

Hveradalir in Kerlingarfjöll, Iceland.

By Johs. Humlum.

A ridge of mountains stretches through the middle of the Icelandic plateau from West to East, and they form the natural boundary between North and South Iceland. This water-shed is marked by three large glaciers. Langjökull in the West, Hofsjökull in the centre of the plateau, and Vatnajökull in the Southeast.

Vatna- or Klfajökull is by far the largest and covers an area of nearly 9000 km², and in this glacier are also found the highest peaks, sometimes 2000—2100 m above sea-level. Both Langjökull and Hofsjökull cover nearly 1000 km², but while the highest peaks in Langjökull are about 1450 m, parts of Hofsjökull reaches a height of more than 1700 m above sea-level.

Hofsjökull has a rounded shape. In the West it is separated from Langjökull by Kjalhraun; between this lava-field and Hofsjökull are extensive glacial gravel strata on both sides of the river Blanda. Sprengisandur lies east of Hofsjökull and consists of a vast desert, covered with gravel. This desert reaches the lavafields Ódáðahraun to the East and Tungnafellsjökull northwest of Vatnajökull. Hofsjökull is also surrounded towards the North and the South by strata of glaciofluvial sediments and moraines.

Most of the hot springs of the plateau fall naturally into two groups, namely those on the plateau north of Vatnajökull, especially Ódáðahraun and secondly those on the plateau round Hofsjökull.

South of Hofsjökull thermal springs occur in the halting place Nauthagi and in Blágnýpaver too (*N. Nielsen: Der Vulkanismus am Hvitárvatn und Hofsjökull auf Island. 1927*). And northeast of the glacier *Thoroddsen* found thermal activity at Laugakvísl in the neighbourhood of the tuff mountain Laugalda. The largest field of the plateau with alkaline thermal springs lies west of Hofsjö-

kull on the North edge of Strýtu-Hraun and is called Hveravellir (i. e.: the plain with thermal springs).

S. L. Tuxen M. A. and I had in the summer of 1934 opportunity to examine this group of springs more closely. We have given the results of our exploration in an earlier number of „Geografisk Tidskrift“ (*Humlum und Tuxen, 1935*).



Fig. 1. Vestur-Hveradalir facing East against the mountains on the eastern side of Mið-Hveradalir. You see to the left 1425-Mountain and to the right 1420-Mountain.

From Hveravellir we rode southwards round Blágnýpa, a spur of the Hofsjökull, and then eastwards to Þjórsá. During a few days stay at the halting place Blágnýpaver we made an excursion one afternoon to the hot springs in Kerlingarfjöll, and this short visit made me desire to examine the vast number of springs in this range of mountains more closely than it was possible to do in a few hours.

At the end of June 1935 I therefore left for Iceland in order to prepare the expedition. I was accompanied by the botanist *Vagn Romose* M. A., and in July we left the parsonage Mælifell in Skagafjarðardalur and for three days rode southwards along Blanda in order to reach Kerlingarfjöll via Hveravellir. We were accompanied

by two young Icelanders; our guide *Páll Ólafsson* and *Kristmundur Bjarnason* who was to assist us in the surveying work in Kerlingarfjöll.

On July 17. we camped in the neighbourhood of Jökulfall in the entrance to one of the northern valleys in the mountain range. The grass was very sparse and could not yield enough fodder for our ten horses for two days. Our guide therefore took the horses back home next day. The camping place was not good, but no other suitable place could be found near Hveradalir. It was therefore necessary on days when the weather permitted it to make a journey of about one and a half hour in order to reach the site of our exploring in the valley. Besides the weather was atrocious during the time we camped in the mountains. The fog lay over the mountains most of the time, and the rain poured down day after day, with intervals of half an hour or so. Nevertheless we had in all three days of fine weather, and in that time we succeeded in determining half a hundred points, and on this basis we made a cartographic outline of the tract in which the springs were situated. Further we completed a preliminary exploration of the springs. In the following I shall give the results of our explorations.

Kerlingarfjöll.

As a beginning it will be necessary to give a general view of the orography of the Kerlingarfjöll. This mountain range stretches in the direction East—West from the southwestern spur of Hofsjökull, Blágnýpa, towards Hvítá. Farthest South and West the range terminates in isolated mountains, of which the most distant is called *Mosfell*; it has because of a dense vegetation of mosses a very characteristic green colour.

The whole of the Kerlingarfjöllgroup is about nine km long and is broadest in the tract nearest to the glacier, its extent North to South here amounting six to seven km. It is also in the northeastern part of the mountain range that the highest peaks and the wildest and most pronounced alpine formations are found. Farthest East is a very prominent, partly isolated mountain, called *Loðmundur* (1432 m).

Jökulfall (Jökulkvisl), one of Hvítá's largest affluents, runs towards West directly from the foot of the mountains. This river has two main sources, one of these runs West round Blágnýpa, the other starts from the glacier east of Blágnýpa. Jökulfall in addition receives many tributaries from Kerlingarfjöll, the largest of these, *Innri Ásgarðsa* (Inner Á.), springs from a large sunken tract

in the northeastern part of the mountain range. The large and widely ramified cluster of valleys, which Ásgarðsá has eroded here in the neighbourhood of the central parts of Kerlingarfjöll, is the seat of a very rich hot spring activity and was named by Th. Thoroddsen *Hveradalir* (i. e.: the valleys with hot springs).

Both east and west of Hveradalir are smaller valleys with affluents to Jökullfall, and thus Kerlingarfjöll gets the character of a

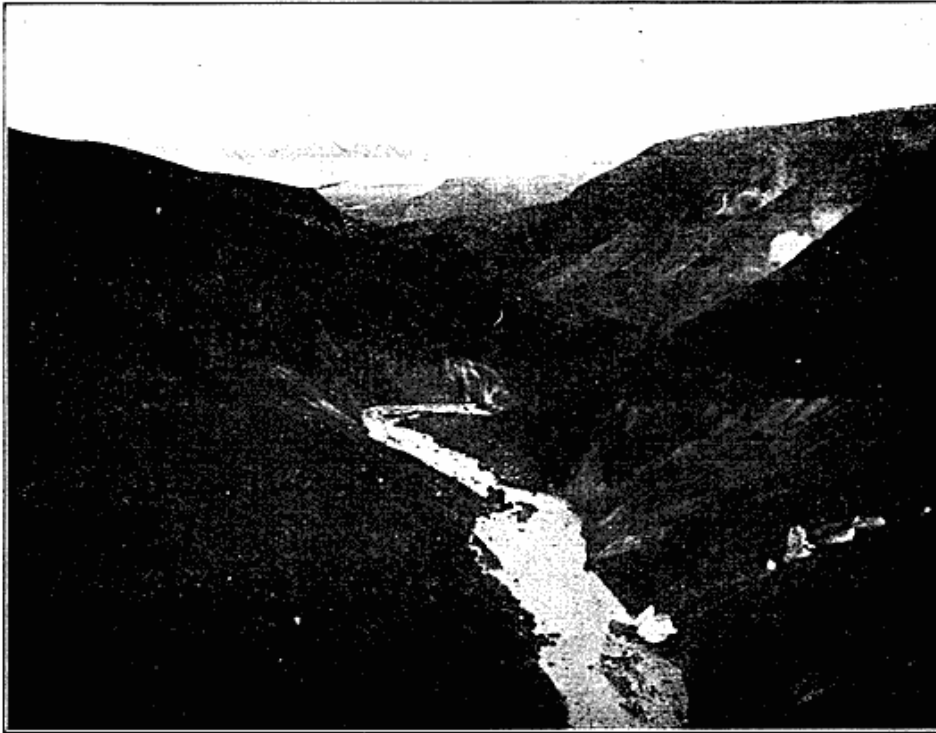


Fig. 2. A view of Vestur-Hveradalir. In the background you see Blágnýpa and Hofsjökull.

East-West running mountain range, isolated chains of which run North to South. The relative heights of these chains is 400 to 500 m, whereas Kerlingarfjöll on the average is about 800 m higher than the surrounding plateau. At the foot of the mountains the plateau is about 700 m above sea-level. From here it rises gradually up to Hveradalir, and the pass is situated at a height of about 1100 m, directly south of the upper plateau in which Ásgarðsá and its numerous tributaries have eroded ravines and fissures 50 to 70 m deep, which often make single valleys almost inaccessible.

The highest peaks in Kerlingarfjöll are east of Hveradalir. The snowclad *1425-Mountain* rises from the valley, but it is surpassed by a mountain in the group further East (*1477-Mountain*).

A peak nearly as high is south of 1425-Mountain, which I have called *1420-Mountain* (Fig. 1). The two mountains are covered with ice, and so are the nearest eastern peaks and the passes between. Three glaciers stretch towards North from this little glacial area, which has a heavy annual rainfall (400-500 cm?). On the other hand no real glaciers are found towards Hveradalir, but

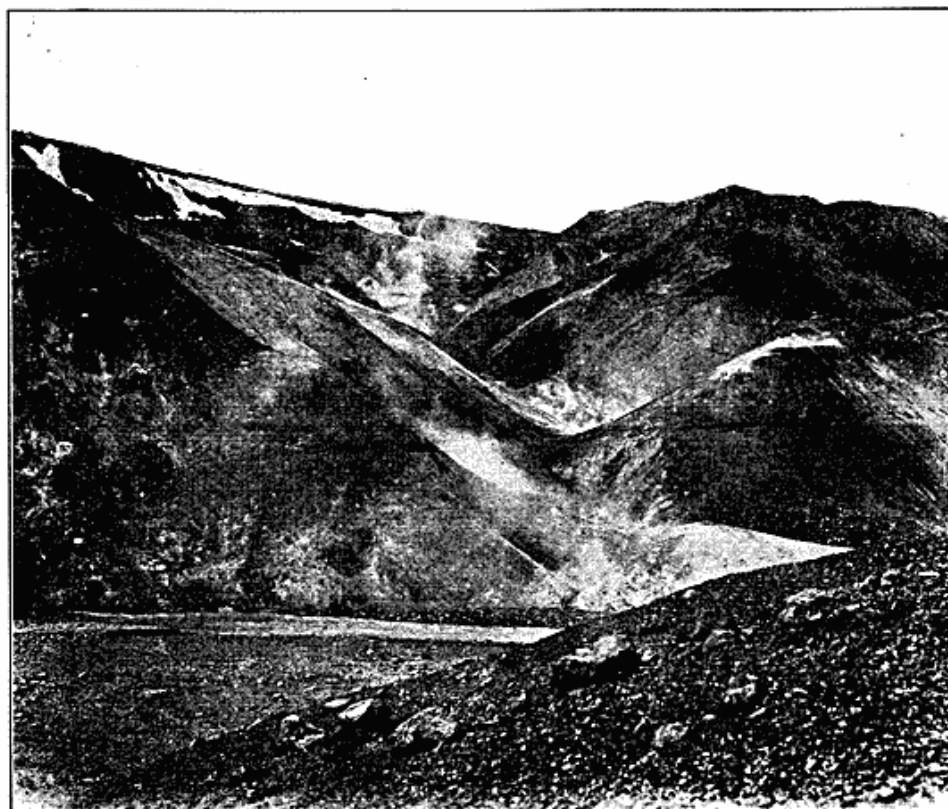


Fig. 3. The hot springs in ravine B of Vestur-Hveradalir.

the glacier passes gradually into the plateau, and in valleys and ravines long tongues of snow reach low down towards the bottom of the main valley.

About two km to the South of Hveradalir lies a very marked, conical mountain that is called *Kisubotnahnúkur* (1136 m). The main sources of Kisa — one of the affluxes of Þjórsá — issue west and east of this mountain.

Finally *Ögmundur* (1352 m) is the highest peak in the western group of Kerlingarfjöll.

West of Hveradalir the mountains are somewhat lower. A partly snowclad ridge stands clearly out, it runs almost parallel with Ásgarðsá, and it rises very abruptly out of the surrounding snowfields

and plateaux. Southwards this ridge — *1218-Mountain* I shall call it in the following — is continued by a large icecovered area whose boundary towards Hveradalir is at steep bare precipice, that rises directly on the western side of the valley. The glacier tract west of Hveradalir feeds two glaciers that slide down into the valley respectively south and north of the above mentioned steep mountain. They debouch in deep ravines which cut up the plateau west of the main valley. The hot springs tract is finally demarcated southwards by the pass, from which the mountains rise steeply towards Southeast, cut by ravines, which have been eroded by the tributaries to Kisa and Sandá. (Amongst others the main source of Sandá, Kerlingará; sic *Thoroddsen*).

Also northward towards the mouth of Hveradalir this area is demarcated by a low ridge of hills, so that the plateau with the sulphur springs stands clearly out as a bowlshaped depression in the central part of the mountain range.

After having cut through the above mentioned secondary watershed in many windings and in a deep river bed (Fig. 2), Ásgarðsá flows into palagonitetúfa, in which it has dug out a gorge with almost perpendicular walls. Through this ravine Ásgarðsá continues its torrent until near its outlet into Jökulfall it receives a large affluent from a valley further West. At the same time the ravine widens out into a fairly broad hollow, in which there is sparse grass and a little poor "Sæluhús" (mountain shelter). Immediately east of the outlet lies the hill-top *Innra Ásgarðsfjall* (955 m).

That Ásgarðsá comes from a chemically active area in which a lively transformation takes place all the time — of this one will get a good impression, if one watches the outlet of the river from *Innra Ásgarðsfjall*. Jökulfall rises in Hofsjökull, and its water is of a grey colour as in all glacial rivers. In spite of this it contrasts sharply with the water of Ásgarðsá, of a pronounced yellow brown colour which keeps in the left side of Jökulfall long after they have flown together. The brown colour in Ásgarðsá is due to clayed, loamy liparite deposits. All Hveradalir and the highest parts of the surrounding mountains consists of liparite, that lies as covers on the palagonitetúfa.

The Oreography of Hveradalir.

After this survey of the site and hydrography of Hveradalir I shall proceed to describe the tract of the springs in detail.

The outline map (Fig. 10) shows that two small brooks flow into Ásgarðsá on its left bank, close to the north boundary of the spring

tract. These rivulets both rise at the limit of perpetual snow on the hills west of the valley and flow in a winding S-formed course towards the main valley, cutting deeper and deeper furrows into the plateau. The precipices along their banks are broken up into several small ravines, a clear evidence that the flow of water in these valleys is far greater in the spring and early summer, when the melting water pours down from the ice-covered mountains. These two affluents I have called *A* and *B*. Ravine *B* is the southmost one. (Fig. 3).

A short distance above the mouth of ravine *B* the main valley turns sharply East. The plateau north and east of the river is here 60 to 70 m higher than the bottom of the valley, and the precipices are often very steep, the angle of inclination being 35° to 40° , or more. But in this corner the plateau ends in a steep spur from which one may with little difficulty descend into the valley. It is possible to ascend the plateau, above, on horseback when the ground is not soaked by constant rains. But in the hot springs tract it is impossible to travel on horseback.

At the turn of the river round the above mentioned spur a third affluent joins it on its left bank. This brook is formed by the junction of two rivulets which have formed a steep, sharp spur between them by erosion. Both rivulets are glacial affluents from the northmost of the two glaciers, fed by the snowfield west of the hot springs tract. The two affluents are marked *C* and *D* on the map. *C* flows into *D* before *D* flows into Ásgarðsá. The mother glacier we have called *C—D* „Jökull“. (Fig. 4).

About 400 m east of ravine *D* the main valley turns again and runs North to South. The part of the valley, described above, from this point to the gorge in the palagonitetúfa to the North is called *Vestur-Hveradalir* by Thorkelsson. The part above this including side valleys is called *Mið-Hveradalir*, and the inmost and highest part of the valley *Austur-Hveradalir* (cp. later p. 31).

Where *Mið-Hveradalir* joins *Austur-Hveradalir* the valley turns from North — South to N.W.W. — S.E.E.

The three sections of it are separated by large side valleys. Where *Vestur-Hveradalir* joins *Mið-Hveradalir* an affluent flows into Ásgarðsá, on its right bank. This affluent which I have marked *F* is the only large one which flows into the river, on the right bank. It originates in the snowfield covering 1425-Mountain. The south slope of *F* is cut by runnels in some of which the snow stretches from the ice-covered mountain top to the bottom of the ravine.

One of the largest affluents of Ásgarðsá springs from the *I-Jökull*, west of Hveradalir and debouches into the main valley where Mið-Hveradalir joins Austur-Hveradalir. This affluent which flows along *Ravine I* receives before its debouchure into Ásgarðsá an affluent from the North, which springs from a southern offshoot of the *C-D „Jökull“*, and is marked *H* on the map (Fig. 5).



Fig. 4. A view of ravine *D* and the *C-D „Jökull“*.

The plateau between ravines *H* and *I* is deeply indented and its western edge is the steep, sometimes almost perpendicular precipice which separates *I-Jökull* and *C-D „Jökull“*.

West of Miðdalur, between Vestur-Hveradalir and ravine *D* to the North and ravine *H* to the South is a plateau, half a km long, and more than one third of a km broad, and relatively level. Still one ravine divides it lengthwise, debouching in Vestur-Hveradalir and half-filled with snow in July, marked *E* on the map. The steep eastern edge of the plateau is cut by a depression, *Ravine G*, de-

bouching in the middle of Mið-Hveradalir. The edges of the plateau, especially towards Vestur-Hveradalir, are covered by numerous sheets of snow, the snow remaining there at the end of July.

East of Miðdalur the right bank of the river rises gradually into the western edge of 1425-Mountain and 1420-Mountain. The slopes on this side are lower and less steep than on the west side where



Fig. 5. The interior part of ravine H. In the background you see Austur-Hveradalir.

erosion is far more pronounced. The eastern slope really consists of numerous parallel ridges, separated by small ravines, often filled with snow.

Northeast of Austur-Hveradalir there is a steeper slope, but otherwise this tract is of a similar character. Where Mið-Hveradalir joins Austur-Hveradalir the eastern slope of the river is cut by a ridge („gravel ridge“, *Thorkelsson* sic), stretching from 1420-

Mountain down to the valley and marked by a little knoll between the mountain peaks and the valley.

Finally it must be mentioned that the slopes between Austur-Hveradalir and ravine *I* in Mið-Hveradalir is furrowed by rain fissures and covered by snow drifts.

As will be seen from the above description the valleys with the hot springs form a wild and rugged tract, difficult of access. One cannot penetrate the valleys along the river, for, even if you can, in many places, walk short distances along the river banks, you are continually held up by precipices, steep towards the affluents in the outer curvature of the meanders. In the little valleys and in the ravines the precipices are steep on both sides of the affluent, often with an inclination of 45° to 50°. You can, therefore, only examine these ravines more closely by walking into them in the stream of the affluent itself. It is possible to do this, too, in the main river, but very difficult because of its relatively large volume of water, rapid course, non-transparent, muddy water and very stony bottom.

To examine this tract closely is, therefore, necessary to climb from valley to valley across the intervening ridges. Ascent and descent are easiest along the rain ravines that furrow the sides of the valleys; in these the stony bottom gives a good foothold, while it is difficult to stand on the wet and clayey slopes.

The Springs in Hveradalir.

The large majority of the hot springs in Hveradalir are solfataras and fumaroles, still there are a few alkaline springs. The springs are very numerous and there can be no doubt this is the largest tract of hot springs in Iceland, and, I imagine, one of the largest known in the world. This tract is about two km long and about one km broad. The springs are not evenly distributed over the whole area, but mainly in the valleys, and only in a few places on the slopes and the plateaus are they so thick, that it is extremely difficult to find one's way between them. On the other hand one may almost everywhere in the side valleys count numerous solfataras and fumarolas in a very small space. I estimate the number of springs in Hveradalir to be considerably more than 1000.

It is necessary to explain how the springs are grouped in separate valleys.

In Vestur-Hveradalir thermic activity can be found almost to where Ásgarðsá flows into the ravine northward. Numerous

steaming springs are spread over the eastern slope, and here, as all over the valley, they make the snow fall down in large, irregular blocks. The original continuous snow and ice cover melts early in the spring near the springs. Thereby the snow is dissolved into separate flakes, which tumble down into the bottom of the valley, where even in late summer you find snow blocks by the river.

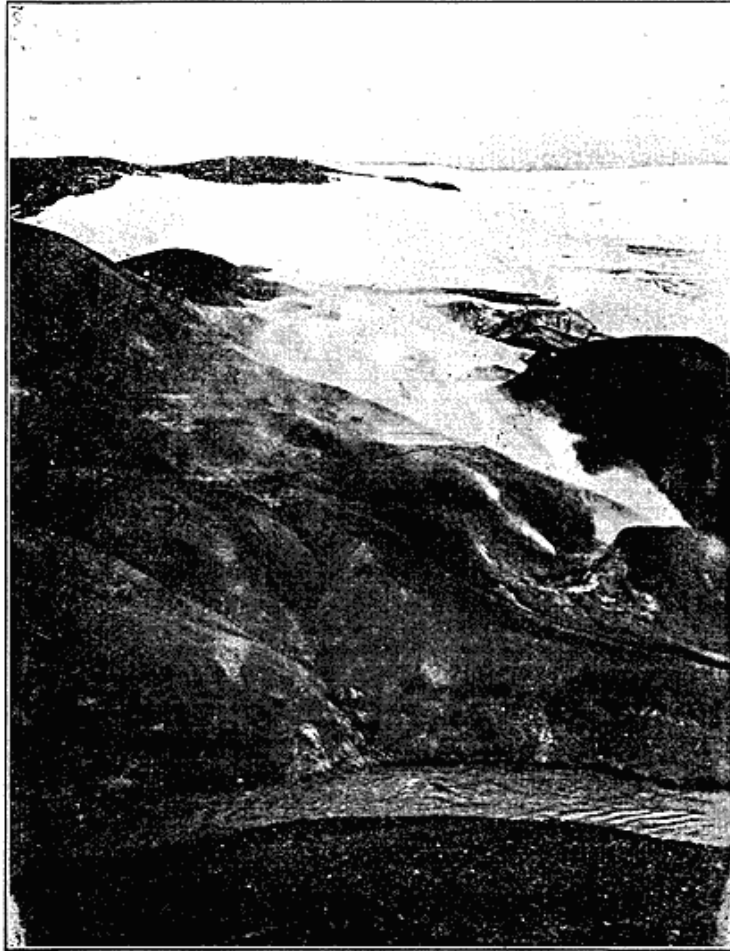


Fig 6. The solfataras on the ridge between the main valley and ravine **D**.

The largest number of springs in Vestur-Hveradalir is found in the side valleys. In ravines *A* and *B* there is lively activity and the steam rises from these valleys far higher than the slopes towards the glaciers above. The same is the case with ravines *C* and *D*. Almost everywhere you find holes in the slopes from which steam issues, hissing, with claps of thunder. You can follow these springs up the valley to where the affluent rises in the glacier, and likewise on the ridge between ravines *A* and *B*.

Some of the biggest springs in Vestur-Hveradalir are found in the tongue of land between the main valley and ravine *D*. A fuller description of these boiling mud springs will give an impression of the lively hot spring activity, characteristic for all these valleys.

On the ridge east of the debouchure of affluent *D* is a large



S. L. Tuxen fot.

Fig. 7. Fumaroles in the ravine *D*.

spring about ten m above the river bed (*D* 1). Its basin, about 5 m long and 2½ m broad, is surrounded by a perpendicular wall, one m high. The muddy liquid is of a pronounced bluish colour (colloidal sulphur), bubbling and boiling continually. You could not get at it to measure its temperature. There is a cut in one side of the basin of this spring, forming an outlet to the main river (Fig. 6).

A few meters further on in ravine *D* is another large, boiling

mud spring (*D* 2). Though the liquid is continually boiling yet its temperature is only 84° (measured at the border of the basin). The spring is circular and its diameter is $2\frac{1}{2}$ m. The outlet to affluent *D* has a dark red colour in two shades, one of which also surrounds the basin at a height of 5 cm (gypsum). There is also a strong deposit of sulphur round the edge of the spring. The mud in this spring is of a pure, grey colour in contrast with the bluish colour of the first mud spring. On the whole it is characteristic that, when you take the springs separately, you are inclined to think they have all the same grey colour, but, when you can compare several mud springs, you find usually an often very clear difference in colour, so that almost all possible shades of grey and blue are represented.

Further up the slope, up the valley are found numerous smaller springs. One is 30 cm in diameter (*D* 3) with crystal clear water, bubbling and boiling. Temperature 94° . Sand and gravel of the size of a centimeter is thrown up 5 to 10 cm with the boiling water. Round the flat, funnel-shaped basin is a strong deposit of sulphur.

Below *D* 3 is a little mud spring of a similar size (*D* 4). The grey mud bubbles as if boiling. Temperature yet only 90° .

Near these springs, in the slope, are many holes and fissures out of which steam hisses in thick clouds. Out of some of these steamholes waters squirts in drops and the surface temperature is from 91° to 92° , i. e. just under boiling point at this level (870 m above sea-level). Some springs nevertheless have a lower temperature than the above ones, and I found e. g. 54° in a little, clear, alkaline spring on the slope.

Most of these springs have outlets down the slope to affluent *D*, and some of these have a vivid, green colour, partly caused by algae, which thrive in the temperate water.

The prevalent colour here as in the whole spring tract is *orange-yellow*, but the clay slopes are speckled with red, blue, grey, orange, brown and violet in many shades.

While hot springs are found almost throughout the whole valley in ravine *D*, they are mainly found in the inmost part of ravine *C*, near the glacier. (Fig. 7).

The part of the western plateau, situated between ravines *D* and *G*, is poor in springs. Far otherwise the southern part of the plateau between ravine *G* and ravine *H*. This is, in parts, thickly covered by numerous, small sulphur springs, and the ground is so sodden through that it is extremely difficult to walk without

East

1425 - Mountain 1420 - Mountain

South

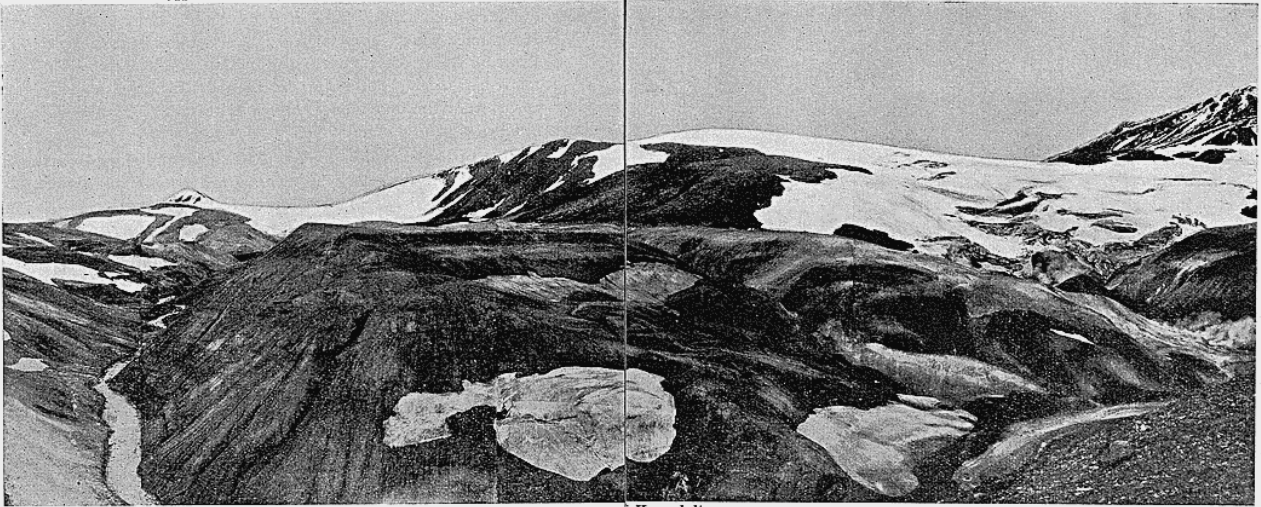


South

Skyggni?

The ravine F
The ravine E

1218 - Mountain West



Mið - Hveradalir

A panorama Hveradalir.

Vestur - Hveradalir

sinking in. The ground is covered with shades of grey and blue everywhere (Fig. 8). The outlet from these springs soon joins the glacier affluent that flows to ravine *H*, immediately west of the plateau.

A similar lively hot spring activity is found on the spur between ravines *H* and *I*, on which there are dozens of mud springs and several large springs with deep basins (Fig. 9).



Fig. 8. A small sulphur spring in the plateau between ravine *G* and ravine *H*.

The most active part of the main valley is undoubtedly the inmost and most elevated part, namely Austur-Hveradalir (950 to 1000 m above sea-level). Numerous columns of steam and boiling mud springs give it the same character as the side valleys in Vestur-Hveradalir. East of Austur-Hveradalir the thermic activity continues up to snow level. Further South, east of Mið-Hveradalir it decreases much and is confined to the valley. Only in ravine *F* the sulphur springs and the steaming fumaroles become prominent again.

Finally I may mention that the northern plateau, at the debouchure of the valley, only partly belongs to the hot springs tract. Only near the valley the earth is of the characteristic orange-yellow colour, and only there are found a few small springs and small

cup-shaped depressions of various colours, evidence of earlier active springs.

The Vegetation of Hveradalir.

The vegetation of Kerlingarfjöll has almost everywhere the character of a barren table land (In Iceland called: *melar*). Only sporadically you find a compact vegetation of gramineae and cypereaceae.

In Hveradalir plant life is as impoverished as possible. In large parts of the plateaux there is literally not a single plant, especially where the springs are close together and prevent plants growing up, but even in the sand and gravel round the groups of springs only extremely few specimens of *Deschampsia alpina* and a few other arctic species are seen.

Plants thrive best — if you can call it so — on the southern slopes of Vestur-Hveradalir. Here you find sporadically grass plots with *Deschampsia alpina* or *Calamagrostis neglecta*, also *Carex rigida* and *Juncus lamprocarpus* are rather prominent, and *Eriophorum Scheuchzeri* and *E. polystachyum* rise here and there with their large white tops. Sporadically among this swampy vegetation are found a few specimens of *Ranunculus hyperboreus*, *Viola palustris* and *Salix herbacea*, the arctic willow. It is at first astonishing to find such a relatively luxuriant and in plots compact plant growth at an altitude of 850 to 900 m, but a closer examination often shows that the ground is temperately heated in these spots and that these small oases arise from the volcanic activity of this tract.

In depressions or under small slopes there are a few shelts of snow with *Gnaphalium supinum* and *Sibbaldia procumbens* and the arctic willow. Finally round cold springs there is found a tiny carpet of the moss *Philonotis fontana*, with sometimes a few specimens of *Cerastium trigynnum* and *Equisetum arvense*.

Ophioglossum vulgatum which you might expect to find near the sulphur springs we have not seen. On the whole plant life is impoverished as hardly anywhere on the Iceland plateau, even in Hraun and near snow-level.

Hveradalir 1888—1935.

For practical reasons I have given the survey of literature at the end of this monograph. There exists no detailed map of Hveradalir. Also, most of the valleys of the spring tract are very much alike so that is it often difficult to identify the separate ravines by the

aid of the often cursory descriptions given by explorers visiting Hveradalir. To review and compare the results of a series of visits to the valley of springs would, therefore, be very difficult unless preceded by a survey of the topography of the area.

„I have seen all other known solfataras and maccalubers in Iceland and find that those of Kerlingarfjöll surpass all the others by

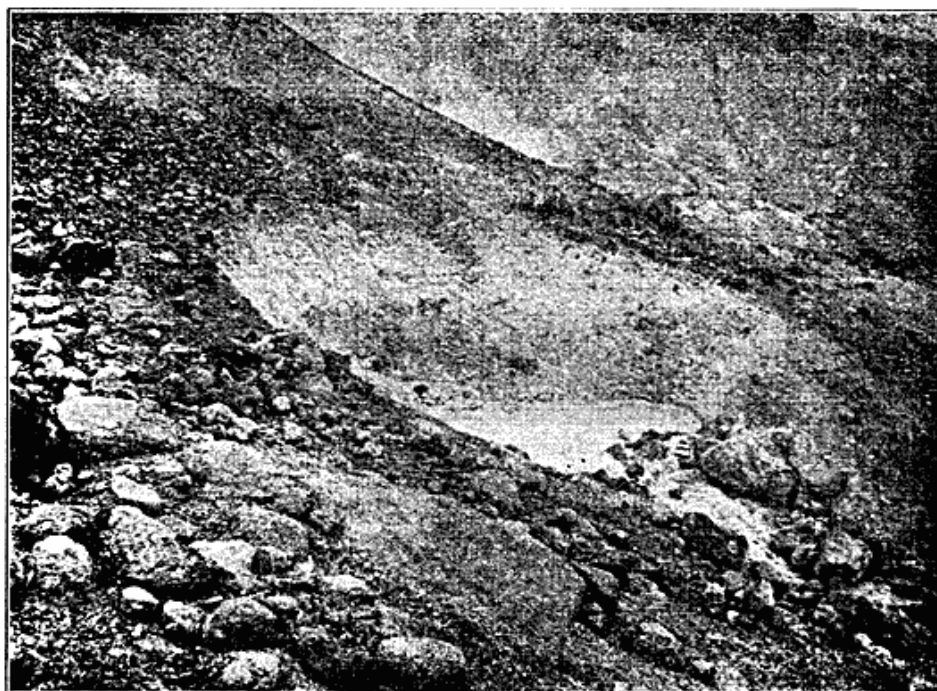


Fig. 9. A mud spring on the southern slope of ravine H. It has a diameter of three m.

far“, thus the great geographer of Iceland, *Th. Thoroddsen*, ends his description of Hveradalir, which he visited, and named, in 1888.

Many years before his visit there it was known that there were hot springs in Kerlingarfjöll. Probably travellers in the mountains had sometimes seen steam rising from the valleys. Already on *Gunnlaugssons* map of the S.W. Quarter of Iceland (published 1844) the signature “Hver eða Laug“ (hot springs) is spread over the whole mountain area. On the other hand *Gunnlaugsson* has placed Kerlingarfjöll too far East on his map, adjoining Hofsjökull, on the site of *Illa-hraun*. In return this lavafield has been moved West and is found south of Blágnýpa on his map.

The first description of Hveradalir is by *Th. Thoroddsen* who has related his explorations in various places (*Thoroddsen*, 1889, 1890 a. o.).

With two guides he reached, on Aug. 20. 1888, from the South the pass between Ásgarðsá and Kerlingará. The highest peak in this mountain ridge they called *Skyggni* (outlook) because of the fine view from it over North and South Iceland. With great difficulty they took their horses thus far. On foot he and his guide *Snorri* penetrated across snow and icefields (I-Jökull?) down into one of the westernmost valleys (*I* or *D*?). *Thoroddsen* mentions several springs in it e. g. a large, bluish, boiling mud pool, 60 feet in diameter (*Snorrahver*) which was situated north of the source of the affluent. Further down the valley he describes another large, boiling mud spring with a basin 5 feet high out of which steam was rising in dense clouds (*Th.* 2). Immediately below it was a very strong fumarola which emitted steam with a deafening roar (*Th.* 3). The side valley debouches, according to *Thoroddsen*, in one of the main branches of Ásgarðsá. Two mud springs at the debouchure are also mentioned (*Th.* 4 and *Th.* 5) the lower of which emitted boiling liquid mud to a height of 15—30 feet and had built up a circular basin 10 to 20 feet high. Of the ravines east of the main valley he merely says: „They are all essentially similar“. Finally he states that the fumaroles and solfataras are often situated on the edge of the snow or even with their craters under snow.

It is difficult to decide which ravine it was that *Thoroddsen* described fully. Several things point to *I*. *Th.* reached the head of the valley across a glacier and he calls it the westernmost valley. But the two characteristic springs, *Snorrahver* and *Th.* 5 I have not been able to find in ravine *I* or ravine *D* which might correspond according to his description. Possibly *Snorrahver* has disappeared and is perhaps covered by ice (cp. later p. 19).

Thoroddsen has described his visit to Hveradalir in several places, but as a rule he repeats or gives extracts from his article in „Geografisk Tidsskrift“.

The next account of the springs in Kerlingarfjöll is by *Daniel Bruun*, who visited Kerlingarfjöll in 1897 (*D. Bruun* 1898). He came from the halting place Gránunes and camped at the mouth of Ásgarðsá innri near the little mountain shelter (*Sæluhús*). On Aug. 11. he rode up to the spring valley. He mentions the ridge that forms the valley to the North and through which Ásgarðsá has made a deep fissure. He also mentions one of the fumaroles on the steep, inaccessible, eastern slope of the main valley: „We saw steam bubbling forth at intervals in a huge column from a large hole. It produced a hissing sound as from a funnel“. For two hours *D. Bruun* waded on foot through the river up to southmost valleys. He em-

phasizes the naked and sodden terrain and the glaring colours and says he was continually passing fumaroles and solfataras during his walk, more than a hundred, in all. He and his guides stayed at the halting place by Ásgarðsá from Aug. 9. to 11.. Then nearly all the grass was eaten and they returned to Gránunes

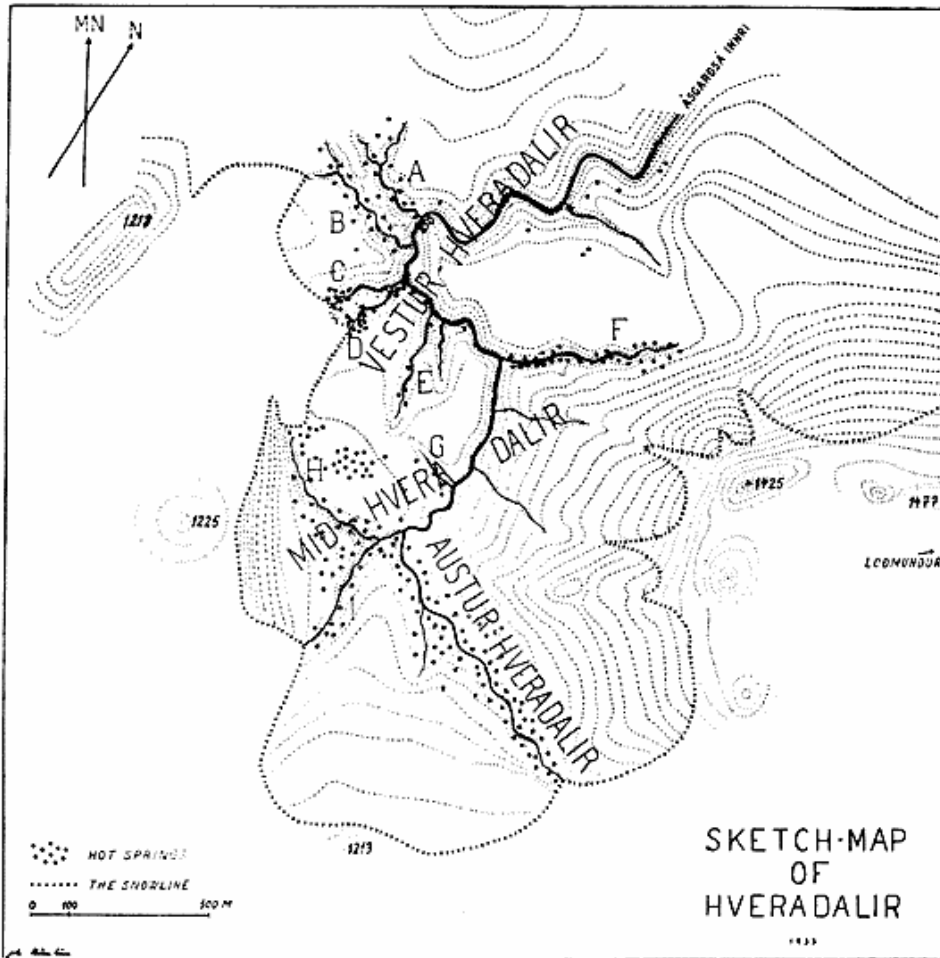


Fig. 10. Sketch-Map of Hveradalir in Kerlingarfjöll.
Scale 1 : 23 000.

“To describe the place is impossible, and mere words are inadequate to explain the nature of the scene” says the English geographer *W. Bisiker* who visited Hveradalir three years after *Daniel Bruun* (*W. Bisiker*, 1902).

Bisiker travelled in July 1900 by Kjalvegur to South Iceland and during a stay at Gránunes made a short excursion to Kerlingarfjöll. He and his guide crossed Jökulfall west of the cañon and rode across moraines and snowfields up to the ridge above the spring

valley. He emphasizes the bright, liparitic colours and the strong smell of sulphur which "suggested the nearness of the lower regions".

Bisiker tried to do some plane-tabling, but a dense mist prevented it and with difficulty he extricated himself from the drifting clouds on to the plateau.

He mentions one of the side valleys, it is narrow, bordered by a narrow ridge on one side, and begins where the snow ends. The description fits ravine *D* very well. If the pond, that *Bisiker* mentions in the innermost part of the ravine is identical with Snorrahver, it has already been on the wane in 1900 and it would not then be remarkable, if it had disappeared by now.

On *Bisiker's* map Jökulfall is too far North, 7 to 8 km from Kerlingarfjöll. The fact is that the river flows close by the mountains.

Two years before the young German geologist Dr. *von Knebel*, lost his life by an accident in Askja he had visited Hveradalir (*W. v. Knebel*, 1905). July 26, 1905, travelling via Kjölur to Akureyri, he made an excursion to Kerlingarfjöll. There he met with the worst weather on his trip, continual rain and later frosts and snow storms. His visit, therefore, yielded little result and in his short account he confines himself mainly to criticism of *Thoroddsen's* map and of his statements as to the extent and appearance of the liparite layers. *Knebel* assumed that the liparite in Kerlingarfjöll was found in the form of veins. Finally he claims that the springs are 6 km too far North on the map. For the rest he omits to mention Hveradalir.

One of the best descriptions of Hveradalir is by *Th. Thorkelsson* who visited the spring tract at the end of July, 1906, and divided it into three sections, he says that the whole of the spring district falls naturally into three divisions, viz. Vestur-Hveradalir to the West, nearest to the outlet of the valley Mið-Hveradalir, the middle part of the valley, where it turns to the East, and Austur-Hveradalir, farthest in the valley, towards the East.

Later he fixes the site of Mið-Hveradalir, and says it seems to be the end of the main valley, because it turns East. After this description I have no doubt *Thorkelsson* agreed with the division as seen on my map.

He only mentions one spring, situated at a height of 1000 m in Austur-Hveradalir. It is a steam-spring of the same kind as Öskurhóll at Hveravellir, only it is still more powerfull. He called it Öskrandi (the Bellow). Unfortunately I had no time to examine the springs in Austur-Hveradalir and I have not seen Öskrandi.

At the time when Knebel lost his life in Askja, his friend *M. von Komorovicz* visited the solfataras in Kerlingarfjöll. He camped in the middle of July at Gránunes and rode thence towards Southeast, crossing Jökulfall at once and continuing eastward along the south side of the deep cañon of this river. Of his short visit to Hveradalir, where in the course of three hours he ascended 1425-Mountain, he gives a long poetic and partly pathetic narrative with several illustrations of Hveradalir and Kerlingarfjöll, but he gives no new details of the spring tract. Besides the fuller description he gives a short account in „Globus“ (vol. 92, No. 24: *Komorovicz: Ein Ritt durch Island*).

The next year *Paul Herrmann* was in Kerlingarfjöll (*P. Herrmann, 1910*). This scholar who had earlier travelled through the greatest part of inhabited Iceland, travelled across the island from North to South via Kjölur in the summer of 1908. During a stay at Gránunes, he made an excursion to Hveradalir, but here he met with the worst weather on his trip: Storm, rain, hail and fog. Herrmann, therefore, gives no new details of the spring tract, but mainly refers to *Thoroddsen*. The pass north of Hveradalir seems to have been under snow, when, one of the first days of August, he visited the valley.

The same year *Hermann Stoll* visited Kerlingarfjöll without adding to the knowledge of the physiography of the valley (*H. Stoll: Quer durch Island. Jahrbuch des Schweizer Alpenklubs 1910—11. Bern*).

The first attempt to give a more detailed cartography of Kerlingarfjöll was made by *L. Wunder* (*Wunder, 1912*), who with stud. med. *E. Weiszenberg* made one week's visit to this mountain chain in the summer of 1911. He camped at the north boundary of the mountains, partly west of Ásgarðsá, partly further East by Jökulfall, north of Loðmundur. Herefrom he ascended and surveyed most of the peaks of Kerlingarfjöll, and made a map to the scale of 1:25 000. This map gives a good view of the relative sites of the peaks, but the various affluents and especially the waters of Hveradalir he has, in his own words, “neglected”.

Wunder mentions a spring tract in the eastern mountain chain, surrounded by 1425-Mountain to the West, Loðmundur a. o. peaks to the Northeast. I was unable to visit these hot springs. *Wunder* supposes that it is this cauldron formed valley which *Thorkelsson* calls Austur-Hveradalir. This is not the case for the following reasons:

- 1) *Thorkelsson* states expressly that Austur-Hveradalir has the direction West to East, but the cauldron valley runs North to South according to *Wunder*.
- 2) In *Thorkelsson's* illustration of Austur-Hveradalir the 1218-Mountain is seen above the mouth of the valley in Mið-Hveradalir. The 1218-Mountain can hardly be seen from the cauldron valley, in any case not to the South, and
- 3) finally *Wunder* on his own map lets Hveradalir commence west of 1420-Mountain and does not continue the valley, south and east of this mountain.

Wunder first tells of his petrographical explorations and then says little of the hot springs, his description of which is based in the main on *Thorkelsson*.

It will be seen from the above that Hveradalir has up till now been only very superficially explored. Not because the spring tract is not interesting — far from it — but because it is very difficult to explore it.

Exploration must be based on cartography of the area which I have attempted. The next step is measurement of the springs and, finally, every separate spring must be explored and described in detail. Only when you have got so far you can follow the evolution of each separate spring.

My experience shows that such a detailed exploration will need the work of several professional scientists for a whole summer. Not least because the weather is so execrable that you cannot count on more than every third day of the time you camp in the mountains. Hveradalir is almost always visited from Gránunes (4 hours on horseback), but I think it more practical to camp in Blánýpaver where there is enough grass for several horses for a longer time, and, if you camp directly under the border mountain Blágnýpa, east of the western affluent, forming Jökulfall, you need only to cross the eastern source affluent to get to Hveradalir. From Blágnýpa to Hveradalir it is one and a half hour's ride, and, for support, you could possibly have a tent placed at the bottom of Vestur-Hveradalir.

It is my hope that Icelanders and Danes may jointly, before long, succeed in carrying through such an exploration.

Finally I wish to thank "*Dansk-Islandsk Forbundsfond*" for its economic assistance to the expedition, and the *Geodetic Institute* which most kindly placed the needful instruments at my disposal.

I also wish to thank my fellow explorer *V. Romose M. A.*, and *S. L. Tuxen M. A.* who, in many ways, have given me valuable assistance in arranging the expedition. Finally I thank the explorer of Iceland *Niels Nielsen, Ph. D.* for the great interest he has taken in my work in the wonderful island under the Polar Circle.

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