergletscherung Norddeutschlands' (*Zeitschr. d. Gesell. f. Erdk. zu Berlin*, 47 (1912), pp. 414–33).

(74) —— 'Schneeschmelzkegel auf Island' (*Zeitschr. f. Gletscherk. zu Berlin*, reprint, vol. II, 1907, pp. 297–301 (Illust.)).

(75) STEFÁNSSON, STEFÁN: 'Iceland Handbook for Tourists, with Illustrations and Maps' (2nd Edit., Hekla Travel Bureau, Reykjavík, 1930, 5*s*.).

(76) THORODDSEN, THORVALDUR: 'An Account of the Physical Geography of Iceland,' 1914 (*The Botany of Iceland*, ed. by L. K. Rosenvinge and E. Warming, vol. I, London, 1912–18).

(77) —— 'Eine Lavawüste im Innern Islands' (*Petermanns Mitteil.*, 31 (1885), pp. 285–94 and 327–39).

*(78) —— 'Eine Rejse gjennem det indre Island i Sommeren, 1888' (*G. Tidsk.*, 10 (1889), pp. 10–29 (Map)).

(79) —— 'Eldgos í Vatnajökli' (published by 'Safn fraeðafjelagsins um Islandsog').

*(80) —— 'Et to Hundrede Aar gammelt Skrift om Islandske Jokler' (*G. Tidsk.*, 13 (1895), pp. 56–60).

(81) —— 'Ferðabók' (Copenhagen, 1914, by the Society 'Hið islenska Fraeðafjelag').

*(82) THORODDSEN, THORVALDUR: 'Fra det sydostlige Island, Rejsberetning fra Sommeren, 1894' (*G. Tidsk.*, 13 (1895), pp. 3–37 (Map)).
(83) —— 'Höhenschichtkarte von Island' 1 : 750,000 (Gotha, 1905).
(84) —— 'Hypothese von der postglazialen Landbrücke über Island und Färöer vom geologischen Standpunkt' (*Naturwiss. Rundschau*, 21 (1906) (Braunschweig), pp. 389–92).
(85) —— 'Iceland' (*Encyclopaedia Britannica*, vol. 14, p. 229 (13th Ed.)).
*(86) —— 'Island, Grundriss der Geographie und Geologie' (*Petermanns Mitteil.*, Ergänz. Nro 152 und 153, Vatnajökull, pp. 187–208).
(87) —— 'Geologische Karte von Island' 1 : 750,000.
*(88) —— 'Rejse i Vester Skaptafells Syssel paa Island i Sommeren, 1893' (*G. Tidsk.*, 12 (1894), pp. 167–234 (Map)).
*(89) —— 'Vulkanske Ubdrud i Vatnajökull paa Island' (*G. Tidsk.*, 23 (1915), pp. 118–132).
*(90) —— 'Zwei Reisen ins Innern von Island' (*Petermanns Mitteil.*, 38 (1892), pp. 189–96).
(91) TODTMANN, EMMY MERCED: 'Glazialgeologische Studien am Südrand des Vatnajökull (Sommer, 1931)' (*Forschungen und Forschritte*, VIII, Jahrgang 8, 26 (Berlin, 1932), pp. 333–5).
(92) —— 'Moränenstudien am Vatnajökull auf Island' (*Petermanns Mitteil.*, 78 (1932), p. 77).
*(93) TORELL, OTTO: 'Bref om Island' (*Kongl. Vetenskaps-Akad. Förhandl.*, Stockholm, 14 (1857), pp. 325–32).
*(94) TRAUTZ, MAX: 'Die Kverkfjöll und die Kverkhnúkaranar im Hochland von Island' (*Zeitschr. d. Gesell. f. Erdk. zu Berlin*, 49 (1914), pp. 169–99 (Map and Photographs)).
*(95) —— 'Am Nordrand des Vatnajökull im Hockland von Island' (*Petermanns Mitteil.*, 65 (1919), pp. 121–6 and pp. 223–9 (Map and Photographs)).
(96) VERLEGER, HELMUT: 'Kurzer Bericht über meine Vatnajökull-Expedition auf Island im Sommer, 1932' (*Geographischer Anzeiger*, 34 (1935), (Gotha)).
(97) —— 'Vulkanausbruch mit Aschenregen und Jökullhaup im Vatnajökull auf Island' (*Geographische Wochenschrift*, 2 (1934), Heft 23 (Breslau)).
*(98) VIDALIN, ÞORDUR: 'Dissertationcula de montibus Islandiae chrystallinis' (Skalholt, 1695). (Translation in *Hamburg Mag.* (Hamburg und Leipzig), 13 (1754), pp. 9–27, 197–218).
(99) VIGFÚSSON, GUDBRAND, and POWELL, F. YORK: 'Origines Islandicae' (Oxford Clarendon Press, 1905, vol. I).
*(100) WADELL, HAKON: 'Vatnajökull—Some studies and observations from the greatest glacial area in Iceland' (*Geogr. Annaler*, 2 (1920), pp. 300–23 (Map and Photographs)).
*(101) WATTS, W. L.: 'Across the Vatnajökull' (London, 1876).
(102) —— 'Journey across the Vatnajökull in the Summer of 1875' (*Journ. R. Geogr. Soc.*, 46 (1876), pp. 1–10 (Map)).
*(103) —— 'Snowland or Iceland; its Jökulls and Fjalls' (London, 1875).
*(104) WIGNER, J. H.: 'The Vatnajökull traversed from North-East to South-West' (*A.J.* 22. 436–48 (Illustrated)).

The 52 publications already indicated by Brian Roberts have been marked with an asterisk.

If unable to obtain maps or books in England, one is recommended to apply to E. P. Briem, Bookseller, Reykjavík, for Icelandic Publications, or to Levin & Munksgaard, Copenhagen K, Nørregade 6, specialists in new and second-hand Polar literature.

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