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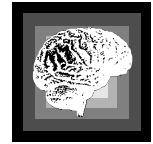
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Ergotism in Norway. Part I: The symptoms and their interpretation from the late Iron Age to the seventeenth century

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Abstract

Ergotism is a horrendous disease with grotesque symptoms caused by ingesting specific ergot alkaloids. Mass poisoning episodes are attributable to consumption of grain – usually rye – infected with the fungus *Claviceps purpurea*. By focusing on possible cases of ergotism, we re-examine Norwegian history from the sagas through to the end of the seventeenth century. Our review – not intended to be exhaustive, or *post facto* to assign medical or psychiatric labels – draws attention to the very real possibility that many remarkable medical cases may have been the result of the ingestion of highly poisonous and psychoactive food substances. Where possible we highlight explanations given at the time – often rooted in religion or demonology – to explain the disease.

Keywords

Ergot alkaloid, fungus, gangrene, Norway, psychoactive

Introduction

Ergotism is a general term for the disease caused by consuming grain infested with the fungus *Claviceps purpurea*. Ergotism in humans was rampant during the Middle Ages (Matossian, 1989), causing numerous epidemics of mass poisoning, although the nature of the disease, and its cause, were not understood. It was interpreted within a religious context as *ignis sacer* or ‘holy fire’. St Anthony, whose ordeals suggest that he might have suffered from ergotism, was venerated as a patron saint of those affected by *Claviceps* poisoning, and monasteries dedicated to his honour

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took care of the victims. Heusinger (1856: 12–14) listed 83 epidemics of ergotism in various parts of Europe from AD 945 onwards, and the list is certainly not complete.

Numerous grass species are prone to ergot infection, but ergot in grain species is what matters in terms of human illness. Various grain species, including for example wheat (*Triticum aestivum*), rice (*Oryza sativa*) and maize (*Zea mays*), are the most important source of human food on a global scale (van Wyk, 2005). However, rye (*Secale cereale*) is by far the most vulnerable species, and most (but not all) European episodes of mass poisoning have been due to ergot-infected rye. Rye grows well in cool areas that have poor drainage and acid soils (the type of area in which wheat does not do well). Unfortunately, *Claviceps purpurea* thrives in conditions that are constantly damp.

In infected plants, the grain (botanical term: caryopsis) is supplanted by the somewhat larger sclerotia of the fungus, which may contain a range of toxic ergot alkaloids. Their black colour serves as a warning signal to grazing animals (Lev-Yadun and Halpern, 2007), but is not especially effective. Although animals will avoid ergot if they have alternative food (Heusinger, 1856: 7), poisoning of livestock and cervids (e.g. deer) is well known in Norway and elsewhere (Barger, 1931: 102–103; Handeland and Vikøren, 2005; Spooft, 1872: 62–63). Humans, to their cost, are much more likely to ignore the warning.¹

The chemical composition of ergot is complex and variable (Haarmann, Rolke, Goesbert and Tudzynski, 2009; van Dongen and de Groot, 1995). Ergot alkaloids are structurally similar to serotonin which is present in nervous tissue in warm-blooded animals. It plays a central role in the biochemistry of behaviour, especially since ergot alkaloids are serotonin agonists. Thus, ergot causes vasoconstriction by acting on the muscles of the arterioles, and repeated doses of ergot eventually damage the vascular endothelium. Continual damage will result in a reduction of blood flow and eventually lead to terminal necrosis of the extremities. Additionally, ergot causes stimulation of the central nervous system followed by a variety of mental states (due to its potent dopaminergic, serotonergic and adrenergic agonist properties), often depression and, in some cases, death. Crucially, the pharmacological effects vary between individual alkaloids, with different strains of *Claviceps purpurea* and different soils all potentially resulting in different ergot alkaloid compositions. A whole range of ergot alkaloids have been detected, of which several are poisonous and some are psychoactive. Others are still unknown, certainly in terms of their effect on humans. Indeed, a recent study of ergot on wild grasses in Norway uncovered a range of previously unknown ergot alkaloids (Uhlig, Vikøren, Ivanova and Handeland, 2007; see also Uhlig and Petersen, 2008). Other ergot alkaloids are well known and studied, due to their medicinal use. When ingested, some ergot alkaloids have dramatic vasoconstrictive effects; crude ergot (usually two to three sclerotia) was a popular remedy during the nineteenth century, and was much (and rather indiscriminately) used to speed up childbirth, especially in the USA (De Costa, 2002; Moir, 1974; Oginz, 1930; Ringrose, 1962). In the twentieth century, ergometrine became a favourite drug to stop post-partum haemorrhage (De Costa, 2002). Ergotamine has been used as a remedy for migraine for about 60 years (Eadie, 2004; Tfelt-Hansen et al., 2000), but has now been largely replaced by triptans.

Traditionally, two different forms of ergotism have been recognized: gangrenous and convulsive. According to European records, convulsive ergotism was predominant in the areas east of the Rhine (e.g. Germany), and the gangrenous type in France and other areas west of the Rhine (Barger, 1931: 20). This broad, geographical pattern must reflect variations in ergot alkaloid composition; this was previously assumed to vary according to conditions during the growth season (e.g. weather) and to the host plant parasitized (Matossian, 1989; Pažotouvá and Parberry, 1999). However, a recent study of chemoraces by Pažotouvá et al. (2000) suggests that *Claviceps* populations are not specialized in

terms of hosts, but rather in terms of habitats, which are obviously interconnected with climatic conditions. If harvested for food or fodder, toxicity may also be affected by storage and transport conditions, and the time involved, as ergot alkaloids are generally assumed to degrade over time (e.g. some over 18 months), though studies of this aspect seem to be lacking.²

The symptoms of ergotism

Despite the general categorization as ‘gangrenous’ and ‘convulsive’ (Barger, 1931), ergotism may take on very different, strange and partly unpredictable forms. Medical descriptions of the disease are available for several episodes of mass poisoning during the nineteenth century (e.g. the excellent account given by Heusinger (1856) of ergotism in Oberhessen, Germany, in 1855–6). In the late nineteenth and early twentieth centuries, the psychiatric effects of ergotism were also studied, in particular in Germany. Based on these and other studies, a long list of possible effects of ergot poisoning may be compiled. Some are common, others seemingly rare.

The first symptoms of disease may occur within one hour of consuming ergot (Spooft, 1872: 13). As in many other kinds of poisoning, general weakness, headache, nausea, vomiting, stomach troubles, and diarrhoea are frequently encountered (Demeke, Kidane and Wuhib, 1979; Heusinger, 1856; Menche, 1883; Spooft, 1872; Wichmann, 1771). These may be the only symptoms during the initial phase, which may last for several weeks (Menche, 1883: 258). Excessive salivation and sweating, strong thirst and stinking faeces are other symptoms (Spooft, 1872: 13–14), whereas the appetite is usually not, or only temporarily, affected (Franque, 1856: 340; Menche, 1883; Spooft, 1872: 13, 47; Wagner, 1839: 25; Wichmann, 1771: 16), and ravenous hunger was observed in some individuals (e.g. by Franque, 1856: 337).

Gangrene

The use of ergotamine to treat headaches is based on its remarkable vasoconstrictor effect. This is also one of the most dangerous and potentially lethal effects of ergot poisoning and ergotism. By constricting the blood vessels, ergotism may lead to gangrene, most frequently of the peripheral parts of the body, especially hands and feet (Barger, 1931; Demeke et al., 1979). Cold and pale skin is an early signal of ergotism (Hudgson and Hart, 1964). Serious cases are soon followed by a blue or black discoloration of the skin (Spooft, 1872: 13), which can desquamate (i.e. shed) (Demeke et al., 1979: 109; Spooft, 1872: 47). The ‘dry’ form of gangrene caused by ergotism may cause fingers, toes or limbs to turn black, and drop off piecemeal at the joints (Barger, 1931: 30; for photographic evidence, see Demeke et al., 1979). Due to the constricted state of the blood vessels, no blood issues from the wounds (Barger, 1931: 30). In less serious cases, only finger-nails are lost, sometimes also the hair (Heusinger, 1856: 74; Spooft, 1872: 47). Victims have often reported feelings of burning heat or intense cold (Spooft, 1872: 40): the *ignis sacer* or ‘holy fire’ of medieval records, which consumed bodies and often left only ‘charred’ remains of the limbs. Those affected by intense ‘heat’ would sometimes seek the outdoors, or immerse their bodies in cold water for relief (Barger, 1931: 30).

Convulsions

Convulsive ergotism is the second ‘main’ form of the disease (Eadie, 2003), though the convulsions may take many forms, from epileptic fits to painful muscular contractions (Franque, 1856; Wagner, 1839: 25ff.). The latter are particularly characteristic; Heusinger (1856: 74) found them in

most (72.2%) of his 54 patients. Those afflicted may suffer painful, involuntary flexions of fingers and wrists (Eadie, 2003: 431), which may be 'locked' so strongly that they are impossible to open without breaking (for illustrations, see Heusinger, 1856).

In more serious cases, the whole body may suffer 'tetanus-like' cramps, being bent backwards and turned more or less into the shape of a ball. The convulsions may last for minutes to hours, and are often recurring (Barger, 1931: 32; Eadie, 2003: 432). They cause intense pain, and the afflicted often cry out loudly when a convulsion starts (Menche, 1883; Spooft, 1872: 44). The frequency varies considerably. According to Spooft (1872: 44), some patients might suffer a convulsion from once to 15 times within a 24-hour period, others only once or twice week, or even less; each attack typically lasts for half an hour to one or two hours. During these, patients often lose consciousness (Spooft, 1872: 44). Cramps may also cause difficulty in breathing (Spooft, 1872: 44–5; Wichmann, 1771: 26). Epileptic fits have been frequently reported (Menche, 1883; Spooft, 1872: 49). The patients studied by Wichmann (1771), Franque (1856), Heusinger (1856) and Menche (1883: 259) often had trouble walking, and the limbs were more or less stiff (Heusinger, 1856; Spooft, 1872: 14).

Formication

Formication (cf. the ant genus *Formica*) is an eerie feeling that 'insects' or other living organisms are crawling beneath the skin. It is a frequent symptom of ergotism (Barger, 1931: 33; Franque, 1856: 338; Heusinger, 1856: 74; Spooft, 1872: 14, 41; Wagner, 1839: 25ff.; Wichmann, 1771). Demeke et al. (1979: 109) reported formication in 15 % of their 93 patients. These crawling sensations, frequently reported, for example, by German victims of ergotism (Menche, 1883; Heusinger, 1856), have given rise to the German vernacular *Kriebelkrankheit* for the disease. Menche (1883: 258) considered this to be the first, characteristic symptom of ergotism, soon (and sometimes immediately) followed by convulsions. In later stages, formication may even be visible, due to twitching of small muscle fibres (Barger, 1931: 33; Franque, 1856: 340).

Absent reflexes

A very typical symptom in many German nineteenth-century victims of ergotism was the absence of a proper knee reflex (Barger, 1931: 36; Heusinger, 1856; Menche, 1883). More recently, Hudgson and Hart (1964) also noted the absence of deep tendon reflexes in an Australian patient.

Difficulty in speaking

The muscles of the tongue can be affected. Finnish doctors reported that this was sometimes an early symptom, leading to a change of voice, 'stiff' talking, or a reduced ability to speak; some victims destroyed their own tongue by biting it. In some, the mouth was fixed in a wide-open position, and the patient was unable to close it (Spooft, 1872: 41, 44). Those who survived severe poisoning sometimes remained speechless.

Disturbed senses

Ergotism affects the senses in numerous ways. In general, a reduced sensibility is common. German nineteenth-century doctors used needles to test this (e.g. Menche, 1883), an eerie reflection of the witch-hunters' search for 'unexplainable' spots or 'witch marks'.

Eye and ear symptoms

Ergot poisoning may cause restriction or dilation of the pupils, poor or 'darkened' sight and poor reaction to light (Barger, 1931: 36; Hudgson and Hart, 1964; Menche, 1883; Spoof, 1872: 14, 40, 43). Temporary or permanent blindness is reported to occur in some patients (Heusinger, 1856: 40ff.; Merhoff and Porter, 1974: 773; Spoof, 1872: 48).

Hearing may also be affected, for example by 'ringing' in the ears (Heusinger, 1856: 31ff.; Spoof, 1872: 14), and patients may turn partially deaf (Spoof, 1872: 40, 43).

Gynaecological effects

Serious poisoning causes menstruation to stop (Heusinger, 1856; Menche, 1883: 260), and abortions might occur (Spoof, 1872: 62).

Psychiatric effects

Ergot alkaloids are derivatives of the molecule lysergic acid, and thus some ergot-induced hallucinations may be similar to that experienced after ingesting lysergic acid diethylamide (LSD), especially in terms of the shining bright colours, changes in space, and 'dangerous' attacking animals. Mental disturbance is a frequent feature of ergotism (Heusinger, 1856: 75; Kolossow, 1914; Siemens, 1881; Spoof, 1872; Wichmann, 1771: 20). Hallucinations are common both in gangrenous and convulsive ergotism (Siegel, 1985). Bechterew (1892) provided some information on the kind of 'visions' seen by Russian victims of ergotism. According to Menche (1883), mental disturbance might accompany the physical symptoms noted above, or start some weeks later. Patients are restless, and can become manic or simply 'stupid' (Menche, 1883: 259). As Tuczek (1882, 1887) and Jahrmärker (1902) have shown, ergot poisoning leads to degradation of the central nervous system and may cause permanent brain damage.

Factors affecting susceptibility to ergotism

Depending on the severity, attacks might 'come and go', followed by deep sleep. Between the attacks, patients sometimes appear unaffected and behave 'normally', whereas others get no respite from pains, formication and other symptoms (Spoof, 1872: 41–2). Death is usually preceded by an increased frequency and intensity of the attacks (Spoof, 1872: 41). As an additional horror, the corpses decayed more rapidly than is normally the case (Wichmann, 1771: 26).

The effect of ergot poisoning is also dependent on the patient's original state of health prior to ergot ingestion (Bennett and Bentley, 1999: 336). Thus, the effects of ergot may be aggravated by malnutrition, especially a lack of vitamin A (Mellanby, 1930), and pregnancy, as well as by the presence of diseases affecting the immune system, sepsis, renal or hepatic disease and thyrotoxicosis (Enge and Sivertssen, 1965; Senter, Lieverman and Pinto, 1976). Consequently, most reported cases of ergotism today are probably iatrogenic, usually secondary to ergotamine treatment for migraine; this has proved to be extremely dangerous to patients suffering from HIV, causing acute ergotism (Fröhlich, Kaplan and Amann-Vesti, 2010; Rosenkranz, Deutsch and Erdmann, 1997). Internal parasites, for example round worms, may also increase susceptibility (Barger, 1931: 28; Wählin, 1771:18). As is the case for many poisons, females are more susceptible to the effects than men. Of the 54 victims of ergotism studied by Heusinger (1856), two-thirds were female; and the majority of his patients (61.2 %) were less than 20 years old. Young people proved particularly

vulnerable in an earlier (1831–2) German epidemic (Heusinger, 1856: 19), and 56% of those affected by the Finnish epidemic of 1862 were under 10 years old (Barger, 1931: 39).

It is worth noting that all patients treated by Heusinger (1856: 30) were described as poor or destitute. Rye was usually the cheapest grain available, and the poor could not afford to throw away any part of the harvest, even if it consisted largely of ergot. Those who were better off could be more selective, and would often prefer the white flour of wheat, a species much less prone to ergot infection. Thus, the poor would be more susceptible to poisoning due to malnutrition and poor health, and still have no choice but to eat the ergot-infected grain.

Identifying ergotism

In the current context, it is important to note that some of the more grotesque symptoms of ergotism are not likely to be confused with other diseases, even those that may precipitate more or less similar symptoms.³ Patients might well survive the ‘dry’ gangrene caused by ergotism, even if it has led to the loss of whole limbs, sometimes leaving only the head and torso, whereas ‘ordinary’ gangrene often led to death in the era before the advent of antibiotics. The violent muscular contractions found in some victims of ergotism, sometimes causing the body to bend backwards into a U-shape or circle, is somewhat similar to tetanus, but patients suffering from the latter would have died within hours. Epileptic fits may be due to either epilepsy or ergotism, but in the latter case other symptoms (or the context) may point to ergotism. Mental disturbances may of course have a whole range of underlying causes, but in the case of ergotism they are often accompanied by quite clear ‘tell-tale’ physical symptoms.

Although the effects of ergotism in a single individual are in many ways unpredictable, the combination of symptoms seen in serious cases of ergotism is unique, and utterly horrific. In the words of Finnish nineteenth-century physicians, ergotism is ‘the most horrible and painful disease that can affect a human being’ (Spoof, 1872: 23). Some of the physical symptoms are indeed grotesque, and are made even more frightening by the mind-altering and hallucinogenic effects of the psychoactive components frequently found in ergot.

The Norwegian sources cited below contain a number of revealing accounts of ergotism and its symptoms. In others, ergotism may only be hinted at, and suggested as a possible source. In particular, the witch trials frequently refer to witches’ victims being affected by ‘unnatural’ disease, with no further details given – but the term itself may lead to suspicion of a disease causing extraordinary symptoms, with ergotism as an obvious possibility, not least because other Norwegian witchcraft trials provide graphic descriptions of gangrenous ergotism and a range of other symptoms (Alm, 2003a; see below). German sources refer to gangrenous ergotism, uncommon there (as opposed to the convulsive type), in similar terms, namely ‘unusual’ and ‘unheard of’ (Barger, 1931: 22).

The link with rye

Of the four major grain crops in Europe (barley, oats, rye and wheat), rye was the last to be introduced, although during the Neolithic period it was present as a weed among the other crops. According to a review by Behre (1992), rye cultivation can be traced back to the pre-Roman Iron Age in central Europe and Russia, but the main expansion occurred from about the second century AD onwards, and especially during the European migration period, about 300–700.⁴ A further increase took place during the medieval period.

The main reasons for introducing rye may have been changes in technology, and the fact that it thrives on poorer soils than the other grain plants (Behre, 2002: 149ff.). Unfortunately rye,

being wind-pollinated (and not self-pollinated as the other main grains), is much more prone to becoming infected with ergot. It is no coincidence that the first reports of major outbreaks of ergotism in Europe are contemporary with the spread of rye as a major crop. The Romans regarded rye as an inferior grain, and perhaps for good reason. In the second century AD, Galen commented on rye bread from the Balkans as being black, with a bad smell (Behre, 1992: 145), and Pliny in his *Historia Naturalis* (18, 16) in the first century AD regarded rye as an inferior cereal, with a harsh taste (Rackham, 1950: 279). Both comments may suggest the presence of ergot.

Ergotism may have troubled the inhabitants of Norway at least as far back as the first cultivation of grain. Since rye, *Secale cereale*, is much more vulnerable to ergot infection than the other grains cultivated there (barley, oats, wheat), the risk of ergotism increased considerable when rye cultivation was introduced; this occurred in Rogaland (south-west Norway) perhaps about AD 400 and elsewhere mainly about 1200 (Larsen, 1965: 108).

Both in Rogaland and in Vestfold (south-east Norway), rye cultivation has been traced back to the fifth century AD (Myhre and Øye, 2002). The Rogaland toponym, and the name of the people living there (*ryger*) may in fact derive from an Indoeuropean stem for rye (Holm, 2008: 49); this is *roggen*, *rugem*, *ryge*, *rez*, etc., in Germanic and Slavonic languages (Behre, 1992: 152).

Ergotism in the sagas: Iron Age and early medieval accounts

As noted by Reichborn-Kjennerud (1940: 155ff.), there are several accounts in the Norse-Icelandic sagas of a disease in humans for which ergot poisoning was the probable cause. Some descriptions are highly evocative of *ignis sacer* or the holy fire, noting that sufferers were tormented by an invisible flame burning inside their body. People believed it destroyed the limbs, sometimes leaving only the head and torso.

A collection of religious legends related to the virgin Mary, *Marius saga*, repeatedly (Unger, 1971: 655, 658, 661, 676, 678, 679, 919) couples fire and disease, caused by *hinn illi eldr* ‘the evil fire’, *grimma elld*, *grimmi eldr*, ‘evil fire’, or just *elldi*, *elldr* ‘fire’. It is also noted that despite the burning pain, victims often felt freezing cold: ‘and it is very strange, that this fire, which is capable of consuming everything, has no heat, and fills the poor men, which it torments, with so much cold, as if they were frozen both inside and outside’⁵ (translation from Unger, 1871: 655).

In the sagas, the gangrenous form of ergotism (and gangrene in general) is referred to as *drep*, ‘kill’ (Reichborn-Kjennerud, 1940: 156). In *Marius saga*, one case in a female victim is described as having ‘*etid allt kiotid af hendinni ok armleggnum*’ (Unger, 1871: 678), ‘eaten all the flesh of the hands and arms’. Another passage offers a similar description of the gangrenous form of ergotism: ‘*etandi ok slitadi kiotid af beinum*’ (Unger, 1871: 676), ‘eating and ripping the flesh from the bones’.

The old Norse language had no separate term for the convulsive form of ergotism, although the muscular contractions to which it led to were certainly known. There are several graphic accounts: ‘*allar sinar i hans likam dró saman*’ (Unger, 1871: 676), ‘all muscles in his body were contracted’, and the victims are described as *bognuðu*, ‘bowed’ or *krypill* or *krepir* ‘creeper’, based on the contracted limbs (Reichborn-Kjennerud, 1940: 156). *Marius saga* includes a characteristic description: ‘and he was tormented so badly, that his knees were bent, so that the heels were lying at the seat, and [it] drew him so badly together, that he became [shaped] like a ball. The blood of his whole lower body was still dead, and he felt nothing there, and even if he was fried in fire, he had to burn ...’⁶ (translation from Unger, 1871: 959).

The translated and adapted tales of *Marius saga* probably refer mainly to German and French victims of ergotism, but provided its (few) Norwegian readers with knowledge of the disease and

its horrors. Other sagas include similar descriptions related to Norway, mainly of the convulsive form of ergotism (Reichborn-Kjennerud, 1940: 157). The legendary saga of St Olav, *Olafs saga hins helga*, mentions a woman who was healed with the saint's help; her affliction is likely to have been ergotism, for her body was '*kropnað oll saman, sva at baðer fætr lagu biugir undir qvið upp*' (Heinrichs, Janshen, Radicke and Röhn, 1982: 216) – 'so pitifully crippled, that both feet were bent back under the lower side of her belly' (Metcalf, 1881: 115). The Norse *kropnað* may mean both 'to be crippled' and 'clenched' or 'stiffened'. The same story is included in an Old Norse book of homilies (Indrebø, 1931: 116).

It is likely that one of the Norwegian kings, Magnus Haraldsson, died of ergotism in 1069, at the age of 20 or so (Larsen, 1965: 108; Reichborn-Kjennerud, 1940: 158). According to Tormod Torfæus (1711: 384), in his *Historia rerum Norvegicarum II*, the king was killed by an 'ignis sacer species' (Munch, 1855: 381). *Konunga sögur* mentions that a young man from Ringerike died of *drep* (cf. above) in 1207 (Unger, 1873: 225).

In this context, it is worth including a comment on the Norse concept of *berserksgangr*, to go berserk. The sagas repeatedly mention warriors who were in a rage or frenzy, feared nothing and would sometimes chew or bite on the edge of their shields. Vigfússon (1957), in a lexical entry for *berserksgangr*, notes that 'In battle the berserkers were subjects to fits of frenzy, called berserksgangr'.

A number of theories have been proposed to explain the condition, ranging from intoxication with fly agaric *Amanita muscaria* (e.g. by Schübeler, 1886: 224) to psychiatric disturbances (Grøn, 1929). The former can be discarded as highly speculative, with no real evidence to support it (Högberg, 2003), since the sleep-inducing and hallucinogenic effects typical of voluntary consumption of *Amanita muscaria* (by Siberian shamans, for example) would hardly make for good warriors! The rage typical of the berserks could possibly derive from ergot poisoning. Accidental poisoning of warriors (e.g. through contaminated beer) is a theoretical possibility (Alm, 2003b; cf. Schwarz, Hill and Rottinghaus, 2007). It could at least explain the very concept of the raging, devil-may-care warriors, obviously a fearsome spectacle to encounter, if not necessarily the most effective in battle.

Droplaugarsonasaga tells of a man called Ketil, who sometimes went berserk. He was a gentle and quiet man, but twice a month, his teeth started chattering, he felt a quivering and then cold spells ran through his body, as if cold water was flowing under his skin. Large fires had to be made to comfort him. However, he soon went into a fury, and spared nothing that stood in his way, no matter if it were people or things, and frequently he also 'went through the fire' (Faye, 1885: 787–8). The symptoms described here are compatible with ergotism, as described for example in nineteenth-century Norwegian accounts (Schübeler, 1886: 230). However, Faye (1885: 787), a Professor of Medicine, considered that the symptoms described suggested 'a form of manic epilepsy'.

It is possible that ergot found some medicinal use in Iron-Age Norway. *Hávamál*, 'the speech of the high one', namely Odin, the supreme god of the Norse pantheon, is a collection of poems and sayings first written down in thirteenth-century Iceland. According to Vigfússon, in a lexical entry (Cleasby and Vigfússon, 1869–74), an obscure passage included there, *höll við hyrogi*, may be a corruption of *haulvi hyrógr*, or *hyrogr við haul*; if so it meant 'spurred rye (ergot) against hernia', thus being medical advice. Others disagree with this reading. Grøn (1907), however, found it likely on medicinal grounds, noting that folk medicine sometimes used 'interior' remedies for hernia. As no further instructions are given, an external use in some kind of cataplasm is also possible.

Following the Black Death (c. 1350), Norway went into decline, losing both its independence (1536) and its overseas territories. The late medieval period offers nothing comparable to the

extensive Norse-Icelandic saga literature, and the surviving sources provide no direct evidence of ergotism. However, its continued presence is witnessed by the establishment of monasteries dedicated to the third- to fourth-century St Anthony of Egypt, the patron saint of victims of gangrenous ergotism. In Norway, the saint is first mentioned at the end of the thirteenth century, when Bishop Thorfinn in his will left money for the monastery church of St Anthony at Hamar (Larsen, 1965: 108). In 1316 the church of St Halvard in Oslo had an altar dedicated to St Anthony. A number of wooden sculptures of the saint, and depictions on altar doors, have been preserved. According to Reichborn-Kjennerud (1940: 158–9), they confirm St Anthony's long-standing and solid reputation as a patron saint, in particular in Northern Norway. Some monasteries survived until the Reformation (1537). About 1500, brethren of St Anthony are mentioned in connection with the Nonneseter monastery in Bergen (Larsen, 1965: 108; Nordhagen, 1941). It was closed down in 1528, allegedly due to the debauched lifestyle of the monks (Kierulf, 1983: 5). Unfortunately, nothing is known of the treatments provided by the monks. Medicinal plants are likely to have been used, as suggested by vernacular names surviving for a few species, e.g. *antueidgras*, 'St Anthony's fire-grass', for both *Antennaria dioica* (Nordhagen, 1941: 64) and *Linnaea borealis* (Alm, 2006).

Ergotism and witchcraft

Although Norway is not mentioned frequently in the context of the seventeenth-century witch persecutions, about 750 witch trials are known (Hagen, 2007: 85). Unfortunately, the original court documents for most trials have been lost. In some cases, the sole surviving documentation is in the form of accounts detailing the financial cost of torturing and burning the witches, which leaves little room for evaluating the trials and accusations as such. By far the best surviving records are related to Rogaland in SW Norway and Finnmark in the far north, but there are also a number of fairly detailed court records from western Norway.

Writing about the seventeenth-century witch-trials, the German historian Wolfgang Behringer suggests that 'lands on the thinly settled periphery (Scandinavia, Eastern Europe, the Iberian peninsula, European colonies) were [also] little affected, since the possibility of diffusion in open spaces served to decrease pressure' (Behringer, 1995: 27); this assumes that the witch persecutions were generally a type of mass hysteria which would spread because of psychological contagion. However, the northernmost county of Norway – Finnmark – was hit exceptionally hard by the European witch persecutions in the seventeenth century, unparalleled in terms of the magnitude and severity of the trials (Hagen and Sparboe, 1998). As discussed by Alm (2003a), symptoms and descriptions suggesting ergotism were especially frequent in these Finnmark trials, and may be unique in providing a coherent picture of ergotism as a contributing factor. They detailed both the acquisition of witchcraft through the consumption of flour-based products (porridge, beer) – which were repeatedly and explicitly stated to contain suspicious black grains (supposedly ergot) – and the ensuing disease, for example the peculiar dry gangrene leading to limbs dropping off, 'formication' and mental disturbances. The hallucinogenic effects, in particular, in the context of a highly religious society where no other mind-altering drugs were available (other than beer or ale which are not very hallucinogenic) were likely to contribute to considerable confusion, as well as strange thoughts and beliefs.

Symptoms and descriptions suggesting ergotism are also found in witch trials from other parts of Norway, though less frequently. Some trials contained descriptions of disease that are hardly compatible with anything but ergotism; others merely pointed in this direction. The explicit coupling with food, frequently mentioned in the Finnmark trials, was absent or vague elsewhere in

Norway, although some trials hinted at it. For instance, in the trial of Malene Askesdatter in Stavanger, SW Norway on 26 Nov. 1683, she was accused of sending to a man, via Peder Skadberg, a cheap ‘bread, through which a spell was cast on him’ (Erichsen, 1906: 417). In the trial of Halvor Rasmussen Kroge on 25 Apr. 1684, he blamed the same Peder Skadberg, who had given him a similar bread, again casting a spell (Erichsen, 1906: 425).

Gangrene

The dry form of gangrene often seen in ergotism was graphically described in some Norwegian witchcraft trials. In Finnmark, a 1634 trial mentioned an alleged victim of witchcraft who lost one arm, it ‘got so painful that it withered’ (Hagen and Sparboe, 1998: 126–7), and a 1632 trial recorded tell-tale symptoms in a female victim: ‘At the autopsy, her back and thighs were found to be as blue as the bottom of a kettle’ (Hagen and Sparboe, 1998: 112–13; Willumsen, 2010: 70; see Alm, 2003a: 409).

The witch trial of Anne Monsdotter Løset at Syvde in Vanylven, western Norway, in 1670 contained a grotesque example of gangrene, with ergotism as the likely cause. A girl blamed Anne for her disease, which occurred shortly after she had met the alleged witch:

It did not take long before Ingrid became ill. One day as she was walking along the road, she suddenly had such a pain in her back. And where she felt it, a black spot appeared later on, and a piece of her flesh fell off, so that they could look straight in at her lungs, and not long after, she died in great agony. (Molvik, 1992: 105)

A case of gangrene was also reported in the trial of Agate Myklebust in 1682, again at Syvde. The female victim, Britta, was a poor woman, who was suddenly affected by excruciating pain. She went home and to bed, and stayed there for three days, and then a large piece of blue flesh fell off one side of her body. She blamed Agate for causing it, by having clung to this side of her body and threatening her (Molvik, 1992: 121–2). However, it turned out that people had seen a blue spot in the same part of Britta’s body on an earlier occasion, and Agate was acquitted.

‘Holy fire’

The burning (and freezing) sensations which gave rise to the term *ignis sacer* or ‘holy fire’ were reported in some Norwegian witchcraft trials. In the Stavanger trial of Trog-Astri (21 Aug. 1662), Rolf Snedker accused her of having caused his disease: ‘for after his quarrel with Trog-Astri, he got such a pain at one side of his body, from the bottom and up and out through his arm, so that even during the warmest part of the summer he had great cold and pain there, ...’ (Erichsen, 1903: 278).

Formication

Formication is an eerie feeling that some living things, often interpreted by the victims as animals or other living beings, are crawling within the body, often just beneath the skin. In the Finnmark witchcraft trials, the alleged victims frequently described a horrendous feeling that something living had been inserted into their body (Alm, 2003a: 410). Similar records also occur in numerous trials outside Finnmark. In Agder, in the extreme south of Norway, a 1660s trial included the testimony of a man who had been affected by witchcraft, which made him feel ‘as if he was lying in an ant-mound’ (Alm, 2003a: 414; Lohndal, 1993) – and it is indeed difficult to find a more vivid

description of fornication. A 1650 trial in Bømlo, western Norway, included a similar account, expressed in terms more familiar to those living on the coast. Syver, the victim, blamed Ingeborg Olsdotter, the accused witch, for his disease: ‘And at once, that very same night, he had such an intense pain as if there was something living inside his body ... One day he was walking by himself, it felt as if someone had emptied a bailer of [marine] amphipods over him.’ (Molvik, 1992: 29).⁷ In the 1667 trial of Steinvor Sørhelle in Farsund, southernmost Norway, a male victim blamed her for his disease, which acted ‘like a living thing’ in his body (Lohndal, 1985: 86).

Fornication was described in almost the same words by the German victims of ergotism treated by Heusinger (1856: 33): ‘*die kriebeInden Schmerzen, die die Kranken beschrieben als wenn ihnen etwas lebendiges unter der Haut weglaufe*’ (‘the crawling sensations, which the diseased described as if something living was running beneath their skin’).

In several cases, the Norwegian victims were convinced that there *was* something inside their body. Some even claimed they could touch it – in which case they were probably referring to the muscular contractions triggered by ergotism (see below) rather than fornication. An example is found in the trial of Marit Rasmusdotter Bjørdal, called Maska, in Sunnlyven, western Norway, in 1663–4. A man called Anders testified that:

... after he got home in the night, and had gone to bed, at about midnight, he got such an excruciating pain that he had no rest. When he put his hand down at the most painful part, he could feel something living between the skin and flesh, about the size of a nut. When he kept it in his hand, the pain lessened a little, but as soon as he let it go, it was as bad again. (Molvik, 1992: 72)

The 1663 trial of Kristina Skryppa, Aksel Skryppa and Ragnhild Myklebust in Jølster, western Norway, provides a similar account. The victim was a man called Peder, who had argued with Kristina. It turned out ‘that correctly enough, that very same night after his quarrel with Kristina, his whole body was as if altered. It was just as if something had entered his body. It went to and fro as if it was living, and he suffered greatly’ (Molvik, 1992: 52). Doctors were consulted (in Bergen), but could not help.

Similar symptoms were reported in the trial of Anne Monsdotter Løset, at Syvde in western Norway in 1679, this time suggesting that the ‘living thing’ within the body was accompanied by *ignis sacer*. The strange disease of Knut Saurdal was known to many, and a witness called Rasmus told the court: ‘For a long time, he [Knut Saurdal] had been troubled by something evil between his skin and flesh – and something that many had both felt and held in their hands.’ Knut himself provided an extensive account of his suffering:

Knut Saurdal now appeared and said that when this Anne had promised him ill fortunes, he remained healthy for three years, but thereafter he became ill and got a pain in his chest and the left limbs. He also told [the court] about this evil he was burdened with. It was of such a kind that he could take it in his hands, but he was unable to control it, not even with both hands. Even if there were three men, they would not be able to hold it, he suggested. It gave the impression of being pointed at both ends. It stung and hurt him a lot, it was as if he was lying in a glowing fire in great agony, and for the last years, he had no rest either night or day, he said. (Molvik, 1992: 101–2)

A year later (1680), the trial of Tater-Ingebrikt at Sande in western Norway reported similar symptoms in a man called Jon Riste, allegedly caused by witchcraft. Jon had for a long time been suffering from something which moved in his waist. Even the priest, the honourable Hans Hellekand, gave witness that he had touched it with his hands. It was like a wooden splinter, sharp at

both ends. Jon Riste never recovered from his suffering, and finally died in great agony (Molvik, 1992: 111).

Convulsions

Epileptic fits, convulsions and muscular contractions are mentioned in several Norwegian witchcraft trials. A detailed account, which included typical symptoms of ergotism, is found in the Stavanger witch trial of Marthe Rasmusdatter, which took place on 3 Dec. 1683. The alleged victim of her witchcraft, Erik Kristensen, had met and quarrelled with her in the fields surrounding the town. When returning home,

he fell backwards, and was unable to rise up, and was incapable of getting home to his house, until his wife led him home. The following night, he lost his senses, and he could neither lie or stand, and had hit and almost killed his own child, and [the skin of] his feet was mottled as a snake, and his hands were swollen and turned backwards. Thereafter, he spent 14 weeks lying in bed, and if his son had not cut his hair and beard, he would have torn it all out himself ... (Erichsen, 1906: 419)

An even better description of the muscular contractions caused by ergotism was included in another Stavanger trial, that of Klug-Anne (7 Aug. 1662). A young boy, allegedly a victim of her evil spells, suffered horrific pains:

His mother said, that on Saturday 14 days ago at 7 or 8 in the evening the boy had nausea and got such a pain in his leg that he screamed, so you could hear it far away out in the street, and [he] was stretched so badly, as if he was lying on a stretch-rack, and one could hear a breaking sound in his body, as if someone was breaking cabbage. Immediately thereafter he jumped up on the floor, ran and leapt, went to church and elsewhere, and at that time, he had been lying for five or six weeks in bed as a cripple and crept on the floor as a worm. (Erichsen, 1903: 267)

The extensive Finnmark records contain a similar description, but in this case (13 May 1620) the alleged witch (Karen Edis Dotter) herself was tormented, and she claimed it as an excuse for her putatively evil deeds: 'She also confessed, that when she refused to do harm, the devil tormented her so badly, and stretched her limbs, so that blood issued from her nose and mouth, and she became, as if she was mad.' (Rutberg, 1918: 12).

Convulsions and involuntary muscular contractions may make people, and even children, appear very 'strong'. Both in witchcraft trials and other sources, we encounter victims who were difficult or impossible to handle or control. In the 1680 trial of Tater-Ingebrikt at Sande in western Norway, he confessed to having caused disease in a boy, 'who got such a pain that several grown men had to hold him when he was at his worst' (Molvik, 1992: 111).

The gaping mouth mentioned in some nineteenth-century victims of ergotism is also found in the Stavanger witchcraft trial of the previously mentioned Klug-Anne. On 11 Aug. 1662, Margrete Gran told the court:

that Klug-Anne had caused disease in her child with her poison, which the magistrate demanded to be recorded. Hans Hansen explained that on the evening when he attended the boy in Margrete Gran's house, the boy told him that he saw two magical cats, which were red, and [they] ran off the boy's hands, and he tried to chase them out of the door. But in terms of his weakness, the boy acted as if he was out of his mind, and his mouth was gaping, as if he was about to suffocate, and, when the disease hit him, he could hardly be kept [still] by two men. (Erichsen, 1903: 272)

Mental disturbances

Unless coupled with physical symptoms suggesting ergotism, it is difficult to evaluate the cause of mental disturbances, which are frequently mentioned in Norwegian witchcraft trials. For instance, in an early Stavanger trial (5 July 1622), a boy was described as ‘having become mad, so that he ripped off his clothes, and tried to run through the wall, attacking the house’ (Erichsen, 1903: 85). In another trial in Stavanger (11 Sep. 1662), a woman called Trog-Astri was accused of having caused disease in Svend’s wife, so that ‘she was completely out of her mind, and stayed that way for about half a year’ (Erichsen, 1903: 280). In the 1642–3 trial of Ola Deknepollen and Anne Høyne (Sogn og Fjordane, western Norway), a man claimed that witchcraft had caused his mother ‘to become ill, just as if she was mad’ (Berge, 1999: 125).

In the trial of Klug-Anne (7 Aug. 1662), she was said to have bewitched the son of Roell Snedker, so that he ‘on the second day became so queer, that he sometimes would stay in the sea, and sometimes in other dangers’. He was also speechless, for ‘in the same disease he pointed a finger into his mouth, took a piece of chalk and wrote, that a woman in a long white dress was standing above him, with a blue skirt and a black apron, and he also wrote, that an angel of God had told him to burn gunpowder three times, and he would again be able to speak ...’ (Erichsen, 1903: 267–8).

A convincing case of ergotism is reported in the 1667 trial of Barbra Åsmundsdatter in Farsund. The victim was a young boy, Gunnar Torkjellson, now crippled, as a result of a disease which had also caused madness, and made his skin turn black. The boy could not walk, so he had to be carried into the court in a trough. According to the testimonies, the boy fell ill within a day of teasing Barbra who had threatened him that he would regret it. Gunnar lost his senses completely, and when he returned at night he was so black that he did not look like a human being. He went to bed, and had been lying there helpless for seven years (Lohndal, 1985: 84; 1998: 61).

We consider it likely that several other witchcraft trials were ultimately based on ergot poisoning, although the surviving records do not contain sufficient detail to establish this for certain. From the above accounts, it is obvious that ergotism was often interpreted as witchcraft in seventeenth-century Norway.

Acquiring witchcraft: the link with food and drink

As noted above, the 1670 trial of Anne Monsdotter Løset included a convincing example of ergot-induced dry gangrene. In this case, Anne confessed to having caused the disease, claiming that she had met the devil while walking along the road. He had given her ‘a black ball which looked like an egg. This she was supposed to get into the girl. Thus, one day she had followed Ingrid, and got the ball into her mouth.’ (Molvik, 1992: 105). The ensuing disease might well suggest that the black ‘ball’ contained a fair amount of ergot.

Both in this and a few other trials (e.g. in Finnmark; see Alm, 2003a: 408), the surviving documents may suggest that some ‘witches’ had realized that ergot was poisonous and dangerous, and could be used to cause harm. It is at least worth noting that, according to the trials, they made use of a ‘black’ or ‘blue’ substance. If so, these were probably rare exceptions. In most cases, ergotism was probably an unexpected (and, to those affected, inexplicable) result of accidental consumption of flour-based products containing ergot. Acquiring witchcraft by consuming it, usually in the form of bread, porridge or beer, was a typical and frequent feature of the Finnmark witch trials (Alm, 2003a), and some of the accused specified that the food had contained suspicious, black grains, which we assume was probably ergot.

Further south in Norway, this link is missing or rare. According to two trials in western Norway, the alleged witches had served (or been served) beer or other drinks that soon turned out to be harmful, acting more or less as a magical potion. Beer, of course, is a grain-based product; ergot alkaloids survive the malting and brewing process, thus potentially resulting in a poisonous and psychoactive drink (for the biochemistry, see Schwarz et al., 2007).

In the 1663 trial of Kristina Skryppa, Aksel Skryppa and Ragnhild Myklebust in Jølster, Sogn og Fjordane, both Kristina and Aksel claimed to have learned their 'art' by drinking beer. Kristina had been persuaded to sell her soul to the devil by another female, who had prepared a bowl for her drink. The beer seems to have been contaminated with a hallucinogenic substance, probably ergot. As soon as she had consumed it, she was as if transformed throughout her body, and soon the devil himself came to her. He looked like a goat kid, but called himself 'the flying bird'. After pledging herself to his service, Kristina participated in the witches' sabbath at the mountain of Hornelen (Molvik, 1992: 53).⁸ Aksel Skryppa had also learned his art through a drink. According to his confession, his mother had called for him, served him a bowl of *Mundgot* [beer] and asked him to renounce his baptism and Christianity. When he drank it, someone would come to him. As soon as he had consumed it, the devil appeared in the shape of a black, spotted cat. Aksel complied, and also attended a black sabbath at Hornelen mountain (Molvik, 1992: 54–5).

Lusi Hole, also brought to trial at Jølster in 1663, had become a witch, or perhaps more likely had been poisoned, by a drink her mother served her. It was supposed to ensure luck with her livestock, but in the end led to the execution of both Lusi and her mother. Her mother had brewed something for her, and as soon as she had consumed it a small devil came running, 'in the shape of a child, naked and with wings, and with feathers as a bird', asking her to renounce her baptism and Christian faith (Molvik, 1992: 65). Anders Teita, accused of witchcraft in the same trial, told a similar story. He had acquired the black arts in a milk drink, served by his mother. When he had drunk it, the devil appeared to him, in the shape of a grey cat (Molvik, 1992: 68).

It should be noted that pieces of bread, and in particular loaves intended for communion, were a frequent feature of Norwegian folk magic, appearing in numerous 'cures' and magical formulas recorded by Bang (1902). Thus, bread may well occur in folk magic – and witchcraft trials – without necessarily containing ergot or other harmful substances. Further details, in terms of ensuing disease, are needed to make this connection. For instance, Ingeborg Otterass was fined in 1701, in one of Norway's last witch trials, for having carried out witchcraft with a piece of *Kling* or 'flatbread' with a layer of butter, perhaps just in an attempt at white magic (Olafsen, 1914: 47).

Discussion

Records of medical symptoms suggest that ergotism in Norway can be traced back about a thousand years (see also Part 2 of this paper). The disease, but not its cause, was known at least to a learned elite during the late Iron Age and in the early medieval period. Norwegian accounts all portray ergotism as a disease, sometimes interpreted within a religious context, and monasteries dedicated to St Anthony, the patron saint of victims of ergotism, are known to have existed during the fourteenth to sixteenth centuries in Norway. The one in Bergen was closed down in 1528, but would inevitably have ceased to operate within a decade because of the Reformation (1537). The loss of the monk's knowledge of *ignis sacer* may have contributed to the subsequent re-interpretation of ergotism as witchcraft, as suggested by a number of Norwegian witchcraft trials, especially in Finnmark (Alm, 2003a). Although ergotism has no connection whatsoever with the devil, it is certainly evil, and its strange, unpredictable and highly variable symptoms made it an easy target for those looking for disease 'brought on' by witches. It was simply too extraordinary to be 'natural',

and nobody in regular society had any knowledge of its rather mundane cause, namely the contamination of ordinary ingredients of food and drinks. Scapegoats were needed, and duly found.

Suspicious black grains – in all likelihood sclerotia *Claviceps purpurea*, as inferred from the symptoms they precipitated (or, sometimes, more nondescript black substances) – are repeatedly mentioned in the Finnmark witch trials, occurring in food (e.g. porridge) consumed prior to the onset of putative witchcraft. The seventeenth-century authorities apparently paid no attention to this. This is evident, for example, from the survey of Finnmark witchcraft trials compiled by district governor Hans H. Lilienskiold towards the end of the century (published by Hagen and Sparboe, 1998). He obviously believed in the reality of witchcraft, but seemingly considered the black grains a detail of no interest. For instance, according to the original court records, Sigri Johnsdatter, tried and convicted as a witch in 1663, confessed that she had acquired the craft ‘with some milk and bread about eight or nine years ago, and she noticed some black specks at the bottom of the bowl’ (Willumsen, 2010: 250); the ‘black specks’ were left out in Lilienskiold’s abridged account (Hagen and Sparboe, 1998: 218). Maren Olsdatter, a young girl from Vadsø, also brought to trial in 1663, confessed that she had learned witchcraft by drinking beer, in which ‘she saw something lying on the bottom of the bowl, something that was as black as dirt’ (Willumsen, 2010: 215); in Lilienskiold’s abridged version, the beer is simply described as ‘thick’ (Hagen and Sparboe, 1998: 198–9).

We find little reason to doubt the connection between ergotism, accusations of witchcraft and the ensuing trials, which is quite obvious in the Norwegian material. In most other areas, this link, originally suggested for the infamous Salem trials of the USA by Caporael (1976), remains highly controversial. Arguably, the American material is circumstantial at best, and the supposed role of ergotism is highly contested (Matossian, 1982; Ray, 2010; Spanos, 1983; Spanos and Gottlieb, 1974; Woolf, 2000). Spanos and Gottlieb (1974: 1390) claim that all members of a given household should fall ill if they eat the same ergot-infested food, but this is just an assumption on their part, and is easily falsified by records of German epidemics, e.g. Heusinger (1856). Some evidence for ergotism is also found in British witchcraft trials, but except for occasional references to symptoms that are unlikely to have had any other cause (e.g. an arm falling off) the evidence is limited and not very convincing (Boyd, 1995; Duncan, 1993; Whyte, 1994). Matossian (1989), on the other hand, provides substantial evidence that support the historical importance of ergotism, in particular in central and eastern Europe.

It should be remembered, however, that ergot is just a fungus. It may cause a strange, horrific and unpredictable disease, but nothing more. Allegations of witchcraft, and belief in it, draconian laws, trials and persecutions are all human inventions and interpretations. Once in place, these measures may well be extended to all sorts of ‘suspicious’ cases, including many where ergot played no role at all. Numerous Norwegian witchcraft trials provide no evidence whatsoever for ergotism. Except in the Finnmark witchcraft trials (Alm, 2003a), ergotism may have been a rather rare cause of trials. On the other hand, the trials involving what we consider to be evidence of ergotism provide gruesome details of a disease that, with seventeenth-century eyes, knowledge and beliefs, could hardly be interpreted as anything other than witchcraft. Thus, they may have served as the spark that ignited (almost literally) the fire, soon used to burn the alleged witches.

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Notes

- 1 Infected cereals are likely to be eaten because the presence of fungus is not easily detected by the eye and the grain is unlikely to taste foul, unlike for example a potato which rots and smells when attacked by a fungus.
- 2 It is probable that much of the flour and grain available for sale today is more than 18 months old.
- 3 We acknowledge that our approach runs the risk of misattributing, for example, cases of syphilis or epilepsy to ergotism. However, we contend that this is extremely unlikely since we have specifically selected cases where there is considerable clinical description available and for which we find ergotism to be the most plausible explanation.
- 4 The 'migration period' is a well-established term in Europe for the waves of people (Huns, Vandals, etc.) invading various territories in the wake of the collapse of the (western) Roman Empire.
- 5 *Ok þat er miok vndarligt, at þessi elldr, er suo er styrkr til at brenna vpp allt, hefir engan hita, fyllir hann þa veslu menn, sem hann pinir; med suo mikklum kulda, sem þeir se i ise vitan ok innan, ...* (All translations are by the authors.)
- 6 *... ok suo hörmuliga var hann pindr; at hans kne beygduzt, suo at hælarni lagv vid þioin, ok dro hann suo hrædiliga saman, at hann vard sem einn bollr. Allr nedri blutr hans likama var sem daudr; ok hann kendi hans ecki, ok þo at hann veri steiktr i elldi, matti hann brenna, ...*
- 7 *Gammarus* sp., crustaceans in the order Amphipoda, common on Norwegian seashores, and sometimes colloquially known as sand fleas.
- 8 Hornelen is categorized as the highest 'sea cliff' in Northern Europe, a steep mountain rising 860 m from a fjord. As it can only be reached by a strenuous hike, and the terrain is extremely rocky, good health is obviously required to attain the summit.

References

(Publications with translated titles are all in Norwegian, except where otherwise stated.)

- Alm T (2003a) The witch trials of Finnmark, northern Norway during the 17th century: evidence for ergotism as a contributing factor. *Economic Botany* 57(3): 403–416.
- Alm T (2003b) Ales, beer and other Viking beverages – some notes based on Norwegian ethnobotany. In: *Yearbook of the Heather Society 2003*. Ipswich: The Heather Society, 37–44.
- Alm T (2006) Ethnobotany of *Linnaea borealis* (Linnaeaceae) in Norway. *Botanical Journal of the Linnean Society* 151(3): 437–452.
- Bang AC (1902) Norske Hexeformularer og magiske Opskrifter [Norwegian witchcraft spells and magical formulas]. *Skrifter udgivne af Videnskabselskabet i Christiania. II. Historisk-filosofisk klasse* 1901 (1).
- Barger G (1931) *Ergot and Ergotism. A Monograph*. London, Edinburgh: Gurney and Jackson.
- Bechterew W v (1892) Über neuro-psychische Störungen bei chronischen Ergotismus. Nach den Beobachtungen von Dr. N. Reformatzki. *Neurologisches Centralblatt* 11(24): 769–775.
- Behre K-E (1992) The history of rye cultivation in Europe. *Vegetation History and Archaeobotany* 1: 141–156.
- Behringer W (1995) Weather, hunger and fear: origins of the European witch-hunts in climate, society and mentality. *German History* 13: 1–27.
- Bennett JW and Bentley R (1999) Pride and prejudice – the story of ergot. *Perspectives in Biology and Medicine* 42(3): 333–355.
- Berge R (1999) Vitemål ved hekseprosess mot [Testimonies at the witch trial of] Oluf Suendsen Degnepold og Anna Jetmundsaater Høyne. *Årbok for Nordfjord* 33: 118–129.
- Boyd WE (1995) 4 and 20 blackbirds – more on ergotism, rye and witchcraft in Scotland. *Area* 27(1): 77–78.
- Caporael LR (1976) Ergotism: the Satan loosed in Salem? *Science* 192: 21–26.
- Cleasby R and Vigfússon G (1869–74) *An Icelandic-English Dictionary*. Oxford: Clarendon Press.
- De Costa C (2002) St. Anthony's fire and living ligatures: a short history of ergometrine. *Lancet* 359: 1768–1770.
- Demeke T, Kidane Y and Wuhib E (1979) Ergotism – a report on an epidemic, 1977–78. *Ethiopian Medical Journal* 17: 107–113.
- Duncan K (1993) Was ergotism responsible for the Scottish witch-hunts? *Area* 256 (1): 30–36.

- Eadie MJ (2003) Convulsive ergotism: epidemics of the serotonin syndrome? *The Lancet Neurology* 2(7): 429–434.
- Eadie MJ (2004) Ergot of rye – the first specific for migraine. *Journal of Clinical Neuroscience* 11(1): 4–7.
- Enge I and Sivertssen E (1965) Ergotism due to therapeutic doses of ergotamine tartrate. *American Heart Journal* 70(5): 665–670.
- Erichsen AE (1903) *Samlinger til Stavangers historie* [Collections on the History of Stavanger], Vol. 1. Stavanger: Stavanger kommune.
- Erichsen AE (1906) *Samlinger til Stavangers historie*. Vol. 2. Stavanger: Stavanger kommune.
- Faye AL (1885) Oplysninger om Forhold og Skikke vedrørende Svangerskab og Fødsel hos de gamle Nordboere. III. Etterbyrden [Notes on conditions and traditions related to pregnancy and birth among the old Norwegians. III. The after-birth]. *Norsk Magazin for Lægevidenskaben* 3. række 15: 753–790.
- Franque JB (1856) Die Kriebelkrankheit im Jahre 1855/56. Nach den Acten mitgetheilt. *Medicinische Jahrbücher für das Herzogthum Nassau* 14: 336–344.
- Fröhlich G, Kaplan V and Amann-Vesti B (2010) Holy fire in an HIV-positive man: a case of 21st century ergotism. *Canadian Medical Association Journal* 182(4): 378–380.
- Grøn F (1907) Bidrag til den norrøne lægekunsts historie. De ældste sygdomsforestillinger og hedendommens folkemedicin [Contribution to the history of Norse medicine]. *Tidsskrift for Den norske lægeforening* 27(3): 73–81, (4): 137–149, (5): 177–187, (6): 237–248, (7): 294–300, (8): 326–333.
- Grøn F (1929) Berserksgangens vesen og årsaksforhold. En medisinsk-historisk studie [The nature and cause of running berserk. A medical-historical study]. *Det kongelige norske videnskabers selskabs skrifter* 1929 (4): 68 pp.
- Haarmann T, Rolke Y, Goesbert S and Tudzynski P (2009) Ergot; from witchcraft to biotechnology. *Molecular Plant Pathology* 10(4): 563–577.
- Hagen RB (2007) *Dei europeiske trolldomsprosessane* [The European Witch Trials]. Oslo: Det norske samlaget.
- Hagen RB and Sparboe PE (eds) (1998) *Hans H. Lilienskiold. Trolldom og ugudelighet i 1600-tallets Finnmark* [Hans H. Lilienskiold. Witchcraft and Impiety in 17th-century Finnmark]. Tromsø: Tromsø University Library.
- Handeland K and Vikøren TJ (2005) Presumptive gangrenous ergotism in free-living moose and a roe deer. *Journal of Wildlife Diseases* 41(3): 636–643.
- Heinrichs A, Janshen D, Radicke E and Röhn H (1982) *Olafs saga hins Helga. Die 'Legendarische Saga' über Olaf den Heiligen. (Hs. Delagard. saml. nr. 8^{II})*. Heidelberg: Carl Winter Universitätsverlag (Germanische Bibliothek, Vierte Reihe, Texte).
- Heusinger TO (1856) *Studien über den Ergotismus, insbesondere sein Auftreten im neunzehnten Jahrhundert; aus Anlass einer Epidemie in Oberhessen im Winter 1855/56*. Marburg: Koch.
- Högberg O (2003) *Flugsvampen och människan* [The Fly-agaric and Man]. Stockholm: Carlssons bokförlag; in Swedish.
- Holm T (2008) Leiver frå saga um rugdbraudet og rygene [Slices of the history of rye bread and rygene [the people of Rogland]]. *Norsk årbok, andre rekkja* 2008: 47–95.
- Hudgson P and Hart JAL (1964) Acute ergotism: report of a case and a review of the literature. *Medical Journal of Australia* 2: 589–591.
- Indrebø G (ed.) (1931) *Gamal norsk homiliebok. Cod. AM 619 4^o* [Old Norse homilie book]. Oslo: Kjeldeskriftfondet.
- Jahrmärker (1902) Zur Frankenberger Ergotismus-Epidemie und über bleibende Folgen des Ergotismus für das Centralnervensystem. *Archiv für Psychiatrie und Nervenkrankheiten* 35: 109–152.
- Kierulf H (1983) Ergotismen og kunsten [Ergotism and art]. *Sandoz-informasjon* 4: 1–8.
- Kolossow GA (1914) Geistesstörungen bei Ergotismus. *Archiv für Psychiatrie und Nervenkrankheiten* 53: 1118–1129.
- Larsen Ø (1965) Ergotisme – en svøpe gjennom århundrer [Ergotism: a plague throughout centuries]. *Liv og helse* (5): 106–109.
- Lev-Yadun S and Halpern M (2007) Ergot (*Claviceps purpurea*) – an aposematic fungus. *Symbiosis* 43: 105–108.

- Lohndal A (1985) Steinvor Sørhelle – ‘ei klok kone’ frå Kvinesdal på 1600-talet [Steinvor Sørhelle – ‘a wise woman’ from Kvinesdal in the 17th century]. *Årsskrift Agder historielag* 61: 84–91.
- Lohndal A (1993) Kirsten Snabbe – ein kvinnelagnad på 1600-talet [Kirsten Snabbe: the fate of a female in the 17th century]. *Årsskrift Agder historielag* 69: 18–27.
- Lohndal A (1998) Trolldomsprosessen mot Barbra Åsmundsdr. 1667: symptom på eit bygdesamfunn i krise? [The witch trial of Barbra Åsmundsdr. 1667: symptom of a village society in crisis?] *Årsskrift Agder historielag* 74: 55–71.
- Matossian MK (1982) Ergotism and the Salem witchcraft affair. *American Scientist* 70: 355–357.
- Matossian MK (1989) *Poisons of the Past. Molds, Epidemics, and History*. New Haven, CT, and London: Yale University Press.
- Mellanby E (1930) The relation of diet to health: some recent investigations. *British Medical Journal* 3614: 677–681.
- Menche H (1883) Die Ergotismus-Epidemie in Oberhausen seit Herbst 1879. *Deutsches Archiv für klinischen Medizin* 33: 246–261.
- Merhoff GC and Porter JM (1974) Ergot intoxication: historical review and description of unusual clinical manifestations. *Annals of Surgery* 180(5): 773–779.
- Metcalf F (ed.) (1881) *Passio et miracula Beati Olavi*, edited from a twelfth century manuscript in the library of Corpus Christi College, Oxford. Oxford: Clarendon Press.
- Moir JC (1974) Ergot: from ‘St. Anthony’s fire’ to isolation of its active principle, ergometrine (ergonovine). *American Journal of Obstetrics and Gynecology* 47: 291–296.
- Molvik H (1992) *Tru og trolldom på Vestlandet* [Beliefs and Witchcraft in Vestlandet]. Larsnes: Vista forlag.
- Munch PA (1855) *Det Norske Folks Historie II* [The History of the Norwegian People]. Christiania: Tønsbergs Forlag.
- Myhre B and Øye I (2002) *Norges landbrukshistorie I. 4000 f. Kr. – 1350 e. Kr. Jorda blir levevei* [Norwegian Agricultural History I. 4000 BC – 1350 AD. The Soil becomes a Way of Living]. Oslo: Det norske samlaget.
- Nordhagen R (1941) De gamle klosterhager [The old monastery gardens]. *Foreningen til norske fortid-sminnesmerkers bevaring. Årsberetning for 1939*. 95: 55–94.
- Oginz O (1930) Ergotismus gangrenosus. *American Journal of Obstetrics and Gynecology* 19: 657–664.
- Olafsen O (1914) Trolldomssager [Cases related to witchcraft]. *Hardanger* 1914: 47–49.
- Pažoutova S, Olšovská J, Linka M, Kolínská R and Flieger M (2000) Chemoraces and habitat specialization of *Claviceps purpurea* populations. *Applied and Environmental Microbiology* 66(12): 5419–5425.
- Pažoutová S and Parberry DP (1999) The taxonomy and phyogeny of *Claviceps*. In: Křen V and Cvak L (eds) *Ergot. The Genus Claviceps*. Amsterdam: Harwood Academic Publishers, 57–77.
- Rackham H (transl.) (1950) *Pliny: Natural History. (Vol. V). Books XVII–XIX*. Cambridge, MA and London: Harvard University Press (Loeb Classical Library 371).
- Ray BC (2010) ‘The Salem witch mania’: recent scholarship and American history textbooks. *Journal of the American Academy of Religion* 78(1): 40–64.
- Reichborn-Kjennerud I (1940) Vår gamle trolldomsmedisin. III [Our old witchcraft medicine. III]. *Skrifter utgitt av Det norske videnskabs-akademi Oslo. II. Historisk-filosofisk klasse 1940 (1)* (separately paginated).
- Ringrose CAD (1962) The obstetrical use of ergot: a violation of the doctrine ‘primum non nocere’. *Canadian Medical Association Journal* 87: 712–714.
- Rosenkranz S, Deutsch HJ and Erdmann E (1997) ‘Saint Anthony’s Fire’: Ergotamin-induzierte Gefäßspasmen als Ursache akuter ischämischer Syndrome. *Deutsche medizinische Wochenschrift* 122(14): 450–454.
- Rutberg H (1918) Häxprocesser i norska Finnmarken [Witch trials in the Norwegian Finnmark]. *De svenska landsmålen och svensk folkliv* 16(4): 3–110.
- Schübeler FC (1886) *Viridarium norvegicum. Norges Væxtrige* [Viridarium norvegicum. Norway’s Plant Wealth], Vol 1. Christiania: Universitets-program.
- Schwarz PB, Hill NS and Rottinghaus GE (2007) Fate of ergot (*Claviceps purpurea*) alkaloids during malting and brewing. *Journal of the American Society of Brewing Chemists* 65(1): 1–8.
- Senter HJ, Lieverman AN and Pinto R (1976) Cerebral manifestations of ergotism. Report of a case and review of the literature. *Stroke* 7: 88–92.

- Siegel RK (1985) LSD hallucinations: from ergot to electric Kool-Aid. *Journal of Psychoactive Drugs* 17(4): 247–256.
- Siemens F (1881) Psychosen bei Ergotismus. *Archiv für Psychiatrie und Nervenkrankheiten* 11: 108–116, 367–390.
- Spanos NP (1983) Ergotism and the Salem witch panic – a critical analysis and an alternative conceptualization. *Journal of the History of the Behavioral Sciences* 19(4): 358–369.
- Spanos NP and Gottlieb J (1974) Ergotism and the Salem village witch trials. *Science* 194: 1390–1394.
- Spoof AR (1872) *Om förgifningar med secale cornutum, förnämligast med hensyn til Dragsjukan i Finland* [On Poisoning with *Secale cornutum*, with Particular Reference to Ergotism in Finland]. Helsingfors: JC Frenckell & Son; in Swedish.
- Tfelt-Hansen P et al. (2000) Ergotamine in the acute treatment of migraine. A review and European consensus. *Brain* 123: 9–18.
- Torfæus T (1711) *Historia rerum Norvegarum in quatuor tomos divisa* [Norway's History Divided into Four Volumes], Part 3. Copenhagen: n.p.
- Tuczek F (1882) Über die Veränderungen im Zentralnervensystem, speziell in den Hintersträngen des Rückenmarks, bei Ergotismus. *Archiv für Psychiatrie und Nervenkrankheiten* 13: 99–154.
- Tuczek F (1887) Über die bleibenden Folgen des Ergotismus für das Central-Nervensystem. *Archiv für Psychiatrie und Nervenkrankheiten* 18: 329–347.
- Uhlig S and Petersen D (2008) Lactam ergot alkaloids (ergopeptams) as predominant alkaloids in sclerotia of *Claviceps purpurea* from Norwegian wild grasses. *Toxicon* 52: 175–185.
- Uhlig S, Vikoren T, Ivanova L and Handeland K (2007) Ergot alkaloids in Norwegian wild grasses: a mass spectrometric approach. *Rapid Communications in Mass Spectrometry* 21: 1651–1660.
- Unger CR (ed.) (1871) *Marius saga. Legende om jomfru Maria og hendes jertegn. Efter gamle Haandskrifter* [Mary's Saga. A Legend of the Virgin Mary and her Omens]. Christiania: Det norske Oldskriftselskab.
- Unger C (1873) *Konunga Sögur. Sagaer om Sverre og hans Efterfølgere* [Royal Sagas. The Sagas of [King] Sverre and his Successors]. Christiania: Det norske Oldskriftselskab.
- van Dongen PWJ and de Groot ANJA (1995) History of ergot alkaloids from ergotism to ergometrine. *European Journal of Obstetrics and Gynecology and Reproductive Biology* 60: 109–116.
- van Wyk B-E (2005) *Food Plants of the World. An Illustrated Guide*. Portland, OR: Timber Press.
- Vigfússon G (1957) *An Icelandic-English Dictionary*. Oxford: Clarendon Press.
- Wagner (1839) Die Kriebelkrankheit im Jahre 1838. *C W Hufeland's Neues Journal der practischen Arzneykunde und Wundarzneykunst* 5: 24–34.
- Wählin AM (1771) Afhandling Om Den i Småland gångbara Drag-Sjukan [Treatise on the Drag-Sjukan disease [ergotism], which is common in Småland]. *Kongl. vetenskapsacademiens handlingar för 1771*: 14–41, 153–167; in Swedish.
- Whyte ID (1994) Ergotism and witchcraft in Scotland. *Area* 26(1): 89–90.
- Wichmann JE (1771) *Beytrag zur Geschichte der Kriebelkrankheit im Jahre 1770*. Leipzig and Zelle: Carl Gsellius.
- Willumsen LH (2010) *The Witchcraft Trials in Finnmark Northern Norway*. Bergen: Varanger museum IKS/Skald.
- Woolf A (2000) Witchcraft or mycotoxin? The Salem witch trials. *Clinical Toxicology* 38(4): 457–460.