universität wien

MASTERARBEIT

Titel der Masterarbeit

The Dry Fog of 1783: Environmental Impact and Human Reaction to the *Lakagígar* Eruption

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angestrebter akademischer Grad

Master of Arts (MA)

Wien, 2013

Studienkennzahl lt. Studienblatt:	A 066 805
Studienrichtung lt. Studienblatt:	Globalgeschichte und Global Studies
Betreut von:	ao. Univ.-Prof. Dr. Margarete Maria Grandner

Abstract

In the year 1783, an unusual fog covered the atmosphere over a large part of the Northern Hemisphere, persisting for a period of up to three months. In particular, the summer in Europe was characterized by the appearance of this phenomenon. Many contemporaries described it as a dry fog. The origin of this was the *Lakagígar* volcanic eruption of 1783-1784 in Iceland.

This research focuses on the environmental impact of the eruption in Iceland and Europe, and analyzes how contemporaries reacted to its influence and what meaning they derived from it. The event is known to be one of the largest fissure eruptions in historical times. As a result of the volcanic activity, notorious amounts of volcanic gases were released into the atmosphere which formed the infamous fog. In Iceland, the volcanic pollution damaged crops and vegetation, and had a disastrous consequence for livelihood in the country. In that sense, the eruption was one of the primary causes of the Haze Famine of 1783-1785, where one-fifth of the Icelandic population perished.

In Europe, the volcanic fog wielded an influence on communities that were oblivious of its origin. While the unusual atmospheric condition caused terror among common people, the Enlightenment thinkers of the day tried hard to reason out its origin. However, the boundary of scientific knowledge in late-18th century Europe contributed to a confused identification of the event. In that sense, the dry fog of 1783 challenged people's world-views. Unlike the Icelandic experience, the environmental impact of the fog does not appear to have been significant in Europe. Despite adverse effects on vegetation due to the aerial pollution being identified in the northern and western part of the continent it did not affect the progress of the summer harvest. It is also difficult to determine whether the volcanic pollution had any effects on mortality in Europe. By highlighting these results, this research challenges notions that have been presented in recent years on the environmental influence of the *Lakagígar* eruption in Europe.

Abstract

Im Jahr 1783 erfüllte ein ungewöhnlicher Rauch die Atmosphäre über großen Teilen der nördlichen Hemisphäre, der sich bis zu drei Monate lang hielt. Vor allem der Sommer war in Europa davon gekennzeichnet. Viele Zeitgenossen beschrieben das Phänomen als trockenen Nebel. Sein Ursprung war der Ausbruch des *Lakagígar* Vulkans auf Island in den Jahren 1783-1784.

Diese Forschungsarbeit befasst sich mit den Umwelteinflüssen des Vulkanausbruchs in Island und Europa und analysiert, wie Zeitgenossen diese Auswirkungen wahrnahmen und interpretierten. Das Ereignis selbst gilt als eine der größten Spalteneruptionen in historischer Zeit. Als Folge der vulkanischen Aktivität gelangten riesige Mengen vulkanischer Gase in die Atmosphäre und bildeten den berüchtigten Nebel. In Island zerstörte der Vulkanausbruch Ernten und Vegetation und hatte katastrophische Auswirkungen für die Lebensbedingungen des Landes. Der Vulkanausbruch war damit einer der Hauptgründe der Hungersnot der Jahre 1783 bis 1785, durch die ein Fünftel der isländischen Bevölkerung zugrunde ging.

In Europa hatte der vulkanische Nebel Auswirkungen auf die Menschen, die sich seines Ursprungs nicht bewusst waren. Während der ungewöhnliche Zustand der Atmosphäre unter einfachen Leuten Angst und Schrecken verbreitete, suchten die Denker der Aufklärung intensiv nach einer vernünftigen Erklärung für die Ursachen. Die Grenzen der Wissenschaft, wie sie im späten 18. Jahrhundert bestanden, führten jedoch zu einer eher konfusen Charakterisierung des Ereignisses. Der trockene Nebel des Jahres 1783 stellte also das Weltbild der Menschen auf die Probe. Anders als in Island scheinen die Folgen des Nebels in Europa nicht schwerwiegend gewesen zu sein. Trotz negativer Wirkungen der Luftverschmutzung auf die Vegetation in den nördlichen und westlichen Teilen des Kontinents kam es zu keiner Beeinträchtigung der Ernte jenes Sommers. Es ist auch schwierig auszumachen, ob die durch den Vulkanausbruch verursachte Luftverschmutzung Folgen für die Sterblichkeit in Europa hatte. Mit der Herausarbeitung dieser Resultate stellt die vorliegende Arbeit Ansichten über die Umwelteinflüsse des *Lakagígar* Ausbruchs in Europa in Frage, die in den letzten Jahren geäußert worden sind.

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Introduction

Iceland – a geological perspective

> Think of the earth as an egg with its shell cracked. We are standing on one of those cracks. Right here is where the North American plate meets the Eurasian Plate ... underneath, lava rises up and pushes the two plates apart. ... California is on the opposite side of the North American plate. Iceland is pushing California into the ocean!
>
> Christina Sunley, *The Tricking of Freya*, p. 133

Iceland is a volcanic island situated in the North-Atlantic Ocean, about 965 kilometers west of Norway and 280 kilometers east of Greenland. The combination of geographic location and strong and unsteady westerly winds, which boom the shores of the island from all directions, made the island out of reach for centuries. As a consequence, it was one of the last places on earth to be permanently settled by human beings, which only happened in the early Middle-Ages when a wave of outmigration from the western fjords of Norway and other parts of Scandinavia navigated the North-Atlantic in search of new land. According to a classic work on early Icelandic history called *Landnámabók* (*The Book of Settlements*), settlement in Iceland took place between 874 and 930 A.D. The majority of Iceland's 320,000 inhabitants today are descended from immigrants who arrived at that time, making the population remarkably homogenous.

Skilled as they were in ship construction and maritime navigation, the Norse settlers (also known as Vikings) probably saw the North Atlantic as a series of landfalls, bridging the Atlantic from the European continent to North America, although of course they had no idea that the latter was a continent. As their westward movement continued, they settled in Greenland a century after arriving in Iceland, and then discovered North America, which they called Vínland (Wine Land). As a stepping stone, Iceland was crucial for this diaspora, which demonstrates a geographical location that has played an influential role in the country's history – the island stands isolated in the middle of the Atlantic between two continents.[1]

How does one define Iceland, then? Is it a European country; a part of the Americas; or simply a landmass between the two surrounded by seawater? In this regard, Iceland could be described as a historically young country whose cultural origin and colonial past under Norwegian and Danish monarchs from 1262 to 1944 has tilted it under the geographic and

[1] For overview see e.g., Karlsson, Gunnar: *Iceland's 1100 years*

administrative belt of Europe. However, a geological perspective provides a somewhat different and more appropriate picture, with the subject of this research in mind.

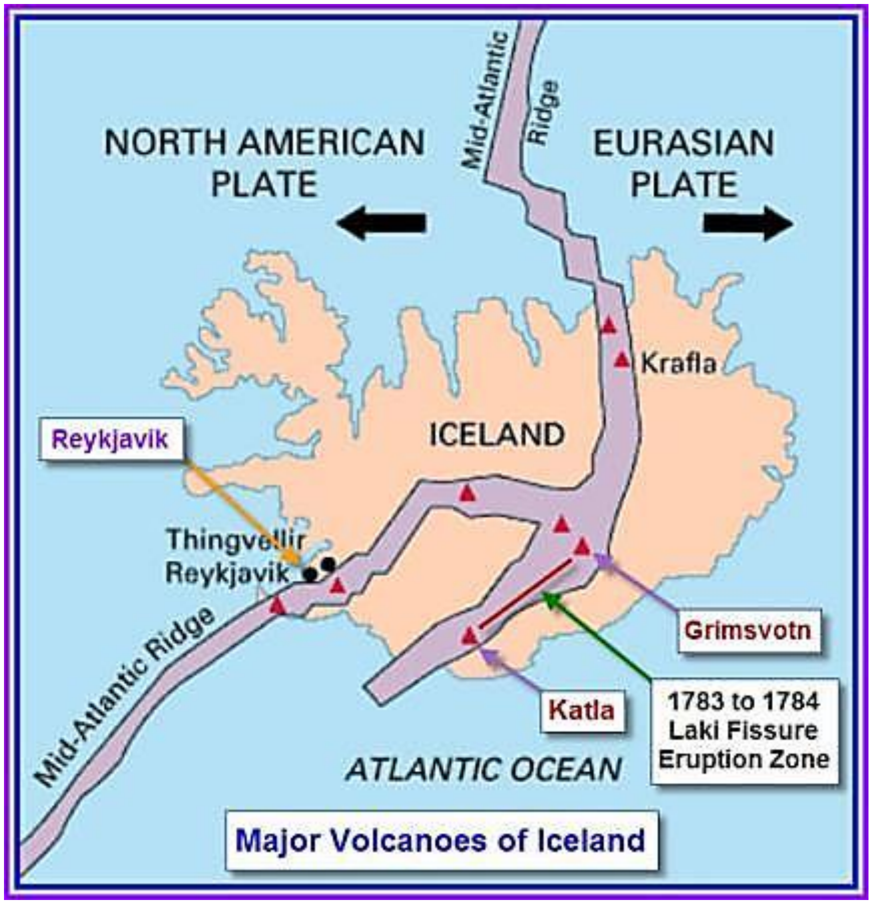

Figure 1: A map of Iceland showing the situation of the Mid-Atlantic Ridge and major volcanoes. The geological setting of *Lakagígar* is highlighted in a text-box far down to the right. Image adapted from U.S. Geological Survey: (http://pubs.usgs.gov/gip/dynamic/understanding.html)

Iceland is not only very young on a historical timescale, but also geologically. The construction of the island is thought to have begun 24 million years ago. In geological time this means that if we take the age of the Earth to be one year, then Iceland was born only two days ago.[2] The country's existence is intrinsically linked with plate tectonics, whose movements are responsible for most volcanic and seismic activity on the Earth.[3] The island sits astride a divergent tectonic, known as the Mid-Atlantic Ridge. As part of a network of rifts which cuts across the entire planet, the ridge winds along the floor of the Atlantic Ocean, marking the boundary between the continental plates of North America and Eurasia; and between the

[2] Thordarson, Thor and Hoskuldsson, Armann: *Iceland*, p. 5
[3] Zeilinga de Boer, Jelle and Sanders, Donald Theodore: *Volcanoes in Human History*, p. 8-10

South American and African plates. This makes Iceland part of a 16,000 kilometer undersea system which forms the floor of the Atlantic Ocean. However, as a consequence of volcanic activity an area of 103,000 square kilometers has managed to rise above sea level to form the landmass which today constitutes Iceland.[4]

Volcanism in Iceland is partly attributed to the Mid-Atlantic Ridge (see Figure 1). This stems from a process called seafloor spreading. For the last seventy million years – since the continental breakup of Newfoundland and Greenland from Europe – the North American and Eurasian plates have been slowly pulling away from one another along the ridge. As the crust pulls apart, molten rock wells up from the Earth's mantle to fill the ever-opening gap. Normally, ocean ridges do not build up above sea level, but they do in Iceland. Earth scientists believe that this is due to additional volcanism provided by active plumes of magma under the ridge that are known as hotspots. Hundreds of such hotspots dot the length of the Mid-Atlantic Ridge, above which lies a number of volcanic islands, including the Azores, the Canary Islands, and Tristan da Cunha. However, Iceland is geologically unique in the sense that it is not only located upon a volcanic mid-ocean ridge, but also above a hotspot.[5]

Consequentially, there is no place on Earth where one can so easily and vividly witness the consequences of plate tectonic movement first hand, as in Iceland. As the piecemeal process of sea floor spreading continues, the landmass of Iceland continues to grow at about 2 centimeters a year (i.e. 1 centimeter a year in each direction). This development can be experienced somewhat palpably at certain places in the center of the island where one can, geologically speaking, stand with one foot in North America and the other in Europe; while the slabs on which the two continents sit pull slowly apart beneath you. From this perspective, it somewhat makes sense that the French writer of science fiction and visionary, Jules Verne (1828-1904), started his travelers on their *Journey to the Center of the Earth* and back in time, through a secret tunnel in the crater of the Icelandic volcano Snæfellsjökull. That is, if one's worldview sees the Western World as the heart of our universe – as is often the case.

The geology of Iceland underlines that volcanism is an ever-present factor on the island – in fact; Iceland is one of the most active volcanic regions on Earth. Since the settlement of the country a total of 205 eruptions have been identified, which implies that on average a volcanic

[4] Thordarson, Thor and Hoskuldsson, Armann: *Iceland*, p. 5
[5] Thordarson, Thor and Hoskuldsson, Armann: *Iceland*, p. 6-8

event occurs every 5 years.[6] Evidently, this feature has been significant in shaping the environment that has given life to Icelandic society during the country's history. However, the environmental implication of volcanism is by no means a private matter for volcanic islands like Iceland. Therefore, as in Jules Verne's story, we derive our narrative from an Icelandic crater and trace the effects it had for the rest of the world during one of the largest volcanic episodes in documented history – the *Lakagígar* eruption of 1783-1784.

Subject and aim of research

In 1783 a massive volcanic eruption took place in the *Lakagígar* area ("the craters of Laki" – *gígar* is the plural of *gígur*: crater) in the south of Iceland. Not only did the eruption cover pastures throughout the country with ash and fill the air with a thick volcanic smoke, its influence also carried over great distances and cast a persistent haze over Europe and a large part of the Northern Hemisphere. Contemporaries described the phenomenon as a "dry fog". Its appearance would characterize the summer of 1783.

As people in Iceland witnessed the eruption, saw the ash fall, heard the roaring sounds of the craters from afar and suffered in the smoke; the outside world remained clueless about the origin of the fog. Telecommunications was yet to be invented and modern scientific understanding, as we know it, was in its early stages. On the European continent, people speculated about the causes of the fog, as well as its implications. For some it signified the end of the world. Meanwhile, the natural scientists of the day tried hard to produce historical precedents and ingenious theories about the fog. Although most of these ideas would later be judged unfounded and even bizarre, others were to inspire our understanding of the relationship between the atmosphere and climate.

It was only months after the eruption began when the vessels of the Royal Monopoly Company of Iceland anchored in Copenhagen with news from Iceland that the world learned of the origin of the dry fog. By that time, it had finished flowering.

The subject of this research is the *Lakagígar* eruption of 1783-1784 and the dry fog it cast over Europe in the summer of 1783. Based on the above-mentioned overview, we approach the event by concentrating on three main analytical points. First, the eruption demonstrates that nature-induced occurrences are not confined to local domains and they do have wider

[6] Thordarson, Thorvaldur: "Perception of Volcanic Eruptions in Iceland", p. 285-286

implications. In the first part of Chapter I, we explore this aspect of volcanism. The questions in this context are: How can the influence of a volcanic eruption be transported over great distances and make itself felt in far-away regions; and what effects can we associate it? By reviewing these questions we seek to establish a causative-role for the *Lakagígar* eruption in the narrative of this work.

This brings us to the second point. Nature-induced occurrences have throughout history been known to have had massive repercussions for human societies. Regarding the *Lakagígar* eruption, the event is frequently described as "the greatest catastrophe in Icelandic history".[7] In the light of this assumption, we devote the second part of Chapter I in discussing how the eruption could have played such a visible role as an actor in Icelandic history. We base our review solely on the part which the eruption can be held accountable for and leave out other factors such as social and economic causatives that may have influenced the scenario.

Understanding the wider implication of volcanism and the significance of the *Lakagígar* eruption in Iceland moves us beyond the island to the European mainland where the lion's share of this work takes place. We begin our discussion of the *Lakagígar*-induced dry fog in Europe in Chapter II, which we approach through the final point of our analysis. In this case, it will be argued that the interpretation of nature-induced occurrences is critically dependent on the cultural context and knowledge available at any given time in history. Based on this, we trace the geographical spreading of the dry fog, demarcate the timeframe of its influence, and analyze how contemporary Europeans reacted to the fog and what meaning they derived from it. From a historical perspective, it will be argued that the dry fog offers a revealing insight on how the late-18th century mentality thought of anomalous natural occurrences.

After discussing the contemporary reaction to the dry fog in Europe we turn our attention to the environmental influence of the eruption. This will be the subject of the third and final chapter of our work. In this part, all three analytical points feature and the questions we highlight are: How did the wider implication of the *Lakagígar* eruption manifest itself outside Iceland; did the impact of the dry fog have repercussions for European societies; and what does the contemporary reaction tell us about it? Providing a comparative view to our analysis, we shall also recount and critically assess some of the ideas that have emerged in recent studies on the environmental influence of the *Lakagígar* eruption outside Iceland. After concluding the discussion of Chapter III, we highlight the findings of this research.

[7] See e.g. Wood, Charles A: "Climatic Effects of the 1783 Laki Eruption", p. 60

To summarize the approach of this work, the analytical points that we have presented correspond with two main disciplines or subfields that the research explores: i.e. *environmental history*, which is concerned with the interaction between human beings and nature; and *cultural history*, which deals with the issue of meaning and interpretation.[8] Based on these themes, our aim is to document the *Lakagígar* eruption and the dry fog of the summer of 1783. The event is certainly one of the most remarkable nature-induced occurrences in modern history. For several months, the fog from the craters of Laki covered a good part of the Northern Hemisphere – reducing visibility in the natural environment, obscuring the sun, and giving it a blood-red visage at rising and setting. As the event appeared virtually unprecedented it gave rise to a lively debate, which featured prominently in European newspapers and journals, at that time. This brings us to the final part of the introduction – namely, to briefly sketch out the sources this research makes use of, and also say a few words about what inspired the work.

Sources and inspirations

Although each chapter of this work features a discussion on relevant source material, the purpose of this section is to give a brief overview on the documentary-approach and touch on some of the main works that have inspired this research.[9] Roughly, the sources that we make use of can be divided into three main categories – i.e., literature from the earth sciences, contemporary sources from the period of the *Lakagígar* event, and recent studies on the effects of the eruption.

The material derived from the earth sciences sheds light on the wider implications of volcanism and locates the *Lakagígar* eruption within that context. Two sources, in particular, are worth mentioning. Regarding general knowledge about volcanism, much information is drawn from the writings of Clive Oppenheimer, professor in volcanology at the University of Cambridge, and his recent and pleasantly readable book *Eruptions that Shook the World*. The geological dimension of the *Lakagígar* eruption is mainly highlighted through research headed by professor Thorvaldur Thordarson, from the Faculty of Earth Sciences at the University of Iceland. His findings are considered the most up-to-date on the event and cannot be overlooked.

[8] Definition provided by Steinberg, Ted: *Acts of God*, p. xxi

[9] For a list of the authors and the sources that are mentioned in this section, see bibliography

Despite the starring role of nature in this work, the author has no intention of trying on the shoes of an earth scientist and practice novelties in that field. The interpretations and assumptions made in this research are based on historical evidence, which brings us to that category of sources. The discussion on the effects of the *Lakagígar* eruption in Iceland rests mainly on Icelandic sources. A key work is *Skaftáreldar 1783-1784*, a comprehensive book that was published on the second centenary of the eruption and features a selection of contemporary historical sources, as well as articles that discuss the eruption from a geological and historical perspective. All translations from Icelandic to English undertaken in this work are specifically notified in footnotes. The author takes full responsibility for any misdeeds.

Concerning the influence of the *Lakagígar* eruption outside Iceland, which we narrow primarily to the summer of 1783 in Europe, a variety of contemporary sources from the period is used. In this case, contemporary newspapers, magazines and journals, yearbooks, biographies, diaries, as well as private letters and even poetry and literature influenced this work. The approach of these sources was partly assisted through the work of other scholars who have recently considered the impact of the *Lakagígar* eruption in various parts of Europe. To name an example, the geoarcheologists John Grattan from the University of Aberystwyth in Wales, and co-authors, have examined archive material and efficiently written about the environmental and social impacts of the dry fog – concentrating mainly on Britain. This research is also indebted to the work of the late scientist of the National Aeronautics and Space Administration (NASA), Richard B. Stothers (1939-2011), who thoroughly studied contemporary documents on the first appearance of the dry fog in Europe. Owing to the clarity of his writing, the notion "dry fog" finally became clear to the author of this research.

Finally, the author would like to acknowledge the work of the environmental historians Gaston R. Demarée and Astrid E.J. Ogilvie. More than any other source material, their twenty-six page collaborative article "*Bons Baisers D'Islande*: Climatic, Environmental, and Human Dimensions Impacts of the *Lakagígar* Eruption (1783-1784) in Iceland" helped shape the approach of this research, and was an inspiration throughout the whole writing process. Let us now turn our attention to the yield of that work.

Chapter I

The Significance of the *Lakagígar* eruption

> Around midmorn on Whitsun, June 8th of 1783, in clear and calm weather, a black haze of sand appeared to the north of the mountains nearest the farms of the Síða area. The cloud was so extensive that in a short time it had spread over the entire Síða area and part of Fljótshverfi as well, and so thick that it caused darkness indoors and coated the earth so that tracks could be seen. The powder which fell to earth looked like burnt ash from hard coal.
>
> Jón Steingrímsson, *Fires of the Earth*, p. 25

So begins a famous contemporary account that describes the outbreak of the *Lakagígar* eruption, which took place in the southern part of Iceland in the summer of 1783. When it came to an end, eight months later, it had produced more lava than any eruption on earth in documented history. The timing of the event coincided with a national catastrophe in Iceland – experienced through famine, disease and death. Meanwhile, the influence of the eruption was felt over large areas of the Northern Hemisphere.

The *Lakagígar* eruption is the best documented pre-20th century volcanic episode in Iceland, and a large body of source material contains information on the event. In this chapter we shall make use of both the primary and secondary literature to give a historical overview of the eruption, and analyze the consequences it had in Iceland. The object is to account for the dimension of the eruption and analyze the relationship between the event and the catastrophe that it is commonly associated with. Reviewing the significance of the *Lakagígar* eruption in Iceland and knowing its particularities should give an idea regarding the wider implication of the event. In other words, it should tell us what the eruption had in store for the rest of the world.

In order to approach the eruption of 1783-1784, we devote the first part of the chapter to volcanoes. By doing this, we shall look at the features of volcanism that are relevant for this research and explore the effects that are commonly associated with large-scale volcanic events. The questions we seek to review in this context are: How can a local feature in the natural environment like a volcano have massive repercussions on a nationwide scale; and even spread its influence to far-away regions? Viewing these questions should help us establish the causative role of the *Lakagígar* eruption in this work.

1.1. The features of volcanism

> It's the mouth of a volcano. Yes, mouth; and lava tongue. A body, a monstrous living body, both male and female. It emits, ejects. It is also an interior, an abyss. Something alive, that can die. Something inert that becomes agitated, now and then. Existing only intermittently. A constant menace. If predictable, usually not predicted. Capricious, untenable, malodorous. Is that what's meant by the primitive?
>
> Susan Sontag, *The Volcano Lover*, p. 6

Volcanism boasts a wide variety of impacts which makes it an attractive, but complicated subject. Eruptions come in all shapes and sizes, ranging from hissing gas to gushing lava flows; and huge explosions of ash and dust. Anyone who opens a scholarly book on volcanology and seeks to understand its mechanism will discover that the field is heavily laden with nomenclature. The technical language covers a broad spectrum of eruption styles, which describe the distinctive physical character and behavior of volcanoes. Some of these are drawn from particular historical eruptions. Like for example "Peléan" eruption style, which connotes to the 1902 pyroclastic flows (a dense mixture of hot volcanic fragments and gas) released by the Martinique volcano Mount Pelée that wiped out the city of St. Pierre, killing 99,997% of its 29,000 inhabitants.[10] Or explosive "Plinian" style eruptions, drawn from Pliny the Elder's (AD 23-79) first-hand description of the 79 AD eruption of Mount Vesuvius. Other eruption styles bear the characteristic behavior of individual volcanoes. A "Strombolian eruption" for example, refers to "gentle" volcanic activity coined after the volcano Stromboli on the same name Italian island; while the non-explosive "Hawaiian eruption", resembles fire fountains as exemplified by the perpetually spouting Kilauea volcano on Hawaii.[11]

When trying to make sense of the eruption style flora, it is useful to look at what volcanoes emit. The products of volcanic eruptions all ultimately derive from molten rock – the building material of Iceland – called *magma* (or lava), which originates within the earth. Generated at the depth of 100 to 150 km, magma's tendency to work its way upward to the surface of the earth stems from its heat and buoyancy – i.e. it is less dense than the surrounding rocks in the earth's crust. Ascending magma will generally find a level, anywhere from 3 to 30 km below the surface, where it has the same density as the host rock. Having

[10] Scarth, Alwyn: *La Catastrophe*

[11] Allaby, Michael: *Encyclopedia of Weather and Climate*, (vol. 1) p. 610

reached what is known as "the level of neutral buoyancy", and gravity no longer acting to propel it further upward the magma accumulates and forms so-called magma chambers.[12]

As long as magma resides in a chamber, its chemistry alters through interaction with the surrounding rocks. It becomes lighter, less dense, richer in gases, and more viscous (i.e. resistant to flow). As more magma is squeezed in, the pressures on the molten mass increases and therefore the potential for an eruption.[13] Important in this context, is magma's capacity of holding quantities of dissolved gases under great enough pressure. When it rises towards the surface, the pressure acting upon it is reduced, and the dissolved gases separate out. This process has often been likened to the opening of a bottle of champagne. The fizz in the drink comes from dissolved carbon dioxide, which along with water vapour is a dominant component of magmatic volatiles. Easing the cork off reduces the pressure inside the bottle, and the gas separates from the liquid and expands suddenly as the champagne flows from the bottle as bubbly foam. When a volcano erupts, of course, the liquid is largely magma, volcanic gases, and water vapor.

A volcanic eruption therefore refers to the "expulsion of magma, gas or rocks, or all three, in any shape or form, onto the Earth's surface."[14] In this process, an eruption can constitute a single explosion that lasts only few seconds; or it can expand into a continuous outflow that can go on for weeks, months, or even years. It can feature a single style activity, or manifest itself in multiple eruption styles. A definition of a volcanic eruption is therefore not clear. However, to simplify, a distinction has been drawn between two main eruption types. These are ranked along the spectrum from gentle to violent, and referred to in the technical language of volcanology as "explosive and effusive volcanism".[15] Roughly, the mechanism behind the two goes as follows: On the one hand, magma that is viscous and cool – at about 800°C, and called silicic magma – tends to erupt *explosively*; while on the other hand magma that is hot and fluid – around 1100°C, and called basaltic magma – tends to rise slowly towards the surface in an *effusive* erupting style.[16] The difference lies between variations in heat and gas components. In basaltic magma, "the gases are under much less pressure and separate easily from the molten rock" while in silicic magma, the gases are trapped, thus forcing an

[12] Oppenheimer, Clive: *Eruptions that Shook the World*, p. 9-14
[13] Zeilinga de Boer, Jelle and Sanders, Donald Theodore: *Volcanoes in Human History*, p. 10-13
[14] Thordarson, Thor and Hoskuldsson, Armann: *Iceland*, p. 17-18
[15] Oppenheimer, Clive: *Eruptions that Shook the World*, p. 14-17
[16] Oppenheimer, Clive: *Eruptions that Shook the World*, p. 4-14

explosive rush out of a vent following a sudden release of pressure.[17] An alternative trigger of explosive volcanism arises when basaltic magma meets water. Depending on the contact between the two, the sudden production of steam and accompanying expansion can yield explosions of tremendous violence. Quite logically this type of activity is referred to as "hydrovolcanic".[18]

Explosive and effusive volcanism not only helps us understand how volcanoes erupt, but also tells us what they emit. In this case, explosive eruptions produce fragmented rocks, such as volcanic ash, pumice and bombs. Collectively these are known as *tephra*, a term which was first proposed by the Icelandic earth scientist Sigurdur Thorarinsson (1912-1983) in 1934.[19] Effusive products are not fragmented, and referred to simply as *lava*. To put this in perspective, the latter eruption style generates lava flows that during a high-intensity can aggregate several cubic kilometers of material. In full force, they burn anything that gets in their way – consuming trees and crops; sometimes burying or surrounding; destroying households and other human structures; and even diverting water supplies when running down river valleys. What they leave behind is new land – i.e. lava fields. However, lava flows seldom move fast enough to catch human beings by surprise. And in its purest form, effusive volcanism is not associated with causing damage and destruction beyond local areas.[20]

The features of explosive volcanism are different. Its distinctiveness is marked by the force, when tephra is blown high into the air above a volcano in great columns that form eruption clouds. Apart from the recently acknowledged hazard that such clouds present to aviation, the most obvious and noted impact stems from the process when the volcanic material falls to ground. The renowned 79 AD eruption of Mount Vesuvius puts this in perspective. Ash fall from the eruption is believed to have buried the ancient Roman city of Pompeii, located 10 km away from the volcano, in up to ten meters; claiming thousands of lives. Unlike the procedure of effusive lava flows, the victims of Pompeii were clearly caught by surprise. Highlighting this, archeological evidence from the site detected dozens of human victims holding hands and clothing to their mouths, obviously trying to keep out the

[17] Zeilinga de Boer, Jelle and Sanders, Donald Theodore: *Volcanoes in Human History*, p. 14-15
[18] Oppenheimer, Clive: *Eruptions that Shook the World*, p.14-17
[19] Sigurdsson, Haraldur: *Melting the Earth*, p. 247-250
[20] Oppenheimer, Clive: *Eruptions that Shook the World*, p. 36-38

suffocating volcanic material. The discovery of uneaten food on household tables also suggests that people continued life as usual right up to the very end.[21]

A Pompeii-type of eruption tells us something about the scope of large scale explosive volcanism. And as we shall see in this research, volcanic clouds are no respecters of national boundaries once they climb high enough into the atmosphere. However, volatile tephra is not the only manifestation of volcanic eruptions that scatters destruction beyond an eruption site. Therefore, to fully comprehend the environmental implication of volcanic eruptions, we have to dig deeper and look at the actions of a much smaller component of magmas that are, as we demonstrated in this section, pre-eminent to the eruption process – i.e. volcanic gas. In order to do this, we move away from surface level and turn our attention to the "ocean of air" that encircles our natural environment, the atmosphere.

1.2. The interplay between volcanism and the atmosphere

The Earth's atmosphere consists of a gaseous mixture, approximately 78% nitrogen and 21% oxygen, with small amounts of other gases including argon, ozone, and carbon dioxide. This mixture is what we call air, and accounts for almost the total weight of the atmosphere. While the proportions of these remain constant – apart from an increasing man-made input of carbon dioxide – there is in addition a constantly varying amount of water vapour, as well as small but significant quantities of solid airborne matter such as dust particles, sand, pollen grains, sea salt, which are a natural and beneficial part of the atmospheric economy. Together these are also vital constituents of the atmosphere in determining the character of the earth's weather and climate.[22] And for the sake of clarity, weather is "what we experience each day" while climate is "the sum of all weathers over a certain period, for a region or for the planet as a whole."[23]

Whenever a volcano erupts it sends volcanic material into the atmosphere. Small eruptions, which constitute the majority of the 10,400 eruptions that have been recorded during the Holocene (the past 12,000 years), produce relatively small amounts of material that either falls or disperses in the surroundings of a volcano, or simply makes an interesting natural spectacle.[24] The rarer bigger eruptions, however, can expel many cubic kilometers of

[21] See Beard, Mary: *The Fires of Vesuvius*: *Pompeii Lost and Found*
[22] Kington, John A: *Climate and Weather*, p. 27-52
[23] Flannery, Tim: *The Weather Makers*, p. 20
[24] See Simkin, Tom, Siebert, Lee and Kimberly, Paul: *Volcanoes of the World*, (Third Edition)

volcanic material into the atmosphere. Typically, a few per cent of the total mass of the erupted material is made up of gases. The rest is just rock – essentially inert bodies of lava or accumulation of tephra. In the atmosphere, the gases, however, are not inert. They add an unknown variable to the atmospheric mix, which can have severe consequences for the environment and its inhabitants, and at its most serious disturb the equilibrium of the atmosphere and affect the world's climate. Let us look closer at the interplay between the atmosphere and volcanism.

The most abundant gas released during a volcanic eruption are obviously those who play the biggest part in the volcanic process; i.e. water vapour and carbon dioxide, as we demonstrated in the previous section. Since these gases already exist in fairly high concentration in the atmosphere they hardly have an impact on a large-scale, although significant emissions of carbon dioxide can have lethal effects in the locality of an erupting volcano.[25] More significant are magmatic gases released in smaller quantities. During volcanic eruption they can rise kilometers into the atmosphere, and once airborne prevailing winds spread the gases either in the form of *volatiles*; i.e. compounds that include sulfur, water vapour, carbon dioxide, chlorine, and fluorine, which are attached to tephra particles, or *aerosols*; i.e. tiny droplets composed mainly of sulfuric acid and water vapour.[26]

What are the effects that can be associated with volcanic gases? The answer is not single-tracked. Depending on chemical composition and quantity they may, on the one hand, provide nutrients that are beneficial for the environment. In fact, volcanic soils have a good reputation for fertility. Regarding this, renowned scholars like Jared Diamond, who draw historical assumptions based on long-term developments in the natural environment, have causally linked the "collapse" of ancient societies to remoteness from sources of volcanic material that would have helped to replenish nutrients lost from the soil by erosion.[27] On the other hand, a dusting of few centimeters or more of volatiles can have severe environmental implication – i.e. plants and soils may be destroyed by suffocation and aggressive acids absorbed on the particles. Fluorine is worth mentioning with the subject of this chapter in mind. Excess of its compound emitted by a volcano are especially harmful to livestock,

[25] Robock, Alan: "Volcanic Eruptions and Climate", p. 193
[26] See Oppenheimer, Clive: *Eruptions that Shook the World*, p. 22-52; and U.S. Geological Survey: (http://volcanoes.usgs.gov/hazards/gas/)
[27] See Diamond, Jared: *Collapse*, p. 79-120

rendering an excruciating process which leads to abnormal tooth and bone growth, hemorrhage and organ failure that eventually kills animals. Fluorine poisoned tephra-falls can also corrupt drinking water with detrimental consequences for people.[28]

When looking at the interplay between volcanic gases and the atmosphere, earth scientists have stressed the importance of one magmatic gas in particular – namely, compounds of sulfur released from a volcano as sulfur dioxide and hydrogen sulfide. Eruptions that emit large quantities of the species into the atmosphere cause volcanic air pollution. In the atmosphere, the gas reacts with water vapour and forms aerosols of sulfuric acids, which cause poor air quality that can have respiratory and cardiovascular health implications for humans.[29] According to the World Health Organization, sulfuric acids also cause an irritation in skin and the tissues and mucous membranes of the eyes, nose and throat. Likewise, the gas is known to have damaging (as well as beneficial in the long-term) effects on the environment. In this case, the sulfuric aerosols combine with precipitation and fall to ground as acid rain. Chronic exposure even of rather low amounts of sulfuric acid may injure leaves, impair plant ecosystems and decrease agricultural productivity.[30]

The late scientist Richard B. Stothers devoted a good deal of his professional career in researching historical incidents involving volcanic-induced aerosols in the atmosphere. According to his work, the documental record describes the appearance of a phenomenon that is known as "dry fogs". The fog is dry, simply because it does not contain the moisture and dewdrops of normal fogs, while by the nature of its hazy appearance it reduces visibility in the natural environment, which often creates optical expressions such as discolored sunrises and sunsets.[31] To put this in perspective, the appearance and effects of polluted volcanic haze has been likened to industrial-induced aerosols (known as "smog"), which have been common place in the natural environment since the coal-driven Industrial Revolution. A nearby example from this analogue was conspicuously felt during the 1960s when lakes and forests at high latitude in the Northern Hemisphere were severely affected by sulfur dioxide emissions from coal-burning power stations. Due to continuous exposure to acid rain, trees lost their colour, leaves and needles, while lakes became crystal clear and emptied of life. This

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28 Pétursson, Guðmundur et al: "Um eituráhrif af völdum Skaftárelda", p. 81-99

29 See Oppenheimer, Clive: *Eruptions that Shook the World*, p. 44-46; and U.S. Geological Survey: (http://volcanoes.usgs.gov/hazards/gas/)

30 U.S. Geological Survey: (http://volcanoes.usgs.gov/hazards/gas/)

31 Stothers, Richard B. and Rampino, Michael R: "Volcanic Eruptions in the Mediterranean before A. D. 630", p. 6357-6371; and Stothers, Richard B: "Volcanic Dry Fogs", p. 713-723

realization prompted legislation to enforce the use of "scrubbers" on coal-burning power plants, which have been in use since the 1970s, dramatically reducing sulfur dioxide emissions and acid aerosol formations, at least in our part of the world.[32]

What we have hitherto reviewed partly reveals how a volcanic eruption may affect the environment and its inhabitants. In our part of the atmosphere, known as the *troposphere*, which on average extends 12 kilometers above the Earth's surface, volcanic gases are subject to the mechanisms at work in that layer of the atmosphere. In the troposphere we find most water vapour of the Earth's atmosphere, and therefore the aforementioned clouds and precipitation that rain down the volcanic acids. We also find all "normal" weather phenomena and therefore the winds that transmit the tephra particles and aerosols from an erupting volcano. On the one hand, these forces provide a vehicle which can spread the volcanic influence "hundreds-to-thousands of kilometers downwind".[33] On the other hand, wind and rain also form a kind of self-cleaning mechanism that rapidly undoes the volcanic impact. Should a volcanic eruption, however, be powerful enough to send large quantities of gases straight through the troposphere and deep into the *stratosphere* (the second layer of our atmosphere), they enter a different equation and trigger an impact that is likely to be more enduring and felt over greater distances.

According to meteorological theory, it has become generally accepted that large explosive eruptions can affect climate, not only on a local and regional scale but also globally, if volcanic particles and gases are thrust up to heights of 20 to 40 kilometers into the stratosphere.[34] The theory is related to the topic of this research, in the sense that the connection between volcanic eruptions and climate seems to have been first brought up in the wake of the 1783-1784 *Lakagígar* eruption, as we shall reflect on later in this work. Since that time, the relationship has been researched extensively.[35] In short, the injected ash particles fall rapidly from the stratosphere and have little impact. The sulfur content of a volcanic eruption, however, is crucial. In the stratosphere, the gas condenses rapidly into aerosols that are carried around the world by powerful stratospheric winds. Within weeks and months the aerosols

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[32] Flannery, Tim: *The Weather Makers*, p. 158-160
[33] Oppenheimer, Clive: *Eruptions that Shook the World*, p. 44-46
[34] Robock, Alan: "Volcanic Eruptions and Climate", p. 191-219
[35] See e.g. Lamb, H. H: "Volcanic dust in the atmosphere", p. 425-533; and Robock, Alan: "Volcanic Eruptions and Climate", p. 191-219

blanket the world, where they can remain suspended for several years and effectively "disturb the stratospheric chemical equilibrium." The consequence of such occurrences can be summed up in the following manner: on the one hand, the aerosols increase the reflection of radiation from the sun back into space and thus cool the troposphere; while on the other hand they also absorb heat radiated up from the earth and thereby warm the stratosphere.[36]

In recent decades an increased scientific and public awareness of a possible "global warming" due to anthropogenic activities has stimulated an interest in volcanic-induced climate change, because it could obfuscate an increased greenhouse effect. Although many questions remain unanswered regarding the actual relationship between volcanoes and climate, there seems to be an agreement within the earth sciences that "large eruptions certainly produce global or hemispheric cooling for 2 or 3 years…"[37] How does one make sense of this knowledge with the context of a historical research in mind? If we take annual temperature reduction as a meaningful parameter for the relevance of volcanic-induced climate change, the impact seems marginal. In historical time, no eruption seems to have reduced hemispheric temperature by more than 1°C, which is well within the boundary of normal annual variation.[38] However, the annual temperature yardstick masks the critical anomalies of seasonal or monthly weather which seem to string along with large explosive volcanic eruptions. Concerning this, regional or seasonal periods of temperature extremes; untimely precipitation; or extreme patterns of storminess and drought can have severe effects on societies. Throughout history people have relied on the regularities of seasonal weather that the world climate delivers. Evidently, unexpected changes to them are a cause for vulnerability for any type of society – let alone the predominantly agrarian structure of the late-18th century that this research discusses.

Based on this, one could argue that climate is an applicable variable to a historical research. The point was emphasized by the economic historian John Dexter Post (1925-2012), whose research on the social- and economic consequences of the 1815 eruption of Mount Tambora is a rare example to draw on volcanic-induced climate change as a causative factor in a historical context. According to Post, a historian should look for documentary evidence of anomalous weather patterns that coincide with large-scale volcanic eruptions. What makes this task problematic, however, is the inability of meteorologist to explain disrupted patterns with

[36] Robock, Alan: "Volcanic Eruptions and Climate", p. 191-219
[37] Robock, Alan: "Volcanic Eruptions and Climate", p. 192
[38] Grattan, John et al: "The Long Shadow", p. 154-155

any "quantitative exactness", as Post points out.[39] The climatic variable is therefore a tricky one, which we shall put aside for the time being and return to at the latter-stages of this research.

The coming narrative derives its context from the interplay between volcanic gases and the atmosphere. The environmental implications of volcanism that we have reviewed in this section: be it the discolored sun and atmospheric haze; suffering livestock; damaged ecosystems and injured plants; irritating and injuring sulfurous stench for people; or abnormal weather patterns – are all familiar features in the scenario created by the *Lakagígar* eruption. We shall devote the remainder of the chapter to the 1783-1784 eruption. The purpose is to give a historical overview of the event and analyze the consequences that the *Lakagígar* eruption had in Iceland. Understanding the scope of the event and the effects it had in Iceland provides us with a comparison that is useful when looking at the wider implications of the *Lakagígar* eruption. It also helps us understand what this volcanic episode had in store for the rest of the world.

1.3. The *Lakagígar* eruption

Thanks to an impressive tradition of documenting volcanic eruptions and nature-induced calamities in Icelandic historiography, we know a lot about the *Lakagígar* eruption. The great general interest in the observation of nature and natural events is an indicator of the effects of the Enlightenment movement that were beginning to be felt in Iceland at that time. At least seven contemporary descriptions of the *Lakagígar* eruption were written in the years following the eruption, some of which were published in other European languages.[40] A special position amongst those holds the account of local pastor, Reverend Jón Steingrímsson (1728-1791), who lived in the vicinity of the craters. His account was finalized in 1788, but earlier descriptions published by other authors were in large part based on reports that he wrote at

[39] Post, John D: *The Last Great Subsistence Crisis in the Western World*, p. 1-26

[40] See e.g. Holm, S. M: *Om Jordbranden paa Island i Aaret 1783*. Copenhagen 1784. Holm's book was published in German the same year, *Vom Erdbrande auf Island im Jahr 1783*; while extracts of it appeared in English in 1799, "Account of a remarkable Eruption from the Earth in Iceland". See also, Stephensen, Magnus: *Kort Beskrivelse over den nye Vulcans Ildsprudning i Vester-Skaptefields-Syssel paa Island i Aaret 1783. Efter Kongelig allernaadigste Befaling forfattet, og ved det Kongelige Rentekammers Foranstaltning udgiven*. Copenhagen 1785. Extracts from the book were published in German in 1786, "Nachricht von den schrecklichen Unglücksfällen, welche Island in dem Jahre 1783 und 1784 betroffen haben."

the time of the eruption.[41] As a consequence, we owe most of our knowledge about the *Lakagígar* eruption to his observations. This section relies mostly on Jón Steingrímsson's account; while in the sections that follow we shall expand on other writings as well as written sources drawn from the archives of the Rentekammer in Copenhagen – a governmental bureau that was much concerned with Icelandic matters under the Danish Crown during this period.[42]

The southern coast of Iceland is a rural tree-less meadowland enclosed by an arc of mountains stretching between two glaciers. To the northeast lies Vatnajökull, the largest glacier in Europe; and to the southwest the more modest, Mýrdalsjökull. Both glaciers partly mask systems of volcanic fissures that burst into life now and then. The volcano Katla lies under Mýrdalsjökull; while Grímsvötn is the most active of several systems beneath Vatnajökull. In 1783 it was Grímsvötn's turn.

Events leading up to the *Lakagígar* eruption clearly indicate that something remarkable was happening under the earth's surface. On the 1st of May 1783, Captain Jörgen Mindelberg of the Danish fishing boat *Boesand* recorded in his ship log that at 3 o'clock in the morning southwest of Reykjanes, he and his crew "saw smoke rising from the sea and thought it to be land; but on closer consideration we concluded that this was a special wonder wrought by God … that natural seawater could burn." On May 3rd the ship approached the area again, but "when we had come within half a mile of the island we had to turn away for fear that the crew might faint owing to the enormous sulphur smell." The "burning island" that Captain Mindelberg and his crew had observed was in fact a volcanic island that had risen from the sea.[43] The offshore volcanic activity may well have been related to changes in underground pressure and movement along the Mid-Atlantic Ridge, which then spread from the seafloor to the shire of Vestur-Skaftafellssýsla. In May, crew members of another Danish ship declared that they had seen a column of fire "in the mountains or in the glaciers" in the neighborhood

41 "Skýrslur um Skaptárgosin", (vol. 4) p. 1-57. For an English translation see, Steingrímsson, Jón: *Fires of the Earth*

42 During the disastrous years of 1783-1785, the Rentekammer received annual reports on the situation of each shire (sýsla) in Iceland from sheriffs and general reports from the prefects. A selection of the original documents, as well as articles that discuss the eruption from both a geological and historical viewpoint, can be found in, *Skaftáreldar 1783-1784*, (ed. Gísli Ágúst Gunnlaugsson et al.)

43 Thorarinsson, Sigurður: "Neðansjávargos við Ísland", p. 58-62 (My translation)

of the Síða district, which probably was the first of a series of eruptions of the Grímsvötn volcanic system.[44]

Probably unaware of this development the people in the south of Iceland had enjoyed a favorable spring and were looking forward to a good summer. However, more serious signs were to follow. From mid-May weak tremors were felt in the shire that escalated into strong earthquakes from the 1st of June. They were accompanied by thunderous noise and felt almost continuously for a week throughout southeast Iceland, where many local people took to staying in tents overnight.[45] The turning point came on Whitsun morning on June 8th. In clear and calm weather people noticed a dark cloud rising in the north, behind the mountains. The cloud was so extensive that in a short time it spread over the inhabited area, and so thick that it covered the ground with black ash.[46] This marked the beginning of the *Lakagígar* eruption.

The eruption took place along a 27 kilometer-long-fissure in the Síða highlands, just southwest of Vatnajökull. It formed an area divided into two nearly equal parts that center on an old and extinct volcano called Laki, which in the non-Icelandic literature has given its name to the event.[47] The fissure zone constituted an opening of 140 vents and craters, some reaching over 100 meters in height. By all accounts the eruption was an awesome sight that offered a vivid and extreme example of the features of volcanism that we have discussed in this chapter. The vigorous expulsions of magma manifested itself in fire fountains that exploded kilometers into the atmosphere, while immense flows of lava gushed from the fissure zone. Let us look closer at the eruption with a special reference to Jón Steingrímsson's account.

By the nature of its fissure activity, the *Lakagígar* eruption was predominantly effusive. Enormous quantities of lava poured from the fissure zone, which formed two main flows. The first one developed during the initial stage of the eruption. On June 10th, lava ejected on the craters to the southwest of Laki accumulated into a large stream that followed the winding gorge of the River Skaftá, which normally carries meltwater southward from Vatnajökull. Its waters turned into steam as the surge of lava proceeded along the river's gorge. At night time, people could see the lava glow behind the uplands and hear terrifying noises as it flowed down

44 Thorarinsson, Sigurður: "Annáll Skaftárelda", p. 11
45 Thorarinsson, Sigurður: "Annáll Skaftárelda", p. 11-37
46 Steingrímsson, Jón: *Fires of the Earth*, p. 25-28
47 In non-Icelandic literature, the eruption is often referred to as the "Laki Eruption". In the strictest sense, this is a misnomer. During the course of events Mount Laki did not erupt, but the craters on either side of the mountain did.

the course of the river and approached the local farmsteads in the coastal plain. Based on Jón Steingrímsson's account, "the flood of lava spilled out of the canyon of the River Skaftá and poured with frightening speed, crashing, roaring and thundering. When the molten lava ran into wetlands or streams of water the explosions were as loud as if many cannon were fired at one time."[48]

An estimate of six cubic kilometers of lava erupted in the first dozen days of the eruption, equating to an average discharge rate comparable to tipping out the water from two Olympic swimming pools every second.[49] The metaphor is brought to life in Steingrímsson's depiction who on June 18th travelled to the gorge of River Skaftá and saw that "[t]he flood of fire flowed with the speed of a great river swollen with meltwater on a spring day. In the middle … great cliffs and slabs of rock were swept along, tumbling about like large whales swimming, red-hot and flowing … they cast up such great sparks and bursts of flames hither and thither that it was terrifying to watch."[50] As the fissure to the southwest of Mount Laki lengthened the volcanic ash continued to fall: "It was calm on the 14th [of June] and the entire area around here was covered by a fall of cinders, with even more of them shaped like threads than in the previous downpour, on the 9th. They were blue-black and shiny, as long and thick around as a seal's hair." Meanwhile, the atmosphere was covered with haze which rubbed out the nearest natural features and made the sun appear red as blood. When rain poured down through the fog it became so strongly odorous that it "caused almost unbearable soreness to the eyes or bare skin" in people who also "suffer[ed] from chest ailments could hardly breathe and nearly lost consciousness". It was acid rain, and it turned iron "rust-red"; caused timber to lose its colour and turn grey "from the downpour of salty and sulphurous rain"; while the grass, "which was green and luscious, now began to fade and wilt."[51]

People soon began to flee from the farms in the area surrounding the fissure zone, as one farmstead after the other was overwhelmed by the lava. The state of the atmosphere was eclipsed and polluted rainfall continued to bring damage to the districts in Vestur-Skaftafellssýsla. There had even been thick snowfall on June 11th and 21st.[52] For reverend Jón Steingrímsson, "the tumult reached its peak" a month later and on July 20th he gathered with

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[48] Steingrímsson, Jón: *Fires of the Earth*, p. 26
[49] Analogy borrowed from Oppenheimer, Clive: *Eruptions that Shook the World*, p. 276
[50] Steingrímsson, Jón: *Fires of the Earth*, p. 33-34
[51] Steingrímsson, Jón: *Fires of the Earth*, p. 25-28
[52] (Note by author: Even in Iceland, snowfall in June is unusual.)

his terrified congregation at the former convent farm Kirkjubæjarklaustur which the lava-flow had approached to within only a few kilometers. As the crowd made their way to service "the clouds of hot vapours and fog coming from the fire farther down the river channel were so thick that the church could hardly be seen … from the doors of the cloister building." It was now that Jón Steingrímsson read his famous *Eldmessa* ("Fire Mass") – whose morale is still celebrated in textbooks for school-children in Iceland – where he beseeched God to stem the advance of the lava away from the church. Foreordination seems to have been on his side, since the lava flow along the River Skaftá phased out from that day. After Jón Steingrímsson's mass, people saw that tremendous amount of meltwater from the glacier had burst from the uplands to stop the lava which piled up exactly where it was when the service began. A testimony of these incredible events can still be seen today in the form of a spit called Eldmessutangi, just few kilometers from Kirkjubæjarklaustur. Or as Steingrímsson religiously put it in his *Fires of the Earth*: it "will rest there in plain sight until the end of the world, unless transformed once again."[53]

Drawing its name from the surge of lava down River Skaftá, the eruption of the Laki fissure zone is usually referred to as *Skaftáreldar* (*eldar* is the plural of *eldur*: fire) in Icelandic historiography. During the first one and a half month episode the *Lakagígar* eruption had been at its most vigorous.[54] By the time the surge of lava came to a halt, it had filled up the gorge of River Skaftá which was approximately 500 meters wide, 100-200 meters deep and 30-40 kilometers long.[55] At times it even looked as though the lava might reach the sea, which would have effectively separated communities. Despite Jón Steingrímsson's spiritual opposition, the *Lakagígar* eruption went on. After the eruption had more or less completely stopped, "the first thuds and rushing sounds were heard from the northeast" on July 29th, and the "noises and cracking sounds were no less than they had been in the canyon to the west".[56] This signaled a new phase in the eruption as the activity moved to the northeastern fissure.

At the beginning of August, a new batch of lava accumulated to form a second main lava-flow down the valley of River Hverfisfljót, which roughly parallels the River Skaftá a few kilometers to the northeast. Its water began to warm up on August 3rd when a steam was seen advancing down its channel. It dried up the following day as lava filled the gorge and carried

[53] Steingrímsson, Jón: *Fires of the Earth*, p. 48-50
[54] Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects", p. 3-4
[55] Einarsson, Þorleifur and Sveinsdóttir, Edda Lilja: "Nýtt kort af Skaftáreldahrauni", p. 37-48
[56] Steingrímsson, Jón: *Fires of the Earth*, p. 54

in the direction of the coastal plain. The river's gorge was 15-20 kilometers long, but just as deep and wide as River Skaftá. On October 25th, Jón Steingrímsson noted that a "great spout of flame shot upwards into the air" from the glacier "accompanied by a terrible surge of fire, with cracking and thudding continuing for a full five days." He described the surge as "the most threatening and the most powerful" during the whole eruption. The fields of hot lava had now captured the inhabitants of the region in a pincer movement between the valleys of River Hverfisfljót and Skaftá. However, at this stage, the craters began to exhaust themselves. From the end of October the lava did not reach the lowlands; although polluted rainfall continued to shower upon them throughout November. In December, "all the flames and glare in the sky began to decrease" as the volcanic pollution cleared and "once the skies were clear, the sun and moon returned to their proper brightness." On February 7th 1784, fire was seen from Laki fissure zone for the last time as the eruption finally petered out after eight months of volcanic activity.[57]

1.4. Interpreting the *Lakagígar* eruption

The *Lakagígar* eruption had severe consequences and in mainstream historiography it is commonly described as one of the severest natural catastrophes ever to take place in Iceland. How were the events of 1783-1784 catastrophic? Based on our previous discussion, it is practical to draw a distinction between separate factors that constituted the *Lakagígar* eruption – i.e. the effects of the volcanic material on the one hand; and that of the volcanic gases emitted during the eruption on the other hand.

Regarding the volcanic material, geologists have decreed that the *Lakagígar* eruption accounted for one the greatest outpouring of lava on earth in recorded history. An estimate of 14.7 cubic kilometers of the material erupted towards the surface during the event which covered an area of 580 square kilometers.[58] To put this in perspective, that is more than enough to cover the combined area of Austria's two largest cities, Vienna and Graz. As the lava found its pathways it spilled over the banks of River Skaftá and Hverfisfljót, and demolished practically everything that got in its way. Perhaps as many as twenty-one farms and two churches were overwhelmed while dozens of farms were damaged. Local farmsteads and meadows met the same fate as the burning lava effectively robbed the agrarian settlements

57 Thorarinsson, Sigurður: "Annáll Skaftárelda", p. 20-23
58 Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects", p. 3-4

in Vestur-Skaftafellssýsla of their livelihood. The two communes of the shire closest to the fissure zone, Leiðvallarhreppur and Kleifahreppur, were left almost uninhabitable for years. Further damage was caused by earthquakes that were felt almost constantly in the region throughout the eruption; while the lava also diverted the courses of local rivers. As a consequence, immense floods deluged over the countryside; partly from the blocking of the river valleys and partly from glacier bursts.[59] Needless to say, the effects of the lava-flow from the *Lakagígar* eruption were severe. However, as far as the documentary record goes, no-one was killed by the burning material. And apart from triggering a wave of migration from the badly affected districts of Vestur-Skaftafellssýsla to the southwest regions of Iceland, the influence of the material hardly spread beyond the area it covered.[60]

The part of the *Lakagígar* eruption that concerns the volcanic gas emission initiated a different scenario. On the fissure zone, atmospheric turbulence was caused by the eruption itself and the temperature difference between the hot volcanic material and meltwater from nearby Vatnajökull. The interaction had an explosive impetus, whose roaring sounds Jón Steingrímsson likened to many cannons being fired simultaneously. The explosions, which at times could be seen tens and even hundred kilometers from afar in the form of fire fountains, immediately blanketed the shire of Vestur-Skaftafellssýsla with volcanic ash. It soon became clear that the tephra was rich in gases. From the initial stage of the eruption, the atmosphere in Vestur-Skaftafellssýsla was covered with aerosols and acid rainfall showered the region. According to reverend Steingrímsson, the sun only appeared "as a red ball of fire" and the moon "red as blood, and when the rays of their light fell upon the earth it took on the same colour".[61] The natural warmth of the sun also seems to have been reduced, seeing that snowfall was recorded during the month of June, as we mentioned in the last section.

Unlike the lava-flows, the explosive part of the *Lakagígar* eruption was not local. And from Jón Steingrímsson's place of narration in the Síða area the wind took over and created the story which this research has set out to document. Though the prevailing winds in Iceland are southeasterly, it is clear to anyone who has set a foot on the island that strong winds can blow from any direction at any season of the year. Coinciding with the explosive activity, the chance direction must therefore have played its part in spreading the eruption's influence

[59] See *Skaftáreldar 1783-1784*, (ed. Gísli Ágúst Gunnlaugsson et al.)
[60] Hálfdanarson, Guðmundur: "Mannfall í Móðuharðindunum", p. 139-163
[61] Steingrímsson, Jón: *Fires of the Earth*, p. 26-27

throughout Iceland.[62] Following the progress of the volcanic cloud anticlockwise from the Laki fissure zone in south Iceland, the documentary record tells us that "a dark-blue sulfuric smoke" was first observed in the southeast on the 14th of June.[63] In the eastern part of Iceland, however, the sheriff of Suður-Múlasýsla records that as early as June 9th the sky became "red as blood at sunrise and sunset" due to the appearance of a thick fog which then spread across the region over the next three days.[64] The northern and western parts of Iceland seem to have been spared a bit longer. In the north, chronicles note that between June 15th and 18th the "great misfortune" came over the area as "haze and smoke" swallowed up the sky, and then "sunk into the ground with an uncomfortable stench and odor."[65] A similar timeframe is given in western Iceland as of when the atmosphere was covered with haze from which "gray dust, a mixture of ash and sulfuric salts, fell out of on and off…"[66] In the northern and western part of Iceland the contemporary sources precisely note that the fumes from the *Lakagígar* eruption arrived as a "thick fog" carried in over the land from the sea by northerly winds – i.e. from the opposite direction of the fissure zone to these parts of the island.

Parallel with the spreading of the fumes from the *Lakagígar* eruption, a pattern of similar experiences was felt throughout Iceland. In the atmosphere the volcanic pollution deprived the sun of its natural shine, which at day-time appeared blood-red; while the thick fog also reduced visibility in the natural environment. The air felt heavy and at times gave an odor of sulfur. Adding to the *Lakagígar* mosaic were also the repeated ash-falls that carried volatile particles, which spared practically no part of the country. Earth scientists have estimated that 0.4 cubic kilometers of tephra (or 2.7% of the total erupted material) were released into the atmosphere during the explosive part eruption.[67] The intensity of this part of the eruption goes hand-in-hand with our review of the eruption in the last section – i.e., it was most vigorous during the first one-and-half month, and then it slightly but steadily declined in activity over the next three months. The volcanic haze also thinned as the eruption declined. However, due to the length of the event the gas concentration in the atmosphere was

[62] For similar reflections see Vasey, Daniel E: "Population, Agriculture, and Famine: Iceland, 1784-1785", p. 333
[63] "Heimildir til sögu Skaftárelda", *Skaftáreldar 1783-1784*, p. 295-297
[64] "Heimildir til sögu Skaftárelda", *Skaftáreldar 1783-1784*, p. 409-418
[65] "Heimildir til sögu Skaftárelda", *Skaftáreldar 1783-1784*, p. 380-382
[66] Cited in Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects", p. 20
[67] The tephra deposit during the *Lakagígar* eruption is the second largest by an Icelandic eruption in the last 250 years. See Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects", p. 3-4

constantly replenished. As a consequence the aerosols are believed to have lingered in the atmosphere for more than a year after the start of the eruption.[68]

It is here where we find the root of the actual catastrophe, which an Icelandic historian has called "the most severe catastrophe of the 18th century" and a "threat to livelihood in the country generally" in an English textbook on Icelandic history. Drawing its name from the hazy appearance of the atmosphere, the event soon came to be known as *Móðuharðindin* in Iceland, or "the Haze Famine".[69] Analyzing the consequences of the famine will be the final piece of the *Lakagígar* puzzle for this chapter. After that we shall trace its tracks outside Iceland.

1.5. The Haze Famine of 1783-1785

According to an Icelandic folklore brought to life in a famous 19th century play, a famine proceeds in the following stages: "First the grass withers and then the beasts die. The horse falls first; then the sheep; the cow; and the vagabond. Then the farmer dies; his wife follows; their children; the dog; and finally the cat. The creatures we loathe and have the least use for tend to outlive us."[70]

The moral of this story-piece illustrates the hardship and vulnerability of pre-modern Iceland. It was largely a subsistent pastoralist society that effectively enforced serfdom, and languished under a Danish colonial trade monopoly which had isolated the country from the wider European economy since 1602.[71] The country was especially vulnerable for disasters during the 18th century. In 1707-1709 a smallpox epidemic is believed to have sent about a quarter of the population to the grave, reducing it from approximately 50,000 to 37,000; while in the 1750s a combination of unusually cold weather which closed off fishing grounds with pack-ice and a large explosive eruption of the Katla volcano in 1755 that damaged crops caused the death of an estimate 5,800 people between 1751 and 1758, decreasing the population from just over 49,000 to little more than 43,000. By 1783 the population of Iceland is considered to have reached its pre-modern demographic mark of around 50,000 and again the resistibility of the country was put to the test.[72]

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68 Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects", p. 3-7
69 Karlsson, Gunnar: *Iceland's 1100 Years*, p. 177-181
70 Björnsson, Lýður: "18. Öldin", (vol. 8) p. 210 (My translation)
71 See Gunnarsson, Gísli: *Monopoly Trade and Economic Stagnation*
72 Karlsson, Gunnar: *Iceland's 1100 Years*, p. 177-178

When analyzing the causes of the Haze Famine of 1783-1785 an obvious starting-point would be to look at the environmental influence of the *Lakagígar* eruption on people and the vegetation. As we showed in the last section, the volcanic gases and ash from the eruption spared no part of the country. But how can we describe the relationship between the volcanic pollution and the Haze Famine? In this case, the documentary record clearly states that the fumes from the eruption were detrimental. Based on Jón Steingrímsson's account, the people of Vestur-Skaftafellssýsla complained of chest pains, shortness of breath and dizziness. In accord to his description, narratives from elsewhere in Iceland also describe that the haze had "suffocating" effects on people.[73] Meanwhile, polluted rainfall is reported to have opened up wounds on bare skin and caused irritation in the eyes; while various accounts note that the acidity made iron rust and wood lose its colour.[74] In general, however, the documentary record leaves more descriptions about effects of the volcanic pollution on the vegetation. In the first week of the eruption, Jón Steingrímsson remarked how the grass, which in early summer had been "green and luscious", began "to fade and wilt". This set the tone for a disastrous development. Two weeks later, Steingrímsson wrote that: [75]

> … more poison fell from the sky than words can describe: ash, volcanic hairs, rain full of sulphur and saltpeter, all of it mixed with sand. The snouts, nostrils and feet of livestock grazing or walking on the grass turned bright yellow and raw. All water went tepid and light blue in colour and rocks and gravel slides turned grey. All the earth's plants burned, withered and turned grey … The first to wither were those plants which bore leaves, then sedges were checked, and the horsetail were the last to go, and would later be the first to return.

Although the substance of the volcanic gases was certainly more effective in regions closer to the eruption site, accounts throughout Iceland give the impression that the volcanic gas and ash literally left a scorched earth behind.[76] In the shire Eyjafjarðarsýsla in northern Iceland it is specifically recorded how the volatiles and acid rain steadily brought devastation to vegetation in the region. By mid-July the fields of this grassy region had "whitened up, withered and died". Similar reports from other parts of Iceland note how cultivated fields withered down to the roots.[77] Out of desperation, people tried to cut the grass and rinse it

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[73] "Heimildir til sögu Skaftárelda", *Skaftáreldar 1783-1784*, p. 419-422
[74] See "Heimildir til sögu Skaftárelda", *Skaftáreldar 1783-1784*, p. 419-422
[75] Steingrímsson, Jón: *Fires of the Earth*, p. 24-42
[76] The west of Iceland was least effected by the volcanic poison – particularly the fjords.
[77] See "Heimildir til sögu Skaftárelda", *Skaftáreldar 1783-1784*, p. 271-422

with water before feeding it to their livestock "but it was all in vain unless they still had some older hay to mix with it."[78]

Once uncontaminated hay became scarce, it was the livestock's turn to wither away. The beasts strolled aimlessly through the damaged fields without paying the slightest attention to the ground beneath their feet. As the flesh steadily whittled off the bones, the animals suffered from lameness and enfeeblement. A good example of this can be read in a report from the sheriff of Þingeyjarsýsla in the northeast of Iceland, who wrote that "the creatures had no appetite for the grass, but instead ran hungry across the fields. After a while they became halt; and thereafter so feeble that they could neither stand nor move. In a state of immobility they died."[79] Based on descriptions such as these it has been deduced that the livestock suffered from severe fluorine poisoning. Lethal sickness in grazing animals is mentioned in official reports from almost all parts of Iceland, featuring horrific descriptions of symptoms characteristic of chronic fluorosis such as softening and deformation of bones and joints, dental lesions, and outgrowth on the molars (known as "gaddur" in Icelandic). As a consequence they cannot stand up; and they lose their teeth and cannot eat. Death is inevitable. In most parts of the country these symptoms became noticeable in late summer, and early winter 1783. However, closer to the fissure zone in the south, where the concentration of volcanic pollution was higher, the sickness was evident almost immediately and resulted in deaths within two weeks after the onset of the eruption.[80]

Even though fluorine poisoning explains most symptoms described in domestic animals, other components of volcanic ash and gases are likely to have had an effect to some extent. Livestock that ate withered grass covered with a layer of acid laden ash probably suffered from lung lesions caused by inhaled volatiles, at least in the vicinity of the Laki fissure zone. But the sulfurous gases, acid particles and fluoride not only damaged the hay crop, they also poisoned other animals and vegetation. Regarding the latter, it is for example reported that birch trees and shrubs dried up and moldered. Other crops that supplemented the rather monotonous diet of Icelanders, like wild berries and lyme grass[81] were wrecked; while the most important of these wild yielders for the Icelandic diet, the Iceland moss (*cetraria islandica*,

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[78] Steingrímsson, Jón: *Fires of the Earth*, p. 28

[79] "Heimildir til sögu Skaftárelda", *Skaftáreldar 1783-1784*, p. 373-374 (My translation)

[80] Pétursson, Guðmundur et al: "Um eituráhrif af völdum Skaftárelda", p. 81-96

[81] Ears of wild lyme grass were harvested for human consumption, the grains dried and even ground and the meal used for porridge or bread making. Since there was no domestic cultivation of grain for human consumption in Iceland after the 16th century, the lyme grass provided a kind of substitute.

in Icelandic *fjallagrös*), was also damaged by poisoning. Various sources report that the Iceland moss disappeared from many regions in Iceland for 3 to 6 years after the eruption, and never returned in some areas.[82] Meanwhile, the biosphere of inland waters did not escape the effects of the volcanic pollution, which caused death in trout and salmon. Coastal fishing was also affected, and the reason was simple: the volcanic fog was at times so thick that fishermen could not find the fishing grounds. However, contrary to what is often claimed, the coastal fishing's were relatively successful in Iceland between 1784 and 1785.[83] The documentary record also indicates massive death in birds; while migratory birds and other nesting birds are reported to have fled and the "eggs they left behind were scarcely edible because of their ill odour and sulfurous taste."[84]

Returning to the relationship between the volcanic pollution and the Haze Famine, the documentary record does not indicate that the volcanic gases and ash from the *Lakagígar* eruption were a direct cause for the loss of life during the event. Of course, one cannot dismiss that the polluting effects caused some damage, especially in communities nearest the eruption, where the pertinent records sadly did not survive. Jón Steingrímsson does mention that those who had respiratory syndromes suffered from the effects of the volcanic pollution.[85] Steingrímsson also writes that until February 1784 "all water, whether flowing in surface streams or from underground sources, had been scarcely drinkable due to its bad flavour and bitter taste in the mouth."[86] The consequences of drinking the polluted water were probably detrimental, and if people were drawn to the water at all, an equal sign could be made between several of Steingrímsson's remarks that suggest symptoms of fluorosis: "Ridges, growths and bristle appeared on [people's] rib joins, ribs, the backs of their hands, their feet, legs and joints. Their bodies became bloated, the inside of their mouths and their gums swelled and cracked, causing excruciating pains and toothaches."[87] This, however, is pure speculation that does not find verification in other sources. Meanwhile, a source from the western shires of Barðastrandarsýsla and Ísafjarðarsýsla suggests that dozens of people had died from pneumonia and estimates that the illness may have been equally fatal elsewhere in

[82] Pétursson, Guðmundur et al: "Um eituráhrif af völdum Skaftárelda", p. 84-86
[83] Hálfdanarson, Guðmundur: "Mannfall í Móðuharðindunum", p.144-145
[84] See Steingrímsson, Jón: *Fires of the Earth*, p. 27; and Pétursson, Guðmundur et al: "Um eituráhrif af völdum Skaftárelda", p. 84-93
[85] Steingrímsson, Jón: *Fires of the Earth*, p. 41
[86] Steingrímsson, Jón: *Fires of the Earth*, p. 67
[87] Steingrímsson, Jón: *Fires of the Earth*, p. 77

Iceland.[88] Again, however, the suggestion is not well-attuned to accounts from elsewhere in the country.

We are better informed about the effects of the *Lakagígar* eruption that concern the natural environment. And in this regard the fate of the livestock was significant. At the time of the eruption, it is estimated that Icelanders derived 75% of their diet from the stock.[89] Any blow struck to the well-being of the animals was therefore bound to affect the people of Iceland, as tended to be the case in Icelandic history until the 20th century.[90] Here one has to draw a distinction between causative factors. On the one hand, it is clear that the polluting effects of the eruption mowed down the animals; but on the other hand, what made a fatal scenario worse was another variable, namely climate. Regarding this, it must be mentioned that Icelandic agriculture was ill-prepared for the *Lakagígar*-induced disaster. The winter that preceded the eruption had been cold in most of Iceland. In the north, there had been severe winter from New Year to the end of March 1783, and there was no pasture because of frozen grounds. Elsewhere in Iceland, winter-fodder for the livestock that provident farmers kept from year to year was scarce.[91] Bearing in mind how early in the harvest season the *Lakagígar* eruption commenced, the summer of 1783 hardly left any hay in store for the coming winter that not only began early but was also very severe and long-lasting in most districts. In the east of Iceland, the sheriff of Suður-Múlasýsla noted that all fjords were frozen over on February 20th 1784, "and this was something that had not occurred for thirty-eight years."[92] This was also a heavy pack-ice year. The summer of 1784 was also cold in most districts and some sources also complain of constant precipitation. Evidently, the fields did not recover under these conditions and in some areas the grass was still poisoned by volcanic gases. In the south and west of Iceland it is even reported that the harvest was just as bad in the summer of 1784 as during the summer of the eruption.[93] The part of the catastrophe which nature can be "accounted for" came to an end in the summer of 1785, which was favorable in most parts of Iceland regarding climate and animal husbandry.[94] By that time, however, approximately 70% of the livestock in the country had died, and the yields from the livestock that survived barely

[88] Pétursson, Guðmundur et al: "Um eituráhrif af völdum Skaftárelda", p. 93-95
[89] Of that percentage almost 50% came from dairy products. See Jónsson, Guðmundur: "Changes in Food Consumption in Iceland *ca*. 1770-1940"
[90] See e.g. Vasey, Daniel E: "A quantitative assessment of buffers"
[91] Ogilvie, Astrid E. J: "The climate of Iceland, 1701-1784", p. 67-69
[92] Ogilvie, Astrid E. J: "The climate of Iceland, 1701-1784", p. 69-71
[93] Hálfdanarson, Guðmundur: "Mannfall í Móðuharðindunum", p. 144-145
[94] Hálfdanarson, Guðmundur: "Mannfall í Móðuharðindunum", p. 144-145

amounted to half-output. To be precise, the death in cattle was 40%; loss of horses 48%; and 75% in sheep.[95] Hunger was the inevitable consequence.

The massive death in livestock must be seen as one of the primary causes for the Haze Famine. The causal link can be found on print as early as 1796 in a publication authored by Hannes Finnsson (1739-1796) who was Bishop of the then episcopal see at Skálholt in the south of Iceland. Certainly initiated by the Haze Famine, as well as the re-occurrence of famine in Iceland during that era, Finnsson's work *Um Mannfækkun af Hallærum á Íslandi* ("Decimation of the population in Iceland due to famine"), presents a historical survey on the consequences of famine on demography and living conditions in Iceland since the settlement. Regarding the events of 1783-1785, Finnsson wrote:[96]

> When the livestock had departed, and what was left of it yielded no fruit […] the lives of people were bound to follow the same path. Hunger and starvation marked people's appearance with all the diseases which thereof spread; particularly dysentery, scurvy, and mumps. The hunger was so common that it could even be seen on many priests and well-off farmers.

The contemporary record leaves no doubt that hunger and deficiency diseases were endemic in Iceland. Scurvy, in particular, seems to have been widespread.[97] Due to food shortages, nourishment was drawn from water and hay; while some accounts note that people ate dogs.[98] Jón Steingrímsson also describes the desperate survival instinct of the people in Vestur-Skaftafellssýsla. In his shire people "cooked what skins and hide ropes they owned, and restricted themselves to the equivalent of one shoepiece per meal…" Others mixed hay with meal to make porridge or bread, while "[a]ny fishbones found on the farm or half-buried in sand on the seashore were collected and cleaned, boiled and crushed in a little milk and eaten as nourishment."[99] Under these desperate conditions, an agent of the Danish Kingdom, who arrived from Copenhagen in April 1784 to write an official report on the state of affairs in Iceland, described what can be likened to an atmosphere of death: "The tormenting sounds of

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[95] Rafnsson, Sveinbjörn: "Búfé og byggð", p. 163-178
[96] Finnsson, Hannes: *Um Mannfækkun af Hallærum á Íslandi*, p. 117-118 (My translation)
[97] Pétursson, Guðmundur et al: "Um eituráhrif af völdum Skaftárelda", p. 93-95
[98] "Heimildir til sögu Skaftárelda", *Skaftáreldar 1783-1784*, p. 394-399
[99] Steingrímsson, Jón: *Fires of the Earth*, p. 81-83

the poor and agony of hunger, the terrible sight of whittled skeletons and desperate behavior of people and animals alike shall never pass from my memory."[100]

The relationship between death in livestock and the haze famine is emphasized in a recent demographic study. According to the research, excess mortality and decline in human population in Iceland did not begin until losses of livestock had dropped to a level of approximately one quarter of the usual.[101] So how do we demarcate the timeframe of the Haze Famine? In this case, parish burial records throughout Iceland actually indicate that there were more births than deaths in the country in 1783.[102] However, the first signs of the mortality crisis are believed to have been in the northeasterly part of Iceland, where people effectively began starving to death in December 1783.[103] In the interim, impoverished people from the eruption zone in the southeast, as well as from areas north of the fissure, flocked to the fishing areas in the southwest. Many are reported to have died on the way; while others who reached the fishing stations were too exhausted and sick to survive. As we mentioned before, the summer of 1784 was cold and showery, and a lot of people were feeble from the cold weather and shortages of the previous winter. For those reasons the famine continued through the following winter. After that the climate became favorable again, and in the summer of 1785 the survivors' housekeeping began to recover. The Haze Famine thus lasted for about a year and a half – i.e. from December 1783 until the summer of 1785.[104]

It is not easy to determine the population loss in the Haze Famine. As if the famine was not serious enough, a disease also raged in the country during the period, which contemporary sources refer to as "landfarsótt" – a common term that can refer to any epidemic.[105] However, since plague can be excluded at this time, no known epidemic would under normal circumstances cause more than a fraction of the mortality of the famine years. But if a disease that is not normally lethal kills a large number of people because of their debilitated condition, as seems to be the case here, this must be seen as the cause of their death. No known epidemic could be so lethal, because smallpox also raged in Iceland in 1785-1787. Contemporary sources keep mortality numbers from the smallpox clearly distinct from the

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[100] Cited in, Laxness, Einar: "Á 200 ára afmæli Skaftárelda", p. 113 (My translation)
[101] Vasey, Daniel E: "A quantitative assessment of buffers"
[102] Hálfdanarson, Guðmundur: "Mannfall í Móðuharðindunum", p. 139-162
[103] "Heimildir til sögu Skaftárelda", *Skaftáreldar 1783-1784*, p. 303-323
[104] See Karlsson, Gunnar: *Iceland's 1100 Years*, p. 180-181
[105] Karlsson, Gunnar: *Iceland's 1100 Years*, p. 180-181

landfarsótt, and state that the smallpox killed about 1,500.[106] In all, the population of Iceland decreased by just over 10,500 from December 1783 until the end of 1786 – from 49,753 to 39,190 to be precise.[107] So the victims of the Haze Famine cannot have been fever than 10,000 – i.e., close to one-fifth of the whole population.

1.6. The significance of the *Lakagígar* eruption

This research derives its context from the environmental implications of the *Lakagígar* eruption. The objective, on the one hand, is to describe how people experienced and reacted to the event, while on the other hand, to critically analyze the consequences that the eruption may or may not have had. We have followed this guideline in the second part of this chapter. Therefore, our review on the 1783-84 eruption has been solely based on the part which "nature" can be held accountable for. Of course, other factors contributed to the Haze Famine. Economic policies that carried unfavorable trade terms probably added to the hardship. With this in mind, it is worth mentioning that while the people in Iceland starved to death, there was only a small decline in the export of food (mainly fish) from Iceland to Denmark. Meanwhile, Icelandic officials had few resources at their disposal to deal with the famine and were slow to seek help from their superiors in Copenhagen. The Danish authorities, on the other hand, were remote and badly informed and a real effort to render assistance only arrived as late as July 1784 – more than one year after the eruption began. The importance of these issues is covered extensively in another historical research;[108] but we shall stick to the environmental causation for the remainder of this work.

Two points, from our overview of the *Lakagígar* eruption, need to be underlined with the broader context of the research in mind. Firstly, the event had a catastrophic effect in Iceland, not because the eruption caused direct loss of lives, but because of the indirect effects which came from volcanic aerosols and volatiles, distributed by the wind throughout the island. The grass, the basic food supply for the grazing livestock, withered and was polluted by fluorine. As a result the animals died. Alternative food sources, drawn from the natural environment, were also damaged by the volcanic pollution. In this sense, the *Lakagígar* eruption must be

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106 Karlsson, Gunnar: *Iceland's 1100 Years*, p. 181

107 Jónsson, Guðmundur: "Mannfjöldatölur 18. aldar endurskoðaðar", p. 158

108 See Gunnlaugsson, Gísli Ágúst: "Viðbrögð stjórnvalda í Kaupmannahöfn", p. 187-215; and Andrésson, Sigfús Haukur: "Aðstoð einokunarverslunarinnar", p. 215-235. Both articles in *Skaftáreldar 1783-1784*, (ed. Gísli Ágúst Gunnlaugsson et al.)

seen as one of the primary causes for the Haze Famine of 1783-1785. Secondly, however, the severe climate of the years 1782-1784 undoubtedly played a part in negatively impacting the livestock and human population, as well as delaying a necessary environmental recovery. Icelandic historians have stressed that it is impossible to assess which of these factors – i.e. the volcanic pollution or the climate – played a bigger part in creating the famine.[109]

The relationship between the *Lakagígar* eruption and climate is integral to the historiography of the event. Today we might think of volcanic-induced climate change in terms of meteorological theory where a myriad of variables either complements or gives reason to perpetual head-scratching. But for 18th century Icelanders, the connection seems to have been clear. As an example, the young medical student Sveinn Pálsson (1762-1840), noted in his almanac for the year 1783: "[…] in addition to the ash-fall, the air felt raw and the weather insanitary. Despite settled weather and cloudlessness at solstice [June 21st, 1783], when temperatures are expected to be highest, the sun did not yield any warmth except chilled vapours which were lukewarm, at best. […] In autumn there was much frost and wind and it appeared as though the frostiness was dictated by the thickness of the haze and clouds. The winter of 1784 has been unbearably frosty […] and people blame the earth-fires [the *Lakagígar* eruption] …"[110] It seems certain that the *Lakagígar* eruption influenced the weather in Iceland, but to what extent it played a role in affecting the world-climate is a question which we shall give thought to later in this research.

The *Lakagígar* eruption is considered to be "[o]ne of the most notorious instances of volcanic degassing" in historical time.[111] Resting on the validity of the estimated size of the eruption volcanologists have calculated that *Lakagígar* pumped into the atmosphere what amounted to 122 megatons of sulfur dioxide[112], 235 megatons of water vapour, 349 megatons of carbon dioxide, 15 megatons of fluorine and 7 megatons of chlorine. Moreover, based on these estimates it is theoretically inferred that the sulfur dioxide combined with water vapour in the atmosphere to form about 200 megatons of sulfuric acid aerosols.[113] The sulfuric acid aerosols

109 *Skaftáreldar 1783-1784*, (ed. Gísli Ágúst Gunnlaugsson et al.)
110 "Heimildir til sögu Skaftárelda", *Skaftáreldar 1783-1784*, p. 421 (My translation)
111 Oppenheimer, Clive: *Eruptions that Shook the World*, p. 44 and 269-294
112 According to petrology basaltic magmas tend to be rich in sulfur. The fact that the *Lakagígar* eruption was predominantly of that composition explains the amount of sulfur emitted in proportion to the other volcanic gases.
113 See Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects", p. 1-29

were responsible for the haze that hung over Iceland and the acid that rained down upon the island and damaged the vegetation; while the other volatiles were carried to ground with ash fall that filled the pastures where the livestock grazed.

For the remainder of this work we shall put our focus on the environmental implication that the *Lakagígar* eruption had outside Iceland. Based on meteorological research it is clear that the gases which were released into the atmosphere during the 1783-1784 eruption "were widely dispersed by the meandering North Atlantic winds."[114] Our object, in the coming chapter, will be to follow the wind and document the journey of the *Lakagígar* influence and see how long it persisted. By doing this, we shall try to get an impression of how people who lived far-away from the Laki fissure zone, reacted to the volcanic signal and made sense of it.

[114] See e.g. Stothers, Richard B: "The Great Dry Fog of 1783", p. 79

Chapter II

A Chronicle of an Amazing and Portentous Summer

In comparison to our previous discussion, this chapter offers an alternative scenario regarding the *Lakagígar* eruption. In Iceland, people either witnessed the lava flows or quickly learned about them; they saw the ash fall and even heard the roars from the fissure zone. In other words, they knew the cause of their distress. Outside Iceland, however, the eruption wielded an influence on communities that were oblivious of its origin, and did not even recognize that a volcanic eruption was the cause of what appeared as a strange alteration of the atmosphere. What obscured the *Lakagígar* signal even more was the context it merged with. In this case, the year 1783 was marked by a series of other nature-induced occurrences. Earthquakes that took place in Southern Italy were high on the agenda in newspapers throughout the year; the summer weather was extreme and thunderstorms unusually ferocious and frequent; an island emerged from the ocean outside Iceland and made headlines; and a flaming meteor was seen soaring through the summer sky.

The scenario was given character by the appearance of the *Lakagígar* fumes, which we shall try to piece together in a narrative in this chapter. The aim is to trace the geographical spreading of the *Lakagígar* influence, try to get an idea how long it persisted, and look at its manifestation. By doing this, we shall document how the phenomenon appeared to the eyes of people outside Iceland. The questions in this context are: How did contemporaries react to the volcanic pollution from Iceland; and what meaning did they derive from it?

The year 1783 has a firm place in history books and chronologies of human achievements which usually does not include the events that this chapter intends to document. And the context very much concerns the atmosphere. During the summer of the *Lakagígar* eruption, a pair of French brothers discovered a new technology, which enhanced the possibility of bringing mankind closer to the atmosphere. Meanwhile, in the political arena, the "miracle in human affairs", as advertised by a renowned figure of the time came to pass in a treaty, signed in a Paris hotel. Between these two events, the summer of 1783 was pretty much marked by the *Lakagígar* influence. In the light of this, it seems appropriate that we begin our overhaul of the summer of 1783 with Benjamin Franklin (1706-1790), in the capital of France.

2.1. Benjamin Franklin's reflections on the summer of 1783

It has been claimed that when villagers outside Lyon, in southern France, saw what appeared to be a giant house soaring through the sky in June 1783, they concluded that the moon had detached itself from the firmament and judgment day was upon them.[115] Soon this ominous phenomenon acquired a name, which by the end of the year was on everybody's lips. "Anyone who wants to talk of anything other than balloons", noted a French newspaper, "doesn't interest us".[116]

The story of aerial ballooning affiliates with the Montgolfier brothers, Joseph-Michel (1740-1810) and Jacques-Etienne (1745-1799), who thought of inflating a 35-foot (10.7 m) paper-covered silk globe with heated air. Their findings recorded a low-profile first flight in history outside the village of Annonay on June 4th 1783, which sparked off a momentum whose spirit has been described with the term, *balloonomania*.[117]

When the balloon premiered in Paris on August 27th, a crowd of more than fifty thousand people gathered to watch as Jacques-Alexandre-César Charles (1746-1823), one of the Montgolfier brothers' principal rivals, sent a hydrogen balloon into the sky above the Champ-de-Mars. Among the spectators that day was the renowned scientist, inventor and revolutionary campaigner Benjamin Franklin, whose name has become integral to the historical narrative of the balloons of 1783. Attending to his side-occupation as chief correspondent of the balloon-affair to the Royal Society of London, a bystander is alleged to have asked Franklin: "What possible utility could be derived from these experiments?" to which he replied: "Eh! Of what use is a new-born baby?"[118] To the Enlightenment the enfant balloon was the actualization of the ancient Greek myth of Icarus: the age of flight was beginning and it was not long before humans could venture into the atmosphere and gaze down upon the earth.

The 77 year old Franklin had originally arrived in France in December 1776 on a mission to raise support for the American rebels in their war of independence from Great Britain. Assuming the position as the first American minister to the court of Versailles, he became a household name in the diplomatic and intellectual circles of Paris. By 1783, Franklin had begun counting the last days of his tenure, and appealed to the congress to be allowed to retire

[115] Story adopted from, *The Papers of Benjamin Franklin*, (vol. 40), p. 393-398
[116] Schiff, Stacy: *A Great Improvisation*, p. 325
[117] Holmes, Richard: *The Age of Wonder*, p. 125-163
[118] See *The Papers of Benjamin Franklin*, (vol. 40), p. 543-551

to his home in Philadelphia. The British army had surrendered to the rebels and their allies in October 1781, and in February 1782 the House of Commons had declared the war over. The peace negotiations dragged on, and after six years of conflict, Britain, France and America were sliding deeper into economic malaise. The breakthrough came in the summer of 1783 and negotiations began reach final stages. Six days after attending the balloon premier in Champ-de-Mars, Franklin joined his fellow commissioners of the United States of America to sign the *Treaty of Paris* in Hotel d'York. Within the space of a week another "baby" had been born. The national independence of the United States had been guaranteed and the country adopted into the world of independent nation states.

In the light of these diplomatic and scientific breakthroughs one might assume that Benjamin Franklin had every reason to be excited. However, in the midst of these developments there is something in his writings that indicates a distraction. By the time that the Montgolfier brothers were conducting their early experiments with the balloon in June something decidedly unusual had been taking shape in the atmosphere. According to Stacy Schiff, who has written a biographical account of Benjamin Franklin's life in France, a "baffling haze" literally cast a shadow on the season, leaving the country in an "unsettled mood". Neither wind nor rain seemed capable of budging this phenomenon, and as the summer dragged on the weather became unusually warm and severe thunderstorms frequent. As Franklin and his fellow commissioners in Europe waited impatiently for an American response in the peace negotiations, people's sentiments grew even murkier – "a feeling of apocalypse hung heavy in the air."[119] And as to avert an instance of mass terror, the French government had to issue a statement before the August premier of the balloon in Paris, explaining that "any one who shall see in the sky such a globe, which resembles 'la lune obscurcie,' should be aware that, far from being an alarming phenomenon, it is only a machine that cannot possibly cause any harm."[120]

What was so alarming about the state of the atmosphere during the summer months? Reflecting on the period, at his residence in Passy just outside Paris, Benjamin Franklin sat down in May 1784 and gathered his thoughts on the unusual season. Looking back, Franklin wrote: "During the summer months of the year 1783 … there existed a constant fog". It showed no sign of dispersing, for "[t]his fog was of a permanent nature", Franklin added, and

[119] Schiff, Stacy: *A Great Improvisation*, p. 347-348
[120] Hallion, Richard P: *Taking Flight*, p. 51

directed his attention to the effect of the fog on the state of the summer sky: "it was dry, and the rays of the sun seemed to have little effect towards dissipating it, as they usually do a moist fog, arising from water." During daylight hours, the power of the sun seemed weakened by the layer of the atmospheric haze. Franklin found that the sun's rays were "so faint in passing through it that when collected in the focus of a burning glass, they would scarce kindle brown paper." Similarly, at night, even the brightest stars appeared dull, while the moon was reduced to little more than a bluish smear.[121]

We shall return to Benjamin Franklin's reflections later in this work. But let us for the time being look into how the "baffling haze" appeared in the eyes of Franklin's contemporaries in Europe.

2.2. The appearance of the fog

A great scholarly effort has been made in tracking down the first appearance and spreading of the "baffling haze" which we described in last section. Grounded on contemporary weather logs and observations, it has been established that the first intense manifestation appeared on the European continent around mid-June.[122] In Dijon, to the east of where Benjamin Franklin derived his reflections on the state of the atmosphere, "an unusual haze or fog, by no means a common occurrence" was recorded on the 14th of June.[123] Similar developments were felt in Le Havre, to the north of Paris, and Provence to the south, where the natural philosopher and correspondent of the Academy of Sciences at Paris, Robert Paul de Lamanon (1752-1787), noted in his observations that "the sun ... was never seen but through the fog, [which] appeared very pale in the day-time; of a blood-red colour at rising, and still more so at setting."[124]

Whatever had happened to the sky above France was unusual enough, but it soon became apparent that the effects were also being felt in neighboring areas. "The fog is not peculiar to Paris", explained a letter from France in the *Gentleman's Magazine*[125]: "those who come … lately from Rome say, that it is as thick and hot in Italy, and that even the top of the

121 Franklin, Benjamin: "Meteorological Imaginations and Conjectures", p. 288
122 See Stothers, Richard B: "The Great Dry Fog of 1783" and Thordarson, Thor, and Self, Stephen: "Atmospheric and Environmental Effects"
123 Cited in Grattan, John, et al: "Volcanic air pollution and mortality in France 1783-1784", p. 645
124 Lamanon, [Robert Paul de]: "Observations on the Nature of the Fog of 1783", p. 81
125 The *Gentleman's Magazine* was a London-based monthly digest of letters and reports from around Britain, the British Empire and Europe.

Alps is covered with it, and travelers and letters from Spain affirm the same of that kingdom. Some people of abilities declare that they never remember the like …"[126] The report finds parity in the writings of the naturalist and later member of the British parliament John Thomas Stanley (1766-1850) who was denied the view of the Alps that he had anticipated on his European tour in 1783: "this splendid and beautiful scenery was concealed from us for a considerable time after our arrival by a fog … it was of a peculiar kind, having no apparent moisture."[127] Southwest of the Alpine regions, an account from Barcelona noted that the atmosphere around the city had been covered by "a white and thick fog", at the end of June. The haze was so thick that it "did not allow [anyone] to see the nearest mountains" while "the sun seemed to be of a bloody colour, particularly at sunset."[128] A similar account was recorded at the Adriatic seaport Fiume (today's Croatian city of Rijeka) on June 22nd. Printed in the *Pressburger Zeitung*, the report noted "eine sonderbare Erscheinung" that "an den Küsten des Adriatischen Meeres, wie auch um die Gegend von Fiume, schon durch 14 Tage, sehr dichte Nebel lagen, wodurch die Schiffe, um nicht an einander zu stoßen, genöthiget waren, sich mit Kanonenschüssen Zeichen zu geben."[129] Further south of the Adriatic Sea, a report printed in the *Gazeta de Barcelona* from the central Mediterranean archipelago of Malta, reported that "… until 20 of the last month [June] such a thick fog was experienced on that island that the sun was obscured."[130] Judging by these accounts it is clear that the haze covered the highest summits on the continent, and travelled the northern and southern European seas.

Meanwhile, at the University of Padua, the renowned Italian natural philosopher, Giuseppe Toaldo (1719-1797), tried, like Benjamin Franklin, to quantify the murky atmospheric condition. In his observations on "the Month of June 1783, with a Dissertation on the extraordinary Fog which prevailed at that Time", he noted that the dimming of the atmosphere had first been felt on the 18th of the month. The haze grew denser with each passing day and neither strong winds nor thunderstorms dissipated it. Due to the alteration of the atmosphere, Toaldo remarked that "people could look at the sun without being incommoded, and without using a colored or smoked glass":[131]

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126 Lalande, Joseph-Jérôme Lefrançais de: "State of the Atmosphere lately at Paris", p. 613
127 Cited in Oslund, Karen: *Iceland Imagined*, p. 40-41
128 Cited in Demarée, G.R., and Ogilvie, A.E.J: "*Bons Baisers d'Islande*", p. 232
129 *Pressburger Zeitung* (19.07.1783)
130 Cited in Demarée, G.R., and Ogilvie, A.E.J: "*Bons Baisers d'Islande*", p. 232
131 Toaldo, [Giuseppe]: "Meteorological Observations made at Padua in the Month of June 1783", p. 418-419

> It appeared of different colours, according to the kind of rays which the difference in the density of the fog suffered to pass. As the yellow and red, being the strongest, were those which pierced it oftenest, the sun appeared like a ball on fire, or of a blood colour; which gave occasion to many whimsical people, whose imaginations were heated, to see there, as in the clouds, the figures of men and animals.

Identical accounts were recorded in Northern Europe. A letter dated July 16th from the province Halland, on the western coast of Sweden, described a *Solrök* (sun-smoke) that had "for weeks been continuously resting over our horizon and is so thick that the sun has been completely red both in the morning and in the evening."[132] A weather observer in Turku, on the southern coast of Finland, noted in his summary for the end of June that "the wind has been strange the whole month, but did not blow away the dry fog";[133] while in Denmark an Icelandic student of theology at the University of Copenhagen, Sæmundur Magnússon Holm (1749-1821), remarked that "in Zealand and at Copenhagen the sun, from the beginning of June till the 8th of August, seemed remarkably red; and throughout the whole month of July the atmosphere was so filled with vapour and dust, that the sun could not be seen in the evening after eight or nine o'clock. Even at noon the sun was red, and this was observed in the night-time to be the case with the moon and the stars."[134]

In the German provinces and Bohemia the first manifestation of the *Lakagígar* haze was recorded on the 16th of June.[135] Reflecting on the state of the atmosphere, the famous satirist and professor of experimental physics at the University of Göttingen, Georg Christoph Lichtenberg (1742-1799), wrote in a letter on July 3rd that "Der Hahl=Rauch[136] erstreckt sich … weit über Straßburg hinaus; gegen Norden über Hannover u[nd] gegen Süden über Gotha; ich habe Briefe über Briefe aller Orten her darüber."[137] Meanwhile, west of Germany, on the other side of the English Channel, a character described as "the oldest man living" was interviewed in the coastal town of Dover in the July edition of the *Gentleman's Magazine*, and quoted saying that he could "scarce remember any fog of so long continuance as the present,

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132 Cited in Thorarinsson, Sigurdur: "Greetings from Iceland", p. 114

133 Cited in Demarée, G.R., and Ogilvie, A.E.J: "*Bons Baisers d'Islande*", p. 232

134 Holm's book, *Om Jordbranden paa Island i Aaret 1783*, was the first description of the *Lakagígar* eruption to be published outside Iceland. This reference from the book is cited from an abstract that appeared in English in 1799, See: Holm, S.M: "Account of a Remarkable Fiery Eruption", p. 113-120

135 Brázdil, Rudolf et al: "Climate in the Czech Lands during the 1780's", p. 310

136 This unusual word is explained in the 1877 edition of the *Deutsches Wörterbuch*, (vol. 10) p. 158-159 from Jacob and Wilhelm Grimm as: "Die Hahl (f.) ... Haken, um den kessel über feuer zu hängen." Contemporary sources from the German speaking world usually described the *Lakagígar* haze with the words *Höherauch, Heerauch, Heiderauch*, or simply *trockener Nebel*.

137 Lichtenberg, Georg Christoph: *Briefwechsel*, (vol. 2), p. 640

not being able to descry the opposite shore for almost three weeks."[138] In the light of the hostilities between France and Great Britain in the American War of Independence it seems as though the unusual fog had assumed a position of neutrality by effacing the two countries from each other's sight in the midst of political hostilities.

Based on these accounts, it is clear that the sulfuric acid aerosols that were responsible for the haze that hung over Iceland had drifted in an easterly direction over the Atlantic Ocean and formed a familiar pattern throughout the European continent. From what we have gathered, the manifestation resembled a kind of smoky or whitish haze in the air which did not give moisture like ordinary fog. As a consequence, contemporaries frequently described the alteration of the atmosphere by employing the term, dry fog.[139] As in Iceland, the fog cast a shadow over the atmosphere. During daytime the sunlight seems to have been clouded to such an extent that people were able to look right into the sun. Visibility in the natural environment was poor and neither wind nor rain seemed capable of clearing the air. The sun, at rising and setting, appeared blood-red; while at night the moon and the stars could scarcely be glimpsed at because of the dimming haze.

Unlike the Icelandic experience the contemporary records from Europe does not associate the haze with tephra falls. With regard to this, the account of Sæmundur Holm Magnússon does mention frequent ash falls on the Faeroe Islands; while adding that Denmark and Norway also experienced ash fall.[140] Similarly, a late-19th century textbook in geology, authored by Sir Archibald Geikie (1835-1924), claims that during the summer of 1783 great quantities of "fine dust" had fallen over parts of the Orkney Islands northeast of Scotland where the "year is still spoken of by the inhabitants as the year of "the ashie.""[141] As far as the author of this research is concerned, the value of these accounts stands and falls with their authors.[142] It is therefore important to note, with the broader context of this work in mind, that tephra falls do not seem to have been a significant factor regarding the influence that the *Lakagígar* eruption wielded outside Iceland.

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138 *Gentleman's Magazine* (53:2) 1783, p. 620

139 See e.g. Demarée, G.R., and Ogilvie, A.E.J: "*Bons Baisers d'Islande*"; and Stothers, Richard B: "The Great Dry Fog of 1783"

140 Holm, S.M: "Account of a Remarkable Fiery Eruption", p. 119

141 Geikie, Sir Archibald: *Text-Book of Geology*, (vol. 1) p. 295

142 No other sources confirm these accounts. Regarding Geikie's account, some doubt remains about his non-contemporary description (originally published in 1882). It has been argued that the year of "the ashie" may refer to the eruption of the Icelandic volcano Katla in 1755, or other 19th century Icelandic volcanic events. See Demarée, G.R., and Ogilvie, A.E.J: "*Bons Baisers d'Islande*", p. 224

On June 17th, one of the most widely read English poets of the day, William Cowper (1731-1800), wrote a letter to his literary agent John Newton (1725-1807), complaining that the anomalous state of the atmosphere had seized the summer away: "Perpetual clouds intercept the influences of the Sun, and for the most part there is an Autumnal coldness in the weather, though we are almost upon the Eve of the longest day."[143] A couple of weeks later, when longest day of the year (June 21st) had come and gone without any sign of improvement, Cowper's worries increased. He wrote another letter to Newton, complaining about the "Bæotian atmosphere":[144]

> So long, in a country not subject to fogs, we have been cover'd with one of the thickest I remember. We never see the Sun but shorn of his beams, the trees are scarce discernible at a mile's distance, he sets with the face of a red hot salamander, and rises (as I learn from report) with the same complexion.

However, Cowper did make an effort to end his letter on an optimistic note: "But possibly it [the fog] may not be universal" he speculated, "in London at least, where a dingy atmosphere is frequent, it may be less observable."[145]

Unfortunately, Cowper was wrong. "The month of June 1783", observed the great man of letters and Whig politician Horace Walpole (1717-1797) from his Thames-side villa in London, had "been as abominable as any one of its ancestors in all the pedigrees of the Junes."[146] The atmospheric condition in London was now just as baffling as it had been in Paris. And the longer it persisted, the more reason newspapers in Europe had to cover something other than the progress of the American peace talks or the inventiveness of the Montgolfier brothers.

As time passed, similar developments were to be recorded in places much further afield. How far did the strange haze actually travel; and what sense did contemporaries attach to its appearance? We shall continue our overview of the appearance of the fog by looking at these questions. Thereafter, we will return to the worries of William Cowper and Horace Walpole during the summer of 1783.

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[143] *The Letters and Prose Writings of William Cowper*, (vol. 2), p. 146

[144] The word "Bæotian" refers to a district in Ancient Greece, called Bæotia. According to the poet Hesiod it was known for having a very unpleasant climate. See *The Letters and Prose Writings of William Cowper*, (vol.2), p. 148-149

[145] *The Letters and Prose Writings of William Cowper*, (vol. 2), p. 149

[146] *The Yale Edition of Horace Walpole's Correspondence*, (vol. 33), p. 402

2.3. A flatulent earth

When documenting the spreading of the unusual atmospheric fog and the contemporary reaction to it, one needs to size up what sources are of an appropriate use. In this case, newspapers were printed in most major European cities by 1783. Another valuable source comes from the work of scientific communities, who were publicly active during the period and published magazines and yearbooks about philosophical matters. It should be noted that "philosophical practice" in the 18th century translated into the study of nature and the physical universe, acting as a kind of precursor to the natural sciences of today. A small but revealing example of the general interest in naturalistic/philosophical matters during the 18th century can be drawn from the fact that two books on the *Lakagígar* eruption were published on the European mainland immediately after the eruption, as we mentioned in the previous chapter. Other useful sources were the works of meteorological networks and individuals who engaged in systematic observation and kept weather diaries; while private letters and even poetry from the period adds an interesting perspective on the subject.

With regard to the 18th century press, a few things should be said about its value as a source. In this respect, news reports on significant events or developments appeared in two forms: either as newsletter from far and wide or readers' letters that carried an opinion on a given matter. What is striking about the content of the news medium at that time is the range and quantity of foreign commentary that appeared in newspapers and journals. Even during periods of significant domestic developments, news from abroad always takes up the greatest proportion of the reportage.[147] Evidently, the flow of foreign news indicates that readers had an idea about what went on in the world. However, taking into account how long it took for news to travel from one region to the other (let alone over oceans or between continents) meant that reporting circulated slowly, was often inaccurate, or even out-of-date once it found its way into the papers.

The human responses to the *Lakagígar* eruption are indicative of this. One of the main difficulties with which 18th century witnesses of the unusual fog had to cope with was the delay in obtaining information regarding what had happened in Iceland. However, in an age that assigned its name to the spirit of the Enlightenment, contemporaries were compelled to form hypotheses for the baffling state of the atmosphere. Certainly there was a reason for the

[147] A personal experience of the author that is also reflected in: Black, Jeremy: *The English Press in the Eighteenth Century*

haze that could be explained through rational principles. Regarding this, the explanations that most observers leaned towards during the summer months rightly assumed that the alteration of the atmosphere had its origin in geophysical activity. But at first they looked in the wrong direction and at a different natural occurrence.

One incident in particular became prime suspect for the strange alteration of the atmosphere. Earlier in the year something terrible had happened. On February 5th, a severe tsunami-genic earthquake shook the city of Messina in Sicily and the south Italian region of Calabria – leaving 32,000 to 50,000 casualties, according to recent estimates.[148] As these rural places were certainly vulnerable to the loss of communication lines, reports of the disaster circulated slowly and for several months confusion reigned concerning their fate. In the Low Countries, for example, the *Gazette van Gent* ran an article on March 6th that began by reporting "the sad news that on the 5th [of February] at 19 hours according to the Italian clock, a heavy earthquake occurred at Messina in Sicily." The report then linked the event to a series of rumors concerning a sequence of other disturbances across the region, which left a chaotic impression to say the least:[149]

> The earthquake is ascribed to the bursting out of the Etna mountain which is situated 25 miles away. However, others assure that this accident is the consequence of a most terrible thunderstorm … It is said that more than 20,000 inhabitants lost their lives in the waves or by the collapsing of their houses … One has counted more than 30 different earthquakes which were preceded by a heavy storm at sea and on land and accompanied by excessive rain with thunder, lightning and terrible darkness. For the rest, it is mentioned from Naples that the mountain Vesuvius throws out such a thick and uncommon smoke that one fears for many catastrophes … Letters from Palermo and Messina contain [information] that the burning mountains in the small islands Vulcano and Stromboli throw out a large mass of fire.

Earthquakes, volcanic eruptions, terrible thunderstorms, and heavy storms at sea – what on earth had happened in southern Italy? Further tremors were felt in the region for the next several months. And while news of the events was regularly reported in European newspapers, it was not until the summer that the pieces came together in a coherent narrative, when several reports from the scene were published. The most widely distributed and famous of these were the accounts gathered by the British Envoy Extraordinary to the court of Naples, Sir William Hamilton (1731-1803). Renowned for his life-long interest in geology and contribution to the field of volcanology – a passion brought to life in Susan Sontag's brilliant

[148] Jacques, E. et al: "Faulting and earthquake triggering during the 1783 Calabria", p. 499-516
[149] Cited in Demarée G.R. and Ogilvie A.E.J: "*Bons Baisers d'Islande*", p. 225

novel, *The Volcano Lover* – Hamilton set out on a 20 day field-trip around the regions on May 2nd, and compiled eyewitness accounts of the disasters, which were published by the Royal Society in London.

The Hamilton accounts contain both detailed and moving descriptions that make a horrific reading. In the Calabrian municipality of Polistena, Hamilton remarked that he had "travelled four days on the plain, in the midst of such misery as cannot be described. The force of the earthquake was so great there, that all the inhabitants of the towns were buried either alive or dead under the ruins of their houses in an instant … here you [could] neither distinguish street or house, all lye in one confused heap of ruins."[150] But given the strange condition of the atmosphere, it was the natural effects of the earthquakes in his description that caught the attention:[151]

> Several fishermen assured me, that during the earthquake of the 5th of February at night, the sand near the sea was hot, and that they saw fire issue from the earth in many parts. The circumstance has been often repeated to me in the plain; and my idea is, *that exhalations which issued during the violent commotions of the earth were full of electrical fire*, just as the smoke of volcanoes is constantly observed to be during volcanic eruptions; for I saw no mark, in any part of my journey, of any volcanic matter having issued from the fissures of the earth; and I am convinced, *that the whole damage has been done by exhalations and vapours only*.

During earthquake episodes in Calabria and Messina in June and July, the fog was not only omnipresent in southern Italy, but it also covered the atmosphere in Europe. And combined with the accounts of severity and strangeness regarding the seismic activity in southern Italy, it gave rise to the idea that the earthquakes were somehow causally linked with the unusual state of the atmosphere. Horace Walpole, for one, thought it perfectly apparent that "the dreadful eruptions of fire on the coasts of Italy and Sicily have occasioned some alteration that has extended faintly hither, and contributed to the heats and mists that have been so extraordinary."[152] How could an earthquake have contributed to the haze in the atmosphere? The reasoning was drawn from the prevailing Renaissance-influenced idea on meteorology, which frequently interpreted the occurrence of nature-induced occurrences as having a direct influence on meteorological conditions.[153] Inspired by the naturalistic theories of Aristotle (BC 384-322), it was held that earthquakes were products of rushing subterranean

150 Hamilton, Sir William: "An Account of the Earthquake which happened in Italy", p. 183-184

151 Hamilton, Sir William: "An Account of the Earthquake which happened in Italy", p. 194. (Remark: Italics by author)

152 *The Yale Edition of Horace Walpole's Correspondence*, (vol. 35), p. 373

153 See e.g. Demarée G.R. and Ogilvie A.E.J: "*Bons Baisers d'Islande*", p. 219-247; Martin, Craig: *Renaissance Meteorology*; and Sigurdsson, Haraldur: *Melting the Earth*, p. 34-83

exhalations (winds), which at times ignited combustible materials underground that escaped above the surface of the earth.[154] There was certain logic to it, for it could be imagined that the earthquakes in southern Italy had unleashed a sort of internal combustion that had gone on to contaminate the atmosphere. The earth, in other words, had broken wind and the escaped contagion dispersed by the slowly meandering winds.

The idea of a flatulent earth was a popular explanation for the extraordinary state of the atmosphere among enlightened Europeans.[155] In the annual report of the Royal Swedish Academy of Sciences for the year 1783, the earthquakes in Calabria were ascribed as the prime reason for the summer haze.[156] Similar thoughts were presented in a scientific inquiry on the subject by the Dutch professor at the University of Franeker, Jan Hendrik van Swinden (1746-1823), who made the link for "the simultaneity of the phenomena, and more general observation, render it probable that dense haze often follow remarkable earthquakes."[157] Analogous were the ideas of his colleague at the University of Padua, Giuseppe Toaldo who was "inclined to think [the haze] came from Sicily and Calabria, where there were violent earthquakes." We know, Toaldo remarked, "that the heavens in those countries appeared cloudy after the great shocks, which may be readily believed when we consider the immense exhalations that must have dispersed throughout the atmosphere."[158]

Similar conclusions were drawn in newspapers and journals throughout Europe.[159] And even when mild tremors were felt elsewhere on the continent, they were immediately assigned to the disturbing news about the disasters in Messina and Calabria and the dry fog.[160] Further away, in the Syrian city of Tripoli (today's Lebanon), an earthquake was reported in the *Journal historique et littéraire* on July 30th. Interestingly, the event was also noted together with the fog and again the link with the earthquakes in south Italy was made:[161]

> … one has experienced here an earthquake that was felt on two occasions. The tremors succeeded each other rapidly, lasting together … 8 to 10 seconds. They had been preceded by

154 Martin, Craig: *Renaissance Meteorology*, p. 62-64
155 Steinþórsson, Sigurður: "Annus mirabilis", p. 134-155
156 Thoroddsen, Þorvaldur: "Eldreykjarmóðan 1783", p. 99
157 Van Swinden, [Jan Hendrik]: "Observations on the cloud (dry fog) which appeared in June 1783", p. 78
158 Toaldo, [Giuseppe]: "Meteorological Observations made at Padua in the Month of June 1783", In: *The Philosophical Magzine* (4) 1799 p. 417-423. Toaldo's dissertation also appeared e.g. in *Journal de Physique* (24) 1784, p. 3-17; *Der Deutscher Merkur* (April) 1784, p. 3-16
159 See e.g. *Gentleman's Magazine* (53:2) 1783; *Gazette van Gent* (17.07.1783); *Pressburger Zeitung*, (13.08.1783); etc.
160 See e.g. news of an earthquake which occurred in the region of Franche-Comté, the Jura, Burgundy, and Geneva on July 6th; and in the Low Countries on 7th and 8th of August. See Demarée G.R. and Ogilvie A.E.J: "*Bons Baisers d'Islande*", p. 224-226
161 Cited in Demarée G.R. and Ogilvie A.E.J: "*Bons Baisers d'Islande*", p. 226

> a muffled rumble, similar to the one of the roaring of the waves which one hears from afar. [In] the evening there was a pouring rain which was extraordinary for the season. For more than one month a heavy fog covered the land and the sea, the winds blew with equal violence as in the winter, the sun appeared only seldom and always with a bloody colour, unknown until now in Syria. The earthquake was also felt in Lebanon. An entire village near Naplouse [Nablus, in the West Bank] was buried under a rock that had collapsed. The Turks, being informed about the disaster of Messina, are in a state of great consternation.

The fog had clearly found its way into the Ottoman vicinities of an area which today is called the Middle East. And at this point, it is worth pondering how far they actually travelled? Continuing in a southeasterly direction from Western Europe, meteorological observations note that the fog reached Baghdad on July 1st.[162] Other contemporary sources claim that it extended into North-Africa[163]; while European newspapers at that time reported a sun-obscuring "thick fog" that was followed by turbulent weather had occurred in today's Turkish cities of Istanbul, Ankara and Izmir from the beginning of August.[164] In a northeasterly direction, accounts drawn from the database of the *Societas Meteorologica Palatina*[165] – the world's first international weather observation network founded by Elector Karl Theodor (1724-1799) of the German state of Palatinate-Bavaria, and operated between 1781 and 1795 – reveal that the haze reached the Russian cities of St. Petersburg and Moscow around the end of June. The same source notes that by July 1st the haze had covered the sky above the Altai Mountains in central Asia – approximately 7000 km away from Mount Laki in Iceland.[166]

Although we cannot state with any certainty how far the haze actually travelled, it is the conclusion of this research that no plausible evidence has so-far been presented that proves that the fog spread further than central Asia. Due to lack of documentation it is difficult to analyze how the sulfuric acid aerosols were felt and perceived in the above mentioned regions. On the one hand, the accounts that have been attained from the old Ottoman territories and North Africa and studied for this research are too few, limited in content, and lack the comparative aspect needed for drawing thought out historical assumptions. On the other

162 Stothers, Richard B: "The Great Dry Fog of 1783", p. 80

163 See e.g. Lamanon, [Robert Paul de]: "Observations on the Nature of the Fog of 1783", p. 80-89; and, *Gentleman's Magazine* (53:2) 1783, p. 803

164 Demarée G.R. and Ogilvie A.E.J: "*Bons Baisers d'Islande*", p. 227

165 The *Societas Meteorologica Palatina* consisted of fifty-seven observation stations, the majority of which were found in Europe and Imperial Russia. Outside these areas, the network had two stations in the state of Massachusetts (North-America); and one in Nuuk (Greenland). See, Fleming, James Rodger: *Historical Perspectives on Climate Change*, p. 11-25

166 A translation from Latin to English of the weather observational data of the *Societas Meteorologica Palatina* relative to the dry fog of the summer of 1783 are presented in, Thordarson, Thorvaldur: *Volatile Release and Atmospheric Effects of Basaltic Fissure Eruptions*, p. 362-516

hand, the Russian and Eurasian data presented in the files of the *Societas Meteorologica Palatina* are certainly reliable, but the observational methodology of the network, with its emphasis of treating weather as a subject of scientific enquiry, strips them of the human aspect which we want to explore in this chapter. We shall therefore stay within the boundaries of Europe for the remainder of the chapter, as we continue our analysis of the human responses to the *Lakagígar* eruption, outside Iceland.

By the turn of July, the baffling haze had become a cause for a growing public concern throughout Europe. These sentiments are summed up in a letter written by the University of Göttingen professor Georg Christoph Lichtenberg, on July 13th. Convinced of the causality between subterranean winds from southern Italy and the fog, Lichtenberg wished "daß der Hehe Rauch, Heiderauch, Heelrauch … und die Sonne mit ihrem rothen Mittags Gesicht in Calabrien geblieben wäre" while adding, much to his annoyance, that this "Nebel hat mir ein solches Mehltau=alias Melthau=Geschmeiß von Briefen und Billeten auf meine Stube gezogen" and the "Beantwortung dieser Briefe hat mir nicht wenig Zeit geraubt."[167]

Meanwhile, in an era where the authority of the church still had considerable influence in public life, religious thoughts regarding the unusual fog were bound surface incident to the enlightened conceptions of the day. In an abstract of the accounts of Sir William Hamilton on the earthquakes in Calabria and Messina, a commentator of the enlightened *Gentleman's Magazine* noted that although it was "not in the fashion of this age to introduce scripture into any comparison" there was a striking parallel with the earthquakes and "the events that were to precede" them and a series of biblical prophecies in "Matth. xxiv.7; Mark xv.8; but particularly Luke xxi.25, 26":

> And is not the destruction of the cities of the plain, perhaps by the first earthquake after the creation, recorded in Genesis, xix. 24-28, an exact counterpart of what happened in the plain of Calabria? A vapour, charged with electrical fire, or a kind of inflammable air; an overthrow, and the smoke of the country ascending like the smoke of a furnace: the same physical causes concurring under divine protection? … *Let us be wise, and consider these things*.[168]

The duality of enlightened and scriptural perceptions regarding the *Lakagígar* influence is worth elaborating on, as we seek to get a better idea on how contemporary Europeans reacted

[167] Lichtenberg, Georg Christoph: *Briefwechsel*, (vol.2), p. 653-658
[168] *Gentleman's Magazine* (53:2) 1783, p. 787

to the strange alteration of the atmosphere during the summer of 1783. And that will be the subject of the coming section.

2.4. The enlightened and the superstitious

What kind of response can we read from the documentary record regarding the unusual state of the atmosphere – characterized by its reduced visibility; pale and blood reddened sunrises and sunsets; and the dryness of the fog – during the summer of 1783? As we saw in the previous sections, the contemporary sources frequently used superlatives to describe the haze, such as "extraordinary"; "the thickest [fog] I remember"; "the oldest citizens do not remember"; "people of abilities declare that they never remember the like"; et cetera. On the other hand, an effort was also made in providing rational explanations regarding the strange alteration of the atmosphere, as the link between the dry fog and the earthquakes of Calabria and Messina shows. In comparison to the sciences of today, such efforts clearly demonstrate that scientific knowledge of the 18th century had not progressed to the point of drawing well-defined boundaries between natural phenomena. And neither had the knowledge at that time filtered through the social strata as to be considered widespread. This signified a problem of perception.

According to the geographer Clarence J. Glacken (1909-1989), who researched the history of ideas regarding the mutual relation between nature and human cultures, natural disasters and their interpretation during an age that knew little of the processes at work "were as baffling as […] the problem of moral evil." As a consequence, scriptural explanations filled in where the shortcomings of human understanding began. The traditional answer of Christian apologetics to the problem of nature's physical force was that they were some kind of divine lessons or warnings – and in aggravated cases, punishments for the sins of humanity.[169]

In light of the spirit of the time, the reaction to the *Lakagígar* haze pertained to this view. The contemporary perception of the dry fog can therefore be divided between the so-called *enlightened* – i.e. those who tried to rationalize its appearance by emphasizing reason; and common people who were often referred to as the *superstitious* – i.e. those who were influenced by the power of persuasion and viewed the strange atmospheric condition with a sense of fear and foreboding. One frequently comes across this duality when viewing documents from the

[169] Glacken, Clarence J: *Traces on the Rhodian Shore*, p. 504-524

period, as this contemporary description of the fog by an 18th century Italian chronicler indicates:[170]

> Many days this month were … foggy at dawn and sunset, and the moon appeared ruddy and equally the sun that could be looked at without being blinded. The fog was high, dry and dense and this phenomenon was observed not only by us, but elsewhere in Italy, Germany, and France, giving the opportunity for some astronomers and meteorologists, by their writings, to dissipate fears conceived by the lower classes …

By looking at this text one sees that while the appearance of the dry fog tested the intellect of the learned, it called forth fears among others. But how do we get closer to the experience of the others – let us say the farmer in the countryside, or artisan in the city? With regard to this, contemporary accounts repeatedly indicate a lot of apprehension which seems to have directed the "lower classes" towards the oratories. In the July edition of the *Gentleman's Magazine* for example, it was reported that "much to the benefit of the priesthood … the churches and saints are more respectfully attended than usual," and that there was "fear of impending calamities".[171] In the Flanders city of Antwerp, an account of the fog mentioned that droughts and hot temperatures had accompanied it, which led to the calling of "1st of August public prayers … in the divine services."[172]

Although newspapers and journals are perhaps not the best source for the content of 18th century church services, one such sermon held by Reverend Johann Georg Gottlob Schwarz (1734-1788), at Alsfeld in Upper-Hessen serves as an example. Delivered on the second Sunday after Trinity (June 29th), Reverend Schwarz described how members of his congregation had spent the previous week "star[ing] at the sky and at the earth, at the, for this time of the year, unusual sunrise and sunset, and at the horizon veiled in dark exhalation", all of which were evidently messages that God had written in the sky to show "us in nature his omniscience, omnipotence, his greatness" which Schwarz praised and took as his duty, as God's servant, to guide "[us] humans, and walkers, on the straight path."[173]

Meanwhile, in the same region of today's Germany, George Christoph Lichtenberg wrote on July 13th, that villagers close to the city of Fulda had held special "fog prayers".[174] Further to the south in Lausanne, the Swiss natural philosopher François Verdeil (1747-1832) noted

170 Cited in Camuffo, Dario and Enzi, Silvia: "Impact of the Clouds of Volcanic Aerosols in Italy", p. 138
171 *Gentleman's Magazine* (53:2) 1783, p. 613
172 Cited in Demarée G.R. and Ogilvie A.E.J: "*Bons Baisers d'Islande*", p. 237
173 Cited in Demarée G.R. and Ogilvie A.E.J: "*Bons Baisers d'Islande*", p. 237
174 Cited in Hochadel, Oliver: ""In Nebula Nebulorum"", p. 60

that the dry fog had been interpreted by some as a sign from the Apocalypse of John 9:2, namely the "vorausgesagten Rauch aus dem Schlunde der Unterwelt gehalten und als Zeichen des nahen Weltunterganges betrachtet", while in other parts of Switzerland ceremonies of repentance and fasting reportedly took place in order to prepare the people for the approaching end of the world.[175]

One can deduce from these accounts that the dry fog called forth sentiments of piety and fear of Armageddon in the minds of many people. Commenting on this, in a lecture at the Société Royale des Sciences in Montpellier on August 7th, the French naturalist M. Mourgue de Montredon (1734-1818) reflected on the "terror that the people … have formed" and added that while "some are waiting and trembling [for] the fate of Calabria; others are believing in the end of the world". This idea had been "so singularly substantiated that one fixed the date on July 1st [1783]", Montredon concluded."[176]

The notion that a supernatural or divine force lay behind the strange state of the atmosphere was frequently evoked throughout the summer of 1783. However, as pointed out by the geoarcheologists John Grattan and Mark Brayshay, who have analyzed media reporting in Great Britain of the dry fog, the newspapers were oblique in narrating such sentiments.[177] Part of the reasons for this could be that newspapers and magazines in 18th century Europe were not so much written or read by ordinary people, but rather the enlightened and wealthier classes.[178] The experiences of ordinary people were therefore often portrayed with a sense of "otherness" – i.e. the others as being "irrational" or "superstitious" counter to the "learned" and "enlightened". For instance, in a newsletter from France, published in the *Edinburgh Advertiser* on July 15th, priests had been accused of playing on the fears of the "common folk", when the reddened sun and smoky air "alarmed the superstitious part of the people, who had been wrought by their priests to believe that the end of the world was at hand."[179] In a similar vein Georg Christoph Lichtenberg, reported that priests in East-Hessen had been chided for agitating superstitious sentiments among common folks.[180]

175 Material on the dry fog and Switzerland cited in Pfister, Christian: "Die Lufttruebungserscheinung des Sommers 1783", p. 23-29
176 Cited in Demarée G.R. and Ogilvie A.E.J: "*Bons Baisers d'Islande*", p. 238.
177 Grattan, John and Brayshay, Mark: "An Amazing and Portentous Summer", p. 130
178 See *Press, Politics and the Public Sphere*, (ed. Hannah Barker and Simon Burrows), p. 1-23
179 Cited in Grattan John and Brayshay, Mark: "An Amazing and Portentous Summer", p. 130
180 Cited in Hochadel, Oliver: ""In Nebula Nebulorum"", p. 60

The distinction between the *enlightened* and *superstitious* can also be found in the letter correspondence of William Cowper, who noted in late-June that while the dry fog had "occasioned much speculation amongst the Connoscenti at this place" it had frightened the others to the point that "[s]ome fear to go to bed expecting an Earthquake, some declare that he neither rises nor sets where he did, and asserts with great confidence that Judgment is at hand." The English poet dismissed the "fallibility of those speculations which lead men of fanciful minds to interpret Scripture by the contingencies of the day."[181] These sentiments were echoed by the curate of Selborne and renowned naturalist Gilbert White (1720-1793), who rejected the "superstitious kind of dread, with which the minds of men are always impressed by such strange and unusual phenomena"[182], while in nearby Fyfield, his brother Henry noted that "ye superstitious in town and country have abounded with ye most direful presages and prognostication."[183] In Switzerland, the reaction of the *enlightened* observer François Verdeil seems to have varied between compassion for the easily frightened people and ridicule and contempt for their gullibility.[184]

In the next chapter we shall try to put the fears of contemporary Europeans in context, when we evaluate the environmental effects that the volcanic aerosols from the *Lakagígar* eruption had during the summer of 1783. But what does the *enlightened* perception tell us about the extraordinary state of the atmosphere at that time; and how did "the learned" react in the midst of religious fear?

As we noted in the last section, the European intelligentsia was prone to think that the dry fog was linked to the earthquakes in Messina and Calabria. From a historical perspective, such ideas offer an interesting insight on how the late Enlightenment understood unwonted natural occurrences. And while part of its endeavor was obviously to search out regularities in nature and provide rational explanations for the disturbing fog in the atmosphere, the *enlightened* also sought to counterweight the outspread of "superstitious prejudices … too gross for this enlightened age", such as those held by the "lower people" – as one naturalist of the day remarked.[185] A good example of this effort can be found in the earliest explanation of the

[181] *The Letters and Prose Writings of William Cowper*, (vol. 2), p. 142-149
[182] White, Gilbert: *The Natural History of Selborne*, p. 232
[183] Cited in Mabey, Richard: *Gilbert White*, p. 190
[184] Pfister, Christian: "Die Lufttruebungserscheinung des Sommers 1783", p. 23-29
[185] White, Gilbert: *The Natural History of Selborne*, p. 163

fog, which stemmed from an appeal of the editor of the *Journal de Paris*, the leading French newspaper of the day, to the French Academy of Sciences for a reasoned explanation regarding the dry fog.

The job of supplying it fell to Joseph-Jérôme Lefrançais de Lalande (1732-1807), one of France's leading astronomers, who responded with what amounted to a press release on behalf of the Academy. A somewhat comical figure, Lalande had in 1773 been responsible for an outbreak of alarm in Paris when he carelessly discussed in a scientific paper the possibility of a collision between the earth and a comet, to which he was later forced to issue an apology.[186] Ten years later he offered a more calm reassurance to the frightened people of France: "To the Authors of the *Journal*: It is known to you, gentlemen, that for some days past people have been incessantly enquiring what is the occasion of the thick dry fog which almost continually covers the heavens", Lalande began, and added in a self-assured tone that he felt "obliged to say a few words on the subject, more especially since a kind of terror begins to spread in society." Inspired by the age of reason, Lalande was wary of such "conjectures which begin among the ignorant even in the most enlightened ages, proceed from mouth to mouth, till they reach the best society, and find their way even to the publick prints." The multitude, he added, may therefore "easily be supposed to draw strange conclusions, when they see the sun of a blood colour, shed a melancholy light, and cause a most sultry heat." For Joseph-Jérôme Lefrançais de Lalande, however, it was clear that the murky state of the atmosphere was:[187]

> … nothing more than a very natural effect from a hot sun after a long succession of heavy rain. The first impression of heat has necessarily and suddenly rarefied a superabundance of watery particles with which the earth was deeply impregnated, and given them, as they rose, a dimness and rarefaction not usual to common fogs.
>
> This effect, which seems to me very natural, is not so very new … Among the meteorological observations of the academy for the month of July 1764, I find the following: The beginning of this month was wet, and the latter part dry; the mornings were foggy, and the atmosphere in a smoke during the day. – This you perceive bears a great resemblance to the latter end of our June, so that it is not an unheard-of or forgotten thing. In 1764 they had afterwards storms and hail, and nothing worse need to be feared in 1783. I have the honor to be, &c."
>
> De la Lande, de l'Acad. des Sciences

Lalande's explanation appeared in the *Journal de Paris* on July 1st 1783 – the date which some of his countrymen had chosen for the end of the world. It was widely translated and

[186] *Dictionary of Scientific Biography*, (vol. 7), p. 579-582
[187] *Gentleman's Magazine* (53:2) 1783, p. 613

reprinted throughout the European press, and constituted the first plausible explanation of the dry fog.[188] Although totally wrong, his explanation was perfectly rational: the atmosphere had been severely fogged due to an overabundance of rain.[189] Moreover, by consulting the archives at the Paris Observatory, Lalande was able to compare the current conditions to those of an earlier summer, thereby coming to a reassuring conclusion, that "nothing worse need be feared in 1783." And perhaps his explanation might have soothed public apprehension, had it not been for the fact that the weather continued deteriorating and the atmosphere did not clear.

We are still a few puzzles short of concluding our narrative on the human response of the summer of 1783. In this concern, however, Lalande's article leaves an indication of two factors that were to blend with and add to the confusion regarding the volcanic fumes from Iceland. On the one hand, the blood-red sun seems to have rendered unusual warmth; while on the other hand, there were prospects of stormy weather.

2.5. Pyrotechnic weather

> Man weiß, wie ungemein trocken die Luft zur Zeit des Höherauchs im Sommer 1783 war, aber auch wie häufig die Donnerwetter, und wie heftig fast überall ihre Ausbrüche. Immer hörte man von Unglücklichen, die der Blitz getötet hatte, und in allen Zeitungen las man Nachrichten von den schrecklichsten Ungewittern und den Zerstörungen und Verwüstungen die sie anrichteten.
>
> Gottlieb Christoph Bohnenberger (1732-1807)
> *Beyträge zur theoretischen und praktischen Elektrizitätslehre*, p. 129

As we adverted to in the previous chapter, the summer of the *Lakagígar* eruption was followed by cold and harsh weather in Iceland – a condition which contemporaries attributed to the volcanic haze that covered the atmosphere. When its influence drifted across the Northern Hemisphere it was also followed by strange weather. However, the signature was upside-down. In Europe, where the effects of the dry fog were the most powerful, it was actually joined by very high temperatures. Another familiar feature to the summer of 1783, were

[188] See for example, for France: *Journal de Paris* 182 (01.07.1783); for Germany: *Münchner gelehrte Zeitung* (8) 1783, p. 60-61; for Great Britain: *Gentleman's Magazine* (53:2) 1783, p. 613; and for the Habsburg Empire: *Pressburger Zeitung* (23.07.1783)

[189] Interestingly, a similar explanation is given on the front page of the *Wiener Zeitung* (05.07.1783) in the first report of the appearance of the dry fog in Vienna. The connection is also made in a newsletter from Hermannstadt (Sibiu, in Romania) from July 15th in the *Pressburger Zeitung* (30.07.1783); while the renowned Swiss naturalist, Jean Senebier (1742-1809), voiced a similar opinion in a letter to Jan Hendrik van Swinden on July 15th, 1783. Since these accounts do not refer to Lalande's writing, one might assume that the explanation was not uncommon in Europe during the summer of 1783.

tremendous and frequent thunderstorms that swept across the continent. Just like in Iceland, the strange summer weather was promptly ascribed by contemporary Europeans to the unusual state of the atmosphere.

The summer of 1783 is known to have been unusually warm in the western, northern and central part of Europe – culminating in a heat wave during the month of July.[190] According to the English meteorologist John Kington, Britain experienced "one of the warmest Julys on record".[191] On the other side of the English Channel, the contemporary account from Joseph-Jérôme Lefrançais de Lalande indicates that the people in Paris were "incessantly enquiring" about "the sun of a blood colour" which coincided with "a most sultry heat" in the French capital. Similar reflections are recapped in the letter correspondence of Georg Christoph Lichtenberg, who somewhat incredibly found that one day in late-July the temperature in Göttingen had reached 45°C (measured in sun).[192] Another memory regarding the summer of 1783 was noted by Lichtenberg's fellow physicist, Christoph Wilhelm Hufeland (1762-1836), whose autobiographical description, decades later, grasps the spirit of the time: "In dem heißen trocknen Sommer des Jahres 1783, wo nach dem Erdbeben in Kalabrien ein trockner Höherauch die ganze Luft erfüllte ..."[193] An analogous account can be found in the annual report of the Royal Swedish Academy of Sciences for the year 1783, which records an unusually hot summer and assigns its cause to the earthquakes in southern Italy.[194] Elsewhere in Europe, thermometer readings from local weather stations were printed in newspapers. In Vienna, the results for the last few days of July appeared in the 2nd of August edition of the *Wiener Zeitung*:[195]

> Die Hitze ist seit einigen Tagen allhier ungewöhnlich drückend. Am stärksten war sie am Donnerstage und Freytage, wie sich aus der hier folgenden auf der kais. kön. Sternwarte

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[190] The assertion is commonly argued by referring to early thermometer data for six European cities that allows quantification of how extreme the summer heat was in 1783. In this case, *World Weather Records* data for Stockholm, Copenhagen, Edinburgh, Berlin, Geneva, and Vienna for a 31-year period (1769-98) centered on 1783 demonstrates that July 1783 was 1.6° to 3.3° warmer than the 31-year average. In all these places, the temperatures in August were average. See e.g. Wood, Charles A: "Climatic Effects of the 1783 Laki Eruption", p. 61-64

[191] Kington, John: *Climate and Weather*, p. 315

[192] Verbatim, Lichtenberg wrote on July 31st 1783: "Wir haben hier vorgestern eine Hitze gehabt, dergleichend ich mich nicht erinnere. In der Sonne noch eine Handbreit von der Wand, stund das Thermometer (Fahrenheit*isch*) 114 Grad [ca. 45° Celsius]." See Lichtenberg, Georg Christoph: *Briefwechsel*, (vol. 2), p. 671

[193] *Hufeland, Leibarzt und Volkerzieher*, p. 58

[194] Cited in Thoroddsen, Þorvaldur: "Eldreykjarmóðan 1783", p. 99

[195] *Wiener Zeitung* (02.08.1783)

> gemachten Beobachtungen des Reaumurischen Thermometers ergiebt … den 28. Julius 22 Grad [= 27.5°C] ober den Gefrierpunkt; den 29. 23 Grad [= 28.8°C]; den 30. 24 Grad [=30.0°C]; den 31. 25 Grad [=31.3°C]; den 1. August fiel er wieder auf 24 Grad [=30.0°C]. Die Beobachtung geschah jedersmal um 3 Uhr Nachmittags.

Adding to the intense heat were frequent occurrences of thunderstorms, which harried the continent immediately after the appearance of the fog.[196] This scenario was recorded in the heart of the Habsburg Empire.[197] Reflecting on the period, the Viennese meteorologist Anton Pilgram (1730-1793) remembered 1783 as the "strongest thunderyear I ever experienced."[198] Similar reports were documented in neighboring lands. On July 11th the *Gazette van Gent*, for example, intrigued that "letters from many places of the German Holy Roman Empire scarcely speak of anything other than the damage which has been … caused by the thunderstorms, the downpours and the inundations."[199] In France meanwhile, Robert Paul de Lamanon noted in his observations of the fog: "It would be too tedious to insert here the name of every place, which I noted down in my journal, where I learned that the thunder fell."[200]

When viewing the documentary record from the period one is particularly struck by the level of destructiveness brought on by the storms. Concerning this, villages or even whole areas seem to have been virtually destroyed. This is highlighted in the July edition for the year 1783, of *The European Magazine and London Review*. One example, describes a massive storm which tore through central France on June 21st, which left the region of Bourbonnais in racks. Depicted as a hurricane, hails of extraordinary size, "driven by an impetuous wind, and followed by a heavy rain that lasted three hours", were said to have "laid the canton to waste." According to the report, the castle of the country's seat "was unroofed, and all the windows broke" while "many trees were torn up by roots, and the harvest of ten domains entirely ravaged…" The report adds that "neither corn nor hay can be expected this year" and concludes that "ten or twelve parishes shared the same fate."[201] Meanwhile, other storms added death to destruction. The grimmest example that the author of this research has come

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[196] See Hochadel, Oliver: ""In Nebula Nebulorum"", p. 45-70
[197] Strömmer, Elisabeth: *Klima-Geschichte*, p. 206
[198] Cited in Hochadel, Oliver: ""In Nebula Nebulorum"", p. 45; See also Pilgram, Anton: *Anton Pilgrams Untersuchungen über das Wahrscheinliche der Wetterkunde durch vieljährige Beobachtungen*, p. 211
[199] Cited in Demarée G.R. and Ogilvie A.E.J: "*Bons Baisers d'Islande*", p. 228-229
[200] Lamanon, [Robert Paul de]: "Observations on the Nature of the Fog of 1783", p. 83
[201] *The European Magazine and London Review, for July 1783*, p. 73. For a report of the same event in German, see *Pressburger Zeitung* (16.07.1783)

across descended on the Prussian city of Glatz (today's Polish city of Kłodzko) on June 22nd. We shall let the report speak for itself:[202]

> …the county of Glatz was visited with so dreadful a storm that there was no distinguishing it from an earthquake. The whole country was entirely overflowed by the violence of the rains, which like a deluge carried away all the bridges that have been built for these 250 years. The claps of thunder were so violent, that several chimneys were thrown down, and walls shattered. Whole villages also were swept away by the fury of the torrents. Several hundred persons were drowned, and a great number of cattle lost. At Glatz, the salt and other magazines, with the barracks, were filled with water. Our advices from Bohemia are as melancholy, and contain a detail of several very unhappy accidents.

Summer storms in continental Europe are by no means uncommon, because of the convection caused when land heats up. But during the summer of 1783 the frequent and fierce thunderstorms entered a context that could be described as a cultural plight at that time. In this case, people had for centuries sought divine protection by ringing church bells in the face of an approaching storm. In a sense, these were divine suicides, given the evident attraction of lightning to bell towers. In 1783, the practice was still widespread, especially in catholic territories; while protestant communities usually sufficed to prayers.[203] As such, the act had enough superstition behind it to reject the utility of the lightning-rod, an invention which Benjamin Franklin perfected in the early 1750s, and had been increasingly installed on North American and European houses since. The bell ringing practice did not go un-criticized by the *enlightened*. In 1783, a German professor in mathematics at the Bavarian University of Ingolstadt, Johann Nepomuk Fischer (1749-1805), calculated that between 1750 and 1783, lightning had struck 386 church towers and killed 103 bell ringers.[204] The numerous lightings that flashed in the European sky during the summer of 1783 further demonstrated the danger of this practice.

This aspect can be discerned in the diaries of parson Karel Hein (1726-1811), who carried out meteorological observations in the South Moravian region of Hodonice between 1780 and 1789. Altogether, Hein noted the occurrence of as many as 17 days with thunderstorm from June to August 1783 – a frequency not observed by Hein in any other summer during the 1780s. A thunderstorm, recorded by Hein on June 29th, had a particularly tragic course in the

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202 *The European Magazine and London Review, for July 1783*, p. 74. For a report of the same event in German, see *Wiener Zeitung* (16.07.1783)

203 Hochadel, Oliver: ""In Nebula Nebulorum"", p. 51-52.

204 Hochadel, Oliver: ""In Nebula Nebulorum"", p. 51-52 (Note by author: Whether Johann Nepomuk Fischer's calculations were limited to Ingolstadt, the region of Bavaria, the German Holy Roman Empire or a greater area is unclear.)

city of Klattau (todays Klatovy). A lightning struck the church of St. Adalbert and set fire to an armory which contained gunpowder. By its explosion several people were injured or killed and damage was done to another church as well as nearby buildings. A week later, on July 4th, Hein noted that 6 people had been killed by lightning during bell ringing in the village of Taubrath (todays Doubrava). A similar scenario unfolded on August 4th, where more death and destruction was caused by a thunderstorm in the region of Leitmeritz (todays Litoměřice).[205]

Elsewhere in Europe, similar experiences were recorded. In Switzerland it was reported that 40 people were killed by lightning in a single day, in the fields near the Matterhorn.[206] Meanwhile the July edition of the *Gentleman's Magazine* reported that the nationwide increase in death in England caused by lightning was "more fatal, during course of the present month, than has been known for many years."[207] With respect to France, Robert Paul de Lamanon also reflected on the "devastation" of the lightning's of 1783 in his account and finds that in the regions of "Provence and Dauphiné alone it killed nearly sixty persons, and a great number of animals." Regarding the bell ringing practice, the historian Eugen Weber has recently claimed that in "1783 alone lightning struck 386 belfries in France and killed 121 bell ringers."[208] All in all, it would be interesting to know how many of them died in Europe during the thunderstorms of 1783.

In general, few places between Scandinavia and the Mediterranean regions were unaffected by the anomalous summer weather. In July and August 1783 there is hardly a newspaper issue without a report describing the unusual summer heat; or death and damage caused by the frequent thunderstorms.[209] Based on these accounts it seems clear that the advent of the extreme summer weather was causally ascribed to the extraordinary and long-lasting foggy

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[205] Cited in Brázdil, Rudolf et al: "Climate in the Czech Lands during the 1780's", p. 311-312

[206] *Wiener Zeitung* (02.06.1783)

[207] *Gentleman's Magazine* (53:2) 1783, p. 621-622

[208] Weber, Eugen: *Peasants into Frenchmen*, p. 28

[209] The author derives his assertion from his research on the July and August editions of the *Pressburger Zeitung* and *Wiener Zeitung*. The former is rich in reports from eastern part of Europe; while the latter covers the central and western part of the continent. Other overviews are provided in Demarée G. R. and Ogilvie A. E. J: "*Bons Baisers d'Islande*", p. 219-247; Thordarson, Thor: *Volatile Release and Atmospheric Effects of Basaltic Fissure Eruptions*, p. 325-538. For the British Isles, see Grattan, John and Brayshay, Mark: "An Amazing and Portentous Summer", p. 125-134

state of the atmosphere. In the Habsburg Monarchy, the connection is clearly stated in the 6th of August edition of the *Wiener Zeitung*:[210]

> Alle übrigen Berichte aus Ungarn, Siebenbürgen und den der Krone einverleibten Provinzen, melden einhellig, daß auch allda (so wie in allen Reichen von Europa) ein dichter trockener Nebel den Horizont lange Zeit bedecket habe, der aber auch hier sonst keine andere Folgen hatte, als die vielen und ungewöhnlich heftigen Donnerwetter, die meist noch mit sehr starken Regengüssen und Hagel begleitet waren, und an vielen Orten grösseren oder minderen Schaden anrichteten.

In a similar vein, a report from France printed in the *Gazette van Antwerpen* on July 18th, noted that "[o]ne has experienced thunderstorms in many regions of the Kingdom. These seem to be the result of the … general state of the atmosphere which has continued for some time."[211]

The frequent thunderstorm of the summer harmonized well with the idea of a flatulent earth. Regarding this, the adherent of the Calabria-Lakagígar connection, Jan Hendrik van Swinden, speculated that the internal combustion had added "certain influx on the electricity of the atmosphere", which in turn gave proof to the "conjecture, that this vapor [the dry fog] evidently had been produced by earthquakes, since the electricity plausibly drove it into certain parts."[212] Based on a similar premise, Giuseppe Toaldo concluded that the fog "must have contained abundance of earthy, fiery, mineral particles, with a great deal of inflammable air and electric fire"; while for some natural philosophers it sufficed simply to refer to the haze as "electric fog".[213]

Meanwhile, other accounts offered alternative views on the relationship between the electrical outbursts and the fog. Interesting are the ideas of the French natural philosopher Pierre Bertholon (1741-1800), who saw a clear connection between the volcanic haze and high frequency of thunderstorms. According to Bertholon, however, the disturbance of the "electrical equilibrium" was the prime cause for the foggy atmospheric condition, and not vice versa.[214] Adding to the plentitude of *enlightened* explanations regarding the strange fog, a parallel to Bertholon's theory can be found in a report from Naples from July 15th. According to the item the hazy state of the atmosphere was nothing more than "ein Übermaß elektrischer

[210] *Wiener Zeitung* (06.08.1783)
[211] Cited in Demarée G. R. and Ogilvie A. E. J: "*Bons Baisers d'Islande*", p. 228
[212] Van Swinden, [Jan Hendrik]: "Observations on the cloud (dry fog) which appeared in June 1783", p. 78
[213] Toaldo, [Giuseppe]: "Meteorological Observations made at Padua in the Month of June 1783" p. 417-423; and Lamanon, [Robert Paul de]: "Observations on the Nature of the Fog of 1783", p. 83
[214] Cited in Hochadel, Oliver: """In Nebula Nebulorum""", p. 50

Flüßigkeit, die unserer Luft erfüllet, und wird in dieser Meinung durch die von allen Seiten einlaufenden Nachrichten von entsetzlichen Donnerwettern bestärket."[215]

The pyroclastic weather of the summer of 1783 only added to the confusion regarding the unusual state of the atmosphere, whose red sun and reduced visibility seems to have been reason enough to stir emotions on the continent. This is summed up nicely in an in-depth article in the *Gentleman's Magazine* that documented a severe storm that took place in the English town Lincoln on July 10th. The storm is said to have been preceded by "a thick vapour that had for several days before filled up the valley between the hill on which the upper town stands and that which descends from the heath, so that both sun and moon appeared through it like heated brickbats, and as they sometimes do in a morning fog near London." As the author of the article pointed out in his conclusion, "various conjectures had been formed on this vapour by persons of different capacities; some conceived it the electrical effluvia travelling hither from Calabria and Sicily; others that the end of the world was approaching; others that it was the effect of violent heats on the earth saturated before with cold rain."[216] At this stage, there was still no news from Iceland. And when it arrived, it did not solve the riddle about the condition of the atmosphere, but only added to the list of nature-induced suspects that confused the scenario surrounding the strange summer haze.

2.6. News from Iceland

One of the main difficulties that the 18th century witnesses of the *Lakagígar* haze had to cope with was the delay in obtaining information regarding what had really occurred in Iceland. The means through which news from Iceland were communicated to the wider world were usually in the form of newsletters carried from the island by the vessels of the Royal Monopoly Company of Iceland. From there the letters were first printed in Danish newspapers and if judged newsworthy their content would circulate to other countries.

What kind of news came from Iceland during the summer of the *Lakagígar* eruption? In June 1783, the Danish newspapers printed mainly positive reports of local developments in the country. On the 23rd of the month, the *Kiøbenhavnske Tidende* for example told its readers that a local farmer in the south of Iceland had received a grant for harvesting three barrels of potatoes in 1782; while a week later the same paper reported that dean Halldór Finsen in the

[215] *Wiener Zeitung* (02.06.1783); A similar hypothesis is made in *Münchner gelehrte Zeitung* (8) 1783
[216] *Gentleman's Magazine* (53:2) 1783, p. 622

valley of Hítardalur had received a medallion for setting up a water-powered mill – much to the benefit of his local community.[217] But around the time when Danish readers were informed about the latest advancement in Icelandic agriculture, the ships from the trade monopoly harbored in Copenhagen with news that was to have a broader appeal, with the subject of the chapter in mind. On June 26th 1783, the Danish government issued a royal decree to the Rentekammer with the following wording:[218]

> Inasmuch as an island has unexpectedly emerged from the earthshaking and fires in the ocean off Reykjanes, few miles from the south coast of Iceland, there is reason to fear that when the fire goes out, which still flames, that foreigners could settle the island with irretrievable consequences for the Icelandic fishery. The kammer shall issue a decided instruction to the governor of Iceland to approach the island at first chance with one of the ships from the Royal Monopoly Company and solemnly stake our claim to it, not only by hoisting the Danish flag on the island but also by placing a 3 ells high stone inscribed with the royal insigne …

The "burning island" which Captain Jörgen Mindelberg and his crew discovered on the 1st of May had become an urgent matter to the internal affairs of the Danish Crown. The Crown immediately named the island, *New Island* (Nye-Ø in Danish: Nýey in Icelandic). On July 1st the first report of its emergence was printed in the Danish *Adresse-Contoirs Efterretninger*. Based on a first-hand account of Captain Peder Pedersen and his assistant Svendborg who had observed the island on May 22nd and 24th in the vessel *Torsken*, the report reads: "We discovered a small land or an island in the ocean, approx. 7 or 8 miles off the outermost Fuglaskerið (Bird Skerries), which we sailed around at half a mile distance in clear and nice weather. It was burning so strongly that we could see the thick smoke which obscured the sky, at more than 6 miles distance." According to Pedersen and Svendborg's account the island had volcanic mountains, and was about 1½ mile in size. Despite its emergence, they added that in Iceland people "had neither felt earthquakes nor volcanic eruptions anywhere on the mainland" and that "the inhabitants had said that around Eastertime [April 20th] they had seen something burning in the ocean south of Grindavík, without knowing what it could be." The report concluded that "this land which thereby formed has by the highest edict of his Majesty been seized under the Crown and given the name New Island."[219]

The emergence of the volcanic island immediately intrigued attention in the European press – indeed much more than reports of the *Lakagígar* eruption would later on – with the

[217] See Steinþórsson, Sigurður: "Annus Mirabilis", p. 135
[218] Cited in Thorarinsson, Sigurður: "Neðansjávargos við Ísland", p. 62 (My translation)
[219] Cited in Steinþórsson, Sigurður: "Annus Mirabilis", p. 136 (My translation)

first reports of the event appearing outside Denmark around mid-July.[220] In accord to Captain Jörgen Mindelberg's remark from the previous chapter, it was truly puzzling for the 18th century mind "that natural seawater could burn" and it was immediately predicted that "this singular production … will no doubt induce such of the learned world as are curious in their investigation of Nature's works, to visit this extraordinary phaenomenon."[221] But although the new volcanic island finally plotted Iceland into the scenario that we have narrated in this chapter, the event also filtered in with the confusion surrounding the geophysical and nature-induced occurrences of the year. In this concern, the first reports immediately linked the new island to the earthquakes in Calabria and Sicily; with some accounts even suggesting that it had emerged as "an effect of the dreadful earthquake that caused such havock in Sicily."[222] Other accounts, however, disputed that an offshore eruption in the North Atlantic might have had anything to do with an earthquake in Sicily and suggested that its formation was indeed bound to volcanic activity: "those who consider that its neighbourhood with Hecla, the second volcano in the world,[223] will rather attribute it to some intestine commotion from that mountain."[224]

As far as the documentary record goes, New Island was last observed by Captain Peder Pedersen and his crew in late May 1783. One must imagine that the particularly hazy state of the atmosphere that followed the *Lakagígar* eruption not only kept the island invisible from shore, but also averted seamen from conducting further field work in the area. It is therefore not unlikely that newspaper readers in Europe actually knew more about the existence of the island than Icelanders. When an expedition was made in the spring of 1784 to investigate the island, it could not be found anymore and therefore the 3 ells stone with the royal insignia never came to use. The island had probably been destroyed by wave action, but geologists

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220 See e.g. in the Low Countries, *Gazette de Leyde* (18.07.1783); for the United Kingdom, *Morning Herald* (18.07.1783); for the German lands, *Münchner Zeitung* (10.07.1783) and for the Habsburg Monarchy, *Wiener Zeitung* (12.07.1783)

221 Cited in Wikisource: (http://en.wikisource.org/wiki/Icelandic_volcanoes,1783-4:_contemporary_reports)

222 Cited in Wikisource: (http://en.wikisource.org/wiki/Icelandic_volcanoes,1783-4:_contemporary_reports) See also Demarée G.R. and Ogilvie A.E.J: "*Bons Baisers d'Islande*", p. 230

223 Rightly spelled Hekla, it is the most active volcano on Iceland. The notion of Hekla being "the second volcano in the world" is probably drawn from a mythological interpretation. Located in south Iceland, Hekla has long been known among the learned community in Europe. During the Middle-Ages, when volcanoes were considered gateways to the underworld, Hekla was often portrayed as the entrance to hell. This was first claimed on print in the 12th century by a French cleric called Herbert of Clairvoux (?-1198) in his *Liber Miraculorum* (Book of Wonders). The view was repeated as late as 1675 in a travel book by another Frenchman, Pierre Martin de la Martiniére (1634-1690). For further information see Sigurdsson, Haraldur: *Melting the Earth*

224 *Gentleman's Magazine* (53:2) 1783, p. 661. A connection between an eruption on the mountain Hekla and New Island is also made on the front page of *Münchner Zeitung* (15.07.1783)

today believe that remnants of it can be found 62 kilometers southwest of Iceland, at a location called *Eldeyjarboði*.[225]

Earthquakes, extreme summer weather and a new volcanic island off the coast of Iceland – the natural occurrences of 1783 were environmental phenomenon as much as they were news phenomena. In the interim, the persistent and widespread sulfuric aerosol cloud from the *Lakagígar* eruption covered the atmosphere like a superstructure. The natural world had been struck by something enormous but as yet ungrasped. While the *enlightened* pondered harmony and reasoned that the atmospheric and earthly events were somehow connected; the *superstitious* feared the convulsion of nature in disorder. And then, as a testament of the latters' religious fear, the skies suddenly lightened.

On August 18th 1783, the Archdeacon of York William Cooper (1759-1786) "set out upon a journey to the sea-side." By the standard of the summer of 1783 it was not an unusual day. In Cooper's words, "the weather was sultry, the atmosphere hazy, and not a breath of air stirring." After suppertime, it had become so dark that Cooper "could hardly discern the hedges, road, or even the horses heads." But as the journey continued, he noted "that there was something singularly striking in the appearance of the night, not merely from its stillness and darkness, but from the sulphurous vapours which seemed to surround us on every side. In the midst of this gloom" Cooper continued:[226]

> …a brilliant tremulous light appeared to the N.W. by N. At the first it seemed stationary; but in a small space of time it burst from its position, and took its course to the S.E. by E. It passed directly over our heads with a buzzing noise, seemingly at the height of sixty yards. Its tail, as far as the eye could form any judgement, was about eight or ten yards in length. At last, this wonderful meteor divided into several glowing parts or balls of fire, the chief part still remaining in its full splendor. Soon after this I heard two great explosions, each equal to the report of a large canon carrying a nine-pound ball. During its awful progress, the whole of the atmosphere, as far as I could discern, was perfectly illuminated with the most beautifully vivid light I ever remember to have seen. The horses on which we rode shrunk with fear; and some people we met upon the road declared their consternation in the most expressive terms.

The buzzing meteor that William Cooper witnessed in the evening of August 18th is considered to be "one of the brightest and most dramatic ever recorded."[227] Although meteors were a familiar celestial phenomenon before the electro-light pollution of today banished them from sight, this one was impressive by its low altitude, which by all accounts offered a

[225] Thorarinsson, Sigurður: "Neðansjávargos við Ísland", p. 58-64
[226] Cooper, William: "Observations on a remarkable Meteor", p. 116-117
[227] Payne, Richard J: "Meteors and perceptions of environmental change", p. 21

shining spectacle in the hazy summer sky of 1783. The meteor was first detected over the Shetland Islands, from where it travelled in a south-southeast direction passing over Scotland and northern England. As it continued its journey over the Archdeacon of York's carriage in eastern England the meteor began to break-up, and it is believed to have exploded somewhere over France. Sightings were also reported in northern continental Europe from Dunkirk, Calais, Ostend, Brussels and Leiden.[228]

Inevitably, the discussion around meteor sighting bore all the attributes that we have reflected on in this chapter. "It [the meteor] was result of the extraordinary state of the sky, with which the atmosphere has been fogged since approximately the middle of June", wrote a correspondent from Ostend in the *Gazette van Antwerpen* in late August.[229] Other observers looked to recently reported events and suggested that the 18th of August meteor may have "been occasioned by some of the vapours issuing from the volcanoes upon the New Island lately sprung up in the ocean, about nine leagues to the S.W. of Iceland" as the *London Chronicle* reported on August 26th. There was also room for meteorological argument – *á la* Joseph-Jérôme Lefrançais de Lalande – as this piece from *The Gazetteer and New Daily Advertiser* demonstrates: "The meteor which has occasioned such a variety of conjectures since its appearance on Monday, a philosophical correspondent assures us, has nothing portentous. Such exhalations are very common in the southern hemisphere, when excessive heats succeed a wet season" the report noted, and concluded that "[t]he uncommon degree of rain that fell last year, the want of frost in the winter months, and so hot and dry a summer now so closely succeeding, has been the natural cause of those phenomena this country has exhibited."[230]

The low-flying meteor that exploded in the European sky on August 18th presented the final piece in the strange summer scenario of 1783. Returning to the desk of Horace Walpole, which we left in Section 2.3., the 4th Earl of Orford had by this time added a few more things to the list of strange summer happenings in one of his letters: "we have had pigmy earthquakes, much havoc by lightning, and some very respectable meteors…"[231] Meanwhile, the events of the summer were a cause of inspiration in the writings of William Cowper. In the outline argument for "The Time Piece", which formed the second part of his six-piece

[228] For a further discussion and overview of primary sources, see Payne, Richard J: "Meteors and perceptions of environmental change", 19-28. See also *Philosophical Transactions* (74:1) 1784, p. 108-118; and *Gentleman's Magazine* (53:2) 1783, p. 711-714

[229] Cited in Demarée G.R. and Ogilvie A.E.J: "*Bons Baisers d'Islande*", p. 229

[230] Cited in Payne, Richard J: "Meteors and perceptions of environmental change", p. 23

[231] *The Yale Edition of Horace Walpole's Correspondence*, (vol. 25), p. 427

epic poem *The Task* (1785), Cowper wrote: "Peace among the nations recommended, on the ground of their common fellowship in sorrow – Prodigies enumerated – Sicilian earthquakes – Man rendered obnoxious to these calamities by sin – The philosophy that stops at secondary causes reproved…" Based on this description and the enclosed verse, it seems as though the English poet had taken to the view of those who feared that the events of 1783 prognosticated the beginning of the end:[232]

> When were the winds
> Let slip with such a warrant to destroy?
> When did the waves so haughtily o'erleap?
> Their ancient barriers, deluging the dry?
> Fires from beneath, and meteors from above,
> Portentous, unexampled, unexplained,
> Have kindled the beacons in the skies, and th' old
> And crazy earth has had her shaking fits
> More frequent, and foregone her usual rest.
> Is it a time to wrangle, when the props
> And pillars of our planet seem to fail,
> And nature with a dim and sickly eye
> To wait the close of all?

2.7. An amazing and portentous summer

By the time the glowing meteor darted through the sky in northwest Europe, things had begun to settle. The earthquakes in south Italy had come to an end, severe thunderstorms were less frequent, and the unusual summer haze was appearing to ease. How long did the dry fog persist? As we highlighted in Section 2.2., the first intense manifestation of the *Lakagígar* fumes were felt in Europe around mid-June 1783. The haze was seen and felt continuously until late July, when it disappeared briefly, only to return with varying intensity in August and September.[233] The period between the early balloon experiments of the Montgolfier brothers and the signing of the *Treaty of Paris* on September 3rd 1783, therefore presents a decent demarcation. From Europe the fog continued its journey into North Africa and the Middle East, as well as into parts of Eurasia. However, the longer the fog travelled the less effective it was. For instance, contemporary observations note that the fog lasted only 17 days in the Altai Mountains.[234]

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232 *The Poems of William Cowper*, (vol. 3), p. 137-140

233 See Demarée, G.R., and Ogilvie, A.E.J: "*Bons Baisers d'Islande*", p. 239-240; Stothers, Richard B: "The Great Dry Fog of 1783", p. 79-89

234 Stothers, Richard B: "The Great Dry Fog of 1783", p. 81-82

Dry fog had happened before, and it was certainly a familiar byproduct of intensive fuel burning in larger cities at that time – as some of the references in past sections indicate. However, the longevity and the scope of the fog made it unique. One must assume that ignorance of the origin of the aerosol pollution influenced the contemporary understanding of the event. In this context, two points are worth revisiting and underlining. The former is obvious: i.e., Iceland was remote from regular commercial traffic lanes and news of the *Lakagígar* eruption was therefore not at hand. From a historical perspective, the latter point is revealing: i.e., the 18th century "mentality" had not reached the point of understanding to draw well-defined boundaries between natural phenomena. As we highlighted in section 2.4., this is demonstrated by the frequent usage of superlatives in public discussion. This aspect can also be read in the work of Grattan and Brayshay who analyzed British newspaper reports of the event – singling out the adjectives used to describe the unusual weather from more than 160 newspaper reports that were published between June 10th and September 3rd, 1783. Out of a total count of 183 adjectives, the words "violent", "tremendous", "dreadful", "remarkable", "alarming", and "awful" make up to 75%.[235] What one could read from these results is that the spirit of the time lacked an accepted vocabulary to describe the events of the summer. Or as university people would say, there was no authoritative means of talking about the unusual state of the atmosphere in the summer of 1783.

In contributing to a historiography of the *Lakagígar* eruption, scholars from the earth sciences have placed a significant emphasis on identifying who was the first "to tie the dry fog in Europe to volcanic activity in Iceland", as it is frequently phrased.[236] Here, a little-known French naturalist, M. Mourgue de Montredon (who we referred to in Section 2.4.) is credited for being the first, when he linked the dry fog to the emergence of New Island. His ideas were published in 1784, but apparently read at a meeting of the Société Royale des Sciences in Montpellier on August 7th 1783.[237] Another contender is the professor of physics at the University of Copenhagen, Christian Gottlieb Kratzenstein (1723-1795). His views are drawn from the 1784 account of Sæmundur Holm Magnússon who wrote: "The learned Professor Kratzenstein said that these phenomena [the fog] must proceed from a fiery eruption in

[235] Grattan, John and Brayshay, Mark: "An Amazing and Portentous Summer", p. 125-134
[236] See e.g., Grattan, John et al: "Volcanic air pollution and mortality in France", p. 644; Scarth, Alwyn: *Vulcan's Fury*, p. 116; and Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects", p. 2
[237] Cited in Steinþórsson, Sigurður: "Annus Mirabilis", p. 148; see also Mourgue de Montredon, M: "Recherches Sur l'origine & sur la nature des Vapeurs qui ont régné dans l'Atmosphére pendant l´été de 1783", p. 754-773. (Note from author: I was unable to get my hands on the original text.)

Iceland; which was most remarkable as Iceland lies at the distance of almost 300 miles from Copenhagen…"[238] Benjamin Franklin has also been credited for being the first to establish the link to Iceland. In May 1784, he speculated whether the fog had drawn its attributes from the "vast quantity of smoke, long continuing to issue during the summer from Hecla, in Iceland, and that other volcano which arose out of the sea near that island, which smoke might be spread by various winds over the northern part of the world…" [239]

Since the information was not at hand, none of them had obviously thought of the *Lakagígar* eruption. But are these speculations in any sense a testimony of ingeniousness on their behalf? Off the top of one's head it is difficult to interpret it that way. As we have demonstrated in this chapter, a variety of natural or meteorological occurrences became dry fog suspects, which in turn contributed to very heterogeneous assumptions on the origin of the fog. This aspect is easily detectable in European newspapers from the period.[240] For most observers, an obvious explanation was to connect it to the earthquakes of Calabria and Messina. Although a child of its time, the substantiality of the hypothesis had an intellectual connotation that was not uncommon in the 18th century. The same cannot be said about the endeavor "to tie the dry fog in Europe to volcanic activity in Iceland". The notion was incidental and not dissimilar to other "ingenious" theories that cropped up during the summer of 1783. Perhaps this is best demonstrated in the speculations of Benjamin Franklin, who actually proposed a second hypothesis for the haze in his essay "Meteorological Imaginations and Conjectures", which is often over-looked. That is, whether the fog was "merely a smoke proceeding from the consumption by fire of some of those burning balls or globes which we happen to meet with in our rapid course round the sun, and which are sometimes seen to kindle and be destroyed in passing our atmosphere", and therefore adding a meteor as a possible agent to the suspect list of explanation for the baffling haze.[241] The fact that Franklin also mentions an eruption of the Hekla volcano is informative but not an unusual misunderstanding as we saw in last section.

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238 Holm, S.M: "Account of a Remarkable Fiery Eruption", p. 119 (Note from author: Although frequently quoted, it should be noted that this is not a good source about Kratzenstein's views. Since the professor did not write anything on the matter, it calls forth following questions: Where did Holm learn about his ideas – in a private conversation; or through hearsay? Until anything else is revealed, one must assume that professor Kratzenstein had the New Island eruption in mind when referring to a "fiery eruption in Iceland".
239 Franklin, Benjamin: "Meteorological Imaginations and Conjectures", p. 288-289
240 For a contemporary overview see e.g. *Münchner gelehrte Zeitung* (8) 1783, p. 60-63
241 Franklin, Benjamin: "Meteorological Imaginations and Conjectures", p. 288-289

With this in mind, one could sum up the contemporary perception of the *Lakagígar* haze with the following statement: If the fog caused fright amongst the ***superstitious*** masses; then it was certainly a source of bafflement for the ***enlightened***. Nowhere is this better described than in the writings of the curate of Selborne, Gilbert White, whose reflections on the summer of 1783 have given its name to this chapter. In his classic work *The Natural History of Selborne*, a book that has never gone out of print since its first appearance in 1789, White wrote: "The summer of the year 1783 was an amazing and portentous one..." As we have demonstrated in this chapter, the aerosol cloud from the *Lakagígar* eruption clearly played the main role in the summer scenario. In this regard, Gilbert White remembered a season "full of horrible phenomena; for besides the alarming meteors and tremendous thunderstorms that affrighted and distressed the different counties of this kingdom, the peculiar haze, or smoky fog, that prevailed for many weeks in this island, and in every part of Europe, and even beyond its limits, was a most extraordinary appearance, unlike anything within the memory of man." White noted in his journal that the fog had persisted "from June 23rd to July 20th inclusive during which period the wind varied to every quarter without any alteration in the air." He concludes his description of the summer, with its sense of insidious, creeping disaster that can send shivers down the spines:[242]

> The sun, at noon, looked as blank as a clouded moon, and shed rust-coloured ferruginous light on the ground, and floors of rooms; but was particularly lurid and blood-colored at rising and setting. All the time the heat was so intense that butchers' meat could hardly be eaten on the day after it was killed; and the flies swarmed so in the lanes and hedges that they rendered the horses half frantic, and riding irksome. The country people began to look with a superstitious awe at the red, lowering aspect of the sun; and indeed there was reason for the most enlightened person to be apprehensive; for, all the while, Calabria and part of the Isle of Sicily were torn and convulsed with earthquakes; and about that juncture a volcano sprang out of the sea on the coast of Norway.[243]

The news of the *Lakagígar* eruption finally reached Copenhagen in late August or early September 1783. On the 5th of September the following report, which is based on a letter that merchant J. C. Sünckenberg (1757-1806) wrote to the board of directors of the Danish Monopoly Company, appeared in the *Kiøbenhavns Adresse Contoirs Efterretninger*:[244]

> A letter from Iceland, dated 24 July, reports the following: On the first Whitsunday, a fire broke out of the Skaftá-mountain in the county of Skaftafellssýsla which emptied the whole of River Skaftá and turned it into a pile of rocks. 2 churches and 8 large farmhouses have been

[242] White, Gilbert: *The Natural History of Selborne*, p. 232
[243] White is probably referring to the New Island eruption.
[244] "Heimildir til sögu Skaftárelda", *Skaftáreldar 1783-1784*, p. 269 (My translation)

> destroyed. The burning material spreads across the land like water that melts and destroys anything within its reach. The size of the fire-water is seven miles at width and fifteen miles at length. The air is loaded with haze, smoke, ash and sand to such an extent that it is like the whole country is covered by fog. Huge boulders have formed where flatland was before. The land that recently emerged [New Island] also continues to burn.

The report immediately circulated from Denmark and was printed more or less unaltered in the European press. Based on the documentary-work conducted for this research, the account was published on September 18th in Munich; September 20th in Vienna; September 23rd in London; September 24th in Pressburg [Bratislava]; and in the Swedish city Lund on the 1st of October.[245] Despite the report clearly stating that the atmosphere in Iceland had been "covered by fog", there was no effort made to draw a link between the events in Iceland and the scenario of the summer. At this point, of course, the volcanic haze from the *Lakagígar* eruption had finished flowering. And here is where our documentation of the human response to the unusual events of the summer of 1783 comes to an end.

It is difficult to assess when Europe received proper information regarding the consequences of the *Lakagígar* eruption. Although the researcher has not made an effort to look specifically into this, the flow of information obviously depended on how well Copenhagen was informed. After learning of the eruption, the Danish government issued a royal decree that allowed for a ship to be sent to Iceland with two representatives who, amongst other things, had the task of investigating the consequences of the fires, as well as the emergence of the new volcanic island. The ship left for Iceland on October 11th 1783. However, due to difficult weather conditions it did not make the journey and was forced to take shelter in Norway over the winter months. As a consequence, the investigators did not arrive in Iceland until April 1784. Up to this point, the Danish authorities had relied on inaccurate and insufficient information about the situation in Iceland and believed that the consequences of the eruption were mainly restricted to the shire of Vestur-Skaftafellssýsla. However, in the summer and autumn of 1784 the Danish authorities finally received reasonably accurate reports on the catastrophic situation in Iceland – i.e. about the terrible destruction of land, livestock and human lives suffered on the island during the winter of 1783-1784. It became clear that further losses would undoubtedly be suffered during the winter of 1784-1785. At this point it has even been claimed that the administration in

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245 *Münchner Zeitung* (18.09.1783); *Wiener Zeitung* (20.09.1783); *London Gazette* (23.09.1783); *Pressburger Zeitung* (24.09.1783); and *Nytt och Gammalt* (01.10.1783)

Copenhagen contemplated deporting all Icelanders to Denmark, since no possibilities were seen of restoring livelihood in the country. Although such measures were probably discussed by some officials, the issue was never seriously raised in the governmental departments in Copenhagen. It was, however, suggested that 500-800 people, paupers, old people and children could be deported, but the proposal was rejected by a special commission founded in 1785.[246]

It would be interesting to research how the *Lakagígar* catastrophe was presented in the European press in the years following the eruption. But that is a subject for another research. We shall, however, dwell on the amazing and portentous summer of 1783 in the coming chapter and look at the environmental implications of the dry fog in Europe.

[246] Gunnlaugsson, Gísli Ágúst: "Viðbrögð Stjórnvalda", p.185-214

Chapter III

The Dual Impact of the *Lakagígar* Haze

The eventful summer of 1783 in Europe and elsewhere was characterized by the appearance of the volcanic fog – emitted by the *Lakagígar* eruption in Iceland. Evidently, the phenomenon had a distinct psychological influence on the continent. While common people seem to have feared the dry fog, the natural philosophers of the day produced ingenious theories to soothe the commoners' fright and rationally explain the unusual state of the atmosphere. However, the boundary of scientific knowledge in late-18th century Europe and lack of news from Iceland contributed to a perplexed identification of the event. In that sense, the dry fog of 1783 challenged people's world-views.

In this chapter, we will try to cast a light on these sentiments by viewing the environmental influence of the dry fog in Europe. In other words, we move away from the psychological influence and turn our attention to the physical impact of the fog. The questions in this context would be: Was the volcanic haze detrimental for human health and vegetation in Europe; can it be compared to the Icelandic experience that we discussed in Chapter I; or did it render a different scenario altogether? We approach these questions from two angles. On the one hand, we shall recount some of the ideas that have been presented in recent studies on the impact of the dry fog of 1783; while on the other hand, we will reflect on how they match with the reality that is presented in the documentary record from the period. The comparison should help us towards a conclusion.

As we saw in the previous chapter, the persistent appearance of the dry fog in the atmosphere during the summer of 1783 made it profoundly distinguishable from other features in the natural environment. This is relayed through contemporary sources across Europe in a manner which makes it a relatively easy for the researcher to describe the phenomenon in a harmonious way. But if the documentary record presents a clear picture on how the fog appeared visually, analyzing its influence is a more difficult task. In this regard, the sources from the period that discuss the impact of the volcanic haze are not as affluent, and the information they communicate somewhat inharmonious. We shall therefore begin our discussion by briefly looking at the attributes of the fog. Getting to know the phenomenon a bit better should help us to approach the subject of this chapter – the environmental influence of the dry fog in the summer of 1783.

3.1. Fog attributes

As in Iceland, people in Europe and elsewhere experienced what might be called a tropospheric pollution – i.e. the movement and manifestation of the dry fog was mostly bound to the mechanisms at work in our part of the atmosphere.[247] Although the volcanic pollution remained visible in Iceland for more than a year, most of the last descriptions of the fog in Europe date from September 1783, as we noted in the previous chapter. By that time, the fog had more or less blotted out of the atmosphere.[248] One must assume that as the intensity of the *Lakagígar* eruption diminished the impetus of the volcanic plumes fell, before wind and rain ultimately washed it away. The distance it travelled was probably an important factor, as well. The further it went, the thinner it got. As a consequence, the influence of the eruption was probably stronger felt in regions geographically close to Iceland in terms of the area that the fog covered.

What do earth scientists tell us about the dry fog? As we mentioned in the previous chapter the sulfur emissions from the *Lakagígar* eruption were the most important for the scenario that took place outside Iceland. According to recent estimates, the *Lakagígar* eruption pumped 122 megatons of sulfur dioxide into the atmosphere. In theory, the gas reacted with atmospheric vapor to produce 200 megatons of sulfuric acid aerosols "that were dispersed eastwards over the Eurasian continent and north into the Arctic" and "removed in the summer and autumn of 1783." The dispersal and removal of the acids from the atmosphere constituted the infamous fog of the summer of 1783.[249]

Evidently, the atmospheric conditions created by the aerosol acids presented a sharp increase in air pollution. To put this in context, a team of atmospheric scientists recently worked out that the estimated gaseous phase of the 1783 eruption was equivalent to the global anthropogenic sulfur dioxide emissions during the year 2005.[250] Based on our review in the first chapter, one would assume that such a concentration of sulfur dioxide would have significant influence on the environment. In this concern, we already know about the Icelandic experience where the volcanic pollution not only had health implications but also

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[247] Grattan, John et al: "'The end is nigh'?", p. 88-89
[248] Demarée G.R. and Ogilvie A.E.J: "*Bons Baisers d'Islande*", p. 230
[249] See e.g. Stothers, Richard B: "The Great Dry Fog of 1783", p. 80-89; Thordarson, Thor and Hoskuldsson, Armann: *Iceland*, p. 114
[250] Schmidt, Anja et al: "Excess mortality in Europe", p. 15710-15711

caused an environmental stress which we have causally linked to the Haze Famine of 1783-1785.

How does the influence of the *Lakagígar* eruption compare to areas outside Iceland? Here, the initial six week phase of the eruption seems to have been the most intense and fateful period in the scenario that we intend to describe in this chapter. The assumption is drawn from the meteorological research of John Kington whose synoptic weather maps for each day throughout 1783 suggest that from late June through most of July the weather coincided with a presence of a low-pressure cell in the vicinity of Iceland and a high-pressure cell over north-east Europe.[251] As high-pressure systems tend to result in more stable weather patterns these conditions are believed to have acted to funnel the aerosol acids down to ground level on the continent, leading to a period of prolonged gas incursion. Kington's findings match with the observation of Gilbert White (cited in Section 2.7.) who wrote in his journal that he had "noticed this strange occurrence [the fog] from June 23 to July 20 inclusive, during which period the wind varied to every quarter without making any alteration in the air." At its peak, the atmospheric circulation is thought to have delivered up to six megatons of sulfuric acid aerosols to the boundary layer of the atmosphere over Europe each day.[252]

Based on this, some scholars from the earth sciences,[253] who have written about the social and environmental impacts of the *Lakagígar* eruption, have argued that "people thousands of miles away [from Iceland] could see, taste, and smell" the poisonous fog whose attributes not only "cause[d] considerable damage to vegetation and crops all over Europe" but also had "serious consequences for human health" through which "people died in numbers". To top things off, the sulfuric acid aerosols from the *Lakagígar* eruption are also said to have triggered "climatic anomalies that affected millions of people […] in Europe, Africa, the Middle East, India, Japan, Central America, and North America."[254] In recent years, the core in these statements has merged into a narrative that has been presented in popular magazines, television documentaries and popular literature – contributing to a historiography of the event

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[251] Kington, John: *The weather of the 1780's over Europe*, p. 86-89
[252] Stothers, Richard B: "The Great Dry Fog of 1783", p. 80-89
[253] When referring to "some scholars from the earth sciences" the author has the work of John Grattan and co-authors, as well as Thorvaldur Thordarson and co-authors, in mind. For a list of their writings see bibliography.
[254] Thordarson, Thor and Hoskuldsson, Armann: *Iceland*, p. 114; and Grattan, John et al: "The Long Shadow", p. 154-157

which appears to be widespread.[255] Although it is not a specific motive of this research to chase after or refute these notions, we shall in the coming sections keep them in mind as we continue to add material to this research by analyzing the environmental influence of the *Lakagígar* eruption outside Iceland. We begin our discussion by reviewing perhaps the most thorough contemporary source on the matter.

3.2. The observations of Jan Hendrik van Swinden

In the secondary literature that deals with the social and environmental impact of the *Lakagígar* eruption outside Iceland references are frequently drawn from the observations that the meteorologist and natural philosopher Jan Hendrik van Swinden made on the dry fog.[256] A professor at the University of Franeker in the province Friesland in the Netherlands, van Swinden's essay is perhaps the most in-depth contemporary account on the subject – touching not only on the attributes of the fog but also correlating them with the effects that it had on people and the environment. It therefore makes sense to briefly review what the Dutch professor had to say about the unusual fog of the summer of 1783.

According to professor van Swinden, the fog first appeared in Franeker on June 19th, where it immediately discerned itself from normal clouds "by its constancy, density, and especially by very great dryness." Neither a lightning storm nor strong wind in the following days was able to clear it from the atmosphere. Van Swinden noted other familiar attributes of the phenomenon. Typically, the sun appeared "deep-red" and people were "able to gaze at [it] with our naked eye without injury"; while features in the natural environment "scattered further were scarcely and only unintelligently perceived." Matching with Gilbert White's observation, the intensity of the fog was strongest as of June 23rd, according to van Swinden. However, on the following day something interesting happened. The volcanic fog appears to

255 For overview articles on the effects of the *Lakagígar* eruption in popular magazines see e.g.: *New Scientist* (21.05.2005) and *The Economist* (19.12.2007). With regard to television documentaries see e.g. *Killer Cloud* (a BBC documentary from 2007) and *Doomsday Volcanoes* (a PBS documentary from 2013). With regard to popular literature see e.g. Hamblyn, Richard: *Terra. Tales of the Earth*, p. 63-121 and Scarth, Alwyn: *Vulcan's fury*: *man against the volcano*, p. 105-121.

256 Jan Hendrik van Swinden's account was originally published in Mannheim in 1785 by the *Societas Meteorologica Palatina*. An English translation from Latin, titled "Observations on the cloud (dry fog) which appeared in June 1783" was printed in *Jökull*, *the Icelandic Journal of Earth Sciences*, in 2001. The translation wrongly authors the article under S. P. van Swinden. The acronym S. P. certainly refers to the given name Simeon Pieter, who was a lawyer by profession in The Hague and Jan Hendrik van Swinden's younger brother. This misunderstanding often appears in secondary literature that makes use of the translated article. A decent information about the van Swinden brothers is presented in Zuidervaart, Huib J: "An Eighteenth-Century Medical-Meteorological Society in the Netherlands", p. 379-410

have penetrated ground level for "it brought with it as a companion a sulfurous odor very readily perceived by the senses, crawling through everything, even closed houses." Under these conditions, "men with delicate lungs … were unable to contain a cough, as soon as exposed to air", van Swinden noted, while adding that "I myself experienced this, and many others, first in the city, then in the country."[257]

Elaborating on the effects that the dry fog had on people, van Swinden added comparison to his essay by quoting a person he calls Dr. Brugmannusnus – presenting him as "a most acute botanist" who dealt with the fog "accurately and fully in a book published in Belgium."[258] A fellow academic from the neighboring city of Groningen of the eponymous province, whose actual name was Sebald Justinus Brugmans (1763-1819), his quoted material also states that the density of the haze had escalated on June 24th to the point that it "brought with it a very distinct sulfurous odor." Echoing van Swinden's experience, Brugmans wrote that the smell "pervaded even into homes and bedchambers" where it "not only affected [people's] sense of smell, but even taste." As a consequence, Brugmans noted that "many experienced very troublesome headaches and respiratory difficulties" and concluded that asthmatics in particular had suffered.[259]

The sulfuric acid precipitation that was felt on June 24th in Friesland and Groningen not only had health implications but also left a clear mark on the vegetation. In this case, van Swinden noticed that on the morning of June 25th, the sulfurous haze "had brought very great loss to the vegetable realm" enumerating that "the leaves of many trees were discovered drooping; grass and leguminous plants were drooping" and that "the green colour of the trees and plants had disappeared". Van Swinden's observation finds parity in Brugmans quoted material, who added that even brass pillars on outer doors of houses had been "tinged with a whitish color." Brugmans description on the environmental effects of the sulfuric acid, however, is more precise and worth highlighting in order to get a better idea of the scope of the matter:[260]

> In the morning of the 25th day [of June] the fields showed a very sad appearance. The green color of the trees and plants had disappeared and the earth was covered with drooping leaves.

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257 Van Swinden, [Jan Hendrik]: "Observations on the cloud (dry fog) which appeared in June 1783", p. 73

258 See Brugmans, Sebald Justinus: *Nauurkundige verhandeling over een zwavelagtigen nevel den 24 Juni 1783 in de provincie van stad en lande en naburigen landen waargenomen*, Nijmegen, 1784. (Note from author: Brugmans original work was not consulted for this research, only the quoted material from Jan Hendrik van Swinden's essay)

259 Van Swinden, [Jan Hendrik]: "Observations on the cloud (dry fog) which appeared in June 1783", p. 74-75

260 Van Swinden, [Jan Hendrik]: "Observations on the cloud (dry fog) which appeared in June 1783", p. 75-76

> One would easily have believed that it was October or November. But happily it befell that not all plants were equally affected … Certain ones were covered with spots, which increased gradually and soon caused drooping of leaves. Some leaves were not entirely spoilt; they continued to quicken, but the places, in which they had been affected, were soon made into little holes. Others faster than a minute turned from green to brown, black, gray, or white. Others kept their color, but began to droop, so, that they were reduced to powder at the touch of one's fingers. A very great abundance of leaves fell. Certain calyxes were injured, but in truth no flowers or fruit, but because the leaves fell, that also caused the fruit to fall, from failure of nutriment. Moreover the injury, and falling of leaves, lasted for some time.

In getting to the bottom of the sulfuric haze, Brugmans conducted several experiments in the summer of 1783. He reproduced the observed effects which the haze had on vegetation by exposing plants to a mixture of sulfur and watery vapor. Based on these experiments professor van Swinden concluded that the haze united some acid gas, which he referred to as "aer-acidus-vitrolicus" – bearing all the attributes of sulfuric acid.

Two points are worth underlining from the observations presented in van Swinden's essay, with regard to what we have hitherto discussed in this research. Firstly, the description of the impact that was experienced on vegetation and human health in the Netherlands resembles an environmental damage caused by air pollution, as we reflected on in Chapter I.[261] Secondly, a connection between these effects can be made with the volcanic pollution from the *Lakagígar* eruption, which clearly reached beyond Iceland and was felt on the European continent. In this respect, the environmental implication of the dry fog presents a familiar pattern: i.e. an intense sulfuric odor that crept into people's dwellings; health implications such as respiratory difficulties and headaches; stained metal objects; and harmful effects on vegetation. All of these aspects were at hand in Iceland, as we highlighted earlier in this research.

In the light of Jan Hendrik van Swinden's essay, the question that inevitably follows is whether his observations were in any sense representative – i.e. was a pattern of similar experiences felt in other European countries during the summer of 1783? In sequel, one might ask to what extent the impact of the volcanic pollution from the *Lakagígar* eruption was felt on the continent – did it have prolonged environmental and health implications? We shall reflect on these questions in the coming sections. And we begin by looking at the influence it had on the vegetation.

[261] This aspect in also reflected in Grattan, John and Charman, Daniel J: "Non-climatic factors and the environmental impact of volcanic volatiles", p. 101-106; and Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects", p. 14

3.3. Sulfur and honey

The observations presented in Jan Hendrik van Swinden's essay give certain leads that we can follow, when examining the environmental influence of the *Lakagígar* haze. Returning to a familiar source, the journals of Gilbert White provide a decent starting-point. Recorded at his residence in the south of England, the curate of Selborne wrote with some optimism on June 21st 1783 that "[t]he late ten dripping days have done infinite service to the grass, & spring-corn." During the rainy-days, White reflected on the delightful state of his flower plants and the potato-shoots, which showed signs of promise. However, as in the Netherlands, something unusual happened on June 23rd as this journal entry bears witness: "Vast honey-dew; hot & hazey; misty. The blades of wheat in several fields are turned yellow, & look as if scorched with the frost. Wheat cones into ear. Red even: thro' the haze."[262]

Elsewhere in England, similar effects were noticed. On the same day (June 23rd), "a very sudden and extraordinary alteration in the appearance of the grass and corn growing in this neighborhood" was noticed in Cambridge where the grazing land looked as if "it had [been] dried up by the sun, and was to walk on like hay." Elsewhere, the local *Ipswich Journal* reported that on June 25th it had first been observed that "all the different species of grain, viz, wheat, barley, and oats" had turned "very yellow, and in general to have had all their leaves but their upper ones in particular, withered, within two or three inches at their ends." The sudden alteration of the fields, the report added, coincided with "an uncommon gloom in the air, with a dead calm" which made the sun "scarce visible even at mid-day, and then entirely shorn of its beams so as to be viewed by the naked eye without pain."[263]

Across the North Sea, on mainland Europe, the agro-meteorologist Baron de Poederlé (1742-1813) noted at his estate in Saintes in the province Hainaut in today's Belgium that June 24th had been warmer than the preceding days and accompanied with a "penetrating, unhealthy stinking fog". According to his account, the fog had the colour of "a light smoke" that "lasted the whole day with a smell of sulphur" which the "country folks" likened to burnt powder. Shortly after its appearance the Baron noticed "that several plants, and the leaves of several trees and shrubs were burnt and had become completely red."[264] Meanwhile in the coastal region Pas-de-Calais in northern France, an undated entry in the journals of the Abbot of Bazinghen says that the "fog made the corn rusty in some parts of the province which

262 *Journals of Gilbert White*, (ed. Walter Johnson), p. 207
263 Cited in Grattan, John and Brayshay, Mark: "An Amazing and Portentous Summer", p. 129
264 Cited in Demarée G. R. and Ogilvie A. E. J: "*Bons Baisers d'Islandé*", p. 233-234

made the bishop call for three days of prayers."[265] Elsewhere in France, the secretary of the Academy of Sciences, Arts, and Letter in Dijon, Hugues Maret (1726-1786), noted in his meteorological observations for June 1783 that the fog had been "odorless, very dry and persistent" and that "by some unknown process the haze gradually descends and by doing so it stunts the fertility of the trees by sapping their moisture, which causes them to wither."[266]

Further north, a stone's throw away from the area where professor van Swinden and Sebald Justinus Brugmans derived their observations on the sulfurous haze, a report from the German seaport Emden in east Friesland, printed in the *Gazette de France*, reflected on the "dry and thick fog which has reigned for a long time [and] seems to have spread over the whole surface of Europe". Recorded on July 12th 1783, the report began by describing the peculiar optical impression which the fog gave during the daytime, while noting that in the evening it had at times been perceived to emit a "vile smell". In some places, the article continued, "it drie[d] out the leaves" while adding that the unusual event had occurred where "all trees on the banks of the Ems [had] been denuded of their leaves in one single night."[267] This astonishing occurrence was referred to in a feature article published in the August edition of the *Münchner gelehrte Zeitung*, titled "Über die neuliche Nebelwitterung, oder den sogennanten Hehr- oder Höherauch". Drawn from a report from the city of Münster, the article remarked that similar developments had been noticed "an allen Gestaden der Ems" where people complained about having all the seasonal appearances of autumn without having enjoyed the summer. As a consequence: "Man besorgte sogar eine Pestseuche, und grosse Teuerung." Elsewhere in the German Holy Roman Empire, the same journal reported that:[268]

> Auch aus der Wetterau, besonders aus den Gebirgen, welche die dasige Gegend, und das Sauerland von Hessen scheiden, hat man ähnliche Nachrichten. Das Laub ward Gelb, wie im Herbste; das Obst unschmakhaft; das Korn schrumpfte zusammen, und fiel nicht aus der Aehre, und der Haber war ganz weg. Morgens eine ½ Stunde vor Tags Anbruch wollte man auch Schwefelgeruch in der Luft wahrgenommen haben.

The impact of the volcanic pollution were also felt and documented in the Scandinavian countries. Sæmundur Holm Magnússon, who resided in Copenhagen in the summer of 1783, wrote in his account that during the night the fields had often been "overspread with a blueish mist; which was accompanied with a certain pale fiery brightness and a sulphureous smell."

265 Cited in Demarée G. R. and Ogilvie A. E. J: "*Bons Baisers d'Islande*", p. 234
266 Cited in Thordarson, Thorvaldur: *Volatile Release and Atmospheric Effects of Basaltic Fissure Eruptions*, p. 462
267 Cited in Demarée G. R. and Ogilvie A. E. J: "*Bons Baisers d'Islande*", p. 233
268 *Münchner gelehrte Zeitung* (8) 1783, p. 59

Under these circumstances, Holm wrote that the earth had been "almost incapable of producing either herbs or grass", and that "leaves [had] even withered on the trees."[269] Similar experiences were recorded in Sweden, where the earliest information about the effects of the dry fog can be found in a readers' letter in the 11th of July edition of *Stockholms Posten*. Dated July 1st 1783, in the province of Älvsborg in the southwestern part of the country, the letter wrote: "In this week the haymaking started at some places. The rye crop round here is poor. However, although the barley in most places has exuberant spikes, the paleae are beginning to turn white and the leaves yellow, but nobody knows why, unless it could be a result of the thick "sun smoke" which has been in the area for about two weeks". Half a month later the same newspaper printed a newsletter from the province South Halland, which speculated that "probably it [the fog] is injurious to the vegetation, because broadleaf trees as well as some other foliate plants wither and drop their leaves."[270]

In the Norwegian city Bergen, the influence of the fog was remembered in a New Year's Day sermon in 1786 by the clergyman and later bishop, Johan Nordahl Brun (1745-1816). Delivered in connection with a collection of relief-fee for the Icelanders who suffered from the effects of the *Lakagígar* eruption, reverend Brun spoke of the haze which approached Norway in the wake of the event "which must have diluted much poison" for "it fell on the leaves of various [types of] vegetation which withered." In the light of this, Brun drew the sharp conclusion that it was "no wonder that the valleys and fields in Iceland were quite destroyed and became useless as pastures" which in turn led to the terrible "hunger, illness and death" in the country.[271]

The above-mentioned accounts are consistent with the observations of Jan Hendrik van Swinden. Looking at the parallels, the evidence clearly demonstrates that the strange atmospheric conditions, caused by the *Lakagígar* haze, had a marked environmental effect. Typical for the scenario are references to withering leaves and defoliation, as well as scorching and damage observed on crops and other vegetation. As we have already noted, these symptoms are in line with sulfuric acid deposition. What further links it to the Icelandic eruption is that many sources identify the effects with an odor of sulfur in the air.

[269] Holm, S.M: "Account of a Remarkable Fiery Eruption", p. 119-120
[270] Cited in Thorarinsson, Sigurdur: "Greetings from Iceland", p. 114
[271] Cited in Thorarinsson, Sigurdur: "Greetings from Iceland", p. 113-114

Also of note is the manner of how the volcanic pollution made itself felt. Regarding this, many sources – especially those who date the occurrence of the impact around June 23rd 1783 – indicate a sudden rather than slow process. As a consequence, the metaphor applied by contemporaries to describe the effects often refers to them as being unseasonable – giving the impression that autumn had arrived in full-force on a summer's night. This indicates a massive acid impact. Not surprisingly, the sudden and unusual effects caused some confusion. In England, for example, several commentators ascribed the injured vegetation around June 23rd to the occurrence of overnight-frost.[272] Alluding to this notion, however, in a manner better suited to the spirit of the summer of 1783, a correspondent wrote in the July 19th edition of the *Norwich Mercury* that he "was of the opinion that the late blast which affected the progress of the vegetation was not a FROST" but rather that the air had "received such a concussion by the late earthquakes at Messina and elsewhere, that it became impregnated with sulphurous particles and had all the qualities of lightning without being inflammable."[273]

Leaving aside the incertitude for the time being, there were further worries for farmers and gardeners in Europe. A sticky and sugary substance, better known as honeydew, seems to have been unusually prevalent during the hot and hazy summer. This aspect was underlined in the writings of pastor Johann Ludwig Christ (1739-1813), who served in Rodheim – 50 km north of Frankfurt. An amateur naturalist who during his lifetime wrote about beekeeping, and other naturalistic matters, Christ sat down on July 11th 1783 and gathered his thoughts on the unusual fog, which were published in a book later that year.[274] Seeking to clarify the subject, he found that the atmospheric haze was not unusual for the time of the year – referring to it as *Höherauch*, which might translate as aero-smoke. Despite its familiarity, Christ noted that while the phenomenon was usually known to persist in the atmosphere for few hours at a time only and seldom longer than one day, the smoke in the summer of 1783 was unprecedented in the sense that it had consistently occupied the atmosphere for four weeks.

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272 For a contemporary account on the night-frost on June 23rd 1783, see e.g. Cullum, Rev. Sir John: "An account of a remarkable frost on the 23d, 1783", p. 416-418. Other examples are presented in Grattan, John and Brayshay, Mark: "An Amazing and Portentous Summer", p. 128-129

273 Cited in Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects", p. 14. A decent argument refuting the notion of an overnight-frost during the hot and hazy summer of 1783 can be found in Grattan, J. P. and Pyatt, F. B: "Acid damage to vegetation following the Laki fissure eruption in 1783", p. 241-247

274 Christ, J. L: *Von der außerordentlichen Witterung des Jahrs 1783, in Ansehung des anhaltenden und heftigen Höherauchs; vom Thermometer und Barometer, von dem natürlichen Barometer unserer Gegend, dem Feldberg oder der Höhe, und von der Beschaffenheit und Entstehung unserer gewöhnlichen Lufterscheinungen, wie auch etwas von den Erdbeben*. Frankfurt, 1783.

A good part of Christ's work revolves around describing the attributes of the *Höherauch*, whose distinctiveness he sums up by applying the familiar term "trockener Nebel". With regard to the "Trockenheit seiner Natur", he noted that the fog was injurious to vegetation – enumerating summer fruits, oats, barley and grassland as victims of its effects by the month of July 1783. This part of his findings is in line with the conditions described elsewhere in Europe that we have referred to in this section. However, what Christ found profoundly distinct about the unusual and persistent atmospheric conditions was the influence it had on plants: "der Höherauch [hat] einen sehr merklichen und auf die allermeisten sehr schädlichen Einfluß, und verursacht in ihren Säften eine heftige Gährung. Die Aeußerung davon ist der eigentlich sogennante Honigthau, der von dem Landmann gewöhnlich Melthau, auch Mehlthau gennant wird." According to his book, the *Höherauch* of 1783 created prime fermenting-conditions for the substance, whose impression was especially striking in wooden areas, as is demonstrated in this short picking from his book:[275]

> Die Blätter der Eichbäume sind ganz von Honig wie mit Firnis überzogen: Die Lindenbäume träuflen und kleben … Alle Hecken und Gesträuche, absonderlich an der Höhe und an Bergen, sind voll Honigthau, und manche Bäume werden bereits gelb, und verlieren das Laub: an anderen sind die Blätter zusammengerollt, und voll Blattläuse ... Der Klee hat häufig Honig ausgeschwitzet.

Johann Ludwig Christ's account from July 1783 is interesting in the sense that it highlights a subject that for some reason has not received much attention in the secondary literature that deals with the environmental influence of the *Lakagígar* pollution outside Iceland. Excreted by aphids, honeydew is a familiar sign of infestation whose fermentation, in this case, can be correlated with the effects of the sulfurous haze. As the acids eliminated the waxy protective layers on the plants – which manifested itself in the yellowing of leaves and other plant lesions, frequently described in the contemporary record – the leaf tissue was left exposed to aggressive agents. This impression was reported in other places of the German Empire. To give an example, the feature article in the *Münchner gelehrte Zeitung* noted that on July 19th the lime trees on the route between Mannheim and Schwetzingen (ca. 20 km) had been "mit einer braunen, glänzend klebrichten Materie dünn überzogen gefunden, und eben so auch die Pappeln; auf letzteren sass alles schwarz voll kleiner kaum merkbarer Tierchen."[276]

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[275] Christ, J. L: *Von der außerordentlichen Witterung des Jahres 1783*, p. 2-27
[276] *Münchner gelehrte Zeitung* (8) 1783, p. 59

The honeydew blight was felt elsewhere in Europe. For instance, a report printed in the 2nd of August edition of the *Ipswich Journal*, told that the area of south London and parts of the county Kent had been covered with the "clammy, glutinous substance".[277] The problem was also mentioned in the diary-entry of Gilbert White from June 23rd. The curate of Selborne later complained how his "honeysuckles, which were one week the most sweet and lovely objects the eye could behold" had by July 11th become "the most loathsome; being enveloped in a viscous substance, and loaded with black aphides, or smother flies" that "deface[d] and destroy[ed] the beauties of my garden".[278] Meanwhile, the development seems to have been pretty severe in Sweden, where an already cited newsletter from South Halland, printed in the 29th of July edition of *Stockholms Posten*, remarked that concomitant the peculiar haze, "noxious dews occurred at midsummer time in some places and damaged the trees and the summer corn, which turned yellow." The report concluded that "[t]ogether with a heavy drought … the crop, especially the rye, has been attacked by tiny gray insects, which in some places has destroyed one third of the crop."[279]

Although it will not be determined in this research how widespread the honeydew blight was in Europe, it belongs to the category of harmful effects that the *Lakagígar* haze played a part in creating in the summer of 1783. Obviously, the impact of the dry fog was attuned to various factors, which not only concerned the effectiveness of the sulfur acids but also biological and ecological variables. That kind of knowledge lies beyond the sphere of this research. However, from a historical point of view it is important to detect and document the effects that the contemporary sources associated with the volcanic pollution. Specifically, the negative effects that we have highlighted in this section have mainly been limited to the northern and western part of Europe. But if the experience in that part of the continent ranged between sulfur and honey, what can we expect from other areas? An indicator of what confronts us in the coming section is provided in the writings of pastor Johann Ludwig Christ, who despite all the misfortune, also found that the "unusual *Höherauch* of 1783" had a beneficial side to it:[280]

> Allein, was das wunderbare hiebei ist daß die in der Blüte stehende Gewächse und Früchte, welche sonst bei Höhenrauchen am meisten leiden, vollkommen gesund sind, weingstens in

[277] Cited in Hamblyn, Richard: *Terra*, p. 85

[278] White, Gilbert: *The Natural History of Selborne*, p. 231; *Journals of Gilbert White*, (ed. Walter Johnson), p. 209

[279] Cited in Thorarinsson, Sigurdur: "Greetings from Iceland", p. 114

[280] Christ, J. L: *Von der außerordentlichen Witterung des Jahres 1783*, p. 27

> hiesiger Gegend. Die Schotenfrüchte, Erbsen, Linsen, Wicken, u. denen sonsten der Höherauch ein Gift ist, stehen vortreflich. Der Maizen, der sonsten in der Blüte unsaglichen Schaden vom Höherauch leidet, hat den diesem allgemeinen und außerordentlichen Höherauche glücklich abgeblühet, und bereits gesunde Körner; und so ist es mit andern mehr, und unter andern mit dem Weinstock.

3.4. Source of fear and plenty

Adding to a series of unusual natural occurrences, the harmful effects of the volcanic pollution that we highlighted in the previous sections belong to the scenario that we presented under the heading "amazing and portentous summer". In a world that consisted of one vast peasantry, where the lives of 80-90% of the people was dictated by what the earth yielded, as the social historian Fernand Braudel once claimed in an important book; was not a sudden environmental damage a source of fear?[281] And together with frequent and vicious thunderstorms and a blazing summer heat; could not a persistent dry fog that appeared virtually unprecedented and emitted a sulfurous odor, be seen as an infernal sign? As we demonstrated in Chapter II, the common people were clearly afraid of the dry fog and all the anomalies that coincided with it. But just as we noted a distinction in human response between them (the so-called *superstitious*) and the *enlightened*; there also appears to have been a dual mechanism at work regarding how the volcanic pollution affected the environment.

Around the time when professor Jan Hendrik van Swinden and his neighbors were trying to figure out the critical state of their gardens and struggled to "contain a cough" in the sulfur-laden air; nature was sending out different signals elsewhere on the European mainland. On June 28th 1783, the front page of the *Wiener Zeitung* reflected on pleasant news from all regions in and around the Habsburg capital, reporting that "alle Getraidefelder sehr reiche Erndte versprechen, und insbesondere die Weingärten so außerordentlich viele Trauben zeigen, daß man sich einer solchen Fruchtbarkeit seit vielen Jahren nicht erinnert".[282] Similar developments were recorded elsewhere in the Monarchy. Southeast of Vienna, newsletters from Rust at Neusiedler See, and the whole of Hungary, recapped tidings about favorable weather conditions and stated that the vineyards promised "a most abundant grape harvest".[283]

Meanwhile, a newsletter from Stuttgart in southern Germany dated June 30th and printed in the July 16th edition of the *Pressburger Zeitung* cast an amusing light on the positive

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281 Braudel, Fernand: *Civilization & Capitalism 15th-18th Century*, (vol. 1), p. 49
282 *Wiener Zeitung* (28.06.1783)
283 *Pressburger Zeitung* (23.07.1783)

development. According to the report, the unusual fog had persisted in the atmosphere for fourteen days – evoking many questions from "intelligent and sober" people, but producing few answers. As a consequence, the news correspondent made an inquiry on the matter and asked an old winegrower what he thought of the phenomenon, to which he replied:[284]

> ... woher dieser Dunst komme, das weiß ich nicht, das möget ihr Gelehrten ausmachen, aber das kan ich ihn versichern, daß die Witterung herrlich ist. Unsere Trauben blühen so schön ab, als mans nur wünschen kan ... und seh er nur auf unsere Wiesen, wir haben viel und herrlich Heu eingeführet, und das neue Gras hat wieder so angesezt, daß wir auch eine reiche Nacherndte zu hoffen haben, welches nicht geschehen wäre, wenn heisser Sonnenschein die frisch abgemächte Wiesen verdörret hätte. Und wie herrlich stehen nicht unsere Getraidefelder, Baum und Gartenfrüchte. Gott sen gedankt, der uns mit einem so guten Jahr segnet.

Other contemporary sources from Austria and Germany give a nod to the old man's account, who interestingly not only ascribed the fog to the fertility of the fields but also claimed that it protected the soil from the burning sun, which otherwise would have dried up.[285] Casting a light on the promising state of the harvest, the *Koblenzer Intelligenzblatt* reported on July 14th that nearly all regions of Germany had experienced "an unknown fertility with which fields and meadows, vineyards and gardens are blessed this year." The report added that similar messages came from Hungary and Austria where the vineyards were so loaded with grapes "that a great part of them must be cut away so that the sticks become aerated and light". In seeking an explanation for the "unusual fertility", the report concluded that possibly it "originates from an exceptional state of the sky which through its composition and modification on all kinds of vegetation and life has a very great influence."[286]

While reports from the German Holy Roman Empire and the Habsburg Monarchy reflected on the positive state of the harvest in late June and beginning of July, some confusion seems to have reigned about the attributes of the dry fog. For instance, Johann Ludwig Christ wrote that despite complaints from many field laborers about an odor of sulfur and concomitant chest pains, he was skeptical of their experience. Priding himself of having "a sensitive smell" and finding none of it, the pastor of Rodheim was sure that "diese starkarbeitende Leute ihre heftige Ausdünstung gerochen, und durch Furcht und Einbildung geleitet, sich geirrt haben."[287] Touching on the familiar issue of *superstitious* sentiments towards

[284] *Pressburger Zeitung* (16.07.1783)
[285] See e.g. the feature article on the dry fog in *Münchner gelehrte Zeitung* (8) 1783, p. 59-63
[286] Cited in Demarée G. R. and Ogilvie A. E. J: "*Bons Baisers d'Islande*", p. 235
[287] Christ, J. L: *Von der außerordentlichen Witterung des Jahres 1783*, p. 29

the unusual state of the atmosphere, a newsletter from Hermannstadt (Sibiu in today's Romania) dated July 14th, also claimed that the imagination of the frightened people in the countryside had led them to believe that the fog stank of sulfur.[288] In Switzerland, as well, the physician and natural philosopher François Verdeil dismissed the superstitious notions of the people in the mountains (die Bergleute), who claimed to have smelled sulfur in the air.[289] Other accounts from mainland Europe struck a similar chord in their reporting.[290]

Mixed experiences regarding the influence of the volcanic pollution were also prevalent in France. In this case, a newsletter from Paris, dated June 28th, informed the readers of the *Wiener Zeitung* about the unusual fog that had resided in the city's atmosphere for thirteen days. According to the report, the phenomenon neither had any specific smell or health implications, but added that some concern remained whether it could hinder the progress of the harvest.[291] Meanwhile, an account dated July 21st 1783 from the city of Saint-Quentin, in Northern France, noted that "far from being scared by the fogs that have persisted for about six weeks", the people from the countryside actually gave "thanks to the Divine Providence that these fogs while stopping some of the sun's rays have prevented the heat from increasing which would have been hard to bear."[292] Elsewhere in France, our boon companion Robert Paul de Lamanon travelled and made observations on "the nature of the fog" in the southern provinces. His writings present a good example of the dual implication of the *Lakagígar* haze. Firstly, he found that "the fog sometimes diffused a very disagreeable smell, difficult to be determined, and which some believed to be sulphureous". From Upper Dauphiné and the northeastern Italian province of Turin he learned that the fog had "blighted several fields of wheat, and rendered copper buttons green" while adding that in "other places it dried the plants." Secondly, however, he also discovered that in Lower Provence and other places "the fog ripened the corn, and was favorable to the harvest." The peasants in the area, de Lamanon concluded; "beheld, with the greatest satisfaction, the effects of the fog on their crops; and yet were afraid of it."[293]

288 *Pressburger Zeitung* (30.07.1783)
289 Pfister, Christian: "Die Lufttruebungserscheinung des Sommers 1783" p. 23-24
290 See e.g. the *Wittenberger Wochenblatt* (26) 1783
291 *Wiener Zeitung* (12.07.1783)
292 Cited in Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects", p. 21
293 Lamanon, [Robert Paul de]: "Observations on the Nature of the Fog of 1783", p. 80-86

The above-mentioned accounts present a very different scenario from what we described in the last two sections. What marks the difference; and how can we define it? Regarding this, the contemporary sources from Europe indicate that the environmental influence of the dry fog ranged between either *harmful* or *beneficial* effects. On the one hand, the former was seemingly limited to parts of northern and western Europe. More specifically, sources from regions neighboring the English Channel, North Sea and Baltic Sea present profound evidence that links the effects of the volcanic pollution to damage caused to vegetation. On the other hand, contemporary sources from regions of today's Germany, Austria, Hungary and parts of France narrate that the dry fog had a positive influence on the vegetation and harvest. The dual implication of the *Lakagígar* haze supports the assumption that we made in Section 3.1. That is, the pull of the volcanic pollution – experienced through odor and negative effects on vegetation – was more actual in regions geographically close to Iceland. This is one issue. However, up until now we have more or less restricted our discussion to late June and July 1783. Which brings us to the question regarding the overall impact of the volcanic pollution in the summer of 1783: namely, did the sulfuric acids have further implications during the period and affect the progress of the summer harvest?

Based on our previous discussion, it seems fitting to look for an answer where we began the overview of this chapter – i.e. in the observations of Jan Hendrik van Swinden. As we gathered from the professors' writing, the influence of the dry fog evoked many parallels with the Icelandic experience. For example, its negative effects brought "a very distinct sulfurous odor" and caused a "great loss to the vegetable realm". But the analogy does not seem to go much further than that. Contrary to Iceland, "horses, cows, [and] sheep, felt no inconvenience" of the acid fog in the Netherlands. And despite wreaking havoc to the vegetation, the pull of the volcanic pollution seems to have been as brief as it was sudden. In this case, van Swinden's account clearly states that the influence of the sulfuric haze was only perceived to impact plants and trees between June 25th and July 3rd. Nothing in his writing indicates that the short-lived damage either exuded or hindered the progress of the summer harvest.[294]

Meanwhile in the British Isles, where the timing of damage caused to vegetation corresponded with Jan Hendrik van Swinden's account, the negative influence of the fog also seems to have been short-lived. Going back to the journals of Gilbert White, the curate of

[294] Van Swinden, [Jan Hendrik]: "Observations on the cloud (dry fog) which appeared in June 1783", p. 73-80

Selborne noted as early as July 19th 1783 that despite claims "that some fields of wheat are blighted: in general the crop looks well. Barley looks finely, & oats & peas are very well." Half a month later, he wrote with some relief that the aphids had "served their generation", and were all dead. The honeydew blight was over, and in the following weeks White was busy adding positive remarks about the ripeness of diverse crops to his journal.[295] His optimism was shared by the British newspapers, who throughout the month of August reported that the summer harvest showed good prospects. Similar tidings were even drawn from the Orkney Islands, who supposedly experienced the so-called "year of the ashie".[296] Further information about the state of the vegetation in Britain during 1783 was presented in the annual report of the squire Thomas Barker (1722-1809) of Lyndon Hall in Rutland, who acted as weather correspondent for the Royal Society of London for more than forty years. Commenting on the summer harvest, he remarked that "the crop of grain was in general pretty good", "there was no want of fruit" and during the autumn months the wheat "in general came up well".[297]

Different conditions seem to have prevailed in the Scandinavian countries. Particularly in Sweden, the negative impact of the dry fog coincided with a drought, hot summer temperatures and not to forget the honeydew blight, which is believed to have "resulted in the failure of the summer harvest."[298] This was relayed in the autumn newspapers in Sweden. On September 4th 1783, the *Stockholms Posten* published a newsletter from Eidsberg Parish in the province South Halland dated August 11th, which read: "With aching heart and tears in their eyes the farmers in this parish harvest their crops, as in general the harvest is poorer than the oldest people can remember". Accounts from the provinces East Gothland and Södermanland reported similar incidents of unusually poor harvest in the September 15th and September 26th edition of the same paper.[299] The hardship was summed up in the October edition of the *Journal politique, ou Gazette des Gazettes* that printed a letter from Stockholm dated September 16th 1783, reporting that "the grain harvest has failed in several provinces, and the hay has become so scarce that the inhabitants fear they will be forced to get rid of a part of their livestock."[300]

295 *Journals of Gilbert White*, (ed. Walter Johnson), p. 210-215
296 See Steinþórsson, Sigurður: "Annus Mirabilis", p. 140; and *Pressburger Zeitung* (06.08.1783)
297 Barker, Thomas: "Abstract of a Register of the Barometer", in *Philosophical Transactions* 74:1 (1784), p. 284-286
298 See Thorarinsson, Sigurdur: "Greetings from Iceland", p. 114-116; and Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects", p. 14
299 Cited in Thorarinsson, Sigurdur: "Greetings from Iceland", p. 114-115
300 Cited in Demarée G. R. and Ogilvie A. E. J: "*Bons Baisers d'Islande*", p. 235

In addition, historian Timo Myllyntaus of the University of Turku has placed the year 1783 on his list of "major crop failures in Finland".[301] Not enough material has been gathered to either determine the scope of the agricultural crises; or the actual role of the volcanic pollution in creating these conditions. What seems fairly clear though is that the influence of the *Lakagígar* haze was not as decisive in Scandinavia, or other European regions, as it was in Iceland. As the case of Sweden shows, other factors formed an important part of the causation; like warm weather and lack of rain. However, under similar circumstances the influence of the dry fog was not necessarily negative. This leads us back to the concept of duality. Remembering the account of the old winegrower in Stuttgart, the dry fog also seems to have acted as a kind of soil protector under unfavorable environmental condition. In the neighborhood of Sweden, on the eastern shores of the Baltic Sea, the German-Livonian naturalist Jacob Benjamin Fischer (1730-1793) remarked in his 1791 publication, *Versuch einer Naturgeschichte von Livland*, that in Livonia (nearly all of today's Latvia and Estonia) the fog had been "advantageous to the wheatfields and the plants in proportion to its covering the sun, so that the heat could not dry out the earth too much, which otherwise with the shortage of rain would have been disastrous for plants."[302]

Elsewhere in Europe, the contemporary sources concentrated on the positive state of the vegetation in the summer 1783 and ascribed it to the beneficial influence of the dry fog. Continuing in the eastern part of the continent, a letter from Warsaw, printed in the 10th of August edition of *Das Wienerblättchen* stated "that already in the beginning of July the corn was cut, an unheard of event there, and oats and barley started to ripen." Other accounts of fruitfulness in the same journal come, for example, from Banat (an ethnically mixed historical region now divided among Romania, Hungary and Serbia) where "there [was] an abundance of fruits of all kinds."[303] Meanwhile in Italy, the thoughts of the Florentine natural philosopher and inventor Felice Fontana (1730-1805) on the matter were communicated in Jan Hendrik van Swinden's essay. In Fontana's opinion, the fog "brought no damage to vegetation in Florence, but on the contrary … roused forth much vegetation." Concerning the attributes of the fog, Fontana sensed no smell of it, and even went as far as saying that he "found the air better than in other years" during the period when it covered the atmosphere![304] Similar

301 Myllyntaus, Timo: "Summer Frost", p. 83
302 Cited in Demarée G. R. and Ogilvie A. E. J: "*Bons Baisers d'Islande*", p. 235
303 Cited in Demarée G. R. and Ogilvie A. E. J: "*Bons Baisers d'Islande*", p. 235
304 Van Swinden, [Jan Hendrik]: "Observations on the cloud (dry fog) which appeared in June 1783", p. 77

conclusion was reached at a meeting of the *Accademia dei Georgofili* (founded in Florence in 1753), the earliest scientific institution in Europe whose goal was the improvement of agriculture, where "the vigorous harvest" of the year was linked to the summer haze.[305] Meanwhile, at Padua, Giuseppe Toaldo did not waste as many words on the subject in his observation on the dry fog, giving the betwixt description that it simply "occasioned no hurt … to the fruits of the earth".[306]

Regarding the German Empire and central Europe "the unknown fertility", which we referred to earlier in this section, seems to have persisted throughout the summer. Underlining this, contemporary accounts from Switzerland mention the plentitude of the fields during the summer months.[307] Particularly, the grape harvest of 1783 was abundant in most regions. In Hungary, a report from October 8th 1783 published in the *Wiener Zeitung* claimed that the wine harvest in all areas of the Empire, had "nearly everywhere been very successful, as one had hoped", concluding that at "many places it … exceeded expectations."[308] Similar tidings were recorded in Austria. In particular, a report from the October 11th 1783 edition of the *Wiener Zeitung* reflected on the plentitude of the grape harvest and autumn fruits in Lower Austria:[309]

> Die Weinlese in Niederösterreich hat gegenwärtig bereits an den meisten Orten ihr Ende erreicht, und ist, verschiedenen Berichten zu Folge, allenthalben so ausgefallen, daß man sich in Ansehung der Menge des Ertrages, seit langen keines glücklicheren Jahres erinnert. Auch alle übrigen Herbstfrüchte hatten heuer das beste Gedeihen, und sind in einer seit vielen Jahren nicht gesehenen Menge vorhanden.

It is a somewhat enjoyable addition to the eventful summer of 1783 that the grapevine should have prospered in the dry fog. Perhaps a combination of hot summer temperatures, sulfuric acid precipitation and soil protection provided by the haze, was the underlying cause? Anyhow, the vintage was later remembered as an excellent wine that even earned literary status. In Johann Wolfgang von Goethe's 1796-1797 epic poem on the Napoleonic Wars, *Hermann und Dorothea*, the author recalled the joyful wine from the summer of the *Lakagígar* eruption, when he wrote: "… und Mütterchen bringt uns ein Gläschen Dreiundachtziger her, damit wir die Grillen vertreiben."[310]

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305 Steinþórsson, Sigurður: "Annus Mirabilis", p. 143
306 Toaldo, [Giuseppe]: "Meteorological Observations made at Padua in the Month of June 1783", p. 419
307 See Hochadel, Oliver: ""In nebula nebulorum"", p. 56
308 *Wiener Zeitung* (08.10.1783)
309 Cited in Strömmer, Elisabeth: *Klima-Geschichte*, p. 208
310 Goethe, Johann Wolfgang von: *Hermann und Dorothea*, p. 16. Footnote nr. 1 on the same page describes the vintage as: "ein damals (1796) schon alter und besonders guter Wein."

As we noted in our discussion about the interplay between volcanism and the atmosphere (Section 1.2.), volcanic gases are not only known to be damaging for the environment, but can also provide nutrients that are ecologically beneficial. The duality between *harmful* and *beneficial* effects applies to the scenario that coincided with the appearance of the *Lakagígar* haze in Europe. Evidently, that contravenes the notion that the volcanic pollution from Iceland rendered something like a homogenous experience, which "cause[d] considerable damage to vegetation and crops all over Europe", as has been claimed. Although the negative impact of the sulfuric haze was substantial in the northern and western part of the continent, it also seems to have been short-lived. It is difficult to imagine that the sudden impact played a significant role in affecting the progress of the summer harvest, in 1783. The beneficial influence of the dry fog, however, casts a light on a subject that rarely features in the historiography of the event, despite being relayed quite prominently in sources from the period.

An alternative view of the story of the summer of 1783, which adheres to what we have described in this part of the research, was noted down in the diary of the prior of Closter Engelport, near the German city of Koblenz in the Upper Rhine Valley. For the year 1783, he wrote:[311]

> "1783: Herrauch im Monath Junio bis fasten in den Julius hinein. Die ältesten Leuth in Teütschland und Frankreich wissen solchen niemals gesehen zu haben. Derselbe hat auch anfangs beÿ acht Tag hindurch übel gerochen … Einige wollen haben, daß a. 1719 ebenfalls solche Nebelen gewesen wären, und wäre darauf ein gewalt guthes Weinjahr gewesen. Ohngeacht sich niemand was guthes prophezeyen wollte aus dem Herrauch, welcher den Monath Junius schier beständig fortgedauert hatte, so ist dies Jahr 1783 ein sehr gesegnetes Jahr gewesen."

In other words, the infamous fog was not only a source of fear, but also of plenty in the minds many contemporary Europeans in the summer of 1783.

3.5. The mortality question

> The Laki fissure eruption generated air pollution on a continental scale, which had a severe impact upon the European environment, and induced a range of illnesses that we might expect to see during any modern pollution incident.
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> Grattan, John et al: "Volcanic air pollution and mortality in France 1783-1784", p. 649

[311] See Pies, Norbert J: (http://www.njpies.de/naturkatastrophe.html)

To summarize the significance of the environmental influence of the dry fog, it is not unwise to revisit some of the main points that we have highlighted in this research. As we argued in Chapter I, the *Lakagígar* eruption had catastrophic consequences in Iceland, not because the eruption itself killed anyone, but rather because of the environmental damage caused by the volcanic pollution. Put across in a simple way, the noxious gases destroyed and polluted vegetation which directly and indirectly led to a great loss of the grazing livestock. This was one of the main causes for the so-called Haze Famine of 1783-1785 and the concomitant mortality crisis that claimed up to 20% of the Icelandic population. In Europe, however, the influence of the fog was much milder. In this respect, no convincing evidence has been reviewed which expresses that the volcanic pollution had any meaningful influence on animals.[312] And despite descriptions of damage caused to crops in some parts of the continent, the impact of the volcanic acids seems to have been short-lived and hardly effective enough to cause any crises. In fact, reports of bumper crops in many regions indicate that food shortage was not the cause of peoples' worries during the unusual summer months in 1783.

In the light of this, it is somewhat surprising that the dry fog has been linked to great losses of lives beyond Iceland's shores – evoking some scholars to apply the idiom "European mortality crisis" in connection to the 1783-1784 *Lakagígar* eruption.[313] Since the circumstances that led to the mortality crisis in Iceland were not in place in Europe, the question that logically follows is: How can it be argued that the volcanic pollution from Iceland was fatal for Europeans?

The advocacy of the "European mortality crisis" is drawn from two researches that appeared in 2004 and 2005. The former was conducted by Claire Witham and Clive Oppenheimer from the department of geology at the University of Cambridge and deals with mortality in England during the 1783-1784 *Lakagígar* eruption;[314] while the latter looked at the same subject in France and was carried out by professor John Grattan from the University of Wales and co-

[312] The most outright description that the author found on the influence of the volcanic pollution on animals is presented in Jan Hendrik van Swinden's essay, where it says: "the haze made a great slaughter of insects". This was hardly of significance with regard to the wellbeing of people in the summer of 1783.

[313] The main advocate for this assumption is the geoarcheologists John Grattan, from the University of Wales, Aberystwyth. See e.g. Grattan, John et al: "The Long Shadow", p. 153-176

[314] Witham, Claire S. and Oppenheimer, Clive: "Mortality in England", p. 15-26

authors.[315] As there are no other studies on the issue available from other European countries, we might as well approach it by looking at these two articles.

The research by Claire Witham and Clive Oppenheimer was conducted in response to data presented in *The Population History of England*, a historical survey on the demography of that country.[316] Among other things the work analyzed "mortality crises" of significantly higher than expected death rates, pointing at a crisis occurring in the "harvest year" July 1783-June 1784. The year ranks 26th in severity out of all harvest years in the period 1541-1871, featuring approximately 30,000 extra deaths. Elaborating on this information, Witham and Oppenheimer worked out a more time-resolved criterion for the period circling around the *Lakagígar* eruption and compared it to the monthly average death rate during the second half of the 18th century. Accordingly, they detected a sharp deviation first in "August-September 1783", where the combined mortality was 40% higher than during the average 1759-1808 period; and then a second in "January-February 1784" where it was 23% higher compared to the same period. As a result, Witham and Oppenheimer calculated an "equivalent to approximately 11,500 and 8,200 additional deaths in these periods respectively."[317] Similar numbers came up in France, where John Grattan and colleagues compiled and studied burial data from 53 parishes. Although grounding their analyzes on a shorter timeframe, they found that mortality increased by 38% between August and October 1783 and by 25% from August 1783 to May 1784 when compared to the general death rate between January 1782 and December 1784.[318] Based on this, Grattan estimated in another article that mortality in France during 1783-1784 had reached "figures well in excess of 30,000 and perhaps as high as 200,000 extra deaths."[319]

Essentially, the studies reveal that the mortality crisis in England and France followed a similar pattern: i.e. it began in late-summer and was particularly bad from August 1783 until September and October; while carrying on through winter where it remained above average in France but mostly bound to January-February 1784 in England. The similarity in death rate and timing provides the first argument for the alleged "European mortality crises". Regarding the influence of the *Lakagígar* eruption on the scenario, the authors were obviously more

[315] Grattan, John et al: "Volcanic air pollution and mortality in France 1783-1784", p. 641-651
[316] See Wrigley, Edward A. and Schofield, Roger S: *The Population History of England 1541-1871*
[317] Witham, Claire S. and Oppenheimer, Clive: "Mortality in England", p. 15-19
[318] Grattan, John et al: "Volcanic air pollution and mortality in France 1783-1784", p. 647-649
[319] Grattan, John et al: "The Long Shadow", p. 157

interested in explaining the late-summer death rate. Based on the premise that summer was generally a time of low mortality in late-eighteenth century Europe, they deduced that "a common vector was causing environmental stress" or as Witham and Oppenheimer put it, "an action of a forcing on mortality unrelated to the normal seasonal trend" that caused the "anomalous mortality" in late-summer 1783.[320]

In order to explain the dimension of the "common vector", the authors of the studies hypothesized that two environmental agents had acted together to cause the high death rate during the period – namely, an air pollution caused by the sulfuric acid aerosols from the *Lakagígar* eruption and the high temperatures that prevailed in the summer of 1783. In this incident, John Grattan and co-authors were more conclusive and argued that "[c]oncentrations of SO_2 [Sulfur dioxide] within the dry fog clearly passed critical threshold for human health on many occasions and were responsible for severe respiratory dysfunction in many people". Adding weight to the claim, they provided evidence from contemporary sources, citing e.g. familiar remarks made in Jan Hendrik van Swinden's essay, where the impact of the fog on human health was linked with chest pains, headaches, and breathing difficulties (see Section 3.2.). Under these circumstances, Grattan and colleagues speculated that "high temperatures can only have added to the physiological stress experienced during the summer of 1783" and concluded that "[i]t is clear that in many respects the events of 1783 are typical of modern severe air pollution events."[321]

The analogy between modern air pollution and the atmospheric conditions in the summer of 1783 sounds promising. In this case, a recent and alarming example experienced in Europe was the heat wave of August 2003. Combined with modern day tropospheric pollution, it is believed to have led to 15,000 deaths in France alone, and many more thousands in England, Spain, Germany and Italy, with a total toll across Europe of as many as 45,000.[322] A scenario like this, zeroes in on to the second and final argument for the causal relation between a possible "European mortality crisis" and the 1783-1784 *Lakagígar* eruption – i.e. if the air pollution, created by the sulfuric acid aerosols from the eruption and the high temperatures caused anomalous mortality in France and England during the summer of 1783, then "[t]he

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320 Grattan, John et al: "Volcanic air pollution and mortality in France 1783-1784", p. 646 and Witham, Claire S. and Oppenheimer, Clive: "Mortality in England", p. 18
321 Grattan, John et al: "Volcanic air pollution and mortality in France 1783-1784", p. 649
322 Oppenheimer, Clive: *Eruptions that Shook the World*, p. 291

atmospheric circulation patterns of the period [referred to in Section 3.1.] would have ensured that the rest of Europe ought to have been similarly affected."[323]

How does the reasoning of the authors match with the reality of the summer of 1783? As we demonstrated in Chapter 2 (Section 2.5.), the season was known to have been unusually warm in the northern, western and central part of Europe – culminating in a heat wave during the month of July. Temporally, the warm phase went hand-in-hand with the most intense fumigation of the *Lakagígar* acids in Europe, from circa June 20th til July 20th. Various contemporary accounts attest that the air pollution impacted human health during this phase, as we have adverted to in this chapter. In the Netherlands, where Jan Hendrik van Swinden pondered the dry fog, the impact seems to have been particularly severe. Verifying his observations, the feature article on the haze in the *Münchner gelehrte Zeitung*, cited a Dutch newspaper which reported that "In den Niderlanden soll der Höherauch ... so stark gewesen sein, das es eine halbe Woche gar nicht Tag ward, und das die Leute beim Ausgehen, wegen des starken Schwefelgeruchs, Tücher umhängen musten."[324] Other accounts from June and July give examples of the adverse effects of the sulfuric fog.[325] An appropriate summary of these can be found in the observations of the French natural philosopher Robert Paul de Lamanon. He noted that the ill-smelling fog was "hurtful to the eyes"; "persons whose lungs were weak, found disagreeable effects from it"; and that some complained of "violent pains in the head; and that, in general, they partly lost their appetite."[326]

Although the documentary record provides strong evidence that the air pollution had health effects such as eye sensitivity and respiratory resistance, the hypothesis that links it to the late summer mortality crisis is inconsistent. During the intense phase of the acid concentration and summer heat there is no indication in the contemporary sources that the adverse effects of the air pollution translated into death. Adverting to this, the frequently quoted article from the *Münchner gelehrte Zeitung* noted that "selbst die Krankheiten und Sterbfälle schinen sich unter den Menschen vermindert zu haben" in June and July 1783.[327] Also in England and France the death rate for these months appears to have been about

[323] See Grattan, John et al: "Volcanic air pollution and mortality in France 1783-1784", p. 645-650; and Grattan, John et al: "The Long Shadow", p. 157-170
[324] *Münchner gelehrte Zeitung* (1783:8), p. 59
[325] Contemporary accounts of the health implication of the dry fog are presented in Grattan John et al: "'The end is nigh'?, p. 87-106; and Demarée G. R. and Ogilvie A. E. J: "*Bons Baisers d'Islande*", p. 219-246
[326] Lamanon, [Robert Paul de]: "Observations on the Nature of the Fog of 1783", p. 81
[327] *Münchner gelehrte Zeitung* (8) 1783, p. 59

normal.[328] With the analogy of "modern severe air pollution events" in mind, Claire Witham and Clive Oppenheimer spot the shortcomings of the argument and admit that the time lag between the intense phase of the *Lakagígar*-induced pollution and the mortality peaks in August-October reconciles badly "with the rapid health impacts observed today following air pollution incidents."[329] Put into perspective, statistics from August 2003, where a comparable lethal environmental cocktail was supposedly at work, show an essential "correlation between high-temperatures days and increased death rate."[330] This was not the case in 1783, which makes it difficult to appeal to air pollution as the cause of the late-summer mortality.

Why did people die in Europe, then? As far as the documentary record is concerned, it appears that epidemic diseases raged on the continent in late-summer and autumn 1783. Although epidemics and pandemics were not infrequent in late-18th century Europe, the occurrence might help explain the anomalous mortality crisis from that period.[331] In England, some evidence of the unhealthy state of the population can be drawn from the memoirs of reverend Charles Simeon (1759-1836) of Cambridge who travelled through the central part of the country in August and September 1783. On return to his parish on September 19th, he wrote: "… many whom I left in my parish well are dead, and many dying; this fever rages wherever I have been."[332] Elsewhere, the letters of the poet William Cowper, who resided in Bedfordshire at that time, also allude to the late-summer epidemic. On September 8th 1783, he stated that "[t]he epidemic begins to be more mortal as the autumn comes on."[333]

Across the English Channel, the fatal conditions were interpreted according to the "neo-hippocratic" hypothesis, which emphasized that an interaction existed between climate, health and environment. Within that framework of though, contemporary observers established a link between the occurrence of late-summer diseases with the atmospheric conditions and extreme weather earlier in the season. Along these lines, a Dutch professor of medicine at the University of Harderwijk, Matthias Steevens van Geuns (1735-1817) speculated that "[o]ne has probably to seek the causes of this illness in the state of the sky, the temperature of the air and the season of the year" while claiming that "the dysentery generally occurs in the great

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328 Grattan, John et al: "Volcanic air pollution and mortality in France 1783-1784", p. 648-649; and Witham, Claire S. and Oppenheimer, Clive: "Mortality in England", p. 18

329 Witham, Claire S. and Oppenheimer, Clive: "Mortality in England", p. 25

330 Oppenheimer, Clive: *Eruptions that Shook the World*, p. 291

331 See e.g. Creighton, Charles: *A History of Epidemics in Britain*, (vol.2); and Demarée G. R. and Ogilvie A. E. J: "*Bons Baisers d'Islande*", p. 236-237

332 Cited in Witham, Claire S. and Oppenheimer, Clive: "Mortality in England", p. 24

333 *The Letters and Prose Writings of William Cowper*. (vol. 2), p. 160

heat of the summer, and that it continues, but always declining, until the autumn, and that finally it disappears in winter." In a similar vein, the journals of the Abbot of Bazinghen, from Northern France, imply that the "putrid illnesses" in 1783 "occurred due to the great heat of the summer", and caused a "larger number of deaths than births during the year, in particular due to the dysentery in the villages near to the swamps." Meanwhile, in Barcelona the fifth Baron de Maldá (1746-1819) kept a diary throughout the period, where he described how "the great heat and the extreme droughts turned into a constellation of illnesses which were malignant fevers, from which no few persons died."[334]

Whether the epidemic diseases in late-summer and autumn of 1783 were in any sense related to the air pollution in the summer is unclear. A possible stimulus, suggested by Claire Witham and Clive Oppenheimer, is that the unusually high July temperatures exacerbated illnesses by enabling certain disease vectors to flourish.[335] On that note, one could also speculate that the volcanic pollution made people more vulnerable for disease. However, as the main advocate of the causality between the "European mortality crisis" and the *Lakagígar* eruption admits: "in the literature of the day, it is not possible to identify the operation of a single environmental vector or outbreak of a single specific illness that can unequivocally be blamed on the eruption."[336] In other words, we cannot be certain what the role of the *Lakagígar* pollution was, or how important the hot temperature might have been in causing the high death rate. And while the uncertainty remains unresolved, the connection between the 1783-1784 eruption and the late-summer mortality crisis belongs to the realm of speculation rather than sound evidence.

The increase in mortality during the winter of 1783-1784 has been associated with a more monocausal culprit, known as climate. On record, the season is thought to have been one of the severest in Europe and North-America in the last 250 years.[337] By that time, the *Lakagígar* haze had cleared from the European atmosphere and people's concerns taken a different pathway. That story lies outside the sphere of this research, and will not be documented. Nevertheless, we find an element of discovery on the border between the unusual summer of

334 Cited in Demarée G. R. and Ogilvie A. E. J: "*Bons Baisers d'Islande*", p. 236
335 Cited in Witham, Claire S. and Oppenheimer, Clive: "Mortality in England", p. 24-25
336 Grattan, John et al: "The Long Shadow", p. 163
337 Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects", p. 15-25

1783 and the cold winter that followed, which is integral to the narrative of the dry fog of 1783. To conclude this research, we return to the reflections of Benjamin Franklin.

3.6. Returning to Benjamin Franklin

By September 1783, the weather in Europe had settled and the strange summer haze mostly cleared from the atmosphere. The signing of the *Treaty of Paris* on the 3rd day of the month meant that Benjamin Franklin's ambassadorial duties were lightened. If his letter correspondence from the period is anything to go by, it appears that a jubilant spirit reigned in the French capital. And for the most part all eyes remained fixed skywards for a display that announced a new type of conquest for mankind: "We think of nothing here at present but of flying," Franklin reported in one of his letters.[338]

The summer of 1783 had been unusual and unsettling. Earlier in the season, on July 21st 1783, Franklin received an urgent request from princess de Beauvau-Craon (1729-1807), on how to install a lightning rod at her residence, the château de Val in the forest of Saint-Germain. "Do hurry" she pleaded, "because if you delay, and if a lightning bolt should lack the decency to wait until the answers arrive, you will be filled with remorse."[339] The desperation in princesse de Beauvau's letter was surely due to the terrible storms that swept through France and the whole of Europe, causing widespread destruction and loss of lives. It was an amazing and portentous summer. Across the continent hot temperatures, lightning strikes, earth tremors, high winds, droughts and torrential rains had been experienced. And to give it all a specific character, an unusual dense haze covered the atmosphere – dry and quite unlike ordinary fog. A greeting from Iceland, one could say.

As autumn turned into winter, Benjamin Franklin's health deteriorated with the first frosts. His state did not prevent him from attending the display of the first manned hydrogen balloon, though. On the cold morning of December 1st 1783, he headed for the Tuileries Garden in Paris and joined a crowd of 200,000 spectators who had gathered for the venue. "Never before" Franklin delighted "was a philosophical experiment so magnificently attended."[340] But the winter season would soon spur Franklin's own philosophical thinking. There seemed to be no relenting of the cold weather. In Paris, the River Seine began to freeze

[338] Schiff, Stacy: *A Great Improvisation*, p. 353-358
[339] Marie-Charlotte-Sylvie de Rohan-Chabot, princesse de Beauvau-Craon, was the wife of Charles-Just de Beauvau (1720-1813), the 2nd prince of Craon. See, *The Papers of Benjamin Franklin*, (vol. 40), p. 352-354
[340] Schiff, Stacy: *A Great Improvisation*, p. 353-358

around the middle of December. Later that month, a Parisian meteorologist noted that snow had fallen in such a "prodigious quantity as we had not seen for a very long time", paralyzing the movement of pedestrians and horse drawn carriages in the city.[341]

Similar conditions prevailed throughout most of Europe. The winter of 1783-1784 turned out to be particularly severe, characterized by below-zero temperatures, frozen soils, icebound watercourses and much snow accumulation. When the thaw came in February and March 1784 there was vast flooding, affecting catchments across France and Central Europe, where it is still considered one of the most disastrous known floods.[342] In the light of the extreme weather, Benjamin Franklin wondered whether the seasonal equilibrium had in any sense been disturbed, and what the meteorological cause might be. In May 1784, he put his thoughts on the matter to paper in an important essay entitled "Meteorological Imaginations and Conjectures". Seeking to establish a causative-relation, Franklin reflected on the unusual haze that covered the atmosphere during "several of the summer months of the year 1783 when the effects of the sun's rays to heat the earth in these northern regions should have been the greatest". The fog, Franklin remembered, so attenuated the strength of the solar rays that "when collected in the focus of a burning glass they would scarce kindle brown paper." Concluding from this that the ability of the sun to heat the earth in the summer had been exceedingly diminished, Franklin deduced:[343]

> Hence the surface was early frozen.
> Hence the first snows remained on it unmelted, and received continual additions.
> Hence perhaps the winter of 1783-4, was more severe than any that had happened for many years.

Thereby Benjamin Franklin became the first modern thinker to publically propose a hypothesis on the existence of a relationship between volcanic eruptions and climate.[344] And by doing so he sparked an ongoing scientific discussion on the subject.

On the relevance of volcanic-induced climate change to the field of history, the late economic historian John Dexter Post told us in Chapter I that a historian should look into documentary evidence of anomalous weather patterns coinciding with large-scale volcanic events. In our

341 See Brázdil, Rudolf et al: "European floods during the winter 1783/1784"
342 See Brázdil, Rudolf et al: "European floods during the winter 1783/1784"
343 Franklin, Benjamin: "Meteorological Imaginations and Conjectures", p. 288
344 Sigurdsson, Haraldur: *Melting the Earth*, p. 10

case, the *Lakagígar* eruption of 1783-1784, there appears to be no shortage of examples. As we highlighted in this essay, Iceland immediately suffered from cooling under the volcanic cloud and snowfall was recorded in the summer of 1783. Meanwhile, Europe experienced high temperatures and turbulent weather during the season, as princess de Beauvau-Craon adverted to in her letter to Benjamin Franklin. The following winter was unanimously reported as cold all over Europe and enormous flooding was experienced. In fact, severe winters are known to have taken place in most regions of the northern hemisphere between 1784 and 1786. To name an example, the eastern part of the United States of America suffered one of its coldest winters in the past 500 years, with a temperature drop of almost 4.8°C below the 225 year average in the winter 1783-1784.[345]

Elsewhere in the world, climatic anomalies were felt in Africa and Asia. While Europe suffered from flooding in 1783-1784, the regions at the mouth of the River Nile in North Africa experienced lack of flooding. A disruption to the monsoons brought insufficient precipitation which decreased the rivers' watershed to the level that the floods of 1783 and 1784 were amongst the lowest in recorded history.[346] At that time, the monsoon rains also failed in India; while Japan experienced cold and moist weather in the summer of 1783. Given the dependence of communities in these regions on seasonal rainfall and stable weather patterns, it has been speculated that the consequence of the climatic fluctuations in 1783-1784 contributed to famine and "a death toll that ran into millions".[347]

With the above-mentioned evidence in mind, the question that logically follows is whether the *Lakagígar*-induced dry fog, which filled the atmosphere in the summer of 1783, could have triggered the world-wide climatic anomalies? In this respect, the relationship between the volcanic eruption and the climate effects is not obvious. As we mentioned in Chapter I (Section 1.2.), it has become generally accepted in meteorological theory that large explosive volcanic eruptions that inject sulfur into the stratosphere can effect climatic patterns around the world. The magnitude and spatial character of the impact appears to be dependent on a number of factors, such as the latitude of the volcano and the precise time of the eruption within the year. However, for Europe at least, there is evidence that explosive eruptions tend to cause cold summers and warm winters.[348] With regard to the state of the

345 Wood, Charles A: "Climatic Effects of the 1783 Laki Eruption", p. 64-67
346 Oman, Luke et al: "High-latitude eruptions cast shadow over the African monsoon", p. 1-5
347 Grattan, John et al: "The Long Shadow", p. 155-157
348 See e.g. Oppenheimer, Clive: *Eruptions that Shook the World*, p. 53-76

climate in the wake of the *Lakagígar* eruption, which was predominantly an effusive eruption, a contrary picture emerged – namely, warm summer and cold winter.

The opposing pattern has not been fully reconciled by earth scientists and meteorologists.[349] On the one hand, those who argue for the climatic impact of the *Lakagígar* eruption have proposed that the high temperatures during the summer of 1783 in Europe "resulted from a short-term greenhouse warming induced by the emissions from Laki and caused by high SO_2 [Sulfur dioxide] concentration in the lower atmosphere [troposphere]." They also propose that the aerosols from the eruption reached the upper troposphere/lower stratosphere and thus "disrupted the thermal balance of the Arctic regions for two summers and were the main mechanism for the associated climatic perturbations."[350] On the other hand, those who find the argument for the *Lakagígar*-climate relationship "poorly constrained", reason that the extreme weather in 1783 and 1784 may have been part of an inter-annual variability unrelated to the volcanic emissions. In this respect, the climatologist Rosanne D'Arrigo and co-authors have inferred that "an unforced variability", in the form of a "synchronous occurrence of a negative NAO [North Atlantic Oscillation] in the Atlantic and an El Niño in the Pacific during the 1783-1784 winter was more fundamentally to blame for the severe conditions over North America and Europe than the waning effects of Laki."[351] Based on the same premise, it has also been suggested that the climatic anomalies in Africa and Asia were more likely associated with an El Niño episode in the period 1782-1786, than the dry fog from Iceland.[352]

It is beyond the field of this research to determine whether Benjamin Franklin was right or wrong regarding the climatic impact of the *Lakagígar* eruption. What the current discussion demonstrates is that the exact nature of the relationship between the eruption and climate is not yet fully understood. From a historical perspective it should also be noted that the *Lakagígar* eruption of 1783-1784 was a unique type of volcanic event, unparalleled in recorded history. Although the coincidence of the climatic anomalies with the eruption is hard to dismiss, it seems irresponsible to venture into the unknown and take unproven assumptions as given, which on top of everything else find no comparative analogue in documented history.

349 Oppenheimer, Clive: *Eruptions that Shook the World*, p. 279-283

350 Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects", p. 1-29

351 D'Arrigo, Rosanne et al: "The anomalous winter of 1783-1784"

352 Demarée G. R. and Ogilvie A. E. J: "*Bons Baisers d'Islande*", p. 227-228

We shall therefore leave the climate issue at that. Further research will help elucidate the unanswered questions which remain regarding the precise interaction. That is the work of the future, but hereby our research on the 1783-1784 eruption comes to an end.

Conclusion

The *Lakagígar* eruption, which took place between June 8th 1783 and February 7th 1784, was a unique type of volcanic event that had an impact far beyond the location of its source in the southern part of Iceland. From a geological perspective the eruption not only accounted for one of the greatest outpouring of lava on earth in recorded history, but it also released a notorious amount of volcanic gases into the atmosphere. The latter attribute of the eruption created the setting for this research. In our documentation of the event, we focused on the environmental impact of the eruption in Iceland and Europe, and analyzed how contemporaries reacted to its influence and what meaning they derived from it.

For Iceland itself, the *Lakagígar* eruption had catastrophic consequences. Although the eruption did not directly result in loss of lives, the indirect effects caused by the volcanic gases were decisive. It is estimated that the eruption released 122 megatons of sulfur dioxide into the atmosphere, which formed a sulfuric haze that covered the atmosphere and rained down acids for more than a year after the outbreak of the eruption. Other volatiles were carried to ground with repeated ash falls from the craters which filled pastures throughout Iceland. The environmental impact of the volcanic pollution accounted for a nationwide damage to vegetation and caused crop failures, which together with the severe climate of the years 1782-1784 is thought to have killed an approximately 70% of the livestock in the country. Given the dependence of late-18th century Icelandic society on the grazing stock as a source of nutriment, we argued that the *Lakagígar* eruption must be seen as one of the primary causes of the so-called Haze Famine of 1783-1785. The victims of the famine counted no less than 10,000 people – i.e. close to one-fifth of the whole population of Iceland.

From Iceland the North Atlantic winds carried the influence of the eruption north into the Arctic and eastwards over Europe to North Africa and the Middle East and even as far as central Asia. The manifestation of the *Lakagígar* signal in these regions was the atmospheric haze that developed out of the sulfur dioxide emission from the eruption. In particular, the summer of 1783 in Europe was given character by this phenomenon, which many contemporaries described as a dry fog. Its appearance was certainly one of the most remarkable nature-induced events in modern history. The haze was virtually persistent in the atmosphere from mid-June until late-July, when it disappeared briefly, only to return with varying intensity in August and September 1783. It had a specific dryness, which made it different from ordinary fog. Due to its appearance, the visibility in the natural environment was greatly reduced, while the sun was obscured and appeared like a red, bloody-looking sphere at sunrise and sunset.

Unlike the Icelandic experience where people were quick to connect their distress with the effects of the eruption, people in Europe were oblivious about the cause of the unusual alteration of the atmosphere. Iceland was remote from regular commercial traffic lanes and news of the *Lakagígar* eruption was therefore not at hand. Ignorance of the origin of the volcanic pollution during the summer of 1783 certainly influenced the contemporary reaction to it. In this research, we drew a distinction between the response of common people, who in the contemporary literature were often referred to as the *superstitious*, and that of the natural philosophers of the time, who were influenced by the spirit of the Enlightenment. While the former were clearly alarmed by the strange state of the atmosphere and viewed it as some kind of a divine warning; the latter tried to rationalize its appearance by emphasizing reason. What complicated the *enlightened* effort to identify the event were coincidental occurrences of other nature-induced phenomena during the period. As a result, the *enlightened* observers frequently associated the dry fog with earthquakes that took place in southern Italy. Other natural occurrences of the summer, such as severe thunderstorms, a flying meteor, and a brief appearance of a volcanic island off the coast of Iceland also became dry fog suspects, which in turn contributed to a list of very heterogeneous assumptions on the origin of the fog.

Judging by the contemporary reaction in Europe to the *Lakagígar*-induced haze, this research shows that the late-18th century mentality had clearly not progressed to the point of drawing well-defined boundaries between natural phenomena. Frequent usage of superlatives, such as "extraordinary", "the thickest fog I remember", "the oldest citizens do not remember", and adjectives like "violent", "tremendous", "dreadful", and "remarkable" in the contemporary discussion, also demonstrates that the spirit of the time lacked an accepted vocabulary to describe the events of the summer. In other words, there was no authoritative means of talking about the unusual state of the atmosphere in the summer of 1783. In this sense, the research offers a revealing insight on how the natural philosophers of the time thought of unwonted natural phenomena, and sheds a light on the duality between the *enlightened* and *superstitious* perception of such occurrences.

If the word duality is descriptive for the reaction of contemporary Europeans to the unusual atmospheric condition in the summer of 1783, the same appears to be the case regarding the environmental impact of the sulfuric haze on the continent. Negative effects on vegetation due to the volcanic pollution were specifically limited to regions neighboring the English Channel, North Sea and Baltic Sea. Typical for the effects were descriptions of withering leaves and defoliation, as well as scorching and damage observed on crops and other vegetation. What supports the connection between these effects and the *Lakagígar* haze is that many sources identified them with an odor of sulfur in the air. Contemporary accounts also link the impact of the dry fog to an unusually extensive fermentation of honeydews, which plagued gardens and wooden areas in various parts of northern and western Europe. However, sources from other parts of the continent reveal that the dry fog actually had a beneficial influence on the vegetation and harvest in the summer. For instance, accounts from the southern part of Europe narrate that the fog "roused forth much vegetation." In a similar vein, descriptions from the German Empire and central Europe link the dry fog with an "unknown fertility" and plentitude in the fields. In these regions, it appears that the grape harvest of 1783 flourished in the sulfuric fog.

The findings of this research contravene the notion that the volcanic pollution from Iceland rendered something like a homogenous experience, which "cause[d] considerable damage to vegetation and crops all over Europe", as has been claimed in scientific journals in recent years. Although the negative impact of the sulfuric haze was substantial in some regions of northern and western Europe, it appears to have been short-lived. Based on the work conducted for this research, it does not seem that the influence of the volcanic pollution affected the progress of the summer harvest in Europe, in 1783. The beneficial influence of the dry fog, however, casts a light on a subject that rarely features in the historiography of the event, despite being relayed quite prominently in sources from the period.

Regarding the impact of the volcanic pollution on human health in the summer of 1783, contemporary accounts from Europe provide strong evidence that the sulfuric haze had adverse effects. Characteristic of these were respiratory difficulties and disagreeable effects to the eyes. However, the sources from the period do not suggest that the impact of the air pollution translated into death. In the light of this, the research finds the hypothesis that links the volcanic pollution from Iceland to an alleged "European mortality crisis" in the summer of 1783, inconclusive.

To put an end to this work, a few remarks should be made about Benjamin Franklin's contribution to the history of the dry fog of 1783. In the wake of the severe winter of 1784, he deduced that the unusual haze of the summer had limited the ability of the sun to heat the earth and thereby caused a consecutive cold winter. Thus, Franklin became the first scientist to publically advance a thesis on the effects of volcanism on climate. As the earliest dry fog to be studied scientifically, the *Lakagígar*-induced haze remains an interesting challenge for meteorologists even today.

Bibliography

References

Allaby, Michael: *Encyclopedia of Weather and Climate*. Volume 1. New York: Facts on File, 2002. (Facts on File Science Library).

Andrésson, Sigfús Haukur: "Aðstoð einokunarverslunarinnar við Íslendinga í Móðuharðindum", *Skaftáreldar 1783-1784. Ritgerðir og Heimildir*. Edited by Gísli Ágúst Gunnlaugsson et al. Reykjavík: Mál og Menning, 1984 (p. 215-235).

Barker, Thomas: "Abstract of a Register of the Barometer, Thermometer, and Rain, at Lyndon, in Rutland, 1783", *Philosophical Transactions, of the Royal Society of London* (74:2) 1784 (p. 283-286).

Beard, Mary: *The Fires of Vesuvius. Pompeii Lost and Found*. Cambridge, MA: The Belknap Press of Harvard University Press, 2010.

Behringer, Wolfgang: *A Cultural History of Climate*. Cambridge: Polity Press, 2010.

Björnsson, Lýður: "18. Öldin", *Saga Íslands*. Volume 8. Reykjavík: Bókmenntafélagið, 2006 (p. 5-289).

Black, Jeremy: *The English Press in the Eighteenth Century*. London: Croom Helm, 1987.

Bohnenberger, Gottlieb Christoph: *Beyträge zur theoretischen und praktischen Elektrizitätslehre*. Stuttgart: Johann Benedict Mezler, 1793.

Braudel, Fernand: *Civilization & Capitalism 15th-18th Century. The Structures of Everyday Life*. Volume 1. London: Collins, 1981.

Bräker, Ulrich: *Tagebücher 1779-1788*. Edited by Andreas Bürgi et al. Volume 2. Munich: Beck, 1998.

Brázdil, Rudolf et al: "Climate in the Czech Lands during the 1780's in Light of the Daily Weather Records of Parson Karel Bernard Hein of Hodonice (Southwestern Moravia): Comparison of Documentary and Instrumental Data", *Climate Change* (60) 2003 (p. 297-327).

Brázdil, Rudolf et al: "European floods during the winter 1783/1784: scenarios of an extreme event during the 'Little Ice Age'", *Theoretical and Applied Climatology* (100:1-2) 2010 (p. 163-189).

Brugmans, Sebald Justinus: *Nauurkundige verhandeling over een zwavelagtigen nevel den 24 Juni 1783 in de provincie van stad en lande en naburigen landen waargenomen*. Nijmegen: Isaac van Campen, 1784.

Campanella, Thomas J: "'Mark Well the Gloom': Shedding Light on the Great Dark Day of 1780", *Environmental History* (12:1) 2007 (p. 35-58).

Camuffo, Dario and Enzi, Silvia: "Impact of the Clouds of Volcanic Aerosols in Italy during the Last 7 Centuries", *Natural Hazards* (11) 1995 (p. 135-161).

Catastrophe & Culture. The Anthropology of Disaster. Edited by Susanna M. Hoffman and Anthony Oliver-Smith. Santa Fe: School of American Research Press, 2002.

Christ, J. L: *Von der außerordentlichen Witterung des Jahrs 1783, in Ansehung des anhaltenden und heftigen Höherauchs; vom Thermometer und Barometer, von dem natürlichen Barometer unserer Gegend, dem Feldberg oder der Höhe, und von der Beschaffenheit und Entstehung unserer gewöhnlichen Lufterscheinungen, wie auch etwas von den Erdbeben*. Frankfurt, 1783.

Cooper, William: "Observations on a remarkable Meteor seen on the 18th of August, 1783", *Philosophical Transactions, of the Royal Society of London* (74:1) 1784 (p. 116-118).

Creighton, Charles: *A History of Epidemics in Britain. From the Extinction of Plague to the present time*. Volume 2. Cambridge: Cambridge University Press, 1894.

Cullum, Rev. Sir John: "An account of a remarkable frost on the 23d, 1783", *Philosophical Transactions, of the Royal Society of London* (74:2) 1784 (p. 416-419).

D'Arrigo, Rosanne et al: "The anomalous winter of 1783-1784: Was the Laki eruption or an analog of the 2009-2010 winter to blame?" *Geophysical Research Letters* (38) L05706, doi:10.1029/2011GL046696, 2011 (p. 1-4).

Demarée, G.R. and Ogilvie, A.E.J: "*Bons Baisers d'Islande*: Climatic, Environmental, and Human Dimensions Impacts of the *Lakagígar* Eruption (1783-1784) in Iceland", *History and Climate. Memories of the Future?* Edited by P. D. Jones et al. New York: Kluwer Academic / Plenum Publishers, 2001 (p. 219-247).

Demarée, Gaston R: "The *Ancien Régime* Instrumental Meteorological Observations in Belgium or the Physician with Lancet and Thermometer in the Wake of Hippocrates", *Sartomania* (17) 2004 (p. 12-42).

Demarée, Gaston R: "The Catastrophic floods of February 1784 in and around Belgium – a Little Ice Age event of frost, snow, river ice … and floods", *Hydrological Sciences-Journal-des Sciences Hydrologiques* (51:5) 2006 (p. 878-898). (Special Issue: *Historical Hydrology*).

Diamond, Jared: *Collapse. How Societies Choose to Fail or Survive*. London: Penguin Group, 2006.

Dictionary of Scientific Biography. Edited by Charles Coulston Gillispie. Volume 7. New York: Charles Scribner's Sons, 1973.

Dreadful Visitations. Confronting Natural Catastrophe in the Age of Enlightenment. Edited by Alessa Jones. New York: Routledge, 1999.

Einarsson, Þorleifur and Sveinsdóttir, Edda Lilja: "Nýtt kort af Skaftáreldahrauni og Lakagígum", *Skaftáreldar 1783-1784. Ritgerðir og Heimildir*. Edited by Gísli Ágúst Gunnlaugsson et al. Reykjavík: Mál og Menning, 1984 (p. 37-49).

Encyclopedia of Volcanoes. Edited by Haraldur Sigurdsson. San Diego: Academic Press, 2000.

Finnsson, Hannes: *Mannfækkun af Hallærum*. Reykjavík: Almenna Bókafélagið, 1970. (Bókasafn AB. Íslenskar Bókmenntir).

Flannery, Tim: *The Weather Makers. The History and Future Impact of Climate Change*. London: Allen Lane, 2006.

Fleming, James Rodger: *Historical Perspectives on Climate Change*. New York: Oxford University Press, 1998.

Franklin, Benjamin: "Meteorological imaginations and conjectures", *The Papers of Benjamin Franklin, in Philosophy, Politics, and Morals*: *Containing, besides all the Writings Published in Former Collections, His Diplomatic Correspondence, as Minister of the United States, at the Court of Versailles; A Variety of Literary Articles, and Epistolary Correspondence, Never before Published. With Memoirs and Anecdotes of His Life*. Volume 3. Philadelphia: Printed and Published by William Duane, 1808 (p. 287-289).

Geikie, Sir Archibald: *Text-Book of Geology*. Volume 1. Fourth Edition. London: Macmillan, 1903.

Glacken, Clarence J: *Traces on the Rhodian Shore. Nature and Culture in Western Thought from Ancient Times to the End of the Eighteenth Century*. Berkley: University of California Press, 1967.

Goethe, Johann Wolfgang von: *Hermann und Dorothea*. Wien, 1925. (Bunte Jugendschriften).

Golinski, Jan: *British Weather and the Climate of the Enlightenment*. Chicago: The University of Chicago Press, 2007.

Grattan, John and Brayshay, Mark: "An Amazing and Portentous Summer: Environmental and Social Responses in Britain to the 1783 Eruption of an Iceland Volcano", *The Geographical Journal* (161:2) 1995 (p. 125-134).

Grattan, John and Charman, Daniel J: "Non-climatic factors and the environmental impact of volcanic volatiles. Implications of the Laki Fissure eruption of AD 1783", *The Holocene* (4) 1994 (p. 101-106).

Grattan, J. P. and Pyatt, F. B: "Acid damage to vegetation following the Laki fissure eruption in 1783. An historical review", *Science of the Total Environment* (151:3) 1994 (p. 241-247).

Grattan, John: "Pollution and paradigms: lessons from Icelandic volcanism for continental flood basalt studies", *Lithos* (79) 2005 (343-353).

Grattan, John et al: "'The end is nigh'? Social and environmental responses to volcanic gas pollution", *Natural Disasters and Cultural Change*. Edited by Robin Torrence and John Grattan. London: Routledge, 2002 (p. 87-107).

Grattan, John et al: "The Long Shadow: Understanding the Influence of the Laki Fissure Eruption on Human Mortality in Europe", *Living Under the Shadow. Cultural Impacts of Volcanic Eruptions*. Edited by John Grattan and Robin Torrence. Walnut Creek: Left Coast Press inc., 2007 (p. 153-175).

Grattan, John, et al: "Volcanic air pollution and mortality in France 1783-1784", *C. R. Geoscience* (337) 2005 (641-651).

Grimm, Jacob and Grimm, Wilhelm: *Deutsches Wörterbuch von Jacob Grimm und Wilhelm Grimm*. Volume 10. Leipzig: Verlag von S. Hirzel, 1877.

Gunnarsson, Gisli: *Monopoly Trade and Economic Stagnation. Studies in the Foreign Trade of Iceland 1602-1787*. Lund: Ekonomisk-historiska föreningen, 1983. (Skrifter XXXVIII).

Gunnlaugsson, Gísli Ágúst: "Viðbrögð stjórnvalda í Kaupmannahöfn við Skaftáreldum", *Skaftáreldar 1783-1784. Ritgerðir og Heimildir*. Edited by Gísli Ágúst Gunnlaugsson et al. Reykjavík: Mál og Menning, 1984 (p. 187-215).

Hallion, Richard P: *Taking Flight. Inventing the Aerial Age from Antiquity through the First World War*. Oxford: Oxford University Press, 2003.

Hamblyn, Richard: *Terra. Tales of the Earth*. London: Picador, 2009.

Hamblyn, Richard: *The Invention of Clouds. How an Amateur Meteorologist Forged the Language of the Skies*. London: Picador, 2002.

Hamilton, Sir William: "An Account of the Earthquakes which happened in Italy, from February to May 1783", *Philosophical Transactions, of the Royal Society of London* (73:1) 1783 (p. 169-208).

Hálfdanarson, Guðmundur: "Mannfall í Móðuharðindunum", *Skaftáreldar 1783-1784. Ritgerðir og Heimildir*. Edited by Gísli Ágúst Gunnlaugsson et al. Reykjavík: Mál og Menning, 1984 (p. 139-163).

"Heimildir til sögu Skaftárelda", *Skaftáreldar 1783-1784. Ritgerðir og Heimildir*. Edited by Gísli Ágúst Gunnlaugsson et al. Reykjavík: Mál og Menning, 1984 (p. 265-436).

Historical Disasters in Context. Science, Religion, and Politics. Edited by Andrea Janku et al. New York: Routledge, 2012.

Hochadel, Oliver: ""In Nebula Nebulorum". The Dry Fog of the Summer of 1783 and the Introduction of Lightning Rods in the German Empire", *Playing with Fire. Histories of the Lightning Rod*. Edited by Peter Heering et al. Philadelphia: American Philosophical Society, 2009 (p. 45-70). (Transactions of the American Philosophical Society, New Series (99:5)).

Holm, S.M: “Account of a Remarkable Fiery Eruption from the Earth in Iceland, in the Year 1783”, *The Philosophical Magazine. Comprehending the various Branches of Science, The Liberal and Fine Arts, Agriculture, Manufactures, and Commerce. By Alexander Tilloch, member of the London Philosophical Society* (3) 1799 (p. 113-120).

Holm, S. M: *Om Jordbranden paa Island i Aaret 1783*. Copenhagen: Peder Horrebow, 1784.

Holm, S. M: *Vom Erdbrande auf Island im Jahr 1783. Durch S. M. Holm, S. S. Theol. Cand. Aus den Dänischen übersetzt mit zwei Landkarten erläutert*. Copenhagen: E. G. Prost, 1784.

Holmes, Richard: *The Age of Wonder. How the Romantic Generation Discovered the Beauty and Terror of Science*. London: HarperPress, 2008.

Hufeland, Leibarzt und Volkerzieher. Selbstbiographie von Christoph Wilhelm Hufeland. Edited by Walter von Brunn. Stuttgart: Lutz, 1937.

Jacoby, Gordon C. et al: “Laki eruption of 1783, tree rings, and disaster for northwest Alaska Inuit”, *Quaternary Science Reviews* (18) 1999 (p. 1365-1371).

Jacques, E. et al: “Faulting and earthquake triggering during the 1783 Calabria seismic sequence”, *Geophysical Journal International* (147:3) 2001 (p. 499-516).

Journals of Gilbert White. Edited by Walter Johnson. London: Futura, 1982. (The Heritage Series).

Jónsson, Guðmundur: “Changes in Food Consumption in Iceland *ca*. 1770-1940”, *Kultur och konsumption i Norden 1750-1950*. Edited by John Söderberg and Lars Magnusson. Helsingfors: Finska historiska samfundet, (p. 37-60).

Jónsson, Guðmundur: “Mannfjöldatölur 18. aldar endurskoðaðar”, *Saga* (32) 1994 (p. 153-158).

Karlsson, Gunnar: *Iceland’s 1100 years. The History of a Marginal Society*. London: Hurst, 2000.

Kington, John A: *Climate and Weather*. London: Collins, 2010. (The New Naturalist Library).

Kington, John: *The weather of the 1780’s over Europe*. Cambridge: Cambridge University Press, 1988.

Lamanon, [Robert Paul de]: “Observations on the Nature of the Fog of 1783”, *The Philosophical Magazine. Comprehending the various Branches of Science, The Liberal and Fine Arts, Agriculture, Manufactures, and Commerce. By Alexander Tilloch, member of the London Philosophical Society, &c* (5) 1799 (p. 80-89).

Lamb, H. H: “Volcanic Dust in the Atmosphere; With a Chronology and Assessment of its Meteorological Significance”, *Philosophical Transactions of the Royal Society of London* (266:1178) 1970 (p. 425-533). (Series A, Mathematical and Physical Sciences).

Laxness, Einar: “Á 200 ára afmæli Skaftárelda”, *Dynskógar* (3) 1985 (p. 97-118).

Le Roy Ladurie, Emmanuel: *Times of Feast, Times of Famine*: *A History of Climate since the Year 1000*. London: George Allen & Unwind Ltd., 1972.

Lichtenberg, Georg Christoph: *Briefwechsel*. Edited by Ulrich Joost and Albrecht Schöne. Volume 2. Munich: Beck, 1985.

Living Under the Shadow. *Cultural Impacts of Volcanic Eruptions*. Edited by John Grattan and Robin Torrence. Walnut Creek: Left Coast Press inc., 2007.

Mabey, Richard: *Gilbert White*. *A Biography of the Author of the Natural History of Selborne*. London: Pimlico, 1999.

Martin, Craig: *Renaissance Meteorology*. *Pomponazzi to Descartes*. Baltimore: The John Hopkins University Press, 2011.

McGuire, Bill: *Waking the Giant*. *How a changing climate triggers earthquakes, tsunamis, and volcanoes*. New York: Oxford University Press, 2012.

Mourgue de Montredon, M: “Recherches Sur l’origine & sur la nature des Vapeurs qui ont régné dans l’Atmosphére pendant l´été de 1783”, *Historie de l‘Académie Royale des Sciences avec les Mémoires de Mathématique et de Physique pour l‘Ánnée 1781*. Paris: Imprimerie Royale, 1784 (754-773).

Myllyntaus, Timo: “Summer Frost: A Natural Hazard with Fatal Consequences in Preindustrial Finland”, *Natural Disasters, Cultural Responses*. *Case Studies toward a Global Environmental History*. Edited by Christof Mauch and Christian Pfister. Lanham: Lexington Books, 2009 (p. 77-103).

Natural Disasters and Cultural Change. Edited by Robin Torrence and John Grattan. London: Routledge, 2002.

Natural Disasters, Cultural Responses. *Case Studies toward a Global Environmental History*. Edited by Christof Mauch and Christian Pfister. Lanham: Lexington Books, 2009.

Ogilvie, Astrid E. J. and Pálsson, Gísli: “Mood, Magic, and Metaphor: Allusions to Weather and Climate in the *Sagas of Icelanders*”, *Weather, Climate, Culture*. Edited by Sarah Strauss and Ben Orlove. Oxford: Berg, 2003 (p. 251-274).

Ogilvie, Astrid E. J: “The climate of Iceland, 1701-1784”, *Jökull* (36) 1986 (p. 57-73).

Oman, Luke et al: “High-latitude eruptions cast shadow over the African monsoon and the flow of the Nile”, *Geophysical Research Letters* (33) L18711, doi:10.1029/2006GL027665, 2006 (p. 1-5).

Oppenheimer, Clive: *Eruptions that Shook the World*. Cambridge: Cambridge University Press, 2011.

Oslund, Karen: *Iceland Imagined. Nature, Culture, and Storytelling in the North Atlantic*. Seattle: University of Washington Press, 2011.

Oslund, Karen: “Imagining Iceland: Narratives of Nature and History in the North Atlantic”, *The British Journal for the History of Science* (35:3) 2002 (p. 313-334).

Payne, Richard J: “Meteors and perceptions of environmental change in the *annus mirabilis* AD 1783-4”, *North West Geography* (11:1) 2011 (p. 18-28).

Pétursson, Guðmundur et al: “Um eituráhrif af völdum Skaftárelda”, *Skaftáreldar 1783-1784. Ritgerðir og Heimildir*. Edited by Gísli Ágúst Gunnlaugsson et al. Reykjavík: Mál og Menning, 1984 (p. 81-99).

Pfister, Christian: “Die Lufttruebungserscheinung des Sommers 1783 in der Sicht schweizerischer Beobachter”, *Informationen und Beitraege zur Klimaforschung*. Edited by Dori Florin and Heinz Wanner. Bern: Geographisches Institut der Universität Bern, 1972 (p. 23-31).

Pfister, Christian: “Learning from Nature-Induced Disasters: Theoretical Considerations and Case Studies from Western Europe”, *Natural Disasters, Cultural Responses. Case Studies toward a Global Environmental History*. Edited by Christof Mauch and Christian Pfister. Lanham: Lexington Books, 2009 (p. 17-47).

Pilgram, Anton: *Anton Pilgrams Untersuchungen über das Wahrscheinliche der Wetterkunde durch vieljährige Beobachtungen*. Wien: Joseph Edlen von Kurzbeck, k. k. Hofbuchdrucker, 1788.

Post, John D: *The Last Great Subsistence Crisis in the Western World*. Baltimore: John Hopkins University Press, 1977.

Press, Politics and the Public Sphere in Europe and North-America 1760-1820. Edited by Hannah Barker and Simon Burrows. Cambridge: Cambridge University Press, 2002.

Rafnsson, Sveinbjörn: “Búfé og byggð við lok Skaftárelda og Móðuharðinda”, *Skaftáreldar 1783-1784. Ritgerðir og Heimildir*. Edited by Gísli Ágúst Gunnlaugsson et al. Reykjavík: Mál og Menning, 1984 (p. 163-179).

Robock, Alan: “Volcanic Eruptions and Climate”, *Reviews of Geophysics* (38:2) 2000 (p. 191-219).

Scarth, Alwyn: *La Catastrophe. Mount Pelée and the destruction of Saint-Pierre, Martinique*. Harpenden: Terra Publishing, 2002.

Scarth, Alwyn: *Vulcan's Fury. Man against the Volcano*. New Haven: Yale University Press, 1999.

Schiff, Stacy: *A Great Improvisation. Franklin, France, and the Birth of America*. New York: Owl Book, 2006.

Schmidt, Anja et al: "Excess mortality in Europe following a future Laki-style Icelandic eruption", *PNAS* (108:38) 2011, (p.15710-15715).

Self, Stephen: "Effects of volcanic eruptions on the atmosphere and climate", *Volcanoes and the Environment*. Edited by Joan Martí and Gerald Ernst. Cambridge: Cambridge University Press, 2005 (p. 152-172).

Sigurdsson, Haraldur: *Melting the Earth. The History of Ideas on Volcanic Eruptions*. New York: Oxford University Press, 1999.

Simkin, Tom, Siebert, Lee and Kimberly, Paul: *Volcanoes of the World*. Third Edition. Washington: Smithsonian Institution, 2010.

Skaftáreldar 1783-1784. Ritgerðir og Heimildir. Edited by Gísli Ágúst Gunnlaugsson et al. Reykjavík: Mál og Menning, 1984.

"Skýrslur um Skaptárgosin", *Safn til Sögu Íslands og Íslenzkra Bókmennta að Fornu og Nýju*. Volume 4. Copenhagen: Hið Íslenzka Bókmenntafélag, 1907 (p. 1-57).

Sontag, Susan: *The Volcano Lover. A Romance*. Lodon: Cape, 1992.

Steinberg, Ted: *Acts of God. The Unnatural History of Natural Disaster in America*. Second Edition. Oxford: Oxford University Press, 2006.

Steingrímsson, Jón: *Fires of the Earth. The Laki Eruption 1783-1784 by the Rev. Jón Steingrímsson*. Reykjavík: University of Iceland Press and the Nordic Volcanological Institute, 1998.

Steinþórsson, Sigurður: "Annus mirabilis. 1783 í erlendum heimildum", *Skírnir* (166) 1992 (p. 133-155).

Stephensen, Magnus: *Kort Beskrivelse over den nye Vulcans Ildsprudning i Vester-Skaptefields-Syssel paa Island i Aaret 1783. Efter Kongelig allernaadigste Befaling forfattet, og ved det Kongelige Rentekammers Foranstaltning udgiven*. Copenhagen: Paa Forfatterens Bekostning, 1785.

Stephensen, Magnus: "Nachricht von den schrecklichen Unglücksfällen, welche Island in dem Jahre 1783 und 1784 betroffen haben", *Hannoverisches Magazin* (14) 1786 (p. 218-224).

Stephensen, Magnus: "Nachricht von den schrecklichen Unglücksfällen, welche Island in dem Jahre 1783 und 1784 betroffen haben", *Hannoverisches Magazin* (15) 1786 (p. 225-232).

Stothers, Richard B. and Rampino, Michael R: "Volcanic Eruptions in the Mediterranean before A. D. 630. From Written and Archeological Sources", *Journal of Geophysical Research* (88:B8) 1983 (p. 6357-6371).

Stothers, Richard B: "The Great Dry Fog of 1783", *Climate Change* (32) 1996 (p. 79-89).

Stothers, Richard B: "Volcanic Dry Fogs, Climate Coolings, and Plague Pandemics in Europe and the Middle East", *Climate Change* (42) 1999 (p. 713-723).

Strömmer, Elisabeth: *Klima-Geschichte. Methoden der Rekonstruktion und historische Perspektive. Ostösterreich 1700-1830*. Wien: Deuticke, 2003. (Forschungen und Beiträge zur Wiener Stadtgeschichte 39).

Sunley, Christina: *The Tricking of Freya*. New York: St. Martin's Press, 2009.

The Letters and Prose Writings of William Cowper. Edited by James King and Charles Ryskamp. Volume 2. Oxford: Clarendon Press, 1981.

The Papers of Benjamin Franklin. Edited by Barbara B. Oberg. Volume 40. New Haven and London: Yale University Press, 2011.

The Poems of William Cowper. Edited by John D. Baird and Charles Ryskamp. Volume 3. Oxford: Claredon, 1995.

The Yale Edition of Horace Walpole's Correspondence. With Sir Horace Mann and Sir Horace Mann the Younger. Edited by W. S. Lewis and A. Dayle Wallace. Volume 25. New Haven: Yale University Press, 1971.

The Yale Edition of Horace Walpole's Correspondence. With the Countess of Upper Ossory. Edited by W. S. Lewis and A. Dayle Wallace. Volume 33. New Haven: Yale University Press, 1965.

The Yale Edition of Horace Walpole's Correspondence. With John Chute, Richard Bentley, the Earl of Strafford, Sir William Hamilton, the Earl and Countess Harcourt, [and] *George Hardinge*. Edited by W. S. Lewis and A. Dayle Wallace. Volume 35. New Haven: Yale University Press, 1973.

The Year without a Summer. World Climate in 1816. Edited by C. R. Harrington. Ottawa: Canadian Museum of Nature, 1992.

Thorarinsson, Sigurður: "Annáll Skaftárelda". *Skaftáreldar 1783-1784. Ritgerðir og Heimildir*. Edited by Gísli Ágúst Gunnlaugsson et al. Reykjavík: Mál og Menning, 1984 (p. 11-37).

Thorarinsson, Sigurdur: "Greetings from Iceland. Ash-falls and volcanic aerosols in Scandinavia", *Geografiska Annaler. Series A, Physical Geography*. (63:3/4) 1981 (p. 109-118).

Thorarinsson, Sigurður: "Neðansjávargos við Ísland", *Náttúrufræðingurinn* (35:2) 1965 (p. 49-74).

Thorarinsson, Sigurdur: "Population Changes in Iceland", *Geographical Review* (51:4) 1961 (p. 519-533).

Thordarson, Thor and Hoskuldsson, Armann: *Iceland.* Harpenden: Terra Publishing, 2002. (Classic Geology in Europe 3).

Thordarson, Thorvaldur and Self, Stephen: "Atmospheric and environmental effects of the 1783-1784 Laki eruption: A review and assessment", *Journal of Geophysical Research* (108:D1) 4011, doi:10.1029/2001JD002042, 2003 (p. 1-29).

Thordarson, Thorvaldur: "Perception of Volcanic Eruptions in Iceland", *Landscapes and Societies. Selected Cases*. Edited by I. Peter Martini and Ward Chesworth. Dordrecht: Springer, 2010 (p. 285-296).

Thordarson, Thorvaldur: "The 1783-1785 A.D. Laki-Grímsvötn eruptions I: A critical look at the contemporary chronicles", *Jökull* (53) 2003 (p. 1-10).

Thordarson, Thorvaldur et al: "The 1783-1785 A.D. Laki-Grímsvötn eruptions II: Appraisal based on contemporary accounts", *Jökull* (53) 2003 (p. 11-48).

Thordarson, Thorvaldur: *Volatile release and atmospheric effects of basaltic fissure eruptions*. Thesis Ph.D. University of Hawaii at Manoa, 1995.

Thoroddsen, Þorvaldur: "Eldreykjarmóðan 1783", *Afmælisrit til Dr. Phil. Kr. Kålunds Bókavarðar við Safn Árna Magnússonar. 19. Ágúst 1914*. Copenhagen: Hið Íslenska Fræðafjelag í Kaupmannahöfn, 1914.

Toaldo, [Giuseppe]: "Meteorological Observations mate at Padua in the Month of June 1783, with a Dissertation on the extraordinary Fog which prevailed about that Time", *The Philosophical Magazine. Comprehending the various Branches of Science, The Liberal and Fine Arts, Agriculture, Manufactures, and Commerce. By Alexander Tilloch, member of the London Philosophical Society* (4) 1799 (p. 417-423).

Van Swinden, [Jan Hendrik]: "Observations on the cloud (dry fog) which appeared in June 1783", *Jökull* (50) 2001 (p. 73-80).

Vasey, Daniel E: "A quantitative assessment of buffers among temperature variations, livestock, and the human population of Iceland, 1784 to 1900", *Climate Change* (48) 2001 (p. 243-263).

Vasey, Daniel E: "Population, Agriculture, and Famine: Iceland, 1784-1785", *Human Ecology* (19:3) 1991 (p. 323-350).

Verne, Jules: *Journey to the Center of the Earth*. Ware (Hertfordshire): Wordsworth Editions Limited, 1996.

Volcanic Activity and Human Ecology. Edited by Payson D. Sheets and Donald K. Grayson. New York: Academic Press, 1979.

Weber, Eugen: *Peasants into Frenchmen. The Modernization of Rural France 1870-1914*. Stanford: Stanford University Press, 1976.

White, Gilbert: *The Natural History of Selborne*. Edited by James Fischer. Harmondsworth: Allen Lane, 1941.

Wilson, Derek: *Britain's Rottenest Years*. London: Short Books, 2009.

Witham, Claire S. and Oppenheimer, Clive: "Mortality in England during the 1783-4 Laki Craters eruption", *Bulletin of Volcanology* (67) 2005 (p. 15-26).

Wolloch, Nathaniel: *History and Nature in the Enlightenment. Praise of the Mastery of Nature in Eighteenth-Century Historical Literature*. Farnham: Ashgate, 2011.

Wood, Charles A: "Climatic Effects of the 1783 Laki Eruption", *The Year without a Summer. World Climate in 1816*. Edited by C. R. Harrington. Ottawa: Canadian Museum of Nature, 1992 (p. 58-78).

Wrigley, Edward A. and Schofield, Roger S: *The Population History of England 1541-1871. A Reconstruction*. First paperback edition. Cambridge: Cambridge University Press, 1989.

Zeilinga de Boer, Jelle and Sanders, Donald Theodore: *Volcanoes in Human History. The Far-Reaching Effects of Major Eruptions*. Princeton: Princeton University Press, 2002.

Zuidervaart, Huib J: "An Eighteenth-Century Medical-Meteorological Society in the Netherlands. An Investigation of Early Organizations, Instrumentation and Quantification. Part 1", *The British Journal for the History of Science* (38:4) 2005 (p. 379-410).

Þorsteinsson, Björn and Jónsson, Bergsteinn: *Íslandssaga til okkar daga*. Reykjavík: Sögufélag, 1991.

Newspapers and Magazines

Münchner gelehrte Zeitung (8) 1783.

Münchner Zeitung (01.06.1783 – 01.10.1783).

New Scientist (21.05.2005)

Pressburger Zeitung (01.06.1783 – 01.10.1783).

The Economist (19.12.2007)

The European Magazine, and London Review; Containing the Literature, History, Politics, Arts, Manners, and Amusements of the Age. By the Philosophical Society of London. For July 1783.

The Gentleman's Magazine: And Historical Chronicles (53:2) 1783.

Wiener Zeitung (01.06.1783 – 01.10.1783).

Wittenberger Wochenblatt (26) 1783.

Sources from the Internet

Pies, Norbert J: *Naturkatastrophen 1783*. (Webpage last visited: 26.10.2013). Retrieved from: http://www.njpies.de/naturkatastrophe.html

U.S. Geological Survey: *Understanding Plate Motions*. (Webpage last visited: 26.10.2013). Retrieved from: http://pubs.usgs.gov/gip/dynamic/understanding.html

U.S. Geological Survey: *Volcanic Gases and Their Effects*. (Webpage last visited: 26.10.2013). Retrieved from: http://volcanoes.usgs.gov/hazards/gas/

Wikisource: *Icelandic volcanoes, 1783-4*: *contemporary reports*. (Webpage last visited: 26.10.2013). Retrieved from:
http://en.wikisource.org/wiki/Icelandic_volcanoes,1783-4:_contemporary_reports

Film Documentaries

British Broadcasting Corporation (BBC): *Killer Cloud*. BBC Timewatch Series 2007.

Public Broadcasting Service (PBS): *Doomsday Volcano*. Nature Documentary. (PBS Nova Series 2013).