4 The Mystery Remains

Outside of Iceland, the true cause of the dry fog of 1783 and the many other phenomena remained literally and figuratively unmapped. Months would pass before the fog dissipated, years before its consequences would be fully revealed, and an entire century before the fog of ignorance that veiled Europe lifted. Ignorance, in this case, is defined as a lack of knowledge or awareness. While the eruption raged on this island just south of the Arctic Circle, the people of mainland Europe were oblivious.[1] Europeans strove to find the truth; the results of this search offer a unique glimpse into the late-eighteenth-century train of thought. An eruption at Mount Hekla or the newly emerged island off the Icelandic coast were singled out as possible sources of the dry fog; however, severe earthquakes in southern Italy were considered a much more likely explanation.

Myth and Legend

Europeans had known about Iceland and its volcanoes since medieval times. Battered by wind and wave, fire and ice, and home to volcanoes, geysers, waterfalls, and the aurora borealis, this wild island was irresistible to the curious minds of the Enlightenment.

Beyond the famous Icelandic sagas, only a few reliable descriptions of Iceland were available to Europeans during the Middle Ages and the Renaissance. Publications, for the most part, describe Iceland as an exotic destination. Tales of mountains spitting fire on a near-constant basis and terrifying monsters inspired awe and fear in equal measure. In some cases, the natives made efforts to clean up the image of the island. For example, in the late sixteenth century, Arngrímur Jónsson (1568–1648), an Icelandic scholar, wrote a treatise to disabuse outsiders of the notion that Iceland was, as some seemed to think, a kind of hell on Earth. For its part, the Royal Society of London collected news from Iceland where possible, presumably to elucidate the peculiarities of the island and cast some light wherever the shadow of ignorance might fall.[2]

Maps like Figure 51, drawn in the late sixteenth century by the Barbantian cartographer Abraham Ortelius (1527–1598), reaffirmed the idea of "Iceland as hell," held by most Europeans. The map shows a violently erupting Hekla while terrifying-looking creatures patrol a sea laden with ice and floating debris. Swedish cartographer Olaus Magnus (1490–1544) had similarly mapped Iceland in 1555.[3]

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1 Grattan, Michnowicz, Rabartin 2007: 154.

2 Agnarsdóttir 2013: 16.

3 Oslund 2011: 39. For a history on other historical maps of Iceland, see Walter, Baudach 2019.

https://doi.org/10.1515/9783110731927-004

Figure 51: Abraham ORTELIUS' *Islandia*, ca. 1590.

In the eighteenth century, the Danish central administration began sending naturalists to Iceland, as they knew that full and accurate descriptions of the conditions would be beneficial for initiatives such as agricultural reforms.[4] The Icelandic sagas often stoked the curiosity of outsiders and an increasing number of foreigners started to visit from the early eighteenth century onward. Some visitors were probably disappointed – after a long, strenuous, and most likely costly journey – to find very little from the times of the *Landnáma*. That so little survived from that time is not surprising given Icelanders' almost endemic poverty and the lack of building materials such as stone or timber: most houses were made of turf and, from the moment of completion, had a relatively short lifespan.[5]

The exoticness of a place is a comparison to one's point of reference – usually a home country or country of residence. Most travelers introduced in this chapter came from other countries in Europe, such as Denmark, the British Isles, Germany, Sweden, or France, to which they then compared Iceland. The island was undoubtedly remote, yet it was still a European territory, part of the Danish-Norwegian kingdom, even if it was marginalized. Icelanders were white Christian Protestants; in terms of race and religion, Iceland was comparable with much of western and northern Europe. It certainly could not match the mysteriousness of the Far East or the Pacific Islands.[6]

Europeans probably perceived Iceland as unique but not "utterly foreign."[7] Icelanders were quite well-educated for their time and impressed travelers they encountered with their linguistic abilities: most often, these travelers would meet the governor or one of the four district governors, who spoke English, German, French, or Danish. As Danish was the administrative language in Iceland and all the other parts of the Danish kingdom, all officials, as well as Icelanders who had received a university education in Copenhagen, spoke Danish. Other Icelanders might only have spoken Icelandic. Visitors regarded Icelandic as a highly sophisticated Germanic language and respected the literary heritage of the sagas. If all else failed, some Icelanders could converse with visitors in Latin, a skill that garnered much admiration and was a testament to their education. For most of the eighteenth century, cities were largely non-existent in Iceland. Reykjavík could not offer the same materialistic standards as other European capitals (Figure 52).[8]

The Danish jurist and amateur naturalist Niels Horrebow (1712–1760) visited Iceland between 1749 and 1751. He sought to conduct astronomical and meteorological observations. In 1752, he published a travelogue in Danish detailing his time in Iceland. Translations in German, Dutch, English, and French followed from 1753 to 1764.[9]

4 Oslund 2011: 74–75.
5 Oslund 2011: 5.
6 Agnarsdóttir 2013: 11; Oslund 2011: 7–10, 19.
7 Oslund 2011: 17.
8 Oslund 2011: 24–26.
9 Horrebow 1752; Horrebow 1753; Horrebow 1758; Horrebow 1764; Agnarsdóttir 2013: 17.

Figure 52: Sæmundur Magnússon Hólm, Reykjavík, ca. 1785.

Horrebow's travelogue was used and cited by virtually all travelers to Iceland in the late eighteenth century.[10]

Another aim of Horrebow's expedition was to refute the popular but sensationalistic book *Nachrichten von Island* (News from Iceland), which was published in 1746 by Johann Anderson, the mayor of Hamburg, and based on tales told by sailors. The outlandish claims made by Anderson include that Iceland saw constant volcanic eruptions and earthquakes. After his two-year-long stay in Iceland, Horrebow was able to debunk these claims and others in his book titled *Trustworthy News from Iceland*.[11] Horrebow was also interested in showing that there was no connection between Hekla, Vesuvius, and Etna, as Athanasius Kircher had suggested: Horrebow pointed out that the Italian volcanoes had been active in the early 1750s, while Hekla had been quiet. He believed

10 McCallam 2019: 203.

11 Anderson 1746; Horrebow 1758; Agnarsdóttir 2013: 17; McCallam 2019: 199.

volcanism had a chemical cause, proof of which, he said, was the flammable sulfuric air released through volcanic vents. Nicolas Lémery and Georges-Louis Leclerc, Comte de Buffon, had previously propagated these explanations.[12]

In June 1750, Icelandic students Eggert Ólafsson (1726–1768) and Bjarni Pálsson (1719–1779), undergraduates at the University of Copenhagen studying natural science, philosophy, and medicine, traveled to Iceland and made the first recorded summit of Hekla. The volcanic peak had been known to Europeans as the gate to hell since medieval times, but Ólafsson and Pálsson did not find any evidence of this at its peak.[13]

Following their successful ascent and their graduation from the University of Copenhagen, the pair received funding from the Danish Royal Society to travel around Iceland between 1752 and 1757 and conduct a survey of the country's natural resources. Additionally, they were to investigate the culture and customs of the Icelanders. Like Horrebow, they aimed to portray Iceland more accurately than previous reports.[14] During their exploration, they witnessed Katla's large 1755/1756 eruption. They documented a *jökulhlaup*, flooding that affected 50 farms, a layer of ash and pumice, and even volcanic bombs.[15] During their expedition, they kept diaries and notes, which they subsequently worked into a treatise. While Ólafsson died early in an accident, Pálsson became Iceland's first general surgeon in 1760. Their detailed treatise, 1,100 pages long, was published in 1772 as *Reise igiennem Island* (Travel through Iceland) in Danish. It was translated into German in 1774, French in 1802, and English in 1805.[16]

In the spring of 1767, the French naval officer Yves-Joseph de Kerguelen Trémarec (1734–1797) led another expedition that mainly explored Iceland from the sea and the Western Fjords. The main reason for their presence in Icelandic waters was to protect French fishing vessels. De Kerguelen published an account of his travels in French in 1771.[17] In his book, he paints the Icelandic population in a rather positive light but describes the Icelandic landscape as volatile: volcanoes and "ice mountains" threatened the traveler, who faced the real possibility of being engulfed by ice and lava at the same time.[18] Despite not exploring Iceland by foot or horse at great length, he

12 Horrebow 1758: 9–10, 15; McCallam 2019: 199–200.

13 Hekla, likely the most well-known volcano in Iceland, was said to be the mouth of hell. Several early modern maps portray Hekla as erupting, or "perpetually vomiting flames," as Karen Oslund (2011: 39) writes when describing Abraham Ortelius' map from 1570. David McCallam (2019: 200–201) traced the idea of Hekla as the mouth to hell back to Cistercian monks in the twelfth century, an idea that was then reinforced by German physician Kaspar Peucer in the fifteenth century; see also Chester, Duncan 2007.

14 Hjalmarsson 1988: 88; Agnarsdóttir 2013: 18.

15 McCallam 2019: 201–202.

16 Ólafsson, Pálsson 1772; Ólafsson, Pálsson 1774; Ólafsson, Pálsson 1802; Ólafsson, Pálsson 1805; Ogilvie 1992; Agnarsdóttir 2013: 18.

17 Kerguelen Tremarec 1771.

18 Agnarsdóttir 2013: 20.

made claims about mineral deposits, the exploitation of which would have aligned with French colonial ambitions.[19]

The English naturalist and explorer Sir Joseph BANKS, famous for taking part in James COOK's 1768–1771 voyage, financed and organized an expedition to Iceland in 1772 with the aim of advancing botany and geology.[20] Reaching the island on 28 August 1772, at the end of the Icelandic summer, the trip was too late in the year to observe the plant life. Instead, BANKS focused on geological explorations: he was specifically interested in observing Hekla.[21] The future Archbishop of Uppsala, Uno VON TROIL (1746–1803), the Swedish botanist Daniel Carl SOLANDO, together with artists, servants, and a French cook, accompanied him on this voyage. Highlights of the six-week-long expedition included a 350-mile round trip on horseback to visit and climb the imposing Mount Hekla and visits to Þingvellir and Geysir. Despite their best efforts, they did not witness any erupting volcanoes, which must have been disappointing. To observers in the late eighteenth century, this should have proven that Iceland was not covered in countless volcanoes producing "fiery vomit" all the time. The group might even have dined with Governor THODAL and Bjarni PÁLSSON; the latter would surely have told BANKS about his summit of Hekla. Although it is not certain that BANKS and PÁLSSON met in Iceland, BANKS likely knew that he was not the first to climb the mountain. Nevertheless, upon their return to Britain in November 1772, an erroneous rumor was printed in the newspapers claiming that BANKS and his companions had been the first to make it to Hekla's summit.[22]

VON TROIL published a report about their expedition in Swedish in 1777, which was translated into several languages over the following seven years. In addition to his observations, VON TROIL corresponded with three Icelanders, making his account quite reliable.[23] The book, and many of the versions published later in other languages, also included a detailed map (Figure 53).

BANKS' expedition and volcanological fieldwork built upon previous travel reports and added to the growing body of knowledge regarding volcanoes in mid-to-late eighteenth-century Europe. These expeditions began to tip the balance in favor of reliable accounts of Iceland as opposed to exaggerated and often unreliable sailors' tales. BANKS' expedition and VON TROIL's report would later inspire others to visit, such as John Thomas STANLEY (1766–1850) in 1789 and William Jackson HOOKER (1785–1865) in 1809.[24] By the end of the eighteenth century, mainland Europeans no longer regarded Iceland as a mythical

19 AGNARSDÓTTIR 2013: 19–20; MCCALLAM 2019: 203–204.

20 AGNARSDÓTTIR 2013: 22–23. See AGNARSDÓTTIR (2016) for detailed insights into Sir Joseph BANKS and his Iceland expedition.

21 MCCALLAM 2019: 204–205.

22 AGNARSDÓTTIR 2013: 22–23; MCCALLAM 2019: 197–213.

23 The three learned Icelanders with whom he corresponded were Bishop Hannes FINNSSON, the scholar and Reverend Gunnar PÁLSSON, and Hálfdán EINARSSON; TROIL 1779; TROIL 1780; AGNARSDÓTTIR 2013: 22–23; MCCALLAM 2019: 197–213.

24 MCCALLAM 2019: 198, 211.

Figure 53: Uno VON TROIL, *An accurate and correct map of Iceland*, 1780.

land of fire; instead, a clear scientific interest in Iceland's landscape and even the customs of its people grew, which will become apparent in the following subchapters.

A Search in Vain

During the Laki eruption, the Danish central administration was far away and poorly informed; what little help they eventually sent arrived too late for many Icelanders.[25] Two reports written between 1783 and 1785 are described below. These examples illustrate that early reports about the eruption were riddled with inaccurate information.

Sæmundur Magnússon HÓLM

Sæmundur Magnússon HÓLM's book on the Laki eruption was the first to be written on the topic outside of Iceland.[26] HÓLM was an Icelandic poet, artist, and scholar, who was born in the Meðalland region, one of the Fire Districts in southern Iceland, which explains his interest in the eruption and its aftermath. At the time of the eruption however, HÓLM was in Copenhagen and relied on letters and reports sent with the merchant ships back to Denmark. His book seems to be primarily based on accounts by Jón EIRÍKSSON (1728–1787) and Skúli MAGNÚSSON (1711–1794). He might have supplemented these accounts with additional information gleaned from letters that Icelanders in Copenhagen had received from friends and family.[27] The central administration allegedly denied him access to government documents in Copenhagen.[28] As far as we know, the book was produced by the author unprompted by any authority.

HÓLM tried to convey what he had gathered about the "fires" and their extent; however, his descriptions were vague. Perhaps because of the way he gathered his information, his account contained mistakes and was, in some cases, exaggerated: for instance, on a map, he drew mountains that did not exist and depicted the lava flow incorrectly.[29]

HÓLM's book titled *Jordbranden paa Island i Aaret 1783* (About the Earth fire in Iceland in the year 1783) was published in 1784 in Danish and later the same year in German.[30] It was not translated into Icelandic, perhaps because it was intended for an audience unfamiliar with the country.[31] The *Ephemerides* of the Societas Meteorologica

25 HERRMANN 1907: 94–97; KARLSSON 2000b: 180–181. The shipment arrived in April 1784, almost one year after the start of the Laki eruption.

26 He was born as Sæmundur MAGNÚSSON in Hólmaseli in Meðalland, which is one of the Fire Districts. When he went to Denmark to study philosophy and art at the Royal Academy of Art in Copenhagen, he added "HÓLM" as a family name. In 1787, he became the reverend of a parish in Snæfellsnes.

27 THORDARSON 2003: 7.

28 RAFNSSON 1984b: 261–162.

29 THORDARSON 2003: 7; PÁLSSON 2004: 76–77.

30 HÓLM 1784a; HÓLM 1784b; Thoroddsen 1925: 30; THORDARSON 2003: 7.

31 DEMARÉE, OGILVIE 2001: 223; THORDARSON 2003: 7.

Palatina for 1783, published in 1785, contained an extract from HÓLM's report. Johann Jakob HEMMER wrote a highly critical introduction for the report, in which he highlighted some of its inaccuracies and remarked that the translator had trouble understanding what HÓLM was referring to at times. HÓLM's publication, though inaccurate in parts, provides valuable information about how the dry fog affected Denmark.[32]

Magnús STEPHENSEN and Hans VON LEVETZOW

Magnús STEPHENSEN and Hans VON LEVETZOW's voyage, ostensibly a mission to help Iceland and investigate the eruption's effects on its society and economy, was also an opportunity for research.[33] STEPHENSEN and VON LEVETZOW wrote a detailed report on their expedition and published it in Danish in the spring of 1785 as *Kort Beskrivelse over den nye Vulcans Iidsprudning i Vester-Skaptefields-Syssel paa Island i Aaret 1783*, which translates as "Short Description About the New Volcano in Vester-Skaftafellssýsla in Iceland in the Year 1783."[34] The publication includes a map that inaccurately details the location of the lava flows (Figure 54).[35] This report, based on first-hand experiences rather than hearsay, was written in the immediate aftermath of the eruption while the country was still heavily affected by famine. Just like many of the other naturalists' travelogues, such publications were quickly translated into other European languages and read by contemporaries at the time.[36]

Upon reading Magnús STEPHENSEN's travelogue carefully, it becomes apparent that he traveled to the highlands north of Klaustur; however, it seems unlikely that he made it as far north as the Laki fissure, as he would then have concluded that it was the origin of the lava flow. STEPHENSEN's travels in this area took place between 22 and 24 July 1784. He found it difficult to make progress in the highlands; the lava was still hot, smelly, and in places hard to bypass. The air was thick with smoke, drastically reducing visibility, and the lakes and rivers were still hot.[37] The tephra deposits of ten to 15 centimeters on the ground made this endeavor even more difficult.[38] STEPHENSEN was expecting to find a stereotypical volcano, that is, a conical mountain with smoke rising from its top; in this case, he would not, and indeed could not. He describes several mountains in his report, many with smoke rising from them, but the Laki fissure eluded him.[39] According to Jón STEINGRÍMSSON, locals already knew that the eruption was produced by a fissure; however, this information was not conveyed to STEPHENSEN.[40]

32 Societas Meteorologica Palatina 1783: 689; THORDARSON 2003: 7.

33 For more information on STEPHENSEN and VON LEVETZOW's journey to Iceland, see Chapter Two.

34 STEPHENSEN 1785; RAFNSSON 1984b: 261–262.

35 THORDARSON 2003: 7–9.

36 STEPHENSEN, EGGERS 1786; STEPHENSEN 1813; THORODDSEN 1925: 31–32; DEMARÉE, OGILVIE 2001: 223.

37 STEPHENSEN 1786: 326–330; THORODDSEN 1925: 58; THORDARSON 2003: 7–9.

38 THORDARSON 2003: 7–9.

39 STEPHENSEN 1786: 326–330; THORDARSON, HÖSKULDSSON 2014: 9.

40 ÞÓRARINSSON 1984: 35; STEINGRÍMSSON 1998: 35–36.

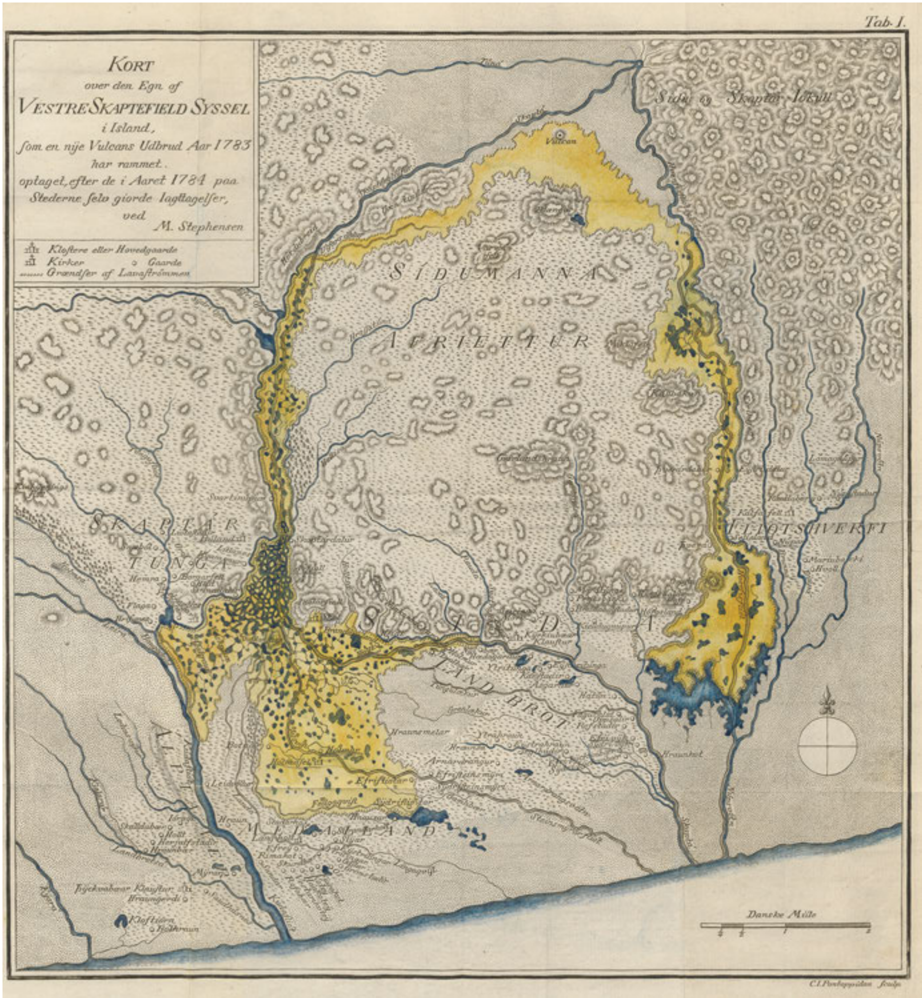

Figure 54: Map of the Laki lava flows by Magnús STEPHENSEN, 1784. The rough shape of the lava flows seems correct; however, the area from which the lava originated is lacking detail. STEPHENSEN did not travel to the location of the Laki fissure. Instead, he expected a single "Vulcan" at the most northern point of the lava (area in yellow).

In his report, STEPHENSEN explains at great length that he does not believe the source of the fire was what he calls an Earth fire mountain (*Jordbranden*/*Erdbrand*) but rather what he refers to as a fire-spitting mountain (*Feuerspeyen*). The fact that the lava flow was consistent and that new lava flows emerged – the first lava flow along the Skaftá River and then the second lava flow along the Hverfisfljót River – pointed to that conclusion, he argues.

> This should be enough to answer my question; I hope to have brought sufficient arguments that the subterraneous fire that erupted in Iceland now was no Earth fire but a fire-spitting [one]. The question remains where the location of this fire-spitting may have been.[41]

Naturalists and geologists at the time usually described volcanoes as *Earth fires* or *fire-spitting mountains*, the phrases seem to have been interchangeable, so it is interesting that STEPHENSEN puts great emphasis on the distinction between the terms; perhaps he did so deliberately to distract from the fact that he had not traveled very far into the highlands.

Icelandic historian Sveinbjörn RAFNSSON accuses Magnús STEPHENSEN of heavily relying upon Jón STEINGRÍMSSON's work without crediting him; Thorvaldur THORDARSON and Stephen SELF make the same allegation. STEPHENSEN did indeed use large parts of STEINGRÍMSSON's text, albeit excluding the latter's religious notions; perhaps he felt that the religious overtone of STEINGRÍMSSON's interpretation of the event was too eccentric for an enlightened European audience.[42]

The largest contrast between STEPHENSEN's and HOLM's publications is that STEPHENSEN emphasized the singularity of this "catastrophe." HÓLM, on the other hand, did not emphasize singularity at all: quite the opposite. He very much assumed that comparable events must have occurred in the past, basing his assumption solely on his awareness of the many large lava fields visible in the Fire Districts and elsewhere in Iceland.[43]

Sveinn PÁLSSON

A native Icelander, Sveinn PÁLSSON (1762–1840) (Figure 55) lived in the northern region of Iceland during the eruption – an area that was severely affected. In the spring of 1784, PÁLSSON wrote a short report about the Laki eruption, giving first-hand accounts of the ashfall and the frosty winter, the latter of which he blamed on the haze produced by the eruption. PÁLSSON penned a second-hand report on the eruption's impact on southern Iceland based on a letter he received from a friend living in the Síða region.[44]

From 1787 to 1791, PÁLSSON attended university in Copenhagen to study medicine. In the Icelandic translation of his travel journal, published in 1945, the foreword mentions how studying in Copenhagen opened a new world for PÁLSSON: he learned many new things and visited museums, art galleries, playhouses, and concerts, all of which

41 STEPHENSEN 1786: 325–326. "Dies mag zu Beantwortung der ersten Frage dienen, wobey ich zur Genüge gezeigt zu haben hoffe, daß das in Island jetzt ausgebrochene unterirdische Feuer kein Erdbrand, sondern ein Feuerspeyen gewesen sey. Es frägt sich nun weiter, wo der Ort des Feuerspeyens gewesen sey."

42 RAFNSSON 1984b: 261–262; THORDARSON 2003: 7–9.

43 RAFNSSON 1984b: 261–262.

44 THORDARSON 2003: 9.

Figure 55: Portrait of Sveinn PÁLSSON drawn by Sæmundur M. HÓLM in 1798 with red chalk. This connection illustrates how small the scientific community in Iceland was at the end of the eighteenth century and is an example of how most scientists knew each other personally.

he greatly enjoyed. During his time at the university, he frequently attended lectures by German naturalist and professor Christian Gottlieb KRATZENSTEIN (1723–1795), who was one of the first non-Icelanders to suspect a volcanic eruption as the cause of the strange fog of 1783.[45]

In 1789, Danish veterinarian Peter Christian ABILDGAARD (1740–1801), Danish-Norwegian zoologist Martin VAHL (1749–1804), and a host of other academics founded the Natural History Society (*naturhistorie-selskabet*), which existed until 1804. The Society gave travel research grants to four scholars.[46] In 1791, PÁLSSON received one of these grants, which was initially supposed to cover four years of field research on Iceland's natural history (1791–1795).[47] The travel research grant totaled 900 *ríkisdalir*, with an additional 58 *ríkisdalir* for the purchase of tools. He used the money for his

45 PÁLSSON 1945, vol. 1: xix, xx.

46 PÁLSSON 1945, vol. 1: xxi–xxii; STRØM 2006: 82–85; STRØM 2017: 62–65.

47 PÁLSSON 2004: xx–xxi.

fare to Iceland from Copenhagen, the support of two local guides, and the many horses he needed throughout his travels.[48]

PÁLSSON used the methods of Enlightenment-era science. As a first step, he went to see the natural phenomena with his own eyes; then, he concentrated on collecting data, which he would subsequently analyze and classify to create an overview of his findings.[49] At this time, between 1783 and around 1800, Icelanders were still struggling with the aftermath of the Laki eruption and faced a near-constant struggle with poverty.[50]

Initially, PÁLSSON's field research had focused on botany and biology; eventually, he became interested in Iceland's geology – primarily its glaciers but also its volcanic eruptions and hot springs. A journey through the Icelandic highlands in the eighteenth century was far from a pleasant experience: equipment and food had to be transported by horse across rough and unknown terrain, and ice-cold rivers had to be forded waist deep. The topography of these riverbeds was often unknown; getting stuck was a common occurrence. Traveling was not made easier by the frequent, almost daily, course changes of the glacial rivers, particularly in the summer – the main travel period of the year – when the sun melted the glaciers or when *jökulhlaups* (glacial outburst floods) occurred.[51] Sometimes fording rivers could be life-threatening; here, PÁLSSON depended on the expertise of his guides.[52] In the summers from 1791 to 1794, he explored Iceland and kept a travel journal of his observations (Figure 56); he was frustrated during the winters when the frigid weather compelled him to stay inside.[53]

The Natural History Society had its own journal, *Skrivter af Naturhistorie-Selskabet*, which was written mainly by the Society's directors and the recipients of the Society's travel research grants. Five volumes were published between 1790 and 1802. Excerpts from PÁLSSON's travel diary were published there too. The first excerpt was published in 1792, covering his departure from Copenhagen on 2 July 1791, his journey to Iceland, and the beginning of his travels through the country until 7 September 1791, presumably just before the last ships of the year returned to Denmark.[54] In 1793, the second excerpt was published, detailing his explorations from 7 September 1791 until April 1792.[55] Finally, the third and last excerpt from his travel diary was published in 1793, outlining his journeys from May 1792 until 20 July 1792.[56]

48 PÁLSSON 1945, vol. 1: xxiii. Price series of Icelandic currency only go back to 1849; therefore, an accurate estimate of the value of *ríkisdalur* from 1783 is impossible. Table 12.25 in JÓNSSON, MAGNÚSSON 1997, 637; personal correspondence with Prof. Guðmundur JÓNSSON, University of Iceland, 16 February 2020.

49 BJÖRNSSON 2017: 157.

50 PÁLSSON 1945: xxiii.

51 HERRMANN 1907: 73–74.

52 PÁLSSON 2004: 76.

53 PÁLSSON 1945, vol. 1: xxiii.

54 PÁLSSON 1792: 222–234.

55 PÁLSSON 1793a: 122–146.

56 PÁLSSON 1793b: 157–194.

A reviewer in *Laerde Efterretninger* (which translates to "learned intelligence") criticized the publications: PÁLSSON had received funds from the Natural History Society to describe the natural history of Iceland; the reviewer concluded that PÁLSSON's writings did not satisfy expectations. PÁLSSON may have been aware of this criticism, as he too believed he had not fulfilled the goals set out for him by the Society. Still, he continued to send letters and additional excerpts from his travel journal and later sent his book on Icelandic glaciers (*islensk Jisbierge*) to Copenhagen: the deliberation protocols of the Society mention the receipt of these documents in 1795 and 1796.[57]

PÁLSSON's manuscript makes it clear that he was aware of at least 70 volcanic eruptions in Iceland since 874. For most of these eruptions, very few reports existed. However, he noticed that people had been writing stories about major natural wonders, such as the Laki eruption, for many centuries to preserve them for future generations. He mentions the texts by HÓLM and STEPHENSEN, but because of their inaccuracies, he consigns them to the "solemn feast of eternal forgetfulness."[58]

On 30 July 1794, PÁLSSON arrived in the Síða region. Before continuing into the highlands and to the origin of the Skaftá Fires, he had to give his horses a few days' rest and find a new and knowledgeable guide. 11 years after the eruption, STEINGRÍMSSON's report and map gave PÁLSSON a rough idea of where he needed to go. PÁLSSON describes the mountains in the Síða region as "some of the greenest" he had ever encountered. This, no doubt, was a result of the green moss growing slowly over the *Skaftáreldahraun*, the Laki lava fields.[59] He was aware that the eruption, including its gases, ash, and lava, had wreaked havoc in this region just a decade before.[60]

When PÁLSSON, his guide, and their horses began their trip into the highlands, they likely left early in the day. On that day, the sun rose at 2:46 a.m. They were met with adverse weather conditions almost immediately: it was windy and raining.[61] In the evening, when they set up their tent in Lauffell, the temperature was 12.5 °C. Lauffell is a mountain about 17 kilometers northwest of Klaustur; this peak roughly marks the halfway point between Klaustur and the Laki fissure. Once they had set up their tent and the wind died down, the men decided to explore further. They forded the Hellisá River and climbed up Blágil and Galti, two hills (621 meters above sea level) just south of the southwestern end of the Laki fissure. On a clear day, it is possible to see Mount Laki from this point. When darkness began to set in – sunset that day was around 8:51 p.m. – the men began their return journey.[62]

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57 STRØM 2006: appendix, 57–58, 86, 89.

58 PÁLSSON 1945, vol. 2: 555, 556 (quote). "[. . .] af því að svo er að sjá sem sú hin sama hafi verið hátíðlega dæmd til eilífrar gleymsku."

59 PÁLSSON 1945, vol. 2: 555–557.

60 PÁLSSON 1945, vol. 1: 354.

61 PÁLSSON 1945, vol. 2: 559.

62 PÁLSSON 1945, vol. 2: 559–560.

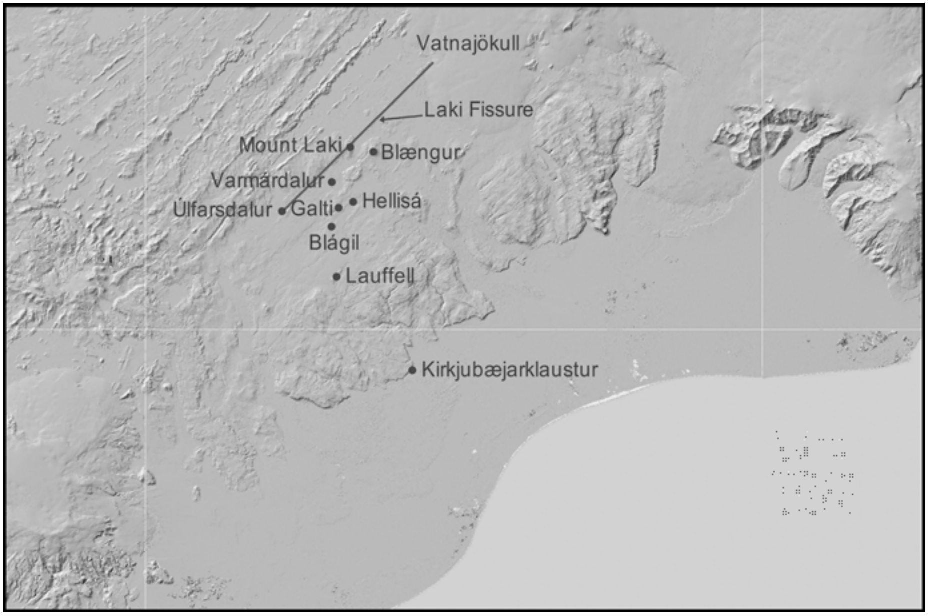

Figure 56: A map of the places and landmarks visited by Sveinn PÁLSSON and his companion.

On the second day of their journey, rain and fog greeted them as they peeked out of their tent. The wind had picked up as well. In his journal, PÁLSSON wrote of his concern over the outcome of the day. PÁLSSON and his guide decided to leave the horses behind for the day and explore the fissure on foot. One of PÁLSSON's goals was to measure the thickness of the lava, for he believed it had been partially eroded by wind and water. He collected samples of the large colorful rocks he encountered during the day, some of which he subsequently sent to the Natural History Society.[63]

Traversing the *Skaftáreldahraun* was made even more strenuous by the flimsy Icelandic shoes that PÁLSSON wore. The terrain was uneven, with many cracks and holes, and at times they could only make progress by moving along on all fours. The ground was loose in some parts and hollow in others; PÁLSSON had to pay attention to avoid falling. Some of the lava was still smoking and releasing a sulfuric smell. The craters that made up the fissure were wide and deep. PÁLSSON thought the Laki fissure was comparable to a large canyon. Interestingly, PÁLSSON was aware that they were the first humans to come across the lava field at this site and remarks upon it in his writings. When nightfall came, PÁLSSON placed a Danish coin on top of a rock on the fissure, as a sign of their arrival, before returning to his tent.[64]

63 PÁLSSON 1945, vol. 2: 560–562.
64 PÁLSSON 1945, vol. 2: 561–563, 588–589.

The next day, on 1 August 1794, the men decided to climb a mountain named Blængur. It is 833 meters above sea level, slightly higher than Mount Laki (812 meters). For once on this trip, the men were blessed with good weather. They set off with their horses and reached the top of the mountain sometime after noon. From their new vantage point, they could observe the "spine" of the fissure just to the northwest of Blængur. Here, PÁLSSON used the time to rest, update his journal, and draw the fissure. He also took notes on Mount Laki and the surrounding valleys, mountains, glaciers, and rivers, such as the Skaftá and Hverfisfljót. PÁLSSON took measurements with his barometer and thermometer whenever he had the opportunity. Sveinn PÁLSSON was the first person to put the Laki fissure on the map (Figure 57). He was also the first to carefully examine the location and understand the nature of this fissure eruption.[65]

After descending the mountain, the men explored the extent of the fissure further: they followed it toward where it cut through a valley called Úlfarsdalur but, once again, nightfall prevented them from traveling further.[66] PÁLSSON was "furious" that he and his companion had such limited time to explore the fissure and the extent of the lava it produced. After two full days of exploring, they returned to Klaustur.[67]

So it was that the source of the 1783 lava flow was discovered: more than ten years after the eruption. It had not come from a single cone-shaped mountain but from a row of "conical hills, stretching in nearly a direct line" within a valley called Varmárdalur.[68] The Laki fissure consists of around 140 craters, not 20, as PÁLSSON claims; that said, some craters are easier to identify than others. He correctly gives the direction as southwest to northeast. All of this gives him some leeway to criticize HÓLM and STEPHENSEN for the inaccuracies of their descriptions. Sveinn PÁLSSON believed that STEINGRÍMSSON's account of the Laki eruption was "the most probable truth."[69] HÓLM's account was understandably inaccurate, given that he had been in Copenhagen at the time. STEPHENSEN simply had not explored the highlands enough to identify the real source of the eruption.

PÁLSSON incorrectly surmised that the Laki eruption did not have a connection with a glacier. However, he knew that *jökulhlaups* had occurred between 1783 and 1785 along the coast of Vestur-Skaftafellssýsla. It was difficult for him to explain the connection between the subaerial, non-glacial Laki eruption and the *jökulhlaups*. PÁLSSON could tell from historical records that volcanic eruptions within the Vatnajökull

65 THORODDSEN 1925: 33; PÁLSSON 1945, vol. 2: 565–565.

66 PÁLSSON 1945, vol. 2: 568–569.

67 PÁLSSON 1945, vol. 2: 584. "Að lokum hlýtur hver maður, sem þekkir leið þá, er höfundur fór á tveim dögum, að falla alveg í stafi yfir flýtinum á honum, er hann les, hvernig hann varð dag og nótt að klängrast fram og aftur í heitu hrauninu, ganga á Miklafell með miklum erfiðismunum, klifra upp á hið mjög svo háa fjall Blæng, gera tilraun á þrem stöðum til að komast yfir hraunið og nota jarð- og steinborana á jafnmörgum stöðum, athuga og yfirlíta allar mögulegar hrauntegundir og önnur furðuverk, enda má það furðulegt kallast, að hann, fylgrarmenn og hestar skyldu endast til alls þessa á svo takmörkuðum tíma!"

68 PÁLSSON 2004: 120.

69 PÁLSSON 1945, vol. 2: 554; 571–599.

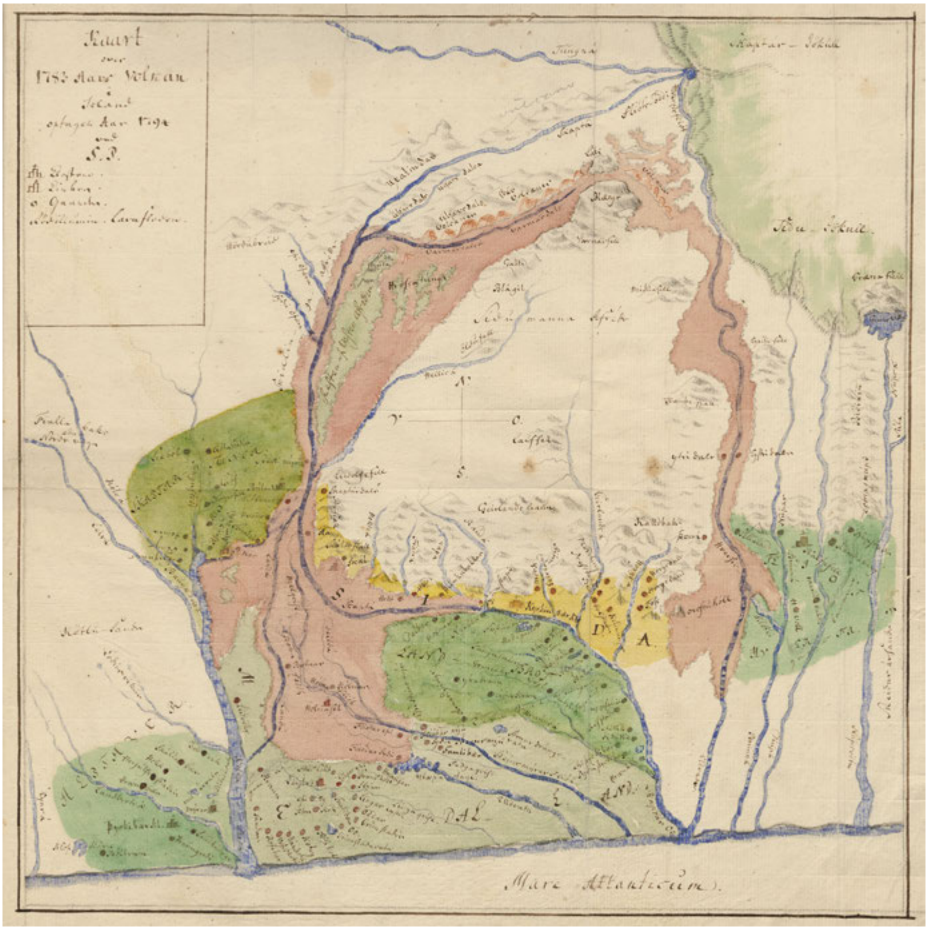

Figure 57: Map of the Laki lava flows drawn by Sveinn PÁLSSON, 1794. Although the extent of the lava flow is similar to the depiction in STEPHENSEN's map, the area where the lava originated is depicted in greater detail here. There is no single "Vulcan" anymore, but instead, PÁLSSON depicts a row of craters and vents near the Skaftá River.

glacier often produced *jökulhlaups* along the coast on the *sandur* plains.[70] Today, these *jökulhlaups* are explained by the fact that the Grímsvötn system, of which the Laki eruption was a part, is under a glacier and was active from 1783 to 1785.

PÁLSSON criticizes STEPHENSEN for believing that the Laki eruption had been a singular event in history. He refutes this notion by referring to several other devastating volcanic eruptions in Iceland's past, such as the Reykjanes Fires in the thirteenth

70 PÁLSSON 1945, vol. 2: 554, 567–576.

century, another flood basalt event, and the 1362 Öræfajökull eruption, the largest historical eruption in Iceland in terms of explosivity.[71]

Furthermore, Pálsson correctly assumed that the lava in the Skaftá gorge had come from the western side of the fissure during the earlier phase of the eruption and that the lava in the Hverfisfljót gorge had come from the northeastern part of the fissure beginning at the end of July 1783.[72] In his writings, Pálsson speculates that the fissure had only two distinct eruptive phases, a view widely accepted for almost two centuries.[73] Thordarson and Self have since proven that the eruption had at least ten eruptive episodes (14 if one includes the eruptive episodes at Grímsvötn).[74] However, it is remarkable that Pálsson was able to deduce that it was two different phases that flooded the two separate rivers with lava, one after the other.

The earthquakes before the eruption were due – so Pálsson believed – to fire coming into contact with flammable minerals that burnt slowly, such as peat or coal. According to Pálsson, this sort of fire was inextinguishable, for it burned deep within the Earth for as long as the mineral that fueled it lasted and could thus go on for several years.[75]

In 1794, the Natural History Society terminated Pálsson's travel research grant one year earlier than they had initially negotiated.[76] What led to the discontinuation of Pálsson's grant? It was most likely a combination of three things. First, the Natural History Society was in a position of financial precarity. Initially, the Society had quite a lot of members, each of whom paid an annual fee, including some royal members who were in the position to pay more than the fixed amount. Over time, the number of members dwindled, as did available funds.[77]

Second, in July 1795, a fire destroyed the publishing house of Nicolaus Møller and Son, and with it the 1795 volume of *Skrifter af Naturhistorie-Selskabet*. This would have been the fourth volume to appear in the series. The gap in publications between 1793 and 1797 was explained in the foreword of the re-written fourth volume when it appeared.[78] A fifth and final volume was published in 1799/1802.[79] In 1804, the Society was dissolved and, after some back and forth, its natural history collections were

71 Pálsson 1945, vol. 2: 576–577.

72 Thordarson 2003: 9–10.

73 Helland 1886; Thoroddsen 1879; Thoroddsen 1894; Thoroddsen 1925; Þórarinsson 1969.

74 Thordarson, Self 1993; Thordarson, Self 2003: 9–10, 26–27.

75 Pálsson 1945, vol. 2: 579. Pálsson also attributed the strong 1784 earthquake in southern Iceland to these flammable materials.

76 Pálsson 1945, vol. 1: 554.

77 Pálsson 1945, vol. 1: xxii; Strøm 2006: 85; Strøm 2017: 65.

78 Skrifter af naturhistorie-selskabet 4, no. 1 (1797), and no. 2 (1798). For the foreword, see no. 1.

79 Skrifter af naturhistorie-selskabet 5, no. 1 (1799), and no. 2 (1802). A sixth volume was written in 1810 but only published in 1818, it contained a register with all the contributions; Strøm 2006: appendix, 52.

taken over by the Royal Natural History Museum (*Det Kongelige Naturalienmuseum*) in Copenhagen.[80]

Third, the Society had heard very little from PÁLSSON. Allegedly, he had not responded to two letters they had sent him. PÁLSSON states in his book that he had only received one of the letters, to which he had replied.[81] Given the distance between Iceland and Copenhagen and the insufficient infrastructure within Iceland, it is possible that the root of the dissatisfaction on both sides was simply a matter of miscommunication and missed connections. Initially, some members of the Society had seemed disappointed with the direction PÁLSSON's explorations had taken and PÁLSSON's self-critical assessment of his work might have exacerbated this notion. In the long run, however, they warmed to PÁLSSON's findings. The deliberation protocols from March 1796 reveal that Christian ROTHE and Niels TØNDER LUND (1749–1809), directors of the Society, discussed the successes of PÁLSSON's trip. ROTHE reported that PÁLSSON had sent receipts for the instruments he purchased for the journey along with reasons why he believed the voyage was not entirely successful. He expressed his wish to keep the instruments and to continue making further observations. TØNDER LUND responded, saying he believed PÁLSSON had indeed fulfilled the Society's purpose, which was to extend the boundaries of science. He stated that the Society had welcomed PÁLSSON's observations and affirmed that he believed PÁLSSON should be allowed to keep his travel gear and tools.[82] In the end, self-doubt and insufficient funds proved to be the main obstacles on this expedition.

Despite the discontinuation of the grant, PÁLSSON persisted, using the long winters, in particular the winter of 1794/1795, to finish the manuscript about his Icelandic travels. In 1795, he then sent it to Copenhagen, perhaps hoping the Society's financial difficulties had been resolved. In the manuscript, he maps and describes Iceland's glaciers and their interactions with volcanic eruptions; he also offers a new system for classifying glaciers and describes their movements as well as their moraines, glacial rivers, and *jökulhlaups*.[83] The Natural History Society never published his manuscript: it simply remained in their archive.[84] The maps he drew are considered to be among the best that existed at the time. His map of Vatnajökull (then sometimes called Klofajökull) remained the most detailed of the glacier until the Danish government started mapping it in 1902 at a modern 1:50,000 scale.[85]

It was only in 1945 that PÁLSSON's glacier and volcano treatise, maps, and cross sections were finally published in their entirety, fully edited, and translated from

80 STRØM 2006: 85; STRØM 2017: 65.
81 PÁLSSON 1945, vol. 1: 346.
82 STRØM 2006: appendix, 89.
83 PÁLSSON 2004: xx–xxi; OGILVIE 2005: 279–280.
84 BJÖRNSSON 2017: 157–158.
85 PÁLSSON 2004: xxvii, 110.

Danish into Icelandic.[86] In 2004, the Icelandic Literary Society published an English translation.[87] The editor of PÁLSSON's work in 1945, Jón EYÞORSSON, describes PÁLSSON as "the best educated of all of his fellow Icelanders in many fields, [and] one of the most prolific writers of his age."[88] Had it been published, his treatise might have been received as a major contribution to the field of glaciology – and would perhaps have connected the Laki eruption and the phenomena in Europe much earlier. As it was, his ideas remained undiscussed in scholarly circles for some time.[89]

Severe hardship characterized the aftermath of the eruption throughout Iceland. Even still, PÁLSSON was able to use the limited means he was offered by the Natural History Society to carry out field research and finish his manuscript. Following his fellowship with the Natural History Society, PÁLSSON had several careers: he worked as a botanist, explorer, glaciologist, natural historian, meteorologist, and later a farmer and physician.[90] In 1795, PÁLSSON married Þórunn BJARNADÓTTIR (1778–1836), whom he had met during one of the winters when he was writing up his manuscript. She was the daughter of Bjarni PÁLSSON, the naturalist and explorer, who, together with Eggert ÓLAFSSON, had traveled throughout Iceland in the 1750s. In 1803, Sveinn PÁLSSON became Iceland's third general surgeon.[91]

A Clearer Picture

In the late eighteenth century, Iceland had already established itself as a magnet for scientific exploration and tourism for those interested in the sagas.[92] The eruption and its aftermath, far from discouraging exploration, motivated scientists to make the journey, particularly geologists: Iceland was an ideal site to study volcanic eruptions, their effects on the landscape, and how volcanoes might have shaped the Earth. A dichotomy existed here: the very thing that brought despair and destruction to the Icelanders now seemed so attractive to outside explorers. News of volcanic eruptions in Iceland drew naturalists and wealthy amateurs who were keen to see the changes that a volcanic eruption could produce in a landscape. These stories likely inspired the expeditions of John Thomas STANLEY, George MACKENZIE, and Henry HOLLAND, among others.[93]

86 BJÖRNSSON 2017: 158; PÁLSSON 1945.
87 PÁLSSON 1945; PÁLSSON 2004: xx–xxi.
88 PÁLSSON 2004: xxii.
89 PÁLSSON 2004: xxv–xxvi.
90 PÁLSSON 2004: xx–xxi.
91 PÁLSSON 1945, vol. 1: xxiii.
92 OSLUND 2011: 35.
93 OSLUND 2011: 39, 43.

Upon spotting an Icelandic volcano, one traveler described it as "ugly, barren, and desolate, although scientifically intriguing." Later, in the nineteenth century, these barren landscapes were celebrated as quintessentially Icelandic.[94]

English naturalist John Thomas STANLEY traveled to Iceland in 1789. Initial reports from the expedition were published in the *Transactions of the Royal Society of Edinburgh*.[95] The expedition's other participants kept diaries, which were posthumously published in the 1970s.[96] STANLEY remarks that the Icelanders lived in "savage" conditions but praises their moral and intellectual abilities, describing them as equal to "the most civilized communities in Europe."[97]

As was typical for affluent young men at the time, STANLEY had embarked on a grand tour of Europe during the summer of 1783; he had wished to see the Alps, but the dry fog conspired to ruin his plans.[98] Another grand tour in 1787 brought STANLEY to Italy, where he climbed both Vesuvius and Etna. By the time he traveled to Iceland in 1789, STANLEY had directly and indirectly experienced volcanoes and the effects of their eruptions. It is, therefore, unsurprising that he was fascinated by Iceland's volcanism. Perhaps it was reading Joseph BANKS' report on his ascent of Hekla almost two decades earlier that inspired STANLEY to attempt the climb himself.[99] Whatever the reason, he climbed to the summit and placed a British flag there.[100]

STANLEY also painted a watercolor of an erupting Hekla with two human climbers in the foreground, looking at the volcano. This painting depicts how he visualized the event in his mind's eye, as it had last erupted in 1766 and would not erupt again until 1845.[101] Historian Karen OSLUND suggests the painting represents the human "posture of powerlessness toward the mountain in the face of nature's might. The diabolic black and red colors of the painting are particularly evocative of Hekla's status in legend."[102] Many subsequent paintings of Hekla were based on STANLEY's sketches and descriptions; most did not allude to the hardships Icelanders experienced after significant eruptions.[103]

STANLEY wrote about his experience with the dry fog of 1783 sometime after the French Revolution, as is clear from the context of his writing.[104] Therefore, it is

94 OSLUND 2011: 39.
95 STANLEY 1794.
96 WEST 1970.
97 AGNARSDÓTTIR 2013: 24.
98 John Thomas STANLEY, MS, JRL 722, John Rylands Library, University of Manchester, Manchester, UK; WAWN 1981; WAWN 1989.
99 WAWN 1981; MCCALLAM 2019: 209.
100 WEST 1970, vol. 1: 208; AGNARSDÓTTIR 2013: 23–24; MCCALLAM 2019: 212.
101 Global Volcanism Program: Hekla.
102 OSLUND 2011: 41.
103 OSLUND 2011: 42.
104 John Thomas STANLEY, MS, JRL 722, John Rylands Library, University of Manchester, Manchester, UK: 103.

possible that he wrote his memoirs about his grand tour to Switzerland after his travels to Iceland. It is unsurprising that his experiences in the land of fire and ice convinced him that Iceland had something to do with the fog of 1783. He writes, “the Mountains of Skaftafell [which] vomited its columns of fire precisely during the period the fog lasted.”[105]

In 1809, Joseph BANKS sent his protégé William Jackson HOOKER to Iceland as part of the PHELPS-JÖRGENSEN expedition.[106] Before this trip, BANKS shared an account of his journey to Hekla with HOOKER. Historian David MCCALLAM argues that toward the late eighteenth and early nineteenth century, the perception of Hekla changed from that of a mountain synonymous with constant and violent fire-spitting to a symbol of “scientific and quasi-imperial ‘conquest.’”[107]

One year later, in 1810, the Scottish geologist Sir George MACKENZIE (1780–1848) traveled to Iceland accompanied by British physicians Richard BRIGHT (1789–1858) and Henry HOLLAND (1788–1873). They sought to explore Iceland’s volcanic regions. A book about their adventures and observations was published in 1811.[108]

MACKENZIE was a member of the Edinburgh Royal Society.[109] There was much debate at the time, within the Society and in wider academic circles, about the natural processes that formed the Earth. MACKENZIE wanted to find evidence to support and advance the theory championed by Scottish geologist James HUTTON, who had suggested that a great heat inside of the planet was responsible for the formation of rock: an idea called Plutonism. The counter to this was Neptunism, a theory that suggested that crystallization processes in the oceans had formed the sediments. Unlike many of his contemporaries, HUTTON imagined the Earth was in a cycle of constant formation and erosion. His theory of perpetual upheaval and renewal seemed to be confirmed by the frequency of volcanic eruptions. Furthermore, HUTTON emphasized that geological processes occurred gradually, regularly, and repeatedly over long periods, which became an accepted geological doctrine that, in the 1820s, finally ended the conflict between Neptunism and Plutonism.[110]

Between 1814 and 1815, Ebenezer HENDERSON (1784–1858) traveled around Iceland for 13 months. Unlike most of his contemporaries, he spent a winter there; he also traveled further afield than most. HENDERSON was a Scottish Calvinist minister and missionary whose trip was supported by the British and the Foreign Bible Society. The main purpose of his visit was to evangelize, and he managed to distribute at least

105 John Thomas STANLEY, MS, JRL 722, John Rylands Library, University of Manchester, Manchester, UK: 95–97.

106 AGNARSDÓTTIR 2013: 24; JÖRGENSEN 2016. William Jackson HOOKER was a British botanist who later in his life became the director of Kew Gardens in London.

107 HOOKER 1813, vol. 2: 105–119; MCCALLAM 2019: 212.

108 MACKENZIE, HOLLAND 1811; HOLLAND 1987; OGILVIE 2005: 278–279.

109 For more information on George MACKENZIE, see WAWN 1982.

110 HUTTON 1788; HOLLAND 1987: 254–255; OSLUND 2011: 43. The geology debate is outlined in PORTER 1977.

5,000 copies of the Icelandic translation of the Bible to people whom he described as grateful.[111] HENDERSON also wrote about his adventures: he published a travelogue about his journey in 1818. His publication was special because Sveinn PÁLSSON had been able to give HENDERSON a handwritten copy of his treatise on glaciers and volcanoes. Long before PÁLSSON's manuscript would be published, HENDERSON was able to study it and share some of its revolutionary content with the world. HENDERSON built on a map drawn by PÁLSSON; both had understood that Skaftárjökull was a part of the Vatnajökull ice cap (Figure 58).[112]

> It not only appears to have been more tremendous in its phenomena than any recorded in the modern annals of Iceland, but it was followed by a train of consequences the most direful and melancholy, some of which continue to be felt to this day. Immense floods of red-hot lava were poured down from the hills with amazing velocity, and, spreading over the low country, burnt up men, cattle, churches, houses, and every thing they attacked in their progress. Not only was all vegetation in the immediate neighborhood of the volcano destroyed by the ashes, brimstone, and pumice, which it emitted; but, being borne up to an inconceivable height in the atmosphere, they were scattered over the whole island, impregnating the air with noxious vapors, intercepting the genial rays of the sun, and empoisoning whatever could satisfy the hunger or quench the thirst of man and beast.[113]

HENDERSON's vivid description gives readers a good idea of the horror of the eruption. His evocative text further details the repercussions of the *móðuharðindin*. It is intriguing to read that in 1814 and 1815, at the time of HENDERSON's journey, the echoes of the eruption's consequences remained. HENDERSON describes the Laki fissure as a stretch of conical hills running in a direct line; he also details the landmarks surrounding the fissure.[114] Unsurprisingly, he refers to the fissure as the "Skaptár volcano," as in Iceland, the eruption was known as "the Skaftá Fires." HENDERSON was the first published author to clearly identify the volcano as a fissure which was certainly a unique assertion in 1818, the publication date of his two volumes; his report, however, did not change the trajectory of the scientific debate.

From his footnotes, we can tell that HENDERSON critically engaged with the materials he used: he realized that STEPHENSEN's report included mistakes, which he "altered according to Mr. Paulson's MS. [manuscript]."[115] This suggests that he found PÁLSSON's work more credible than STEPHENSEN's. HENDERSON then linked the eruption to the dry fog in Europe: "The quantity of ashes, brimstone, &c. thrown up into the atmosphere was so great, that nearly the whole European horizon was enveloped in obscurity [. . .]."[116] Just as his peers had in Europe, HENDERSON attempted to bring together

111 AGNARSDÓTTIR 2013: 24.
112 OSLUND 2011: 43; BJÖRNSSON 2017: 157–158.
113 HENDERSON 1818: 274.
114 HENDERSON 1818: 276.
115 HENDERSON 1818: note on 287.
116 HENDERSON 1818: 287–288.

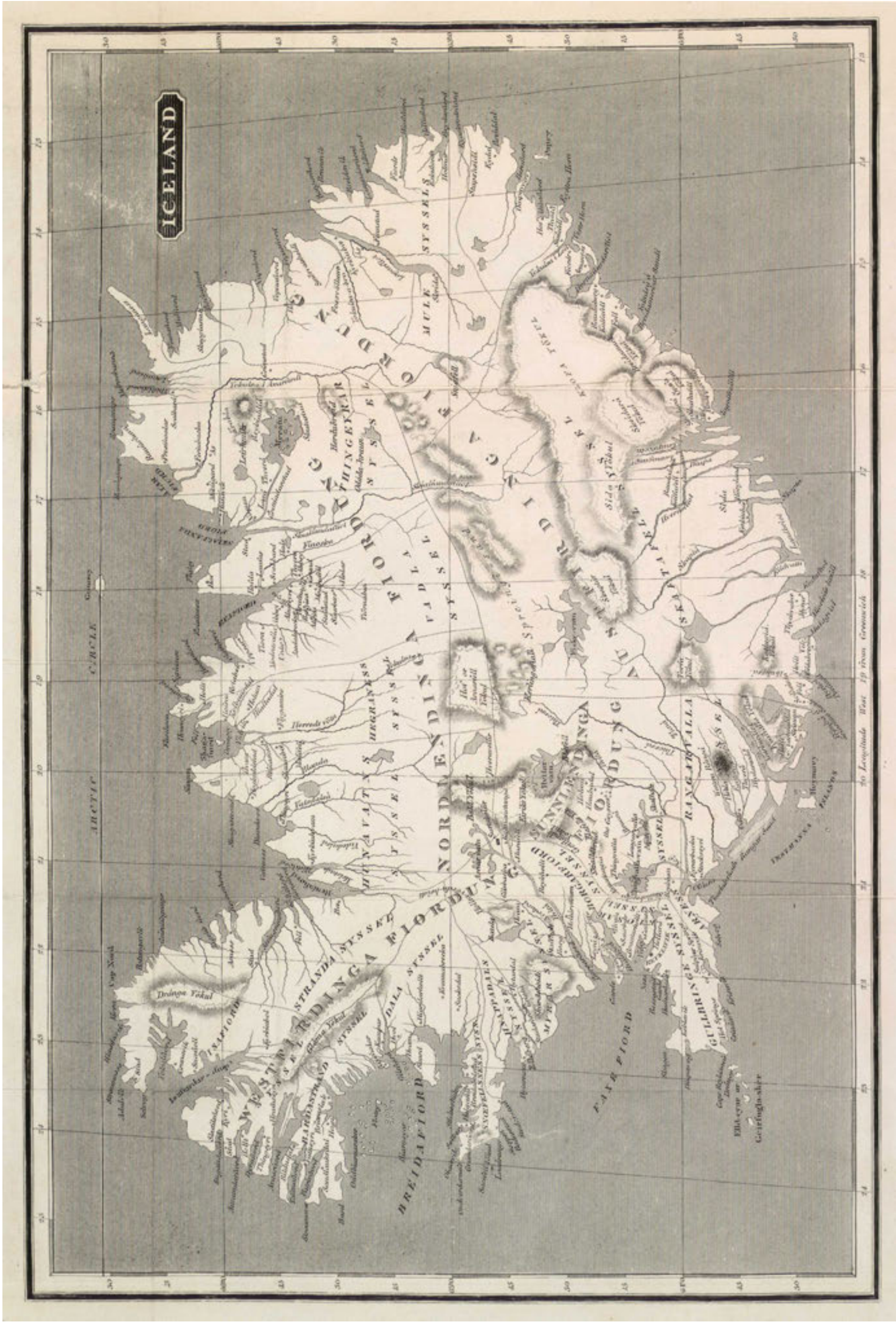

Figure 58: Ebenezer HENDERSON's map of Iceland, 1818.

all the phenomena witnessed that year rather than distinguishing one cause for one effect. Despite this, even in the 1830s, dictionary articles on the topic of the fog still repeated the plethora of theories that had been debated all the way back in 1783.[117]

Perhaps if the Tambora eruption of 1815, the largest in recorded history, had happened in full view of the outside world, there would have been more interest in HENDERSON's publication just three years later. The Tambora eruption dramatically changed the weather in large parts of Europe and North America, causing a year without summer in much of the world in 1816. Famously, this inspired novelist Mary SHELLEY, on a retreat in Switzerland, to write *Frankenstein*. Although reports about the Tambora eruption eventually circulated, its occurrence remained unconnected to the cold weather of the following year for almost one century.[118]

In 1830, British geologist Charles LYELL (1797–1875) wrote his *Principles of Geology*, which became the foremost geology textbook of the nineteenth century. The text explains that Iceland plays host to a volcanic eruption or large earthquake at least once every 20 to 40 years.[119] It reaffirms how "terrible" Hekla's eruptions are: "So intense is the energy of the volcanic action in this region, that some eruptions of Hecla have lasted six years without ceasing. Earthquakes have often shaken the whole island at once."[120] He states that volcanic and seismic activity changes the landscape: rivers change their course, new lakes appear, hills sink, and "new islands have often been thrown up near the coast, some of which still exist, while others have disappeared."[121]

The text mentions both the Nýey and "Skaptár Jokul" eruptions in Iceland in 1783. LYELL understood the direction of the spreading axis in the center of Iceland: "Many cones are often thrown up in one eruption, and in this case they take a linear direction, running generally from the northeast to the southwest, from the northeastern part of the island where the volcano Krabla [Krafla] lies, to the promontory Reykjanes."[122] He believed that

> [t]he convulsions of the year 1783 appear to have been more tremendous than any recorded in the modern annals of Iceland; and the original Danish narrative of the catastrophe, drawn up in great detail, has since been substantiated by several English travelers, particularly in regard to the prodigious extent of country laid waste, and the volume of lava produced.[123]

117 BRANDES et al. 1833: 34–53.

118 SYMONS 1888: 29, here, the eruption is listed as "Tomboro." HUMPHREYS 1913: 369; KRÄMER 2015: 23–26; BRÖNNIMANN, KRÄMER 2016: 11. Daniel KRÄMER has established that in 1913, William Jackson HUMPHREYS proposed a connection between the cold weather and the Tambora eruption.

119 Today we know that Iceland sees a volcanic eruption every three to five years on average.

120 LYELL 1830: 371.

121 LYELL 1830: 371.

122 LYELL 1830: 361, 372 (quote).

123 LYELL 1830: 372.

In an accompanying footnote, he mentions STEPHENSEN and HENDERSON's publications. He also gives credit to "Mr. Paulson's" manuscript and states that PÁLSSON had visited "the tract" in 1794. LYELL further details the course of the eruption, the drying-up of the rivers, and their subsequent engorgement with lava.[124]

In his conclusion, LYELL seems mesmerized by the sheer volume of "melted matter produced in this eruption." He calculated that the two rivers, which had been filled with lava during the eruption, had a length each of 40 to 50 miles and that the Skaftá River was 12 to 15 miles in breadth and the Hverfisfljót River seven. He estimated the height of the lava to be between 100 and 600 feet and claims that this volume exceeds any other. The Skaftá lava, at its peak, "rival[ed] or even surpass[ed] in height Salisbury Craigs and Arthur's Seat."[125] He was not aware of any "ancient strata" or "igneous rocks of such colossal magnitude" – but concedes that the geologists so far had "hitherto investigated but a small part of the globe."[126]

Frederick HAMILTON-TEMPLE-BLACKWOOD (1826–1902) was a British diplomat and politician better known as Lord DUFFERIN. His travels took him to Iceland, Norway, and Spitsbergen; during these voyages he wrote many letters to his mother. Upon his return, he turned these letters into a book, *Letters from High Latitudes*, which became very popular and was translated into several languages. His book was instrumental in turning Iceland into a tourist destination.[127] Travelogues like these, said to describe "the real Iceland," were much sought after by Europeans during the late Enlightenment. After the Napoleonic Wars, travelogues in many European languages became widely available.[128]

Other scholars who traveled to Iceland in the second half of the nineteenth century and produced notable publications include William PREYER (1841–1897) and Ferdinand ZIRKEL (1838–1912), who together published a travelogue in 1862. PREYER, an English-born zoologist, and ZIRKEL, a German geologist, had both traveled to Iceland and the Faroe Islands. Their publication included scientific observations and a chronology of past Icelandic eruptions, including the eruption of "Skapárjökull."[129]

124 LYELL 1830: 372–374.

125 LYELL 1830: 374–375.

126 LYELL 1830: 376. Today we know that there are several large igneous provinces around the planet (see also Figure 6 in this book). Their volume exceeds the Laki eruption's lava volume by orders of magnitude.

127 DUFFERIN 1856; HANSSON 2009.

128 AGNARSDÓTTIR 2013: 24.

129 PREYER, ZIRKEL 1862: 462–468. This source details the consequences of the Laki eruption for Iceland, but there is no reflection of the consequences of this eruption outside of Iceland.

Rediscovering Sveinn PÁLSSON

It took almost a century for the Laki fissure to find its way back into the scientific discourse: when it did, things moved quickly. In the 1880s and 1890s, the Laki fissure once again drew explorers to Iceland; literature about those journeys invigorated interest in the topic.

Icelandic geologist and geographer Þorvaldur THORODDSEN (1855–1921) stumbled upon Sveinn PÁLSSON's unpublished manuscript, *The Physical, Geographical, and Historical Descriptions of the Icelandic Ice Mountains*, in an archive in Copenhagen.[130] In 1879, THORODDSEN published "The Volcanic Eruption in Iceland in the Year 1783" in *Geografisk Tidsskrift*, a Danish geography journal. In his paper, THORODDSEN describes the fissure and details PÁLSSON's travels and findings alongside mentions of STEPHENSEN's journey.[131] As early as 1880, THORODDSEN had done extensive work on Icelandic volcanism and published a chronology of past volcanic eruptions since around 900 CE.[132]

Amund HELLAND (1846–1918), a Norwegian geologist, glaciologist, and later a professor, traveled extensively between 1875 and 1877, visiting Norway, Iceland, Greenland, Italy, Germany, and England.[133] HELLAND likely heard mention of Sveinn PÁLSSON's manuscript whilst researching in Copenhagen.[134] In the early summer of 1881, HELLAND returned to Iceland on a Swedish cargo ship.[135] It is safe to assume he was interested in Iceland's geology, volcanoes, and glaciers.

A footnote in THORODDSEN's posthumously published German manuscript clarifies that HELLAND and THORODDSEN knew each other. When HELLAND came to Reykjavík, he asked THORODDSEN to recommend an interesting volcano to visit; THORODDSEN suggested the Laki crater row "without reservations."[136] THORODDSEN further supplied HELLAND with a handwritten copy of Sveinn PÁLSSON's manuscript.[137] HELLAND then made the journey to the fissure, arriving on 14 August 1881 and staying in its proximity until 18 August. According to Þorvaldur THORODDSEN, only one other person had visited Laki

130 THORODDSEN (1879: 67) states that he found PÁLSSON's manuscript about the glaciers at the Royal Library (Kgl. Bibliothek), in the Ny Kgl. Saml. (new royal collection), nr. 1094 b-c. THORODDSEN (1879: 70) further writes that he found PÁLSSON's manuscript titled "Tillaeg Beskrivelserne over den Volcan, der braendte i Skaptafells syssel Aar 1783, sam let ved en Rejse i Egnene 1793 og 1794 med et kort" in the "isl. Lit. Selsk. Arkiv fol nr. 23," presumably also in Copenhagen.

131 THORODDSEN 1879.

132 THORODDSEN 1880.

133 KRISTJÁNSSON, KRISTJÁNSSON 1996: 28; BRYHNI 2009.

134 BJÖRNSSON 2017: 157–158; HELLAND 1886: 8.

135 KRISTJÁNSSON, KRISTJÁNSSON 1996: 29.

136 THORODDSEN 1925: note on 34. "Ich hatte 1879 über diese Ausbrüche, die mich sehr interessierten, geschrieben, und da A. Helland in Reykjavík mich frug, ob ich ihm einen besonders interessanten Vulkan nachweisen könnte, schlug ich ihm ohne Bedenken die Kraterreihe des Laki vor, worauf er dann auch hinreiste."

137 KRISTJÁNSSON, KRISTJÁNSSON 1996: 31.

since PÁLSSON's visit: an Icelandic politician, Jón GUÐMUNDSSON, who had made the trip in September 1842 while residing in Klaustur; this made HELLAND the first foreigner to visit the Laki fissure.[138]

Upon his return to Norway, HELLAND published papers on the various parts of his journey around Iceland, focusing particularly on matters of volcanology and geomorphology.[139] He also published several parts of PÁLSSON's manuscript in 1881, 1882, and 1884 in *Den Norske Turistforeningens Årbok*, the Yearbook of the Norwegian Travel Association. The title of these Danish publications translates as "Descriptions of the Icelandic volcanoes and glaciers by the Icelander Sveinn Pálsson."[140] HELLAND, the first geologist to inspect the Laki fissure, was appointed professor of geology at the University of Kristiania, today's Oslo, in 1883.[141]

In 1882, Scottish geologist Archibald GEIKIE (1835–1924) published his seminal work, *Text-Book of Geology*.[142] From the book, it is clear that the Laki eruption – at this point still referred to as "the eruption of Skaptar-Jökull" – caused great quantities of fine dust to fall on Caithness in Scotland. "In the year 1783, during an eruption of Skaptar-Jökull, so vast an amount of fine dust was ejected that the atmosphere over Iceland continued loaded with it for months afterward. It fell in such quantity over parts of Caithness – a distance of 600 miles – as to destroy the crops." This led GEIKIE to conclude that distant volcanoes can have far-reaching effects.[143] Although GEIKIE established a connection between the Laki eruption – albeit under a different name – and the ash fall observed in Scotland that year, he did not explicitly establish a relationship between the Laki eruption and the dry fog of 1783.

As late as 1887, a German encyclopedia's entry for *Herauch*, another word for *Höhenrauch*, stated that the dry fog of 1783 was caused by "great volcanic eruptions in Calabria and Iceland."[144] It was serendipitous that THORODDSEN and HELLAND had published about the Laki eruption in 1879, 1881, and 1882, since in late 1883, a colossal volcanic eruption in the tropics would alter the scientific debate and cast new light on old questions.

138 THORODDSEN 1925: 33–35.
139 KRISTJÁNSSON, KRISTJÁNSSON 1996: 31–33.
140 HELLAND 1881; HELLAND 1882; HELLAND 1884.
141 KRISTJÁNSSON, KRISTJÁNSSON 1996: 28, 33.
142 KRISTJÁNSSON, KRISTJÁNSSON 1996: 33.
143 GEIKIE 1882: 219.
144 "Herauch" in MEYERs Konversations-Lexikon 1887, vol. 8: 402. "Ebenso wie der H. des Jahrs 1783 aus den großartigen vulkanischen Ausbrüchen erklärt wird, die in diesem Jahr in Kalabrien und Island stattfanden [. . .]."

The Krakatau Eruption of 1883

On 27 August 1883, a volcanic eruption produced what was probably the loudest noise in recorded history. Its source was more than 12,000 kilometers away from the Laki fissure, yet its intellectual and physical reverberations would reach all the way to Iceland and beyond. The source of this loud noise was Krakatau, a volcano in the Indonesian Sunda Strait between the islands of Java and Sumatra. The island of Krakatau itself was uninhabited, but the Sunda Strait was busy with fishermen and other vessels.[145] The volcano erupted violently, reaching a six, "colossal," on the volcanic explosivity index. The noise of the eruption was audible from Perth and Alice Springs in Australia (3,000 and 3,500 kilometers away, respectively) to Rodrigues, an island near Mauritius in the Indian Ocean (4,700 kilometers away) (Figure 59).[146] The volcano is known as Krakatoa; however, Krakatau is its Indonesian name.

An earlier, smaller eruption had occurred in May 1883, news of which quickly traveled to Europe. Readers of newspapers were getting used to the name "Krakatau" with its various spellings. The eruption's final stage lasted from 26 to 27 August 1883; four final explosions almost destroyed the entire island of Krakatau and submerged most of it under the sea. The ejected ash and gases turned the area around the volcano dark. Pyroclastic flows, a tsunami, and invisible pressure waves followed. The tsunami reached Batavia, today's Jakarta, around two and a half hours later.[147] In South Africa, the resulting tsunami reached a height of half a meter. In Europe, a sea level change caused by the tsunami was registered. The eruption had a death toll of around 35,000 people, mostly caused by the tsunami.[148]

The Tambora eruption, although much larger than Krakatau, had not furthered the scientific understanding of dust transportation over long distances. Krakatau deposited a tephra layer a few centimeters thick 1,500 kilometers away and even produced a light layer of dust on ships some 6,000 kilometers away.[149] The ejecta penetrated high into the atmosphere, the dust of which later changed the apparent color of the sun and the moon. Furthermore, it gave the impression that both were encircled by halos. These optical effects lasted for as long as three years after the eruption.[150] The dust particles traveled westward around the globe; two weeks after the eruption, they formed a band around the equator. Later the particles formed belts in the Northern and Southern Hemispheres, moving gradually to higher latitudes. Starting in early November 1883,

145 Schröder 2003: 391.
146 Symons 1888: 78–88; Winchester 2005: 236–237.
147 Schröder 2003: 389; Winchester 2005: 146–154, 167–169, 177–178, 193–214, 228–234.
148 Global Volcanism Program: Krakatau; Schröder 2003: 392; Winchester 2005: 221.
149 Wilkening 2011: 322. Precise maps of floating pumice and volcanic dust observed in the Indian Ocean until October 1883 can be found in Symons 1888: plate 4, 56.
150 Wilkening 2011: 322.

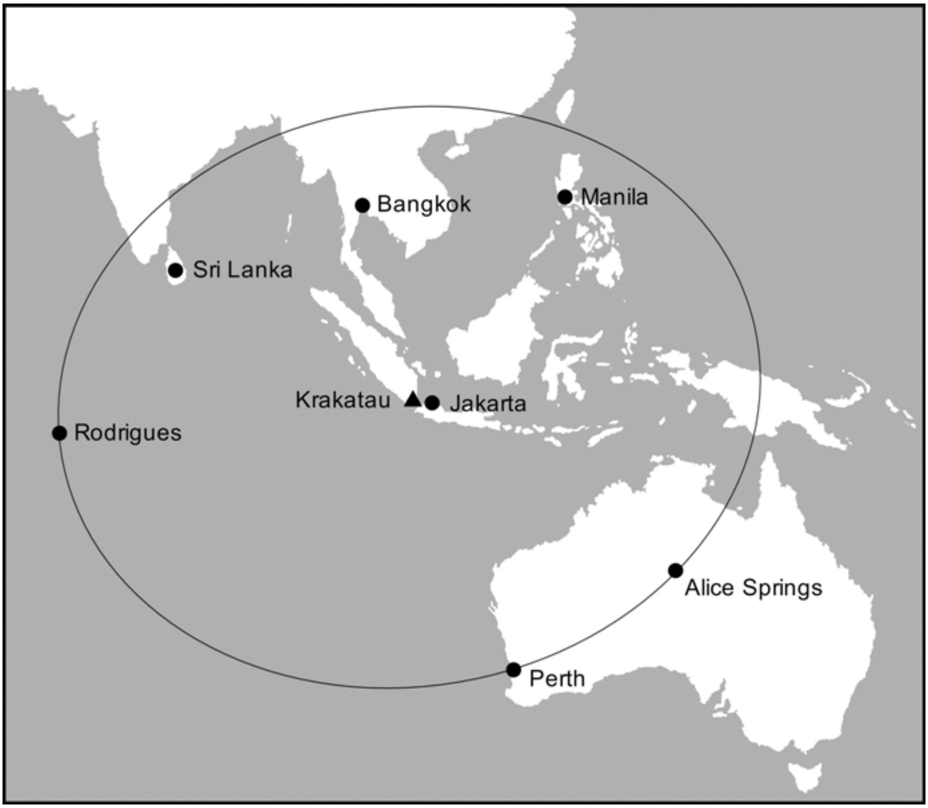

Figure 59: The explosive sound of the Krakatau eruption. The explosion was audible within the encircled area on the map.

unusual skies were reported as far away as England and Denmark.[151] The observed phenomena included amazing sunsets and a prolonged twilight period that featured a lurid afterglow. Policy analyst Ken WILKENING tells of a tale from London on 8 November 1883, when an afterglow was so intense that people alerted the fire brigade.[152] In the second half of November 1883, these phenomena also appeared in North America and Iceland (Figure 60).[153]

Something that was only apparent thanks to the scientific instruments of the time was the extent of the atmospheric pressure wave produced by the final explosive phase of the eruption. This phenomenon was recorded by observatories and amateur weather watchers alike.[154] Early in 1884, The Royal Society of London formed the so-

151 SCHRÖDER 2003: 393.
152 WILKENING 2011: 322.
153 KIESSLING 1885; SCHRÖDER 2003: 393.
154 SYMONS 1888: 58–88; SCHRÖDER 2003: 391–392.

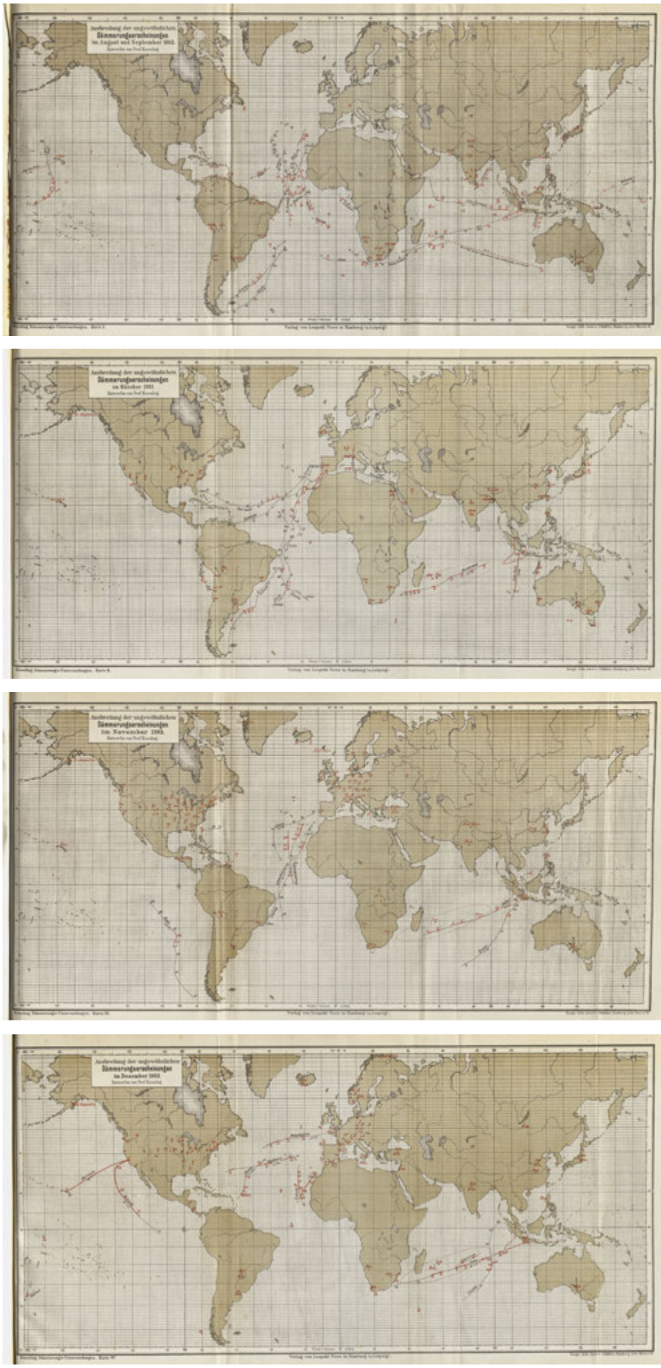

Figure 60: The extent of the prolonged twilight appearances between August and December 1883 as depicted by Johann KIESSLING, 1888.

called Krakatoa Commission, which consisted of 13 members. The committee's task was to collect all the facts they could gather about the eruption's impact, particularly concerning pumice and ashfall, irregularities in pressure, and tidal waves. They procured data from ship logs, weather stations, eyewitness statements, newspaper reports, and any other source they deemed appropriate. The committee worked for almost five years and published a 500-page report in 1888.[155] A large portion of this comprehensive text dealt with the observed optical phenomena in the eruption's aftermath. The report revealed that a single natural event could have a marked impact on the entire planet.[156]

Hypotheses recorded by the committee show that some believed the volume of volcanic ejecta produced by the eruption was insufficient to be responsible for the wide-ranging and long-lasting effects around the globe. Echoes of the previous century could be heard in their beliefs that the tail of a comet, or perhaps "needles of ice, or a cyclone in the sun's photosphere," could be to blame. The committee, however, eventually concluded that the eruption of Krakatau was responsible for the phenomena observed from 1883 to 1886. They asserted that the dust was injected into the atmosphere to a height of 30 kilometers and that this "smoke stream," consisting of dust and water vapor, traveled with the trade winds two and a half times around the equator, with some dust spreading into the mid-latitudes.[157]

The text reads:

> [Judging] by the quantity of materials ejected, or by the area and duration of the darkness caused by the volcanic dust, the eruption of Krakatoa must have been on a much smaller scale than several other outbursts which have occurred in historic times. The great eruptions of Papandayang in Java, in 1772, of Skaptar Jokull (Varmárdalr [sic]) in Iceland, in 1783, and of Tomboro [sic] in Sumbawa, in 1815, were all accompanied by the extrusion of much larger quantities of material, than that thrown out of Krakatoa in 1883.[158]

The committee erroneously believed the Laki eruption, here still named after the Icelandic glacier and the valley of its location, to be larger than the Krakatau eruption.

In the committee's publication, one can find mention of the "Skaptar Jökull" alongside several remarks on the unusual atmospheric phenomena witnessed in 1783. In particular, the authors assert, "The year 1783 was remarkable for a thick dry mist or fog which spread over Europe in June, and continued, more or less, for three or four months." The authors of the report were even aware of the effects of the dry fog:

> In some places, objects at 5 kilometres (3 miles) distance could not be distinguished; the sun was red and was invisible sometime after rising, and before setting. [. . .] The fog of 1783 commenced

155 WINCHESTER 2005: 242–252; WILKENING 2011: 323; PYLE 2017: 154–158; MORGAN, no date.

156 WILKENING 2011: 322.

157 WILKENING 2011: 323.

158 SYMONS 1888: 29. The spelling of Varmárdalr (without the u at the end) is identical to the spelling used by Þorvaldur THORODDSEN (1880: 458–468). This might have served as the basis for the committee's background information on the 1783 eruption.

> about the same day (18 June) at places distant from each other, such as Paris, Avignon, Turin, and Padua. [. . .] The sun's disc was altogether obscured at rising and setting, and half-obscured during the daytime. The sky was blood-red at rising and setting of the sun. Great consternation prevailed in northern Europe.[159]

The dramatic events of 1815 are also mentioned: "Tomboro [sic], Sumbawa. 7 to 12 April 1815. This eruption was the greatest since that of Skaptar Jokull in 1783. For three days, there was darkness at a distance of 300 miles."[160] Furthermore, the report found:

> Of the period since 1750, thirteen years may be named as specially marked by numerous widespread or great eruptions, [. . .]. In 1783, 1831, and 1883, the sun was seen rayless, or like the moon, in some parts of the world, and in these years, the sunset after-glows were most conspicuous and long-enduring.[161]

The context of the report is important; in 1883, information spread much more quickly than ever before, leading some scholars to believe that a greater number of volcanic eruptions was occurring than ever before. However, this illusory notion came down to the fact that the world simply had improved methods of communication.

In 1888, Johann KIESSLING (1839–1905), a professor at the University of Hamburg, analyzed the optical phenomena witnessed in the aftermath of the Krakatau eruption, particularly the afterglow seen during dusk. He published his findings as *Untersuchungen über Dämmerungserscheinungen zur Erklärung der nach dem Krakatau-Ausbruch beobachteten atmosphärisch-optischen Störung* (Investigations into Twilight Phenomena to Explain the Atmospheric-Optical Disturbance Observed after the Krakatau Eruption).[162] He looked to the past to find historical precedents and found what he believed to be a comparable event in 1783: a fog that turned the sun red. KIESSLING had read reports of violent volcanic activity within Iceland "which had a causal relation to this fog."[163]

The main factor that led to a global recognition that the Krakatau eruption had considerable and far-reaching consequences was telegraphy. Krakatau was located within the Dutch East Indies in a colony founded in 1800 after the Dutch East India Company (*Vereenigde Oost-Indische Compagnie*, VOC) went bankrupt. The colony's

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159 SYMONS 1888: 388–389.

160 SYMONS 1888: 393.

161 SYMONS 1888: 403.

162 KIESSLING 1888.

163 KIESSLING 1888: 26–27. "Ausser dem südlichen Italien war jedoch auch Island im Sommer 1783 der Schauplatz heftiger vulkanischer Thätigkeit gewesen, welche mit der Entstehung dieses Nebels in ursächlichem Zusammenhang zu stehen scheint." Johann KIESSLING used Karl Ernst Adolf VON HOFF's compilation of volcanic eruptions as his source for the foggy appearance just before the earthquakes in Calabria; HOFF 1841, vol. 2: 48–53.

capital, Batavia, was located around 150 kilometers from the volcano.[164] The fact that Batavia was a hub of international activity accelerated the speed at which the news of the eruption traveled to Europe and beyond. In October 1883, the Dutch also initiated a scientific commission to study the Krakatau eruption. Among the scientists in the commission was Dutch geologist Rogier Diederik Marius VERBEEK (1845–1926), who lived in Java at the time. He was an eyewitness and documented the events in a journal, which he later published as a report.[165]

Samuel MORSE (1791–1872) helped invent the electric telegraph in the first half of the nineteenth century and by the 1880s, networks were well-established.[166] By August 1883, the world had become a "global village."[167] In 1755, it took four weeks for the news about the Lisbon earthquake to be printed in the *Hamburgischer Unpartheyischer Correspondent*. In 1783, it took almost three months for the news of an Icelandic eruption to reach Denmark. By contrast, in 1883, the *Hamburgischer Unpartheyischer Correspondent* first mentioned the Krakatau eruption on 29 August, only two days after it had occurred, thanks to a telegram from the Reuters news agency. On 31 August 1883, the newspaper followed up with a detailed report about the eruption featuring a mention of the tsunami, which was compared to the tsunami that followed the 1755 Lisbon earthquake: this clearly indicates that the catastrophe in Lisbon was still present in the European consciousness.[168] As early as 6 September 1883, the academic journal *Nature* reported on the Krakatau eruption; the article was titled "The Java Upheaval." It followed up on this with another report, titled "Scientific Aspects of the Java Catastrophe," on 13 September 1883.[169] German meteorologist Wilfried SCHRÖDER opined that the Krakatau eruption and its volcanic dust gave scholars and amateur weather observers a chance to think deeply about geological processes, global wind systems, and the atmosphere.[170]

This volcanic eruption in the Dutch East Indies, separated from Iceland by a great distance and the Laki eruption by a century, significantly impacted the understanding of the 1783 eruption and volcanoes in general. A century later, Europe witnessed phenomena comparable to those of 1783; most were, at the same time, fully aware that a distant volcano on another continent had exploded into life. The fact that information about this colossal volcanic eruption in the Dutch East Indies arrived in a timely fashion, i.e., while scientists were observing those strange phenomena, made it much easier for them to connect the dots between the eruption, the blood-red sunsets, and the dust in the air.

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164 WINCHESTER 2005: 35–41, 141.
165 VERBEEK 1886; MORGAN without year.
166 WENZLHUEMER 2013.
167 MCLUHAN 1962; WINCHESTER 2005: 182.
168 WILKE 2014.
169 Anonymous 1883a; Anonymous 1883b.
170 SCHRÖDER 2003: 393–394.

The Dots Connected

Amund HELLAND and Þorvaldur THORODDSEN

In 1886, Amund HELLAND published a Danish-language book on Laki's craters and lava flows. In his 40-page publication, he describes the eruption and its consequences and outlines his experiences on his journey to the fissure.[171] He only spent a few days at the Laki fissure, and therefore he did not explore the entire extent of the lava, leading to some errors in his map illustrations (Figure 61). Nevertheless, the book and the map serve as evidence that he did, in fact, visit the fissure.

HELLAND's book included a new hypothesis:

> It is generally known that an unusual glow of the sky could be observed around sun rise and fall in the years after the Krakatoa eruption in the Strait of Sunda. This could be observed in India in September 1883 and in Norway in November 1883. As a rule, this sky glow can be explained with volcanic particles, which comes from Krakatau [. . .], these particles can stay in the atmosphere for months.[172]

As he observed the dust in Oslo, he was drawn to conclude that it must be present everywhere in the Earth's atmosphere. "Interestingly, similar phenomena could be observed in Denmark and Iceland after the eruption of 1783, and even then, the sky had changed its color and can be connected with the eruption."[173] HELLAND also included a quote from HÓLM's 1784 report, which mirrored his own description of the sky. He realized that it must have looked as spectacular in 1783 as it had in Norway the previous year – the latter, thanks to Krakatau.[174]

100 Years after PÁLSSON

In 1886, only 20 to 25 percent of Iceland's volcanoes were known. Most scholars traveled the same routes, almost exclusively within populated regions. Few ventured into the highlands: Þorvaldur THORODDSEN was an exception to this rule. Between 1882 and 1898, THORODDSEN extensively explored and mapped Iceland; for instance, he was the first geologist to explore Vatnajökull from all sides.[175] His primary focus was on volcanoes and landscape morphology.

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171 HELLAND 1886: 8, 24–27.

172 HELLAND 1886: 33. "Som bekjendt har man i de senere aar efter det store udbrud i Krakatoa i Sundastrædet iagttaget en eiendommelig golden af himmelen, der har ledsaget solens opgang og nedgang. Denne glod blev allerede i september 1883 iagttaget i Indien og her i Norge i november 1883."

173 HELLAND 1886: 33. HELLAND refers to Oslo as Kristiania, which was Oslo's name from 1877 to 1925. "Interessant er det nu, at lignende fænomener er iagttaget i Danmark og paa Island efter udbrudet i 1783, og at man allerede da satte denne himmelens farve i forbindelse med udbrudet."

174 HELLAND 1886: 34.

175 HERRMANN 1907: 70–71; THORODDSEN 1914; THORODDSEN 1925: 9, 36.

Figure 61: Laki's craters and lava flows, as drawn by Amund HELLAND, ca. 1881.

From 18 to 21 July 1893, THORODDSEN followed the Skaftá River through the Síða region to the Laki fissure. In 1794, PÁLSSON had noticed a subterraneous heat coming from the vents as well as “ugly smelling smoke” and “an eerie roaring from deep down.”[176] By the time of THORODDSEN’s expedition, the area had cooled down entirely. While visiting the “crater row,” he was fortunate enough to enjoy clement weather and used the opportunity to take measurements. He estimated that the fissure had a length of 30 kilometers, the lava covered 565 square kilometers with a volume of 12.3 cubic kilometers, and the tephra and scoria volume totaled three cubic kilometers – all of which come very close to modern estimates.[177]

After his visit to the Laki fissure, THORODDSEN traveled further north. On 22 July 1794, he came across an even larger fissure that had produced a similar scar in the landscape. He called the fissure *Eldgjá*, the “fire fissure.” It was 75 kilometers long. THORODDSEN assumed that this fissure erupted around 950, shortly after the settlement of Iceland.[178] In his subsequent publications in Danish, English, and German, he extensively discusses PÁLSSON’s manuscript and findings on volcanoes and glaciers in the context of his own research. Additionally, THORODDSEN drew a geological map of Iceland. He used Björn GUNNLAUGSSON’s map from 1844 but made his own adjustments, particularly to the depictions of the highlands and the regions that Icelandic cartographer GUNNLAUGSSON (1788–1876) himself had never visited. THORODDSEN’s map shows the Vatnajökull ice cap as a single glacier, the first map to do so. Furthermore, his map featured the Skaftá River, Mount Laki, and Eldgja.[179]

The practice of using color schemes for geological maps was developed in the late seventeenth and early eighteenth century; THORODDSEN added color to his map, albeit in a slightly different manner than today’s cartographers. Today, the color scheme used in geological maps shows lithographical units and temporal patterns of rock succession (Figure 62).[180] A significant color difference on a geological map shows a hiatus, i.e., an unconformity of the rock succession. This means that a particular stratum was unpreserved, in some cases due to erosion.[181] With their color schemes, modern geological maps inform the reader about the different units of rocks, their ages, and

176 THORODDSEN 1925: 59. “Als Sveinn Pálsson 1794 die Kraterreihe besuchte und die Krater bestieg, bemerkte er noch die unterirdische Wärme, denn aus den Rissen ‘stieg der abscheuliche und häßlich riechende Rauch hervor und gleichzeitig hörte man tief unten ein unheimliches Sausen.’ Jetzt scheinen die Lavaströme völlig abgekühlt zu sein.”

177 THORODDSEN 1894: 295.

178 THORODDSEN 1893: 177–183; THORODDSEN 1925: 67: “Eine offene Spalte dieser Größe, die große Lavaströme ausgegossen hat, findet nicht ihresgleichen auf Island und vielleicht nicht auf der ganzen Erde.” The Eldgjá eruption is estimated to have occurred between 934 and 939. For further information on the eruption and modern dating: THORDARSON et al. 2001; MCCORMICK, DUTTON, MAYEWSKI 2007; KOSTICK, LUDLOW 2015; OPPENHEIMER et al. 2018; EBERT 2019; EBERT 2021.

179 THORODDSEN 1880; THORODDSEN 1882a; THORODDSEN 1882b; THORODDSEN 1925; BJÖRNSSON 2017: 158.

180 Commission for the Geological Map of the World, BOUYSSE, 2014.

181 FRIEDRICH 2019.

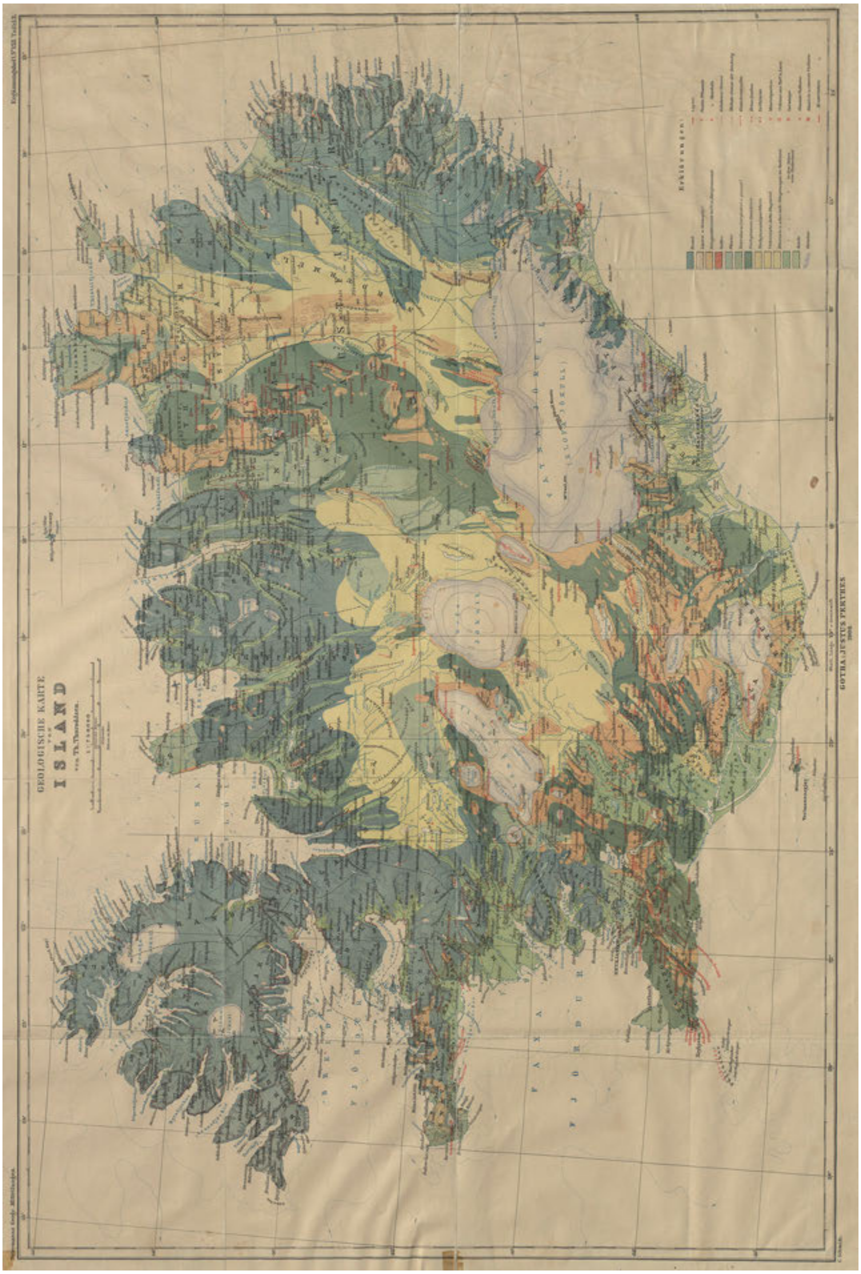

Figure 62: Þorvaldur THORODDSEN's geological map of Iceland, 1906. The white color indicates glaciers; the dotted light green marks out the *sandur* plains, dark green the lava fields, and orange the highlands. The red dots indicate the locations of volcanic fissures.

the nature of the contact zones between them. Therefore, "geological maps are generally the most important compilations of geological work."[182]

THORODDSEN remarks that although Amund HELLAND had been the first foreign naturalist to visit the Laki fissure, he was only there for a short time on a trip marred by bad weather and fog. THORODDSEN holds that although HELLAND had made several interesting observations, his map, based on speculations rather than measurements, was inadequate.[183] Although HELLAND's map work does indeed have shortcomings, he is responsible for bestowing upon the eruption the name that stuck.[184]

What's in a Name?

The Laki eruption has been known by many different names since 1783. Within Iceland, the eruption is known as *Skaftáreldar* ("Skaftá Fires") or *Skaftárgígar* ("Skaftá craters").[185] Older names such as *Siðueldur* ("a fire in the Síða region") are still in use. Many remember the eruption for its consequences and, therefore, refer to it as *móðuharðindin* ("the famine of the mist"). Other names reference nearby landmarks, most obviously Mount Laki. Sometimes, particularly in the European newspapers, it was called "Skaftárjökull" in its various spellings, as it was believed – not unreasonably – that the eruption had occurred underneath the glacier.

Initially, as the location of the eruption was unclear, the event was referred to as "fire(s)," a common term used for large volcanic eruptions in Iceland at the time. An observer might not easily distinguish the entire fissure as (the source of) an individual phenomenon, given that it is composed of many craters.[186] Outside of Iceland, during the late eighteenth century, the concept of a fissure volcano or flood basalt event was quite foreign. In the popular imagination, volcanoes resembled Vesuvius, Etna, or Stromboli.

Amund HELLAND noticed the plurality of names in circulation and then proposed a solution. He suggested naming the row of craters after the mountain in its center: Laki, a short and easy-to-pronounce name. Thus, today, in non-Icelandic literature, the eruption is called the Laki eruption or *Lakagígar*, which means the "Laki craters."[187] Mount Laki, although volcanic in origin, did not erupt in 1783: a prior eruption at the Grímsvötn system during the Holocene, probably the Botnahraun eruption of 4550 BCE ± 500 years, produced this hyaloclastite palagonite volcano.[188] This term indicates that the area was, at the time,

182 FRIEDRICH et al. 2018: 174. For a history of assigning colors to rock units, see also: SCHÄFER-WEISS, VERSEMANN 2005; OLDROYD 2013; BRESSAN 2014.
183 THORODDSEN 1894: 294–295.
184 KLEEMANN 2020.
185 KARLSSON 2000b: 178.
186 THORODDSEN 1925: 46–47.
187 THORODDSEN 1925: 46–47.
188 EINARSSON, SVEINSDÓTTIR 1984: 48. Information on the Botnahraun eruption can be found in the "eruptive history" section in Global Volcanism Program: Grímsvötn.

covered by a glacier. In the eighteenth century, this area was remote and sparsely populated; shepherds sometimes came here to herd their sheep. The shape of the mountain reminded them of the third compartment of the stomach of a dairy cow, which looks like the fanned pages of an open book. This is called *omasum* in English and *laki* in Icelandic.[189] In Iceland, the lava field produced by the eruption is called *Skaftáreldahraun*.[190]

Field Trips to the Laki Fissure

Soon, photographs would make Iceland accessible to faraway spectators. While photography had been around since the 1820s, the cumbersome equipment necessary made it impractical for anyone on the move. During the 1890s and 1900s, photography made several advances: film replaced photographic plates and soon after, it became possible to switch film during daylight hours.[191]

When Tempest ANDERSON (1846–1913), a British surgeon and amateur photographer, traveled to the Laki fissure in the summer of 1890, he did so because he had read Lord DUFFERIN's *Letters from High Latitudes* and wanted to visit "the craters that had never been visited."[192] It was only upon his return that he learned that Amund HELLAND and Sveinn PÁLSSON had already visited the fissure and called it *Lakis Kratere*. ANDERSON himself liked the name *Skaptár Lava* better.[193] It appears that the name bestowed upon the fissure by Helland was not yet firmly established, even in the early twentieth century. ANDERSON was the first person to take photographs of the Laki fissure, which were published in 1903 (see Figure 63 for the photo from 1903 and Figure 64 for a modern color photo). He also captured several other volcanoes from around the globe on film and later published the results in his book.[194]

It remains unclear whether ANDERSON's photograph of Laki made it sufficiently obvious that the "Skaptá Lava" was, in fact, a fissure volcano. Further research is needed to establish whether this image and its distribution changed public perception of the Laki fissure or had any impact on scientific discourse at the time.

Other scholars who visited the Laki fissure in the early twentieth century and wrote about their experiences include German geologists Karl SAPPER in 1906 and Hans RECK in 1908.[195] Karl SAPPER (1866–1945) stayed at the fissure for three days.[196]

189 The history of the name is described and illustrated by ÁMUNDASON (2019). Additionally, the entry about Laki's name was also featured on Icelandic milk cartons. I thank Óðinn MELSTED and his father, Eyjólfur MELSTED, for this information.

190 Katla Geopark Project: 10–11.

191 BLANCHARD 1998: 508–513.

192 DUFFERIN 1873.

193 ANDERSON 1903: 122.

194 THORODDSEN 1925: 35–36.

195 SCHWARZBACH 1983: 42.

196 ÞÓRARINSSON 1969: 910–912.

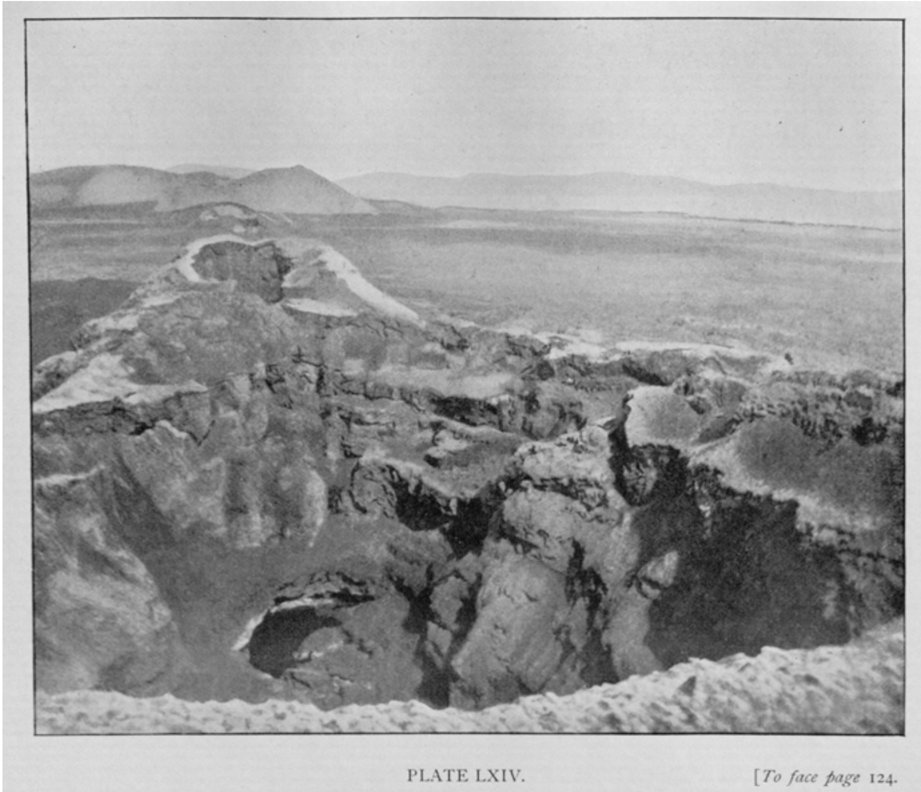

Figure 63: A photograph of one crater in the Laki fissure, taken by Tempest ANDERSON, ca. 1903. ANDERSON published his book and its photographs in 1903. This one is called "Plate LXIV. Iceland. A Crater, Skaptár lava."

He was aware of Þorvaldur THORODDSEN and Amund HELLAND's publications and of the fact that the fissure had erupted in 1783. He notes that Laki was also known as "Varmárdalr" or "Skaptárjökull" (in its various spellings).[197] SAPPER also visited Eldgjá and concluded that these two "large eruptions" (*Riesenausbrüche*) "without a doubt outdid all other volcanic eruptions in historical time."[198]

In the summer of 1907, German geology student Walter VON KNEBEL and landscape painter Max RUDLOFF traveled through and studied some of the most remote areas of Iceland. Ultimately, they failed to return from their trip. This prompted their friend

197 SAPPER 1917a: 65; SAPPER 1917b.

198 SAPPER 1917a: 72. "Unter den selten tätigen Ausbruchsstellen sind aber einige, die sich durch ganz besondere Intensität des Ausbruchs ausgezeichnet haben, so vor allem Laki 1783 und Eldgjá um 930. Es waren diese Riesenausbrüche, die auf der Erde in geschichtlicher Zeit nicht ihresgleichen haben, sofern man die Lavaförderung zum Maßstab nehmen will [. . .]."

Figure 64: In contrast, one crater of the Laki fissure in August 2016. The size becomes apparent when looking at the person walking along a path at the very bottom of the image.

and fellow geology student Hans RECK (1886–1937) and VON KNEBEL's fiancée, Ina VON GRUMBKOW (1872–1942), to travel to Iceland in June 1908 to find their remains. RECK and VON GRUMBKOW traveled on horseback for 11 weeks. They did not, however, find the remains of the two Germans who had vanished.[199] The trip likely inspired RECK to write his doctoral dissertation about Icelandic "mass eruptions." It also brought RECK and VON GRUMBKOW closer, for they married in 1912.[200]

Among other sights, Hans RECK and Ina VON GRUMBKOW's journey took them to the Laki fissure. In 1909, VON GRUMBKOW published a travelogue about her journey through Iceland, which was dedicated to her late fiancé. It is likely that Ina VON GRUMBKOW was the first woman to visit the Laki fissure. One chapter of VON GRUMBKOW's book describes her travels to Laki; from her account, we learn that RECK "tried to use" HELLAND's map to find the fissure. This was difficult because sandstorms had significantly changed the landscape since HELLAND's visit in 1881.[201] RECK and VON GRUMBKOW relied on local guides, one of whom, Sigurður, was the son of the man who had guided THORODDSEN in 1894. The journey to Laki was exhausting: some rivers were impassable; a fog reduced the visibility; the horses were tired; and at times, RECK and VON GRUMBKOW had no idea where they were. Once they arrived at their campsite near the fissure, they were exhausted. The next day, RECK, VON GRUMBKOW, and Sigurður hiked four hours to reach

199 MAIER 2003: 86–87.
200 MAYR 2013: 232.
201 GRUMBKOW 1909, chapter VII.

and climb Mount Laki. VON GRUMBKOW writes of the "wonderful panorama up until the edge of Vatnajökull." She further describes how the palagonite mountain, Mount Laki, had been pulled apart by "a deep volcanic fissure," and estimates the fissure to be 25 kilometers long.[202] Her book includes a photograph taken from Mount Laki (Figure 65).

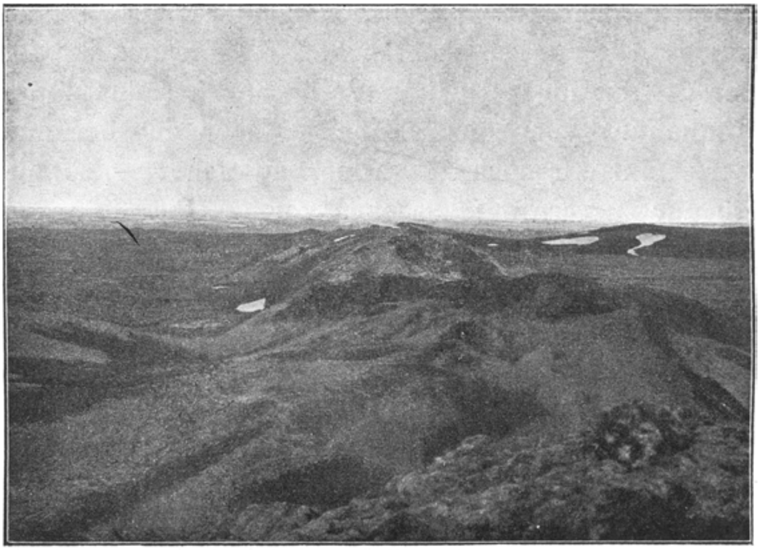

Abb. 19. Blick von der Höhe des Berges Laki auf die östliche Kraterreihe.

Figure 65: A photograph of the eastern part of the Laki fissure in 1908, taken by Ina VON GRUMBKOW from Mount Laki.

VON GRUMBKOW describes the view from Mount Laki as "an extremely odd view of this grand expanse, a dead landscape that has offered an entirely unchanged image for more than 120 years."[203] Nevertheless, the forms and colors of the landscape, especially the lava fields, deeply fascinated her. Thus, she drew the fissure and explored it

202 GRUMBKOW 1909, chapter VII. "Wohl hatte ich eine dunkle Vorstellung von einem Ruhetag, aber der berühmte Berg Laki war doch zu verlockend nahe, – so ging ich nur zu gern mit [. . .]. Eine mühevolle Kletterei begann hügelauf, hügelab, über Geröllhalden, Schneeflecke, alte moosbewachsene, jüngere zackige Lava; nach fast vier Stunden ununterbrochenen Wanderns hatten wir die Höhe des Berges Laki erreicht, von wo wir ein wunderbares Panorama bis zum Rande des Vatna-Jökull genossen. Der 850 m hohe, durch eine tiefe vulkanische Spalte in zwei Hälften gerissene Palagonitberg liegt in der Mitte der sich von Südwest bis Nordost auf 25 km erstreckenden Kraterreihe."

203 GRUMBKOW 1909, chapter VII. "Einen überaus eigenartigen Anblick gewährte diese riesenweite, tote Landschaft, die seit mehr als 120 Jahren völlig unverändert dasselbe Bild bietet."

alone while her companions busied themselves somewhere else. From her travelogue, it becomes apparent how profoundly this landscape affected her:

> The cold dusk hours of this melancholic scene of loneliness were overwhelming. At the same time, despite the rain showers, it was wonderfully compelling, and it was difficult to turn away from this place; barely any human eyes have ever seen its peculiarities.[204]

The wealth of information that these naturalists compiled is impressive, given the scant number of days they spent at the fissure. PÁLSSON visited the Laki fissure in July 1794, HELLAND in August 1881, THORODDSEN in July 1893, ANDERSON in 1903, SAPPER in 1906, and RECK and VON GRUMBKOW in the summer of 1908.[205] As Sigurður ÞÓRARINSSON noted in 1968, if one counts the days these geologists spent at the Laki fissure and puts them together, the total is less than one month.[206]

Lifting the Fog of Ignorance

When Magnús STEPHENSEN attempted to explore the Síða region, he concluded that the "Skaftá Fires" came from some unknown cone-shaped volcano. Sveinn PÁLSSON found the source of the "fires" in 1794 and identified it as a fissure. Despite his best efforts, his findings did not impact the scientific discourse at the time. Þorvaldur THORODDSEN and Amund HELLAND revitalized interest in the Laki eruption in the 1880s. After the Krakatau eruption in 1883, the scientific community paid more attention to the far-reaching effects of volcanic eruptions and the variety of different phenomena they produced worldwide. The Laki fissure had now been put on the map. Geologists from several (mostly European) countries traveled to Iceland in ever-increasing numbers to study the exotic and dynamic landscape where the fissure sprang to life.

At the time of the Laki eruption, those concerned with the emerging discipline of geology were in the midst of a debate that centered around the conflicting ideas of Neptunism and Plutonism. Volcanoes were still considered accidents of nature, and scientific belief in the biblical Flood was only slowly going out of fashion.[207] The Laki eruption occurred during an intellectual revolution: the Enlightenment. The dry fog that followed

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204 GRUMBKOW 1909, chapter VII. "Überwältigend wirkte in den kalten Dämmerstunden dieser melancholischen Szenerie die Einsamkeit, die trotz der Schauer, die sie erregte, doch wunderbar fesselte und schwer trennte ich mich von dem Ort, den fast nie Menschenaugen in seiner ganzen Eigenart sehen."

205 GUNNLAUGSSON 1984: 96, plate 7. This source includes two maps of the route that Karl SAPPER took to and along the Laki fissure. GRUMBKOW (1909) states in chapter VII that, once they arrived at the Laki fissure, the horses would get to enjoy four days of rest.

206 ÞÓRARINSSON 1969: 910–912.

207 RAPPAPORT 2007.

sparked widespread speculation. Various plausible explanations emerged; some suggested volcanic eruptions, potentially in Iceland (Nýey or Hekla) or the German Territories (Gleichberg, Cottaberg, Gottesberg, or Roßberg), were the source of this oppressive mist. The most popular theory suggested that the fog appeared as a result of the Calabrian earthquakes, themselves the result of a subsurface revolution within the Earth's bowels. Further manifestations of this revolution at surface level included earthquakes in France and the German Territories and the spontaneous emergence of a new island near Iceland.

Consulting the primary sources, it becomes clear that the European contemporaries' lack of awareness ran deep and could effectively be described as ignorance. The news about an Icelandic volcanic eruption reached Europe in September 1783. By that time, the dry fog had dissipated, as had any great interest in pursuing an understanding of its cause. If the mist was assumed to be a product of the Calabrian earthquakes, as it generally was, then news about an Icelandic volcanic eruption would not have moved naturalists to revisit the issue.

Sveinn PÁLSSON discovered the Laki fissure as early as ten years after the eruption; however, due to a series of unfortunate events, his manuscript remained unpublished until 1945. He managed to hand a copy to Ebenezer HENDERSON, who used PÁLSSON's findings to suggest that the Laki fissure had caused the fog in Europe. In 1818, the Laki eruption was already a 35-year-old event; HENDERSON's groundbreaking description of the Laki fissure did not seem to have much impact. So, from 1818 onward, a book that describes the Laki fissure accurately was essentially ignored.[208]

It took until the 1880s for interest in the eruption to be rekindled. This was as a result of Þorvaldur THORODDSEN's paper and Amund HELLAND's re-publications of parts of PÁLSSON's papers. The Krakatau eruption of 1883 and its intellectual consequences were the real breakthrough. They led the scientific community to finally connect the dry fog and the blood-red sunsets and sunrises of 1783 to the Laki eruption.

I conclude that the connection between the dry fog and the Laki eruption was only fully understood in the aftermath of the 1883 Krakatau eruption. Scientists and amateur weather observers noticed that the global impacts of the Krakatau eruption were similar to those in the wake of the Tambora and Laki eruptions. A vital contributing factor to the unfolding mystery was the almost instant communication between different parts of the globe via telegraphy. Contemporaries were aware of the volcanic eruption in the Dutch East Indies as they observed its impact on Europe. This device helped lift the fog of ignorance. Only in retrospect, it seems, could the dry fog of 1783 be attributed to the Laki eruption.

208 The name of the book was *Iceland or the Journal of a Residence in that Island During 1814 and 1815*; HENDERSON 1818.