Reviewed research article

The 1783–1785 A.D. Laki-Grímsvötn eruptions I: A critical look at the contemporary chronicles

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Abstract – *The 1783–85 Laki-Grímsvötn eruptions are the best documented of the pre-twentieth century volcanic events in Iceland. A large body of contemporary sources contain information about the sequence of events and eruption phenomena. A number of these are chronicles of these events and in Iceland they are known as Eldrit (Book of Fire). The Eldrit compiled by the Reverend Jón Steingrímsson at Prestbakki in the Síða district (about 35 km to the south of the Laki fissures) are by far the most detailed and informative. Here I evaluate the accuracy and reliability of the Eldrit and other contemporary chronicles and show that, apart from minor discrepancies, they give an accurate account of the course of events during the Laki eruption.*

INTRODUCTION

The 1783–1784 Laki eruption was the main event in the volcano-tectonic episode within the Grímsvötn volcanic system that lasted from May 1783 to May 1785. The Laki event is the greatest natural disaster in Iceland since its settlement in the 9^{th} Century and the only basaltic flood lava eruption witnessed and reported on in detail by man. It is also the best documented volcanic event in Iceland pre-dating the twentieth century. These contemporary sources contain valuable information about the eruption and its effect on the environment and local communities (Table 1, see also Thordarson *et al*., this issue and references therein). Narratives, letters and official documents written before 1795 are considered contemporary, because they either document direct observations or are excerpts from descriptions obtained from eyewitness accounts. A number of these are chronicles of the eruption, or Eldrit (Book of Fire). Eldrit is derived from the term *eldur* (fire), which was often used by Icelanders to describe volcanic eruptions that most commonly feature fire or lava fountain activity, or as they saw it, columns of fires. The fourteen authors listed in Table 1 documented in varying detail the many aspects of the Laki eruption. The accuracy and reliability of these accounts vary significantly, but when evaluated critically, they are a rich source of information. Of the 20 accounts listed in Table 1 ten are classified as Eldrit (Rafnsson, 1984). Those compiled by the Reverend Jón Steingrímsson are the most detailed and informative.

Steingrímsson's most famous description of the Laki eruption, *Fullkomið skrif um Síðueld* (A complete description of the Síða Fire), was completed in 1788 (Table 1). Recently an English translation of the whole work was published for the first time (e.g. Steingrímsson, 1998). This is truly one of the most amazing eruption chronicles ever to be compiled, despite its convoluted style, where direct observations are mingled with and often obscured by religious connotations. Steingrímsson gives a vivid and truthful description of the eruptive events as well as the impact the eruption had on the local communities. However, *Fullkomið skrif um Síðueld* is not flawless and as will be shown below inconsistencies do occur. Furthermore, the broader exposure of this most valued Eldrit by Steingrímsson, along with the fact that existing interpretations of the course of events during the Laki

eruption rely heavily on information contained in the contemporary accounts, call for a critical evaluation of the Eldrit's written by Steingrímsson and the others.

Here, I present an analysis of the consistency and reliability of the accounts written by Reverend Jón Steingrímsson, along with an inspection of other chronicles that provide significant information for assessing the sequence of events during the eruption. A comprehensive re-construction of the sequence of events during the Laki eruption, as it is revealed in the historic chronicles, is presented in the second part of this study (see Thordarson *et al*., this issue).

ACCOUNTS OF ERUPTIONS IN ICELAND

Records of eruptions in Iceland date back to the times of early settlement, or almost eleven hundred years. Many of these eruptions were disastrous (Finnsson, 1796; Thorarinsson, 1979; Thorarinsson and Sæmundsson, 1979). Initial records are limited to brief accounts of major eruptions. By the 17$^{\text{th}}$ Century Iceland was fully dependent on the Danish economical and political system. In order to obtain support from the Danish authorities during difficult times, Icelandic officials had to report the cause and the effect of these hazards. By the time of the Laki eruption, complete descriptions of several eruptions were in existence and in general Icelanders had a good understanding of the nature of volcanic eruptions (Thordarson, 1990).

NATURE, QUALITY, AND RELIABILITY OF THE ELDRIT

STEINGRÍMSSON'S DESCRIPTIONS AND OBSERVATIONS

Reverend Steingrímsson served the farming community in the Síða district from 1778 to 1791 and resided at his farm, Prestbakki, located 40 km south of the erupting fissures (for location of geographic place names see Figures 1 and 2 in Thordarson *et al*., this issue). Being directly exposed to the ferocious nature of the Laki eruption and the desolation that followed Steingrímsson kept a detailed register of the course of events during the eruption, preserved in three separate Eldrit (Table 1); *Lítið ágrip um nýja eldsuppkomu í vestariparti Skaftafellssýslu* [Eldrit 1], *Einföld og sönn frásaga um jarðeldshlaupið í Skaftafellssýslu árið 1783* [Eldrit 2] and *Fullkomið skrif um Síðueld* [Eldrit 3]. Furthermore, Steingrímsson wrote a number of letters to authorities, wherein he discussed the progress of the eruption and its social impact. Unfortunately many of these letters are lost, but letters containing replies from authorities give some information on their original content (Rafnsson, 1984).

The latest Eldrit, *Fullkomið skrif um Síðueld*, is the only one containing complete coverage of the eruption. Like the first two, it is written in the form of a diary and follows the progress of the eruption. The first three months are described almost daily but later descriptions are more intermittent and less detailed.

Steingrímsson was familiar with volcanic eruptions and their effects before witnessing the Laki eruption. He was acquainted with the descriptions of the Mývatn Fires 1724–1729 written by Reverend Jón Sæmundsson (Sæmundsson, 1729). He also witnessed the 1755 Katla eruption, which prompted him to collect information on the eruptive history of the Katla volcano and publish his work in an essay titled Um Kötlugjá (About the Katla fissure; Steingrímsson, 1757). The origin of ash layers preserved in Icelandic soils was also clear to Steingrímsson as is evident from this passage in Eldrit 3: "Ash-falls from volcanic eruptions have effected this area variably, because some soil profiles contain 5 ash layers but others have up to 11 ash layers."

He was a keen observer as is evident from his descriptions of the flowing lava and the explosive activity (see Thordarson *et al*., this issue). The following quotation from *Fullkomið skrif um Síðueld* where he describes the occurrence and shape of spatter bombs is a good example of his perspicacity: "There [in the vicinity of the Skaftá River gorge] we found here and there fire-blobs, which had fallen down from the air and burned the grass around them as they solidified. Some of these were half buried in the ground, shaped like cow-dung. Others were shaped like twisted bundles that pierced into the ground from the force of the fall and had broken up on impact. These fire-blobs

Table 1. List of Eldrit and relevant contemporary accounts describing the Laki eruption. Complete references are given in the bibliography of Thordarson *et al.*, this issue. Eldrit status is indicated by ⋆ and superscripted roman numerals, that is Eiríkssон^{I} and Jón Eiríkssон^{II} are used here and in the main text to distinguish between the authors. – *Listi yfir eldritin og aðrar lykilheimildir um Skaftárelda.*

Authors *Höfundar*	Title *Titill*	Comments *Athugasemdir*
Jón Steingrímsson	*Lítið ágrip um nýja eldsuppkomu í vestariparti Skaftafellssýslu.*⋆ A short compendium of the recent volcanic outburst in western part of Skaftafellshire.	Prestbakki, 4. July 1783.
Jón Eiríkssон^{I}	*Extract of Forpagter Erichsens Skrivelse.* Extract from agent Erichsens letter.	Ljótarstaðir, 11. July 1783.
Johan C. Sünckenberg	*Skrivelse til den islandske Handels Direction.*⋆ Report to the Directors of the Iceland Division of the Royal Monopolistic Commerce.	Stykkishólmur 24. July 1783
Lýður Guðmundsson	*Skýrsla til Thodals Stiftamtmanns.* Report by Lýður Guðmundsson sheriff of W-Skaftafellshire to Chief Prefect Thodal.	Öxará (Þingvellir) 26. July 1783
Lýður Guðmundsson	*Bréf (Pro Memoria!)* Letter from Lýður Guðmundsson	2. August 1783
Ólafur Stephensen	*Extract af Amtm. Stephensen's Brev til Conferenceraad Erichsen.* Extract from Prefect Stephensen's letter to Deputy Erichsen.	15. August 1783
Jón Steingrímsson and Sigurður Ólafsson	*Einföld og sönn frásaga um jarðeldshlaupið í Skaftafellssýslu árið 1783.*⋆ A simple, but true narrative of the eruption in Skaftafellshire in the year 1783.	Kirkjubæjarklaustur 24. Aug. 1783
Sigurður Ólafsson	*Um jarðeldinn í Skaftafellssýslu 1783* About the earth fire in Skaftafellshire 1783.	Kirkjubæjarklaustur 27. Aug. 1783
Jón Steingrímsson	*Póstur úr bréfi til séra Bjarna Jónssonar.* Summary from a letter to Reverend Bjarni Jónsson.	Prestbakki 31. Aug. 1783
Svendborg	*Extract af Assistent Svendborgs Skrivelse til Agent Pontoppidan.* Extract from assistant Svendborg letter to agent Pontoppidan.	Hafnarfjörður 31. August 1783
Lýður Guðmundsson	*Bréf (Pro Memoria!).* Letter from Lýður Guðmundsson sheriff of Western Skaftafellshire.	1. September 1783
Árni Thorarinsson	*Hr. Provst. Thorarinsens Beretning.* Narrative by Reverend Thorarinsson.	Undated, written in October 1783
Einar Björnsson	*Relation eins prests sem ár 1783 ferðaðist um sumarið á Suðurland frá Múlasýslu yfir Skaftafells bæði áfram og heimleiðis.* Relation by one clergyman, who in the summer 1783 travelled across S-Iceland from Múlashire through Skaftafellshire, back and forth.	Undated, written in fall 1783
Jón Eiríkssон^{II}	*Efterretning om Ilds-Udbrydelsen i Vester Skaptafells-Syssel i Island.*⋆ A Narrative on the Eruption in Western-Skaftafellshire in Iceland.	Copenhagen December 1783
Sæmundur M. Hólm	*Om Jordbranden paa Island i Aaret 1783.*⋆ About the Earth Fire in Iceland the Year 1783.	Copenhagen 25. February 1784
Sveinn Pálsson	*Historia ignis in oriente Islandiae erumpentis anno 1783, quad innotuit in tractu Skagafjördensi; complectitur historia in se et effectus varios.*⋆ The story of the earth fire that broke out in Eastern Iceland in the year 1783, as it was observed in Skagafjörður; progress of the eruption and its various effects.	Written in spring 1784
Magnús Stephensen	*Kort beskrivelse over den nye Vulcans Ildsprudning i Vester Skaptafields-Syssel paa Island i Aaret 1783.*⋆ A short description of the new volcanic eruption in Western Skaftafellshire the year 1783.	Copenhagen 1785
Jón Pétursson	*Om Ildrögens kiendeligeste Virkninger, paa Nordlandet i Island 1783.*⋆ About the perceptible effects of the volcanic haze in Northern Iceland in 1783.	Unpublished, the original script is lost. Information on its content is preserved in rebuttal by M. Stephensen 26. June 1786
Jón Steingrímsson	*Fullkomið skrif um Síðueld.*⋆ A complete description on the Síða volcanic fire.	Prestbakki 24. November 1788
Sveinn Pálsson	*Eldritið, viðbætir við lýsingar á Skaftáreldum 1783.*⋆ Book of Fire, additions to the descriptions of the Skaftá Fires (Laki eruption) 1783.	Written in 1793 and 1794

appeared to weigh around ten pounds or more."

This may be the oldest known description of cowdung and spindle bombs. Moreover the passage emphasises that Steingrímsson looked upon volcanic eruptions as a natural phenomenon and that he observed the Laki event from a realistic point of view. He also realised the importance of keeping records on the course of events and the damage caused by the eruption, in order to ease any proceedings with the Danish authorities with regard to natural disaster assistance. Although his writings contain a certain overtone of religious superstition, he clearly discriminates between observations and interpretations in his descriptions.

CONSISTENCY OF THE ELDRIT WRITTEN BY STEINGRÍMSSON

The first two Eldrit written by Steingrímsson in 1783 were documents accompanying letters to the authorities (Rafnsson, 1984). They record the progress of the eruption up to the cited dates (Table 1). The third Eldrit was regarded by Steingrímsson to be a complete description of the eruption and was written so that the public could become acquainted with this "chastisement of the Lord for their reformation."

Earlier publications regarding the Laki eruption, i.e. the works by S. Hólm and M. Stephensen (Table 1) were not accessible to the Icelandic public, because they were published in Danish and in Steingrímsson's opinion they were "incomplete and inconsistent." In light of this and the famine caused by the Laki event, Steingrímsson felt it necessary to describe the details of the eruption and its consequences, or as he stated in his epilogue to *Fullkomið skrif um Síðueld*; "Here I will compile in one document what I wrote down day after day, season-after-season during the eruption, to the day the good Lord relieved us of this burden. Everything written here is accordant with what other veracious human beings and I saw and experienced during the eruption, as my conscience and the Lord God can verify. Nothing is overstated or exaggerated, but minor incidents are left out, especially those which concerned families and individuals because such details would be too redundant."

In general the consistency of Steingrímsson's works is very good and the discrepancy that occurs is mainly concerned with dates of specific events. In most cases the difference is only one day and therefore does not seriously affect the reconstruction of events. If it is kept in mind that the two earlier works, Eldrit 1 and Eldrit 2 were written during the eruption, but his latest Eldrit was completed five years later, this kind of inconsistency could be expected. It is logical to assume that dates and statements, where they differ, are correct in the earlier works.

The first thing to consider is Steingrímsson's description of the ash-fall during the first days of the eruption. In the first Eldrit it is noted that footprints could be made in the ash on the third day of the eruption, i.e. 10 June. For footprints to mark in a tephra deposit it needs to be at least 0.1 cm thick (Thorarinsson, 1955). In Eldrit 2 and 3 this is said to have occurred on the first day of the eruption. At the same time the descriptions of the volcanic cloud become statelier (see Thordarson *et al*., this issue). Another interesting addition in the two later Eldrit is Steingrímsson's statement that the plume was pushed back in the afternoon on 8 June by a southerly sea breeze. This statement seems to challenge the above-mentioned descriptions of a statelier plume, because a light sea breeze would hardly have a significant impact on the dispersal of an expanding eruption column.

All of the Eldrit clearly show that the ash-falls during the first days of the eruption were all of short duration, lasting for few hours at the time, and were frequently accompanied or followed by heavy rain. Ashfall occurred in the Síða and Fljótshverfi districts and it is likely that some ash fell in the Landbrot district. According to J. Eiríksson I (Table 1), no tephra fell in the Skaftártunga district during this time and no reports mention tephra fall in the Meðalland and Álftaver districts (position of these districts are shown on Figure 1 in Thordarson *et al*., this issue). Reconstruction of the tephra dispersal from thickness measurements in soil profiles indicates that the Skaftártunga, Meðalland and Álftaver districts were not severely affected by tephra fall from the Laki eruption (Thordarson and Self, 1993).

If the eruption cloud was as large as Steingrímsson indicates in Eldrit 2 and 3, the tephra would be ex-

pected to have a greater distribution than noted above. Therefore, Eldrit 1 appears to contain the most realistic description on the amount of ash that fell in the Fire districts during the first days of the eruption. It is possible that Steingrímsson magnified the descriptions of the ash-fall and the eruption cloud when he realised the effects the eruption had on the community and the environment.

There is a considerable inconsistency between Eldrit 2 and Eldrit 3 in their documentation of events around 16 June. In Eldrit 2 the events are described as follows: "15, 16, 17 June the lava flowed with the same rate towards south and southwest from the farm Skál, which was still standing. The flow crept into hollows in the older lavas [i.e. the 934 A.D. Eldgjá lava] and caused them to swell up so high, that those who did not see it with their own eyes would find it hard to believe. These old crags and boulders were thrown up into the air with a cracking noise as if many cannons were fired off, but on impact loud claps and rumble were heard." In Eldrit 3 the events are described as such: "On 16 June the weather was the same [as on 15 June]; an awful lava surge emerged from the Skaftá River gorge, so that the whole gorge appeared to be filled up by the lava. This surge completely abolished and destroyed the following farms that belonged to the abbey and the king: Á in Síða and Nes in Skaftártunga, each worth 1200 coins of silver. It also flowed over and covered the old lava flows between the Síða and Skaftártunga districts, which were largely grown up with brushwood and trees, very useful pasturelands. This area included Brandaland, a good woodcutting area, belonging to Kirkjubæjarklaustur. — Brandaland was located west-southwest of the pinnacle Skálarstapi in the nook where the river turns east along the Síða scarp and bordered by a branch from the Skaftá River. This surge destroyed the so-called Skálargarðar and Holtsgarðar, where it was stationary for a while. Another lobe of lava advanced south towards the Meðalland district, where it first flowed over the Botnar and Steinsmýri lavas. The activity was intense to the north of the mountains bordering the Síða district, with cracking and crashing sounds, fire and haze, along with earthquakes, such that no one was certain whether the settlement was going to be saved. Therefore 3 farmers, who lived at the farm Mörtunga, climbed up to the highest lookout point on mountain Kaldbakur for visual observation on the progress of these fires in the pasture. They saw, as it appeared to them, 22 columns of fire rising from the fissure in Úlfarsdalur Valley. — On 16 June was calm weather, so I [Steingrímsson] made a trip out to the farm Skál to look after the church and its belongings and also to see and observe carefully the advance of the lava flow."

These two descriptions do not have much in common. However, their difference does not have any bearing on their veracity or which is the correct one. The description in Eldrit 3 gains a new perspective when considered in broader context and compared to the descriptions from 13 to 20 June in Eldrit 2. In both works Steingrímsson describes the occurrence of two lava surges in the period of 13 to 20 June. According to Eldrit 2 they occurred on the nights before 15 June and on 18 June, respectively. In Eldrit 3 the former surge is said to have occurred on 16 June and the latter on 18 June. Steingrímsson's descriptions of each event are very similar in both accounts; they only differ in the date of the former surge. In Eldrit 2 Steingrímsson states that two trips were undertaken to explore the progress of the eruption in the Síða highlands, on 13 June and 20 June, respectively. In Eldrit 3 he does not mention these trips on the above noted dates. A similar description of an exploratory trip, as is noted on 13 June in Eldrit 2 (see Thordarson *et al.*, this issue), is present in Eldrit 3 in writings about the events on 16 June (see quotation above), suggesting that these are descriptions of the same trip. It is also of interest that in Eldrit 3 the date 16 June occurs twice in the same paragraph, despite that the description of events is coherent and in continuity. This is the only time that this occurs in the whole work.

The progress of the eruption between 13–15 June as it is described in Eldrit 2 is very similar to the description on 16 June in Eldrit 3. It appears that Steingrímsson summarised the course of events from 13 to 15 June into one paragraph in his final work and most likely confused the dates.

The descriptions of the advance of the lava that followed the explosive activity on 29 July directly

north of Mt. Blængur is not internally consistent. In Eldrit 2 the description is as follows: "Between 22 July and 2 August the weather was calm with occasional heavy rainfall. During this period columns of fire and steam were constantly seen, along with occasional thunders and rumble in the pasture. On 3 August people noticed that the water in Hverfisfljót River was getting warmer. Its temperature increased steadily, until the river finally dried up.

On 9 August intensive thunder and lightning were seen around the fissure north of Fljótshverfi. The same day a lava surge emerged out from Hverfisfljót River gorge and advanced like running water out onto the sandur plain, one mile [i.e. Danish mile = 7532 m] beyond so called Orustuhóll hillock, and from there due south until it stopped. — along with occasional thunders, claps and fountain activity which were seen off and on emerging from the fissures up in the pasture as well as lava emerging from the gorges out over the settlement. It was not foreseen what these fires and the rivers that were dammed by the lava might do in the following fall and winter."

In Eldrit 3 the same events are described as follows: "On 29 July a rumble and boiling sound was first heard northeast of Mt. Kaldbakur, on the strike with [directly behind] a high mountain called Blængur. The rumble and cracking were not any less than those heard from Vesturgjá at the time when activity was at the greatest vigour, but had dwindled considerably at this stage. Later that day a dreadful volcanic cloud emerged from the site with sandy tephra fall that was dispersed over Fljótshverfi and the eastern part of Síða and caused almost complete darkness indoors. On 30 July there was calm and nice weather, thunders, rumbles and cracking sounds were heard almost continuously from all sides. On 31 July a steam cloud was seen advancing down the Hverfisfljót River gorge, which was almost as deep and wide as the Skaftá River gorge and the river carried same amount of water which now effervesced/boiled in many channels due to the heat. — 1, 2, and 3 August the same whizzing continued to be heard from this fissure [Austurgjá], along with tremor, rumble, thunder and lightning, along with flowing lava north of the mountains, which dried up Hverfisfljót River. — The first lava surge came out from the Hverfisfljót River gorge on 7 August. On 8 and 9 August it advanced down one of channels of Hverfisfljót, the channel closest to the eastern margin of Síða district trending south-southwest. The lava flowed far out onto the sandur plain, beyond the hill Orustuhóll. — on the eastern side [of the gorge] it advanced a short distance beyond the promontory Dalshöfði."

In the quotation from Eldrit 2 the heating of the Hverfisfljót River is said to have begun on 3 August, or 4 days after activity was first noticed north of Mt. Blængur. In the Eldrit 3 this is said to have occurred on 31 July and that the river dried up on 4 August. Furthermore, the day when the river dried up is not specified in former quotation, but it is evident that it occurred after 3 August and most likely on the 4^{th}. It is known from the accounts that the Skaftá and Hverfisfljót rivers were of similar size. As stated in Steingrímsson's descriptions, the flow of lava at the beginning of the eruption dried up the Skaftá River in one day. Then why should it take 4 days for the lava flow to dam and dry up the Hverfisfljót River?

The volume or the flow rate of the lava was not much less in the latter case (Thordarson and Self, 1993). Therefore, it is logical to assume that it would take a roughly equal amount of time for the lava to dry up both rivers. This indicates that the lava did not reach the Hverfisfljót River gorge until 3 August as stated in Eldrit 2 and that it took the lava 4 to 5 days to flow from the vents and down into the gorge. The location of the vents straight north of Mt. Blængur explains the time it took the lava flow to reach the gorge. The lava had to flow down a narrow valley between Blængur and Innri Eyrar, a distance of 13 km, before entering the gorge near Mt. Miklafell (see Figure 2 in Thordarson *et al.*, this issue). This implies that the lava advanced at rates of $\sim$3 km per day. This estimate is consistent with the calculated average flow rate for the lava as it continued its advance down the gorge. The lava travelled from Miklafell to the mouth of the gorge ($\sim$15 km) in about 4 days, giving average flow rates of 3–4 km per day (Thordarson, 1990).

According to Eldrit 3 the lava surge emerged out from the Hverfisfljót River gorge on 7 August, but in Eldrit 2 this is said to occur on 9 August. In both ac-

counts the surge advanced one Danish mile beyond the hillock Orustuhóll on that day. This inconsistency in the dates given for the lava emerging from the Hverfisfljót River gorge can be explained by considering the geographic condition around the mouth of the gorge, which was and still is located at the southern tip of Mt. Dalsfjall, 7 km north-northeast of the hillock Orustuhóll. The north-south trending Mt. Þverárfjall is approximately 1 km north of Orustuhóll and because of that mountain the mouth of the Hverfisfljót River gorge is not visible from the Síða district. However, the mouth of the gorge is clearly visible from the Fljótshverfi district in the east (see Figure 2 in Thordarson *et al*., this issue).

I conclude that the description in Eldrit 2, when the lava is said to have emerged from the gorge on 9 August, refers to the time when Steingrímsson saw the lava advance beyond the southern tip of Þverárfjall from the Síða district. On the other hand, the description in Eldrit 3 about the surge emerging from the gorge on 7 August, is most likely based on observations by inhabitants of the Fljótshverfi district and Steingrímsson did not get news of that until after he wrote Eldrit 2.

Another way of evaluating the veracity of these descriptions is by reconstructing the flow rate of the lava during this period. The distance the lava flowed from the vents until it reached the mouth of the gorge is ∼28 km. According to Eldrit 3 it took the flow 8 days to flow this distance, i.e. from 30 July to 7 August. According to the description in Eldrit 2 it took the lava 10 days to flow the same distance. If the statement in Eldrit 2 that the lava emerged from the gorge on the 9^{th} is correct, then the lava advanced about 10 km in less than a day. If the lava emerged out from the gorge on the 7^{th}, as stated in Eldrit 3, the flow advanced the same distance in 3 days, or about 3 km per day. As the lava emerged from the gorge, where it had been confined to a narrow passageway, and spread out onto the sandur plain, its flow rate would be expected to decrease but not increase as is the case if the description in Eldrit 2 is assumed to be correct.

This discussion on the inconsistency between the Eldrit written by Steingrímsson is by no means exhaustive, but demonstrates that the discrepancies are minor and does not have substantial effects on our reconstruction of the events of the eruption.

HÓLM'S DESCRIPTIONS

Om Jordbranden paa Island i Aret 1783 (About the Eruption in Iceland in the year 1783) by Sæmundur Magnússon Hólm was published in both Danish and German in Copenhagen 1784 (Table 1). An extract from his Eldrit was also printed in the *Ephemerides Societatis Meteorologicae Palatinae, Observationes Anni 1783* published in Mannheim 1785. The author was born and raised in Meðalland, one of the Fire districts. In 1771 he drew up a map of the area featuring the local landscape and farming communities (Figure 1). This map is a valuable source about local conditions in the Fire district before the Laki eruption and the inhabitants' perception of geographic directions (see Thordarson *et al*., this issue). At the time of the eruption Hólm was located in Copenhagen, thus in writing his compendium of the eruption he had to rely on news, letters and reports sent to Copenhagen via the trading vessels from Iceland in fall of 1783. His main sources appear to be the Eldrit of Jón Eiríksson^{II} (Table 1) and a report by Skúli Magnússon, Governor of Iceland (Rafnsson, 1984), along with personal letters sent to him and other Icelanders living in Copenhagen. Consequently, Hólm's descriptions on the progress of the Laki eruption are often exaggerated and thus not a reliable source on the details of the course of eruption events. However, his writings provide useful information about the occurrence of the Laki haze and its effects in Denmark. The Eldrit included a map, showing very inaccurately the distribution of the Laki lava flow.

STEPHENSEN'S DESCRIPTIONS AND OBSERVATIONS

Magnús Stephensen and H. C. D. W. von Levetzow were sent to Iceland in the summer 1784 by the Danish government to investigate the Laki eruption and its effect on the Icelandic community. Stephensen published the results of his investigations in 1785, along with a map of the lava flow (Table 1). The descriptions of the eruptive events are largely based on Steingrímsson's documentation of the eruption, and as pointed out by Pálsson (1794), facts are often dis-

Figure 1. Map of Western Skaftafellshire drawn by S. M. Hólm in 1771 (Hólm 1784) showing his perception of location and distribution of farms and topographic features in the Fire districts prior to the Laki eruption. The circles indicate the location of Kirkjubæjarklaustur (large) and Prestbakki (small). The arrow points to the southern edge of the Síða highlands (the Síða scarp), shown here trending east-west (true orientation is 55°east of north). – *Yfirlitskort af Vestur Skaftafellssýslu teiknað af Sæmundi M. Hólm árið 1771.*

torted. On his two-day exploratory trip into the Síða highlands, Stephensen conducted some observations on the eruptive products from the Laki event and attempted to locate the source vents. He notes that the moors above the Síða district and most of the Síða highlands were covered with a 10 to 15 cm-thick tephra deposit. Stephensen's descriptions of landmarks in the highlands, and his map of the lava flow and vent locations in the northern part of the highlands, were very inaccurate (Stephensen, 1785; Pálsson, 1794). Stephensen states that he could not get a clear view of this part of the highlands due to smoke and mist that filled the air. Pálsson (1794) noted that it was rumoured in the Fire districts that Stephensen never went far into the Síða highlands and the incompleteness of Stephensen's descriptions in that area supports this.

PÁLSSON'S DESCRIPTIONS AND OBSERVATIONS

In the spring of 1784, Sveinn Pálsson wrote a short compendium about the Laki eruption (Table 1), mostly describing the distal effects of the eruption in northern Iceland, i.e. ash fall, sulfuric haze and how these phenomena affected vegetation and weather. He relates the severe frost in the fall and winter of 1783–1784 to the sulfuric haze produced by Laki because it reduced the solar radiation flux to the Earth's surface. This is similar to the explanation put forth by Pálsson's contemporaries Mourgue de Montredon (1784), Johann L. Christ (1783), and Benjamin Franklin (1784). Pálsson's brief descriptions concerning the progress of the eruption are based on a letter from a friend living in the Síða district.

In 1794, eleven years after the eruption, Pálsson explored the Fire districts and the Síða highlands. His travel log, written in 1791–1797 but not printed until 1945, gives a detailed description of his observations in the area, along with a map which fairly accurately depicts the distribution of the Laki lava flow, vent locations and prominent landmarks (Pálsson, 1794). He noted that the tephra at that time had completely disappeared into the bogs. Furthermore he states that where the tephra had fallen on bare ground in the northern part of the highlands, it was largely removed by wind and surface runoff. The western slopes of Mt. Galti, however, were completely covered with tephra and the fall deposit was about 15 cm thick.

Pálsson and his partner were the first to reach and investigate the Laki cone-row, July 31st 1794. After a difficult walk across the lava flow they reached the cone-row midway between the Laki and Hnúta mountains (See Figure 3 in Thordarson *et al.*, this issue). Pálsson's descriptions are remarkably accurate and the cones he describes have been identified as those situated on fissure segment 3. He estimated the length of the cone-row between Laki and Hnúta to be 2 Danish miles, or ∼15 km. The correct length is 13 km. From his observations, Pálsson correctly concluded that the lava in the Skaftá River gorge was derived from the fissures southwest of Laki and the lava filling the Hverfisfljót River gorge originated from the fissures northeast of Laki. He also suggested that the fissures southwest of Laki were formed during the initial phase of the eruption and that the fissures northeast of Laki were formed on 29 July, when activity was first noticed in the eastern part of the Síða highlands.

It is obvious from Pálsson's conjecture on the progress of the eruption that he considered the cone rows on either side of Mt. Laki to be two discrete fissure segments, one opening at the beginning of the eruption and the other about two months later. Later geologists (Helland, 1886; Thoroddsen, 1879, 1894, 1925; Thorarinsson, 1967, 1969) adopted this idea without question, as the basic reasoning appeared logical, although erroneous as demonstrated by Thordarson and Self (1993).

Another important contribution was Pálsson's documentation of the location of the Úlfarsdalur Valley, which was eradicated by the Laki lava and is wrongly placed on modern topographic maps. The first outbreaks of the Laki eruption were reported to be in the Úlfarsdalur Valley, therefore it is important to know the exact location of this valley. According to Pálsson, Úlfarsdalur trended north along the western slopes of Úlfarsdalssker, separated from the Skaftá River gorge by a low lava ridge. The lava that ran westwards from the craters at Hnúta (see Figure 2 in Thordarson *et al.*, this issue) and dammed the Skaftá River gorge on the third day of the eruption now cov-

ers the Úlfarsdalur Valley. Pálsson also notes that fires were seen in the direction of the Grímsvötn volcano in the years 1783–1785.

OTHER DESCRIPTIONS

The Eldrit written by Svendborg, Sünckenberg and Eiríksson^{II} (Table 1) provide little additional information about the Laki event and their descriptions of the eruption are taken from other sources and not based on their own observations (Table 1).

The work of Pétursson (Table 1) is now lost. According to comments and critiques on its content written by Stephensen in 1786 (Rafnsson, 1984), the work was mainly concerned with the haze produced by the eruption and its effects in Northern Iceland. Being a physician, Pétursson conducted investigations on how the haze affected humans and animals and described the results in his Eldrit.

A wealth of official documents, personal letters and newspaper clippings concerning the Laki eruption have been compiled by Gunnlaugsson and Rafnsson (1984). They are commonly concerned with specific aspects of the eruption or how it affected local areas in Iceland. The key sources are a letter written by Eiríksson^{I} at Ljótarstaðir in Skaftártunga, the only account which describes the earthquakes in May 1783, as well as short accounts by Einar Björnsson, Árni Thorarinsson and Ólafur Stephensen (Table 1). These authors provide important information on the precursor earthquake swarms and developments of the fire fountain activity and associated eruption columns.

CONCLUDING REMARKS

The analysis presented here shows that the reliability and consistency of the contemporary chronicles describing the Laki eruption is highly variable. The accounts written by the observers, e.g. J. Steingrímsson, E. Björnsson, J. Eiríksson^{I}, Á. Thorarinsson, Ó. Stephensen, and S. Pálsson (Table 1), contain the most accurate descriptions and are thus the most reliable source of information for reconstructing the course of eruptive events. On the other hand, compilations by authors that did not witness the eruption, e.g. S. Hólm and M. Stephensen (Table 1), are riddled with erroneous information regarding the nature and timing of events and thus of no practical use.

The last Eldrit compiled by the Reverend Steingrímsson, contains the most thorough description of the Laki eruption. However, it includes a few significant mistakes but fortunately other eyewitness accounts supply complementary information needed to correct them.

The "true" eyewitness accounts give a remarkably accurate and detailed description of the eruption-related phenomena and provide a unique and invaluable source for studies on the physical volcanology of flood lava eruptions. These chronicles are the key building blocks for reconstruction of the sequence of events during the eruption, because they provide information on the nature and timing of events otherwise unobtainable (see also Thordarson and Self, 1993 and Thordarson *et al*., this issue).

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ÁGRIP

Margar samtímaheimildir eru til um Skaftárelda og umbrotin þeim samfara, en umfang og gæði þessara heimilda er mjög misjafnt. Upp úr standa lýsingar Jóns Steingrímssonar, sem nú eru varðveittar í þremur eldritum og geyma nákvæmustu upplýsingarnar um gang gossins og aðra nátengda atburði. Til samans eru eldrit Jóns án efa merkilegustu og ítarlegustu lýsingar sem til eru af íslensku eldgosi fram að 20. öldinni. Þó gætir nokkurs ósamræmis milli eldrita Jóns og þá einkum milli þess yngsta sem hann lauk við 1788 og hinna tveggja eldri (skrifuð árið 1783). Þetta misræmi kemur helst fram í dagsetningu einstakra atburða og í flestum tilvikum skeikar aðeins degi til eða frá. Af þessum sökum er auðvelt að leiðrétta ósamræmið og það hefur lítil áhrif á heimildagildi eldritanna.

REFERENCES

See reference list in Thordarson *et al*, this issue.