

**Royal
Geographical
Society**

with IBG

Advancing geography
and geographical learning

WILEY

Askja, the Largest Volcano of Iceland; With a Short Description of the Ódáðahraun

Author(s): Wm. Geo. Lock

Source: *Proceedings of the Royal Geographical Society and Monthly Record of Geography*,
New Monthly Series, Vol. 3, No. 8 (Aug., 1881), pp. 471-483

Published by: [Wiley](#) on behalf of [The Royal Geographical Society \(with the Institute of British Geographers\)](#)

Stable URL: <http://www.jstor.org/stable/1800278>

Accessed: 12/06/2014 21:25

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at
<http://www.jstor.org/page/info/about/policies/terms.jsp>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.



The Royal Geographical Society (with the Institute of British Geographers) and Wiley are collaborating with JSTOR to digitize, preserve and extend access to Proceedings of the Royal Geographical Society and Monthly Record of Geography.

<http://www.jstor.org>

ranges were distinctly marked, one being generally of a volcanic character, and the other being fossiliferous to its highest summits. Mr. David Forbes had informed him that the loftiest mountains in Bolivia had Silurian fossils to their topmost heights. Mr. Whymper had stated that the peak of Sara-urcu (which meant *male maize*) was not volcanic. Possibly that might indicate a continuation of the Eastern Cordillera of Peru. Mr. Whymper appeared to have been informed that the President of Ecuador who ordered the restoration of the pyramids erected to mark the ends of the base measured by the French savans, placed them where they could best be seen instead of in the exact positions in which they were originally built. Don Vicente Rocafuerte, however, was well acquainted with the geodetic science of his time, and it was his intention and his orders, at all events, that the pyramids should be placed in their former positions. He was one of the most enlightened men who ever ruled in South America, a mathematician and good classical scholar, as well as a statesman. At present it is the fashion to depreciate South Americans, but it ought to be remembered that the South American Republics have produced men of great distinction as mathematicians, geographers, and botanists. At the present time, Don José Triana, of Colombia, is an eminent botanist, of European reputation, while our Honorary Associate Paz Soldan of Peru, Vidal Gormaz of Chili, and Moreno of Buenos Ayres are distinguished geographers.

Mr. ETHERIDGE said that Mr. David Forbes, whose observations had been alluded to by Mr. Markham, examined the geological structure of Peru and Bolivia in the years 1857-60, and brought home a remarkable series of fossils ranging from the Silurian to the Jurassic rocks. These fossils were examined by the late Mr. Salter and himself (Mr. Etheridge), the result of which was that twenty-five species were named. The Silurian fauna predominated and was observed by Forbes 25,000 feet above the sea at the summit of the Andes. These Silurian rocks occupied an area of 80,000 square miles. The Devonian formation was present also, many species from strata of that age having been collected. The carboniferous rocks ascend up to 15,000 feet in Bolivia, in the provinces of Arque and Oruro, and north of Lake Titicaca. These rocks are highly fossiliferous, containing many British species; besides these, Jurassic rocks extensively occur, with ammonites closely allied to our own species. The Jurassic series range from Chili through the Desert of Atacama.

Askja, the largest Volcano of Iceland; with a short Description of the Ódáðahraun. By Wm. Geo. Lock.

Map, p. 512.

HAVING twice visited Askja (in 1878 and 1880), of which there is no account in English except the brief notice by Mr. Watts,* the writer is enabled to give a fuller and more detailed account of this remarkable volcano.

Slightly to the east of the centre of the island lies the Ódáðahraun ("misdeed lava-desert"), the largest lava-desert in Iceland. According to the cartographer Herra Gunnlaugsson the Ódáðahraun has an area of 1200 square miles, and it forms part of a fire-blasted uninhabitable wilderness of at least double that area, lying between the Jökulsá and

* In his paper in vol. xlv. of the Royal Geographical Society's Journal, and in his book 'Across the Vatna Jökull.'

Skjálfandafjót rivers north of the Vatna Jökull, whose icy wastes stretch thence to the south coast. The area of the much smaller lava-desert around Hekla is stated by Professor Johnstrup to be twelve Danish (= 240 English) square miles.

Some ten miles south-east of the centre of the Ódáðahraun stands a large mountain, with numerous smaller ones lying to the north-east of it. These mountains are the Dýngjufjöll. They have been known by this name from time immemorial; and upon Gunnlaugsson's large map of Iceland a curious oval space is shown encircled with a mountain wall having an opening in the N.N.E.; the oval being named Askja ("basket"). This, presumably is the "bower" from which the mountains derive their name. As will be seen by Lieutenant Caroc's map, Askja is almost circular in shape, and has an area of not less than 23 square miles, its circumference being between 17 and 18 miles. Those who have Gunnlaugsson's large map will observe that the oval space shown thereon very incorrectly delineates Askja; and on the map accompanying Mr. Watts's paper the orological features of this part of the country are but a modification of Gunnlaugsson's, a long oval space being shown, with two breaks in its encircling wall on the east, and one in the south-west at the extreme end of the oval. It is believed that Gunnlaugsson never visited the Dýngjufjöll, for if he had I feel confident, from the correctness of his map in every other part of the island where I have been, that the orological features of the Ódáðahraun would have been more correctly delineated than they are. When in 1837 he made an excursion into this portion of the interior to map it out he was compelled by fogs and snowstorms to abandon his project, and it was with the utmost difficulty that his party made their way to a farm. It is asserted that he repeated his excursion in the following year, but for the reason just stated I doubt if he then visited the Dýngjufjöll.

Svartákot ("black-river-cot") is the nearest inhabited house to the Dýngjufjöll, from which it is distant in a bee-line 20 miles, and from here, in favourable weather, it is possible to ride across the Ódáðahraun to Askja in from ten to twelve hours, including the ascent of its engirdling mountains, to a height of 4500 feet, and the descent into the crater. The "cot" is situated about 16 miles south-west of Mývatn, and is distant two longish days' ride from Akureyri, the chief port in the north of Iceland. On both my excursions I hired the farmer at Svartákot as guide; he is not only a first-rate guide, but also a capital fellow in every respect.

The first hour's ride from the cot is across level moorland, alive with willow grouse (*Lagopus subalpina*), when the Súdrá (? "south-river") is struck. This river, which is tributary to the Skjálfandafjót ("shivering-or shimmering-flood"), flows through an extensive sandy waste—not lava-desert as shown on Gunnlaugsson's map, and there named Súdrárhraun—bordering the Ódáðahraun on the north-west. The course of the Súdrá

is followed for about four miles, and the river is quitted at a spot where there is a very remarkable pool in which the water is in rotary motion, caused by a small hole at the bottom, through which it is descending to some underground channel. The source of the Súdrá is somewhat singular, consisting of numerous shallow pools in the sand, wherein frequently as many as half-a-dozen beautifully clear springs briskly bubble forth. The phenomenon is easily accounted for. The surface lava of the Ódádahraun lying at a higher level than the sandy waste, the melted snows and rains percolating through the porous lava for centuries have worn channels in the substrata, along which the surface water now flows until it reaches the sand, through which it rises as we have seen. In about an hour after quitting the river the lava is entered. The Ódádahraun lies at an altitude of about 1500 feet, and consists chiefly of countless lava-floods, varying greatly in age, some being thousands of years old and clothed with lichen, while others are as black and new-looking as those which flowed from the volcanoes east of Mývatn a century and a half ago. The newer lava-floods in the vicinity of the Dýngjufjöll on the north, have flowed from rifts which have opened time after time in Askja's encircling mountain wall, and at its base; while the south-west portion of the desert is stated by Mr. Watts to be covered with those which have flowed from the Trölladýngja ("Trolls-bower") which lies about 15 miles distant from Askja in that direction. Mr. Watts is the only man, I believe, save his guides, that has visited this mountain of late years, or crossed the desert between it and Askja; and it is to be regretted that he did not push on to the summit, so that he might have informed us whether a "bower" exists in the heart of this mountain similar to Askja. If such exists, it cannot, however, be nearly so large as Askja, the mountain being far smaller than the chief of the Dýngjufjöll. "The summit (of the Trolls-bower) was enveloped in clouds," Mr. Watts says, page 9 of his paper, "so I stopped within 300 feet of the top to get a good view of the country," and he subsequently makes no further mention of the mountain.

A large extent of the desert, especially in the north and north-west, is covered with lava that has welled forth from huge rifts in the substrata, in the same manner as a small lava-flood did north-east of Hekla in 1878, and a far larger one from Askja in 1875. The lava-floods which have issued in this manner are the newest looking and most rugged. The oldest superficial lava appears to be the last of veritable oceans of molten rock that at one time overspread the plain; its surface, congealed into innumerable dome-shaped bubbles, starred with deep fissures formed by the contraction of the mass when cooling, is passable on horseback, so evenly and freely has the lava flowed. As one's pony picks its way carefully over the flattened domes, the sound of its hoofs striking against the rock rings hollow, as if caverns were beneath, which is doubtless the case. Extensive tracts of black and lighter coloured pumiceous sand are

met with, where depressions between the newer lava-beds have been filled in by pumice eruptions and sand-drifts in stormy weather.

From the above brief description of the "Misdeed lava-desert," it will be evident that it can only be traversed by a very circuitous route; a bed of the rougher lava will frequently compel a detour of over half a mile.

The ascent of the encircling mountain wall of Askja may be said to begin out in the desert, at a point eight miles distant from the highest part of the defile, through which on the north it is possible to descend into the crater. Here we meet with the first of a number of ancient lava-streams, that most probably issued from the volcanic vent beneath Askja before its present encircling mountain wall was built up; and as each succeeding lava-flow was less in bulk than the one preceding, they form a succession of not very clearly defined terraces, the surface of each having a slight upward gradient until just at the limit of the one above, where there is a steeper incline for 50 feet or so. The altitude above sea-level of the surface of the highest terrace is about 3500 feet, 200 feet less than that of the surface lava in Askja, and 1300 lower than the highest point of the pass.

Ascending these terraces in a south-south-easterly direction, on the left hand, for a distance of five miles, a number of crater-cones and hills of scoriæ, several hundred feet in height, evidently mark where the vast deposits forming the terraces have been disturbed and upheaved by explosions, caused by the molten matter beneath the lava-filled cauldron Askja struggling to force a vent; while for a like distance on the right hand there is a tremendous chasm, beyond which a mountain, seven miles in length from north-west to south-east, rises precipitously to a height of at least 4000 feet from the depths of the chasm. This mountain is not shown on any map of Iceland that I have seen, and I think must have escaped Lieutenant Caroc's notice, owing to the thick weather which he experienced on his journey to and from Askja. Peculiar black domes, possibly of obsidian, crop like Mount Paul in the Vatna through the snow covering the summit of this mountain.

Shortly after leaving the last terrace the ascent becomes more steep, and it is necessary to dismount from one's pony and drag it reluctantly after, carefully picking one's way over lava-flows that have forced themselves through rifts in the defile, the spots where these issued being marked by crater-cones built of a peculiar light-red, slag-like lava; and later on, over the ice lying in the defile, which forms a steep, slippery declivity between two mountain walls, whose jagged peaks rise on either hand to a height of close upon a thousand feet. The direction of this pass—named *Jóns-skard* ("John's Pass") in honour of the first man who visited Askja—is from N.N.W. to S.S.E., and it is about half a mile in width throughout its whole length, which, I should judge, slightly exceeds two miles. Upon both occasions when I have visited Askja the

summers have been unusually hot, and the ice here has consequently been very rotten and dangerous. It is quite black in colour in places, owing to the immense quantities of black volcanic ash imbedded in it. The highest point of the pass is a few hundred yards from its southern end, where it terminates in a precipitous declivity of ice and ashes. From the verge of the precipice, a splendid view over Askja's weird amphitheatre is obtained. Lying 800 feet below is the lava-covered floor of this huge crater, whose circumference, as before stated, is between 17 and 18 miles, and its area at least 23 square miles. The somewhat jagged mountain wall encircling it rises above the floor of the crater to heights varying from 800 to 2500 feet. The highest hollows are filled with ice, and the peaks are snow-clad for ten months out of the twelve. In one place east of the pass there is a glacier exceeding four miles in length by one in width. Upon both occasions the floor of Askja, notwithstanding it lies 3700 feet above sea-level, has been free from snow at the time of my visit; owing, probably, to internal heat, as 20 miles south we have the glaciers of the Vatna Jökull, with a mean altitude of less than 5000 feet, and in the north-west of Iceland, at an altitude of less than 3000 feet, there are the icy wastes of the Glámu and Dránga Jökklar, neither of which tracts can possibly be more favourably formed for glacial deposit than Askja. The encircling mountain wall is highest on the south and north, and lowest in the north-east, where it does not rise more than 800 feet above the floor of Askja for over a mile. East of this there is a gap to the level of the lava-floods deposited in Askja, through which lava has coursed down the outer slope and spread over the Ódádahraun. There is another gap in the mountain wall in the south-west, but the only man who has been through this gap is Mr. Watts, and he says that "a lava stream here enters from the Ódádahraun, and has run for some distance uphill." From the appearance of the gap in the north-east, the declination, and especially the altitude of the surface lava in Askja, *2300 feet above the level of the Ódádahraun*, I am inclined to believe that Mr. Watts was deceived by some peculiarity in the appearance of a lava-flood from the south-west gap. It probably flowed from Askja in the winter season, and its outer surface, rapidly congealing, formed a covered way through which a molten stream coursed downward for some time; the supply ceased for a short period, a core of igneous rock formed in the covered way, and upon the flow recommencing, the lava stopped by the core was piled up above the upper end of the covered way, and now appears as though it had flowed upwards through it. Professor Johnstrup states that the lava on the eastern side of Askja has an inclination towards the gap in the north-east of 300 Danish feet in a stretch of 12,000, equal to one in forty, or a declination of $1^{\circ} 26'$.

The whole surface of Askja, save in the south-east where there is a hot-water lake five miles in circumference, and an extensive tract

covered with pumice erupted in 1875, is a chaos of rugged lava-floods that have issued here at different periods. From those on the left, looking south across the crater from the pass over an area exceeding a square mile, ascend innumerable small jets of steam. These do not mark the site of the 1875 eruptions, however, for these stufa are dwarfed into utter insignificance by enormous volumes of steam that belch forth on the farther side of the amphitheatre close under its encircling mountain wall in the south-east. These bursts of steam issue from rifts and vents opened by the 1875 eruptions.

The crossing of the lava-covered floor of Askja from the foot of the pass, where one perforce leaves his pony, is most fatiguing work; each time that I have crossed it has taken me—a young and active man—four hours to proceed as many miles, most of the way by the aid of my hands, protected by thick woollen mittens that they might not be cut by the lava. I may mention that it utterly ruins the pair of boots worn while crossing; so that an old pair with good soles should be taken by any one who purposes in the future to visit this volcano. When within a mile of the northernmost of the large bursts of steam one is able to walk upright, the lava being buried under a covering of pumice, which rapidly increases in depth as the site of the 1875 eruptions is approached. The pumice is of three colours, light silvery grey, black, and golden-brown, the latter very fibrous, and presenting the appearance of masses of the interior of the outer husks of gigantic coco-nuts. This substance is fast degrading into pumiceous sand.

In crossing the crater four times I saw no lava anywhere so new-looking that it could possibly have issued as recently as 1875, but among the pumice were huge blocks of obsidian and pitchstone that had undoubtedly been ejected at the same time as that substance.

The apex of the slope formed by the pumice is a cone-shaped crater, whose summit lies about 250 feet above the superficial lava beneath the pumice. When I was here in 1878 tremendous blasts of steam were belching forth almost continuously with perfectly deafening roars, but this year (1880), to my astonishment, all was still; and upon climbing to the summit I found that in the crater at a depth of 150 feet was a placid pool of apparently cold water. About 10 feet above the surface of the water were several inconsiderable stufa. The diameter of the mouth of the crater is between 450 and 500 feet, and the interior tapers down to a diameter of about 300 feet at the level of the water. This crater is beyond all doubt "the shaft like the mouth of a large coal-pit" mentioned by Mr. Watts in 'Across the Vatna Jökull,' though it is not situated in the "N.N.E. corner," but in the south-eastern part of Askja; for there is no other volcanic vent here that will answer Mr. Watts's description. The crater is built up entirely of pumiceous sand and a clayey loam; I saw no traces in its walls of scorïæ, or lava-like slag.

By the reading of my aneroid in 1878 the summit of this crater has

an altitude of 3850 feet, therefore the superficial lava in Askja at this spot lies at an altitude of 3600. According to Lieutenant Caroc's map, the lava just east of the north-east gap has an altitude of 3600 Danish feet = 3713 English, and the crater 3660 Danish = 3775 English.

This crater on the south-west slopes abruptly down to the surface of a hot-water lake lying some 600 feet below. The bed of the lake was formed by the disruption and subsidence bodily into an abyss beneath Askja of a huge mass of the lava deposits—of which more anon—oval in shape, of unknown thickness, and five miles in circumference. That this disruption and subsidence took place during the 1875 eruptions is proved by the fresh appearance of the face of the cliffs encircling the lake on the north, which show the strata underlying the present surface of Askja *en profile*.

Respecting the lava deposits thus bared, I beg leave to translate an interesting paragraph from Professor Johnstrup's paper read before the Danish Geographical Society.

“An excellent insight into the history of Askja's formation is here afforded, the vertical recently bared surfaces showing what a multitude of lava-floods must have been deposited in Askja's cauldron-shaped valley (*kjedelformige dal*) one above the other. The divisions between the lava-floods are distinctly marked by the layers of red slag-like lava which time after time has formed the surface of the underlying lava-strata; and I doubt very much if there can be found in any other part of Iceland—except the *Almannagjá*, where, however, the formation is far from being so distinct—such an instructive and grand profile as this. It has more than ordinary interest, owing to the striking resemblance presented by the volcanic deposits here to those widely spread rock-formations of basalt and dolerite which have been pronounced by most geologists to be of plutonic origin (*plutonisk Oprindelse*). Had they had an opportunity of viewing this profile, they would certainly have entertained a different opinion.”

When the Professor visited the volcano, he says the surface of the sunken mass lay 740 Danish feet below its original level; and according to Caroc's map, a lake existed in the south-eastern part of this, nearly circular in form and 4400 Danish feet in diameter, the surface of its water lying at an altitude of 2885 Danish feet. In 1878 I found that during the two years which had elapsed since the Professor's visit, the lake had greatly increased in size, its water then covering the whole surface of the subsidence to a considerable depth, and from the level of the water this year (1880) I should say that it had risen quite 40 feet since 1878. This is not to be wondered at when it is borne in mind that the greater part of the rain and snow which fall in Askja doubtlessly drain into the abyss. The Professor adds that he found the temperature of the water 104° Fahr., but when I tested it in 1878 it was only 97° Fahr.

The presence of this vast quantity of water within the crater of an active volcano is a most alarming feature; a comparatively slight eruption might be attended by an explosion that would further disturb the lava-floor of Askja, which appears to be but a roof to an abyss in which molten matter, it is reasonable to believe, lies at no great depth; the contents of the lake would find its way below when a terribly violent explosion must inevitably ensue, one that will be likely to cause an earthquake to which that in 1875 will be comparatively insignificant; and likewise to affect the volcanic repose of Europe, by forcing back, by the violence of the concussion, the molten tide lying in the channel or channels, connected with the earth's interior, underlying Europe; there being reason to believe that such do exist and are connected with the Icelandic volcanic vents, the great European earthquakes and volcanic disturbances having been either followed or preceded by terrific eruptions in Iceland, e. g. the earthquakes that destroyed Lisbon in 1755 were preceded by the commencement of a series of terrible eruptions from the K  tlugj  , which lasted a year; while thirty-two years later the Upper Calabrian earthquakes were followed by the outburst of prodigious lava-floids in the vicinity of Sk  ptarj  kull.

It is recorded that the great eruption of pumice took place on the morning of the 29th March, 1875, the eruption being preceded by a sharp shock of earthquake. A strong westerly gale must have prevailed at the time, for but a comparatively small quantity of the pumice ejected fell in Askja, the bulk being borne away to the eastward and scattered over the country in that direction and out to sea.

South-east of the lake, stretching into Askja's encircling mountain wall for nearly 1000 yards, is a deep gorge bordered on either hand with sheer precipices 600 feet in height at the very least. Herein are innumerable vents from which immense volumes of steam, perhaps also hot water, belch forth with such violence that the rock trembles under one's feet when standing 600 feet above them. This gorge has never been explored, neither by Johnstrup's party nor myself, for to make a descent therein a long rope is necessary, and with this I was unprovided; and owing to the clouds of steam which accompanied the more noisy outbursts it was impossible to see whether any hot water was ejected or not. However, I think it almost certain such is the case, and that one or more geysirs here exist, the stream of steaming hot water that was flowing down to the lake being too considerable to have been formed by condensed steam alone. By the violence with which the steam here escapes it is evident that even at this time (five years after the eruption) the heat in the abyss, whatever its nature, beneath Askja must be intense, and the pressure of steam very considerable, and that were it not for the vents, indeed safety-valves would be the fitter term, which here exist, another terrible eruption might at any moment take place.

The Askja eruption of 1875 is a very remarkable one in several

respects. No lava was ejected from the volcano itself, this substance forcing its way through a subterranean channel for a distance of 30 miles ere it found a vent, coming to the surface in a desert region known as the Mývatns Örafi ("Midgelake Desert") at a lower altitude by 2400 feet than the rift and crater in Askja, from which the pumice and ashes were ejected.

It was on the 4th January, 1875, that a violent explosion in Askja first notified to the Icelanders that a volcanic eruption of some magnitude was about to take place. This explosion caused an earthquake, one of the most alarming ever experienced, immense rifts 30 miles in length being opened in the deserts N.N.E. of the scene of the explosion. The greatest disturbance of the earth's surface at a distance from the volcano, took place at the spot where the lava-flood issued. Here an immense tract 20 miles in length, between two of the rifts, sank bodily into the earth to a depth of about 25 feet along its borders, and molten lava flowed forth nearly continuously for four months after the earthquake. The rifts on each side, where the tract has broken away, are somewhat similar in appearance to the well-known Allmens-rift and Raven-rift near Þingvellir, but narrower and far deeper, their depths not having been filled in with débris and soil, as is the case with the two mentioned. There can no longer be any doubt that the Allmens-rift and Raven-rift were formed by an earthquake and the breaking away and subsidence of the tract between them in the same manner as the two recently formed rifts here in the Örafi.

The lava now forms a bed about twelve miles in length from S.S.W. to N.N.E., by from half a mile to three miles in breadth. It is very rugged; the supply having been intermittent, the earlier lava-flows congealed into beds of rock ten to twenty feet in thickness, which have been shattered into fragments and upheaved by later lava-flows, in whose fiery embrace the jagged masses of the torn-up beds were borne along partly imbedded, and from which, now that those later molten floods are solid rock, they project at all angles. Above the longitudinal fracture down the centre of the displacement, bed after bed of congealed lava had been upheaved, the fragments being everywhere piled up in the wildest confusion, and in places built up into cone-shaped craters having an altitude of from 80 to 150 feet. Owing to there having been no impediment to the free flow of the lava, in the trough-like hollow formed by the subsidence, it has an average thickness along its borders of about 12 feet. Allowing that the mean width of the lava-bed is one mile only, and that the surface of the sunken tract slopes upwards on both sides of the longitudinal fracture at an angle of but 5° (unquestionably it is considerably more, midway between the southern and northern extremities, there being also an upward slope in those directions from this point to the level of the Örafi as well as laterally from east to west), the lava must be 236 feet in thickness along the centre, without taking

into account the immense quantity piled up above the longitudinal fracture, gradually decreasing to 12 feet at the sides; and thus computed the whole mass of igneous rock which has here issued must amount in round numbers to 36,000 of millions of cubic feet!

Thus this lava-flood is considerably more than twice as large as that from Hekla in 1845, which is computed to contain 14,400 millions of cubic feet (Danish), and it dwarfs into insignificance the lava streams ejected during the eruptions of Vesuvius in 1794 and 1855, which have been computed at 727 and 567 millions of cubic feet respectively. Only once since the settlement of Iceland has a larger one flowed forth, and that was from rifts which opened in, and adjacent to the Varmárdalr ("warm-river valley") near the Skáptarjökull on the west side of the Vatna. This lava-flood is erroneously stated by all previous writers to have flowed from the Skáptarjökull, where, it is positively asserted by Herra Thorodssen, an Icelander who has made the volcanoes of his native land his study, an eruption has never yet occurred!

I think it but right to add that Professor Johnstrup computes the bulk of the lava-bed in the Öräfi at 10,000 of millions of Danish cubic feet only; a ridiculously low computation, especially as the Professor gives the length of the bed from north to south at three Danish miles, and says that "its average breadth can be set down at a quarter of a Danish mile, and its depth along its borders from 10 to 15 Danish feet."

I am able to give the following particulars of the eruption in the Öräfi, for which I am indebted to Jón of Reykjahlíð, the nearest inhabited house to the scene of the outbreak; where, by-the-by, I stayed last summer, when I bagged four reindeer—the first, it is believed, of those animals that have fallen to an Englishman's rifle in Iceland.

Lava was first seen issuing on the 18th February, forty-six days after the earthquake; but it is probable the fiery flood commenced to stream forth immediately after, no one having crossed from Reykjahlíð to the eastward, or *vice versá*, during that period, but little travelling naturally being done in Iceland during the winter. For nearly four months the lava continued to stream forth more or less freely, and then ceased to flow until the 15th August, when a smart shock of earthquake was felt and a slight eruption of ashes and bombs took place—the only eruption of ashes at this spot. This eruption, I believe, was the one witnessed by Mr. Watts, and described in the above-mentioned paper and in his book 'Across the Vatna Jökull.'

I will now proceed to give my reasons for asserting so positively that the earthquake which opened the rifts in the Öräfi was caused by an explosion in Askja, and that the lava came thence through a subterranean channel. Steam and smoke were seen ascending from Askja immediately after the earthquake, and explosions continued to take

place there with such violence and frequency, during the whole time that lava was flowing forth in the Öraefi, that that exceptional and enterprising Icelander after whom the pass to the crater is named, Jón of Vidrkær, induced some of the peasants living on the borders of the desert to accompany him to the volcano in the month of February, the coldest month of an Icelandic winter. Moreover, *while no lava was erupted from Askja itself*, pumice (which is believed by geologists to be a scum which forms on the surface of molten lava) was ejected there, and only an infinitesimal quantity in the Öraefi; the quantity of pumice from Askja was prodigious, and proportionate to the magnitude of the lava-flood, which, I contend, came thence. Professor Johnstrup reported that 150 Danish (= 3000 English) square miles of country east of Askja were buried under a covering of pumice varying in depth from two inches near the coast to several feet at the base of the Dýngjufjöll. This, however, was only a tithe of what was ejected, the bulk being carried out to sea, some, as before observed, even being borne so far to the eastward as the inland districts of Sweden.

The beds of basaltic and doleritic lavas bared in the face of the cliffs bordering the hot-water lake in Askja are irrefragable proofs that a huge cauldron-shaped hollow formerly existed here, which has been filled up to its present level by lava-floods that have issued therefrom and spread one over the other. It is reasonable to believe that in the course of time these vast deposits first narrowed and then entirely blocked up the vent or vents whence the lava issued, so that in 1875 it required less force to upheave, at a lower level by some 2400 feet, the rocky roof of an old channel * running under the Öraefi, than to force a vent through the lava deposits in Askja itself. To judge from what occurred at both places it is probable that the force required to open the rifts in the Öraefi and that necessary to force an outlet through the old crater were nearly equal, and that at the same moment the rocky strata lifted in the desert, the huge oval mass that has sunk in Askja was also forced from its bed. Naturally, vents having been formed in two places, the heavier molten matter would flow from those at the lower level, while the steam and gases would make their escape, carrying with them the lighter substances such as pumice and ashes, from the vents at the greater altitude. The latter, moreover, would act in a manner as safety-valves, and the molten lava, not being subjected to any great pressure from confined steam or gases, by its own gravity would well gently forth through the newly formed vents at the lower level, instead of being forcibly hurled far and wide by the enormous pressure of confined steam

* The course of this channel is in all likelihood marked by the depression in the Mývatns Öraefi running in a N.N.E. direction, named the Svinagjá (? "swine-rift"), as at the spot where a line drawn from it would intersect the bed of the Jökulsá, a river east of the Öraefi, there is a group of small new-looking craters, and the surface of the earth has been greatly disturbed by earthquakes in modern times.

The displacement whence the lava issued in 1875 is in the Svinagjá.

No. VIII.—AUGUST, 1881.]

and gases generated above it, as most certainly would have happened if the "safety-valves" had not existed.

Fortunately for the inhabitants of the north-easterly part of Iceland this is exactly what occurred, as we have seen.

The shock of earthquake on the 15th August and the slight eruption of ashes in the Öräfi are, I think, easily accounted for. It is extremely likely that a quantity of water had been gradually collecting in the hollow in Askja, now the bed of the lake, and that at this time it suddenly found its way through a newly opened fissure into the abyss beneath, in which the molten lava had then fallen so low that its surface was lower than the level of the roof of the subterranean channel connecting Askja with the Öräfi, that the steam generated caused the shock of earthquake and forced out the pumice and other substances forming a scum on the lava in the channel. The fact that the lava had ceased to issue for some time previous to this shock of earthquake confirms the view taken, that the channel was only partly filled with lava so that a scum could form upon that lying therein; and from what was taking place in Askja a month earlier, when Mr. Watts was there, it is not very speculative to imagine that a fissure was newly opened and that through it the water from the snows, rapidly melting under the summer sun, found its way into the heated abyss.

In conclusion, it cannot be questioned that Askja is justly entitled to be considered Iceland's largest volcano, notwithstanding that no earlier eruption there than those of 1875 is recorded, and that prior to February of that year it was not known that the largest mountain-mass amidst the Ódáðahraun encompassed an almost circular crater having an area of at least 23 square miles. Those "hardy Norsemen" who sought a home in Iceland rather than abandon the pagan religion of their forefathers at the behest of a king, thoroughly explored their island home, and there can be no doubt visited this crater. This is conclusively proved, I think, by the name given to the mountains around, Bower-mountains; the bower being the crater Askja. In the course of time the verbal accounts of these early explorations became forgotten lore, and as nothing was to be gained by venturing into a wilderness of igneous rock, the interior of Iceland east of the Sprengisandr ("bursting-sand") became a *terra incognita* to the listless, apathetic, yet kind-hearted and hospitable modern Icelanders, till Jón of Vidrkær in 1875 and Mr. Watts in 1876 showed that the lava-desert was not so impassable as was believed. Although a decade seldom passed away without a volcanic eruption in the interior, no one was ever bold or curious enough to visit the spots where these took place until Jón of Vidrkær did so in 1875; and it was but seldom the trouble was taken even to record the date or duration of an eruption. Volcanic eruptions in Iceland invariably take place in thick weather, and are attended with the emission of immense quantities of steam; accordingly, from the inhabited

coast region (it is believed that in Iceland there are only two inhabited houses distant 40 miles from salt water) it is impossible to tell, if the scene of the eruption is any great distance off, the exact spot where it is taking place. Therefore it is hardly to be wondered at that in the annals of Iceland we find no mention of any eruption among the Dýngjufjöll. Eruptions that took place among the mountains in the desert were mostly placed to the credit of the Trölladýngja; consequently we find it stated that this volcano erupted in the years 1151, 1188, 1340, 1360, 1389, and 1510. In 1341 and 1510 we also find it mentioned that Herðubreið ("the broad-shouldered"), a mountain 12 miles north-east of Askja, erupted; but Professor Johnstrup, who has examined Herðubreið, says this cannot be correct, as it is not volcanic. In 1477 and 1598 great eruptions of sand and pumice took place from some volcano or volcanoes in the interior, but it is not recorded which. These were followed in 1618, 1862, and 1872 by violent earthquakes in the north; and in 1638, 1744, and 1862 we find it on record that flames were seen ascending in the desert. It is highly probable that some or most of these eruptions took place in Askja, as it is certain from the present state of this immense crater and the outer slopes of its encircling mountain wall that they have been the seat of eruption after eruption during historical times. The flames that were seen ascending from the desert doubtless marked outbursts of lava from channels radiating from Askja underlying the Ódádahraun, similar to the one that burst forth in the Mývatns Örafi in 1875. That such did issue at about the times mentioned the newer lava-floods seen on the way to Askja conclusively prove.

GEOGRAPHICAL NOTES.

Arctic Expeditions of the present Summer.—The expedition appointed by the United States Government for the search and relief of the *Jeannette*, sailed in the *Rodgers* from San Francisco, on the 16th of June. The vessel is a full-rigged barque of 420 tons, heavily sheathed with three-inch oak-plank and otherwise strengthened for ice navigation. The commander, Lieutenant R. M. Berry, has had previous Arctic experience whilst with the *Tigress* in the search for the *Polaris*. Thirty-five officers and seamen sail with him and the vessel is provided with stores for four years. After passing through Behring Strait, the instructions of the expedition are to cruise along the Siberian coast, communicating with the natives and endeavouring to obtain tidings of the missing vessel. From Cape Serdze Kamen the *Rodgers* is to proceed northward to Herald Island, hunting for cairns. Should no clue be met with up to this point, leading in a different direction, she will next direct her course towards the southern shore of Wrangel Land, and select a suitable shelter for wintering, and as soon as the ice is hard enough, sledging parties will be sent out in various directions. If no news be obtained of

