The 1310s Event

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33.1 INTRODUCTION

In the 1310s, northwestern Europe experienced two environmental crises, each on a catastrophic scale. First, between approximately July 1314 and July 1316, there were twenty-four months of extreme weather, characterised by almost incessant torrential rain in summer, autumn, and spring, and then frost during winter. The disastrous weather resulted in three back-to-back harvest failures and omnipresent food dearth. Because of both anthropogenic and demographic factors, the ‘Great Famine’ of the 1310s became probably the single harshest subsistence crisis in Europe of the last two millennia. Second, between around 1314 and 1321, Europe was devastated by a disastrous cattle pestilence, most likely caused by rinderpest. In order to appreciate the environmental and biological foundations of the two disasters, it is necessary to consider their wider ecological and climatic contexts.

33.2 THE WIDER CLIMATIC CONTEXT: TRANSITION FROM THE MCA TO THE LIA

Despite much progress in the last two decades, the climatic reconstruction of the past remains far from straightforward, and there are still more questions than answers.\(^1\) Nevertheless, scholars have reached a solid consensus regarding some long-term palaeoclimatic trends. It is now generally accepted that by the second half of the thirteenth century (c. 1250–70), some profound climatic changes were under way. After some 200 years dominated by warm climate (the Medieval Climate Anomaly, or MCA), when average annual temperatures

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approached those of around 2000 CE, the North Atlantic region entered a new climatic phase, in effect a transition from the MCA to the Little Ice Age (LIA) (see Chap. 22).

This transition, a part of a much broader global climatic shift, is a highly complex and still poorly understood phenomenon. Although its chronology is debated among both historians and palaeoclimatologists, it would be reasonable to place it at about 1270–1420. Around 1270, we witness a shift to a surface and air temperature and great variance in year-to-year precipitation levels. This was caused by a general weakening of the North Atlantic Oscillation (NAO), especially since the 1320s, to the point that by the 1430s it became strongly negative. This shift created stormy conditions and cold spells, which became predominant for the duration of the LIA. These conditions were a stark contrast to those of the MCA, dominated by a strong positive NAO, when strong winter westerlies brought mildly wet and relatively warm weather to northwestern Europe and arid conditions to the Mediterranean and North Africa (see Chap. 23).

In addition, there was a gradual reduction in solar irradiance, partially caused by major volcanic eruptions in 1257, 1268, 1275, and 1341/2. In particular, solar irradiance was depressed between around 1280 and 1340, a period known as the ‘Wolf Minimum’. During this period, levels of solar irradiance were significantly lower than average for the period 1000–1500 CE. Piecemeal weakening of the NAO on the one hand and reduced levels of sunshine on the other meant gradual cooling. Indeed, Greenland witnessed a period of severe cold spells, peaking in 1303, 1320, and 1353, while Iceland saw sea-ice formation along its northern coast in the 1310s and 1330s.

These macroclimatic shifts and climate instability are reflected in various types of climate proxies all over Northern Europe. Thus, between the 1270s and the 1380s, sea-surface temperatures fluctuated a great deal from year to year in the North Atlantic Ocean, and in the waters of Atlantic France. In England, summer precipitation levels varied significantly from year to year, reflecting the corresponding annual fluctuations in sea-surface conditions of the North Atlantic, as indicated in the Greenland ice-core record. Thus, the summers of 1315 and 1316 were very wet, followed by a relatively dry summer in 1317, an excessively dry summer in 1318, and a fairly wet summer in 1319. The period 1315–18, overlapping with the Great Famine years, coincided with unusually warm North Atlantic sea-surface temperatures, which created atmospheric conditions encouraging unusually wet, cold, and stormy weather all over Northern Europe.

There is further physical and biological evidence of the increasing cooling and storminess in Scotland and northern England during the second half of the thirteenth century and the first half of the fourteenth century. As recent archaeological and palaeoenvironmental evidence from the Western Isles has revealed, commercial fisheries declined significantly because of changes in the migratory behaviour of herring and other deep-sea species. Similarly, there are archaeological indications of sand-blowing and dune deflation events across both the west and the east coasts, which ruined the quality of soil and reduced the arable production capacity of Scotland and, evidently, northern England. In some regions, arable land was abandoned altogether. The grazing season shrank by approximately one month, with adequate grass no longer growing in early May and late September. The reduced growing season would have produced less annual biomass for grazing animals, and this fact would have made livestock husbandry more challenging and costly than before.

### 33.3 THE WEATHER ANOMALY OF 1314–16

Such was the climatic context for the abnormal weather of 1314–16. Torrential rains seem to have spread all over northwestern and north-central Europe, from western Poland in the east to Ireland in the west, from northern Italy in the south to Norway in the north. However, the only place where a meticulous reconstruction of seasonal weather is possible is England. This is largely due to the uniquely rich English source material, consisting of chronicles and manorial accounts. Manorial accounts were financial and agricultural reports rendered on an annual basis by estate officials of local lords. Although these documents were concerned primarily with the financial income, expenditure, and agricultural production of those manors, there are occasional references to seasonal weather conditions, especially in the case of bad weather. The written and statistical sources can be complemented by evidence from the archives of nature, chiefly tree rings and speleothem bands (see Chap. 3).

Taken together, the following picture emerges. The downpour started in summer 1314, possibly around July. By harvest time, namely late August–early September, the torrent was strong enough to disturb harvesting. The flooding continued into autumn, persisting into October and possibly November. We are unaware if the flooding stopped temporarily at some point in the late autumn or early winter, or if it turned right into snow, as some documents suggest. The winter crops failed miserably, which indicates frost, hail, or ice storms. The torrent kept coming in the spring of 1315, pouring incessantly into the summertime, disturbing mowing and harvesting. The rain was accompanied by severe gales and thunderstorms, which destroyed buildings and felled trees. As a recent palaeoclimatic study of late medieval Norfolk concludes, April–July temperatures in 1314 and 1315 were remarkably low, standing at -11.92 °C and 11.79 °C, respectively, or 1 °C lower than average for the period 1250–1330.

The rain poured during the harvest period, making harvesting long and challenging. In some places, the harvest of 1315 continued until October. The winter and spring of 1316 were excessively rainy and stormy. The pluvial weather continued into the summer, and the downpour was so strong that in some places spring fields lay submerged under water by the harvest time. It seems that the rain stopped during the harvest, and the weather finally turned
The weather anomaly had a destructive impact on both vegetation and food resources. First, there were three back-to-back crop harvest failures in 1315, 1316, and 1317. The annual composite gross yields (that is, the ratio between the present year’s harvest and the amounts of crop sown in the previous year) stood, respectively, at about 25, 35, and 14% below the average late medieval figure. The net yields (the ratio between the present year’s harvest minus the harvest share used as seed-corn and the amounts of crop sown in the previous year) were much lower, standing at about 38, 50, and 26% below average in 1315, 1316, and 1317, respectively.

In the case of the 1315 and 1316 harvests, legumes and winter grains (wheat, rye, the wheat-rye mixture known as ‘maslin’, and winter barley known as ‘bere’) performed much worse than the spring grains (barley, oats, and barley-oat mixtures). Weather conditions were particularly harsh in winter, when wheat, rye, and winter barley germinate and legumes are planted (usually in late January–early February). There are references to snowy conditions, but it is also possible that that at some point the flooding turned into hail or ice storms, stunting the growing winter grains and the recently planted legumes. Indeed, as some recent studies have demonstrated, hail storms and ice storms can be devastating for field crops, much more than snow.

In 1317, on the other hand, it was oats that fared worse than other crops, despite the fact that the weather seems to have normalised by spring 1317.

In actual figures, the composite gross per-seed yields (ratio between this year’s harvest and the previous year’s seed) were approximately 2.76 in 1315, 2.39 in 1316, and 3.16 in 1317 (compared with approximately 3.70 years around 1300). The net per-seed yields (gross yields minus seed-corn) were approximately 1.68 in 1315, 1.32 in 1316, and 2.08 in 1317. After the deduction of one-tenth of the harvest paid in tithes, the figures are deflated to about 1.40 in 1315, 1.09 in 1316, and 1.76 in 1317. It is true in theory the tithes should not be regarded as a loss, because tithe-owners would usually redistribute them for sale at local markets. But given the excessively high prices of the famine years, very few tenants had the means to purchase additional grain. In other words, an average English tenant was left with virtually nothing to eat.

While net crop yields stood at about 38, 50, and 26% below average, the calorific decline may have been even worse. As several English chronicles narrate, grains were devoid of their usual nutrients because of the lack of the summer sun. As a result, the poor-quality bread could not satisfy people. Although any interpretation of this report might be speculative, we should bear in mind that excessive rain can damage maturing grains and reduce their calorific value in several ways. It can create mould, namely micro-fungi, which encourage biodegradation through mycotoxins. It can also reduce the quality and size of kernel contents (germ and endosperm). Perhaps most importantly, it causes unwanted sprouting of seeds, whereby enzymes break down the kernel starch and reduce the calorific value, nutrients, and quality of flour. In any event, the events of 1315–1316 destroyed much arable, it also produced grain in great abundance, to the point that the supply well exceeded demand, and the value of pasturage declined a great deal. At the same time, the incessant rain made mowing extremely difficult and costly. As a result, much grass remained unmown, destined to be consumed by water and rot. But even in those instances, when some meadow was mown, it could not be easily dried and converted into hay, on account of the torrential rain. In many cases, putrefying hay encouraged the activity of parasitic fungi, bacteria, worms, and gastropods. It appears that the consumption of putrid herbage was the single most important factor contributing to the outbreak of sheep and cattle murrains during the famine years. As we shall see below, one possible cause of sheep mortality was a liver fluke epizootic, while the bovine murrain of 1315–16 (not to be confused with the rinderpest panzootic of 1319–20) could have been brought about by either Barber’s pole worm or by mycotoxic mould.

The torrential rain had an equally devastating effect on vineyards. There are numerous references to the destruction of the wine harvest in Normandy, the Paris region, and other parts of northern France. In some areas, the vintage declined by 50% in 1315 and 1316 and by some 80% in 1317. Similarly, the bad weather ruined vineyards of the Rhineland. In those instances, when grapes
were harvested and processed, the quality of wine appears to have been deplorably sour.\textsuperscript{29} Furthermore, making wine was impossible in parts of northern Italy, because of the rainy weather in the summer of 1315.\textsuperscript{30} In England, viticulture was practised on a very limited scale, confined primarily to the southern counties. However, there can be little doubt that local vineyards were damaged at least as badly as on the Continent.

Other, minor sectors of agriculture deserve discussion, too. One such sector is fruit horticulture. The available evidence is scarce—only a few manorial accounts from southern English estates. The paucity of evidence can be explained by the fact that horticulture contributed only a small fraction of total calorie intake, and fresh fruit and vegetables were traded on a small scale and in an under-recorded real produce yields. Still, the few accounts from southern England shed some light on the depression within the horticultural sector. As they indicate, in 1315 and 1316, very few apples were picked. At Shapwick (Somerset), 2.5 quarters (\textasciitilde840 lbs) of apples were harvested in 1315, compared to 16 quarters (5376 lbs) in 1314. At Westonzoyland (Somerset), the apple harvest amounted to 11 quarters in 1315, compared to 27 quarters in 1314. At East Meon Church (Hampshire), only one quarter was picked in 1315 and no apples were harvested in 1316—in contrast with 27 quarters in 1312.\textsuperscript{32} Two main factors are essential for good fruit tree yields: sufficient solar irradiance and sufficient pollination by pollinating insects, primarily bees and butterflies. Cold and rainy springs hinder fruit tree blossoming and prevent insect pollination. Additionally, bees and butterflies (and other insects, with the exception of mosquitoes) cannot fly in the rain. To make things even worse, cold and rainy winters increase mortality rates of insects, because they are unable to secure food. Finally, the torrential rain of 1314–16 undoubtedly encouraged gastropods, that is slugs and snails, both notorious destroyers of leaves. Taken altogether, it is hardly surprising that those few accounts recording orchard production reported abysmally low figures.

The low levels of fruit harvest were closely related to the health of bees, often managed in garden beehives to produce honey and wax, both highly commercial products.\textsuperscript{33} As with horticulture, beehive management is reported in few English manorial accounts, but those few documents clearly indicate that the rainy and freezing winters of the famine years greatly increased honeybee mortality. For instance, at Werreore and Cosham (Hampshire), five of eight swarms died during the winter of 1315–16 “because of excessively rainy weather”.\textsuperscript{34} Similarly, at Pilton (Somerset), thirteen out of seventeen swarms died in the course of the winter of 1314–15.\textsuperscript{35} The same manors also reported depressed yields of honey and wax.

Salt production was yet another sector severely depressed by the inclement weather. In the late medieval period, salt making depended much on natural evaporation of brine (created by the formation of pools of seawater on the beaches during high tide in late spring).\textsuperscript{36} Clearly, the flooding of 1314–16 would have prevented the evaporation of brine, and stoking fires around the salt ponds to quicken evaporation would have been extremely wasteful and inefficient.\textsuperscript{37} Although there is no way to quantify the decline in salt production during the crisis, there are more than enough narrative references to the extent of the disaster. There was widespread deficiency of salt in England, and in northern France.\textsuperscript{38} Although England boasted several important salt-producing centres, especially in Cheshire and Lincolnshire, it still depended much on foreign salt, imported primarily from Bourgneuf Bay (on the frontiers of southern Brittany and Poitou) but also from Brittany, Normandy, and Lüneburg (Lower Saxony). Although the torrential rain poured over the Breton, Norman, and Saxon saltmires, the Bourgneuf salt works were located outside of the climate anomaly zone and there is no evidence that salt production was disrupted there. However, the disruption of salt production within the climate anomaly zone drove an increased demand for, and dependence on, the Bourgneuf salt all over Northern Europe, which trebled and quadrupled salt prices in northern France and England.

### 33.5 From Shortage to Famine

Although the environment played a central role in initiating the shortage, it did not by itself create famine. The transformation of shortage into famine—or to use Amartya Sen’s terminology, the transformation of ‘food availability decline’ (FAD) into ‘food entitlement decline’ (FED) (see Chap. 27)—depended on purely anthropogenic, and especially institutional, factors.\textsuperscript{39} Once the harvest was collected and tithe paid, an average tenant would have been left with very little food supply, since the return from harvest barely exceeded the seed investment in the previous year. The consequences were especially harsh in those lands caught in a so-called Malthusian trap: namely, population was too large in relation to available resources. Thus, in England—where the population was somewhere between 4.75 and 5.25 million people on the eve of the famine, where over one half of the total population lived on less than ten acres of land, and where, according to one estimate, about 41% lived below the poverty line—an average tenant’s parcel of land could not possibly provide sufficient food.\textsuperscript{40} Grain-based products, primarily bread and ale, contributed about 70% of the calorie intake of an English commoner, which translates into about 1400 kcal per day.\textsuperscript{41} Under those circumstances, well over half of the required kilocalories had to be secured from outside the tenancy strips, namely from local markets.

There was very little grain available for sale at local markets. This was not because of the abysmally low yields: after all, if crop harvests failed by, say, 50%, it implied that at least some grain should still have been available for sale, especially given that many wealthy producers would still end up with a surplus. The disruption of grain supply to local markets may be explained by the reluctance of the same producers to make their cereal stocks available for sale. As the manorial accounts indicate, in the course of the first fiscal year of famine
(September 1315 to September 1316) only about 30% of the 1315 grain harvest was released for sale by the spring of 1316, while the rest was hoarded in expectation of high prices. Here the issue of storage played an enormous role. Because of widespread poverty and crowding, peasants rarely had efficient storage facilities. To make things even worse, inclement weather ruined local granaries and barns. In contrast, better-off producers had both the storage space and means to make repairs as necessary. In addition to the storage issue, we also have to account for the rise in transportation costs. The abnormal ox-drawn transportation became more time consuming and expensive; shipping became even more costly and dangerous, not only because of the high tides and storms, but also because of the ongoing piracy in the North, Irish, and Celtic seas.42

Pirate attacks, often targeting food supplies, should be seen in a wider context of ongoing warfare. The most violent theatre of war was in the British Isles, where north English counties, southeastern Scotland, and the eastern parts of Ireland were devastated in the course of the ongoing Anglo-Scottish War (1296–1328). To this we should add the rebellion of Llewellyn Bren (28 January–18 March 1316) in south Wales. In the course of hostilities, all sides engaged in environmental destruction, including the desolation of arable fields, pasture, woodland, and wildlife resources, as well as plundering of granaries and barns, thus cutting local communities off from their access to food.43 In addition, Louis X of France invaded Flanders in August 1315, but this short-lived invasion was doomed to fail because of the inclement weather, which destroyed French soldiers’ provisions and discouraged them from fighting.44 In Sweden, there was civil war between King Birger Magnusson and his magnates in 1317–18, which ultimately led to the king’s downfall.45

It was due to these anthropogenic factors that transactions costs went up, driving abnormally high grain prices. In England, the selling price of one quarter of wheat (424 lbs) rose from 7 shillings in September to 24s in June. The average annual wheat prices were 15s and 16s a quarter in 1316 and 1317, respectively—that is, about three times higher than in an average “non-famine” year around 1300.46 Black market prices rose even higher: in one instance, a quarter of wheat was selling for an overwhelming 44s.47 Grain prices rose in a similar manner in northern France, the German Empire, the Low Countries, and Central Europe.48 As we have seen, salt prices in England and northern France trebled and quadrupled.49 There is also evidence of a rise in apple prices in England, owing undoubtedly to the depression of orchard production during the crisis years.50

The disruption of grain supplies and excessively high market prices left the poorer elements totally helpless in the face of the crisis. This was especially true in those regions that suffered from overpopulation (most of England and northern France, the Low Countries, and presumably the western parts of the German Empire).51 In other words, this seems to have been a classical Malthusian scenario, when there were too many hungry mouths and too few resources. The oversupply of agricultural labour meant low (and virtually stagnant) nominal wages and excessively low real wages (nominal wages deflated by the Consumer Price Index). At no other point were living standards in England so low; and although the scarcity of data does not allow any quantification, the same was probably true of other famine-stricken parts of Europe. This point is especially crucial in explaining hunger and malnutrition. As we have seen, the abysmally low crop yields implied that at least half of England’s population needed to secure additional food from outside of their parcels, population needed to secure additional food from outside of their parcels, population needed to secure additional food from outside of their parcels, population needed to secure additional food from outside of their parcels, population needed to secure additional food from outside of their parcels, population needed to secure additional food from outside of their parcels, population needed to secure additional food from outside of their parcels, population needed to secure additional food from outside of their parcels, population needed to secure additional food from outside of their parcels, population needed to secure additional food from outside of their parcels, population needed to secure additional food from outside of their parcels, population needed to secure additional food from outside of their parcels, population needed to secure additional food from outside of their parcels, and this was especially true of the Londoners and the inhabitants of the large cities and towns.52

3.6 Malnourishment and Mortality: Humans

The adverse combination of environmental and anthropogenic factors ultimately condemned both humans and domestic animals to malnourishment and mortality. At first, local communities attempted to take up the slack by switching their dietary patterns. In England, there is much evidence for an increase in livestock consumption, especially pigs, the quintessential peasant animal. However, as one English chronicler narrates, there were not enough legumes to fatten swine, and therefore ham, bacon, and lard could be produced only on a limited scale.53 The shift from arable to pastoral husbandry would have been a highly expensive enterprise, unaffordable for the majority of famine-stricken peasants, who lacked both the necessary start-up capital and physical space for animal management. To make things even worse, there were (as we shall see in the next section) several outbreaks of livestock diseases in the 1310s, which made the task of securing healthy animals all the more challenging. According to the same chronicler, “even flesh of animals became to be deficient, and eggs and other dairy products began to disappear too. One could hardly find capons or geese; sheep were lacking, because of their murrain.”54 Another English chronicler stated that no one dared to eat the meat of animals that perished from murrain.55

It was in this context that the poorer elements of society had to resort to famine foods, consisting of otherwise inedible and repugnant comestibles. According to one source, people of Northumberland (north England) ate horses and dogs.56 Another English chronicler reports the consumption of mice, dogs, and pigeon dung.57 ‘Pigeon dung’, however, seems to have been a Biblical cliché, rather than the actual comestible.58 One Dutch chronicler reported that hungry people devoured cattle carrion, just like dogs, and meadow grass, just like oxen.59 Consumption of cattle that died from murrain is also reported in Würzburg.60 Several English and Irish narratives tell in detail about instances of cannibalism, whereby both men and women ate their own and other peoples’ babies, prison inmates ate each other, and hungry and exhausted Ulster soldiers dug up corpses in order to eat them.61 Instances of eating children and corpses were also reported in Poland, Bohemia, Germany, and the Baltic lands.62 The authenticity of these reports (and similar descriptions from later historical famines) has long been debated among historians. Some dismiss them as outright hearsay or curiosities; others remain...
undecided. Given the recurrent reports of cannibalism in later famines, some based on first-hand witnesses, the possibility of human- and corpse-eating during the Great Famine—arguably the single harshest subsistence crisis in Europe in the last 2000 years—should not be dismissed lightly.

The omnipresent malnourishment and famine food consumption compromised the immune systems of the starving population and made them susceptible to various hunger-related diseases. Thus, some German chronicles speak about a ‘general and universal pestilence’. Other sources are more precise: several English chroniclers narrate that people succumbed to dysentery, caused by the consumption of corrupt foods. An outbreak of a disease called *pustis gutturosa* (‘throat pestilence’), interpreted by some as scarlet fever, was also reported. Although scarlet fever indeed accompanied some famines, including the Irish Potato Famine (1845–52) and the Finnish Famine of 1866–68, this identification is by no means definitive. It has been suggested that some may have died of ergotism caused by the consumption of fungus-infested rye. There is no evidence, however, that there was an outbreak of ergotism, despite the fact that wet conditions encourage the growth of the fungal parasite. It is more likely that malnourishment and consumption of famine foods led to diarrhoea and dehydration, weakening the population and increasing its morbidity rates. Although the contemporary sources do not reveal mortality patterns across gender and age, it is plausible that children and old people were more prone to these diseases, as modern famine studies show (see Chap. 28). Recent palaeopathological studies based on skeletal evidence from a Black Death cemetery in London indicate that the Great Famine targeted trailer individuals. Likewise, food deprivation in breastfeeding mothers was likely to reduce their immunity and hinder the physical development of their children.

Any estimate of human population decline during the famine remains somewhat speculative. This is largely due to the remarkable paucity of demographic studies on the early fourteenth century. Nevertheless, data from five English manors based on local court proceedings suggests that between 1315 and 1318 England’s population declined by 10–15%. It is likely that mortality rates in towns were even higher, given urban dependence on the surrounding agricultural hinterland. For instance, one London chronicler reported that the capital lost 20,000 people during the famine years—possibly an exaggeration, given that London’s population on the eve of the famine was probably no more than 60,000 people. At Ypres and Tournai (both in Belgium), about 10% of the population died.

### 33.7 Malnourishment and Mortality: Animals

Humans were not the only victims of the crisis. The destruction of fodder resources by the torrential rain and freezing winters had a devastating impact on livestock, especially cattle and sheep. As we have seen, the crisis years destroyed much forage, including pasture, hay, and straw, which deprived domesticates of healthy fodder. Indeed, as some English chronicles state, animals succumbed by eating rotten grass and herbs. To make matters even worse, the inclement weather had very negative implications for animals who were already exposed to colder temperatures and deprived of their most basic kinds of fodder, and therefore had to waste more energy to maintain body heat. These conditions likely decreased their resistance to pathogens within a very short period of time. Malnutrition also delays physical growth in young animals, chiefly the development of muscles. Several months of deprivation in a young bullock or hogget (young sheep) will do enough damage to turn them into infertile and weak animals, prone to various diseases.

Such was the context for three outbreaks of animal mortality, each attacking different groups of livestock with different levels of intensity. First, from late 1313 or early 1314 until 1317, there was an outbreak of sheep murrain in England, Wales, and parts of Ireland, targeting primarily young animals. Second, sources record an excess bovine mortality in 1315–16 in England. This episode, however, was nothing compared to the devastating outbreak of bovine pestilence that decimated European stocks between about 1315 and 1321.

The murrain in British sheep broke out either in late autumn 1313 or around January 1314, long before the beginning of the torrential rain in the summer of that year. Although the outbreak is reported in many chronicles, the descriptions are rather lacunary and at times vague. Thus, one chronicle specifies that there was ‘a common rot *communis putredo* and sheep murrain, as well as mortality of other animals’. Some historians have speculated that this ‘rot’ was an infestation of liver fluke (*Fasciola hepatica*), a parasitic flatworm infecting sheep livers. There is one manorial account from Bourton-on-the-Hill (Gloucestershire) mentioning sheep mortality because of ‘the rot in bile duct’, which indeed fits the symptoms of liver fluke infestation. Moreover, although ‘rot’ (*putredo*) was a generic term, it was also used to describe liver fluke in several late thirteenth-century English agricultural treatises. Liver fluke activity is encouraged by rainy conditions, whereby the parasites migrate into the sheep’s liver and bile duct via ingestion of rotten grass and then begin laying eggs. About twelve to fifteen weeks after ingestion, animals exhibit the first signs of the disease known as *fasciolosis*, whose common signs include liver malfunction and failure, jaundice, anaemia, gall bladder damage, weight loss, and diarrhoea.

It seems, however, that liver fluke infestation was not the only cause of excessive sheep mortality during the famine years. A 1315–16 account from Stevenage (Hertfordshire) reports ‘red disease’ (*rubens morbus*) devastating local flocks. This term is far from straightforward. It might be identified with a now obsolete disease called ‘Blood’ in several early modern agricultural treatises. Once sheep contracted this disease, they would suddenly die in agony, and if not culled in time, their skin would become red as ‘blood’. Although it cannot be established with certainty, it appears that Stone’s identification of *rubens morbus* with the ‘Blood’ disease is plausible. Some accounts also refer to *veroles*, most likely the sheep pox (*Variola ovina*) mentioned in one late.
thirteenth-century agricultural treatise. Although the identification of this disease remains debatable, it is likely that *verolas/variola* is in fact *Variola major*, or sheep pox. Sheep pox is mentioned in one version of Walter of Henley’s agricultural treatise as *pockes*. Sheep pox is a highly contagious viral disease caused by a poxvirus. The clinical symptoms include lesions around the lips, in the axilla, and on the tail.

To complicate matters even further, manorial accounts contain numerous indirect but unambiguous references to a concurrent outbreak of yet another disease: scab. Although the accounts do not refer to scab by its proper name, they indicate that traditional scab-treatment medicaments including lard, butter, oil, verdigris, quicksilver, and copperas were applied on ailing sheep. Scab is an acute infectious form of dermatitis caused by the faeces and bites of sheep mites (*Pseudestes ovius*). Sheep mites tend to mate and act aggressively during the cold and damp months of autumn and winter. Indeed, the weather conditions of 1314–16 provided ideal conditions for mite mating and aggressive behaviour. It should also be borne in mind that during those late autumn and winter months sheep were most likely concentrated in sheppotes, in order to be protected from the inclement weather. This brought the animals into close contact and encouraged transmission of the mites. This outbreak of scab was one of several recurrent waves of the disease, which devastated Britain’s ovin stocks between 1279 and around 1330. However, the 1313–14 outbreak was harsher, with mortality rates standing at 20% that year (albeit not as harsh as the 1279–81 wave that killed almost half of English stocks). As such, it was yet another setback with harsh economic implications, particularly in the wool industry.

Bovine animals were yet another victim of the crisis. Several narrative sources report that cattle died from eating rotten herbs. The accounting year of 1315–16 (running between two Michaelmas, that is, 29 September) stands out, with mortality rates reaching 9%, compared with only 3% in 1314–15 and 1316–17, a figure comparable to normal years. Although most documents do not specify the nature of the disease, several accounts state that local animals died ‘because of rot’. It is possible, just as in the case of sheep, that the ‘rot’ was an infestation of gastrointestinal parasites. For instance, Barber’s pole worm (*Haemonchus contortus*) is associated with rotten herbage and is known as the single most common type of stomach worm in cattle. But it is equally possible that the ‘rot’ was caused by mycotic or mycotoxic mould infecting rotten herbage. The consumption of mouldy herbage can often lead to liver disease in cattle, causing periportal fibrosis (severe liver lesions) and biliary hyperplasia (enlargement of the bile duct), and leading eventually to death.

This local animal mortality of 1315–16 was nothing compared to a much greater bovine crisis that devastated all of Europe around the same time, caused most likely by the rinderpest virus. Unlike scab disease, which seems to have been confined to the British Isles, the cattle pestilence affected a vast stretch of Eurasia. Similar to the Black Death a generation later, the geographic origins of the pestilence remain obscure, but the disease seems to have originated in the Eurasian steppe. Outbreaks are reported in Mongolia between 1288 and 1311; in northern China in 1288, 1301, 1306, and 1335; in the Ilkhanate (comprising Persia, Azerbaijan, and parts of Asia Minor) during the reign of the Great Khan (1291–95); and in the Golden Horde (stretching from the Caspian to Siberia) during the reign of Tohto Khan (1291–1312). The pandemics crossed the steppes into Russia in 1298 and 1309, but it was not until about 1316 that it reached Central Europe, possibly through Lithuanian trade routes, and its presence was attested in Bohemia and eastern German lands. By 1318, the pestilence ravaged northern France, the Low Countries, and parts of northern Italy. In the same year, cattle mortality was reported in Denmark. Finally, by Easter 1319 the disease came to Essex, England. It swiftly spread throughout the British Isles, reaching Scotland shortly after September 1319, Wales by summer 1320, and Ireland in 1321.

Although the bovine pestilence is attested in various European and non-European chronicles, the language of the sources tends to be laconic and vague. Thus, one later Brabant chronicler, Edmond de Dynter (1375–1448), reported that the epizootics were of such catastrophic proportions that hardly one cow in ten survived. It is only in England and east Wales that an accurate estimate of mortality rates is possible, thanks to detailed information found in manorial accounts. They indicate that about 62% of bovids perished. Unlike the scab outbreak, when both male and female animals died at a similar rate, this disease was particularly devastating to female animals, killing about three-fourths of all cows and heifers. This undoubtedly had to do with the fact that the immune system of lactating animals was compromised by malnourishment and the abnormally damp and cold weather. The morality rates of oxen, on the other hand, stood at about 50%, which may be explained by their better resistance to pathogens, because of stronger physiology and better diet, which included oats and legumes.

Although the exact nature of the disease has yet to be scientifically determined, several recent studies relying on descriptions of symptoms have suggested that it was rinderpest. Rinderpest is a viral disease with death rates approaching 100% in infected animals. The pathogen incubates from three to nine days and gets transmitted mostly through respiratory and sexual contact. Its dissemination is remarkably fast. The disease is characterised by haemorrhaging, fever, erosion of the lower intestine, debilitating diarrhoea, and nasal and ocular discharge. Animals succumb between six and twelve days. During symptoms and after death, infected animals contaminate fodder, pasture, and sources of water.

### 33.8 LONG-TERM IMPACTS

Although the agricultural crisis was more or less over by 1318, and the bovine pestilence in 1321, the crisis had enduring environmental and economic repercussions. The recovery of bovine stocks proved a long and expensive process. As English evidence indicates, it was not until the late 1330s that...
herds reached their pre-crisis levels. Oxen were the most important draught animal in England and many other parts of Northern Europe struck by the crisis; they had to be replenished first in order for the predominant arable sector to recover. In the meantime, to fill the vacuum, the draught-horse sector was temporarily expanded. Thanks to these steps, there is no evidence of depression in the agrarian sector until the Black Death. The agrarian recovery allowed the human population to grow anew, as demonstrated by English evidence. The dairy sector, however, remained depressed for some twenty years, because of the comparatively slow recovery of cow stocks. The contraction within the dairy sector meant the English population was deprived of their most important source of some vital nutrients, including protein, calcium, and vitamin B₁₂.

Obviously, early fourteenth-century Europeans had no knowledge of nutritional science and hence could not devise alternative strategies to compensate for nutritional loss by, say, expanding legume acreage. This fact had some far-reaching consequences on human health and susceptibility to pathogens. As skeletal evidence from one Black Death cemetery in London reveals, individuals born after 1319 (the year of the outbreak of bovine pestilence in England) clearly show more numerous signs of frailty and pathology, chiefly short stature, cleft palate (lesions on orbital roofs), porotic hyperostosis (lesions on cranial vault bones), and linear enamel hypoplasia (horizontal lines on the enamel of an affected tooth). These pathologies are usually associated with insufficient intake of the aforementioned nutrients during physical development in childhood and adolescence. It is hardly surprising that the same frail individuals, born and maturing after 1319, were susceptible to the Black Death, now proven to have been caused by a biowar of the pathogen Yersinia pestis.

A connection among these three biological disasters of the fourteenth century—the famine, cattle plague, and Black Death—is likely but by no means clear and straightforward. This remains a fascinating topic, which at present poses more questions than answers. It is only through meticulous interdisciplinary studies based on strong collaboration among historians, archaeologists, and scientists that we may one day reach definite conclusions.

### 33.9 Conclusion

The crisis of the 1310s was, by all means, an unusual natural event with far-reaching implications. It was a short-term weather anomaly within a wider climatic shift, which came as unusually wet and cold weather destroying virtually all sectors of agriculture at once. Biologically speaking, it wreaked much havoc in weakened and nutrient-deprived human and animal populations, susceptible to various pathogens and diseases. Economically speaking, it came when the living standards of northwestern European populations reached their lowest point in many centuries (if we assume that English evidence reflects conditions in other lands). The climatic and biological instability was a major setback for

### Notes

1. Brázdl et al., 2005.
2. Dawson et al., 2007.
7. Mary et al., 2015.
13. Longleat House Muniments (henceforth, LH) 10666, membranes 9v, 33v
   (manors of Pilton and Wrinton); LH 10030 (manor of Walton)
   (manors of Pilton and Wrinton); LH 10030 (manor of Wrinton)
   (manors of Pilton and Wrinton); WAM 8802 (manor of Kinsbourne, alias Harpendenbury).
14. The National Archives (Kew) (henceforth, TNA), SC 6/996/14, memr. 15r and 7r (manors of Haughley and Thorndon, both in Suffolk); Northamptonshire Record Office (henceforth, NorthantsRO), FM 248 (manor of Boroughbridge, Northampt
   (manors of Haughley and Thorndon, both in Suffolk); LM 1011/4 (manor of Byfleet, Surrey).
15. LH, 10666, membranes 9r and 39r (manors of Baltonborough and Pilton, both in Somerset).
   13v (manor of West Wycombe, Buckinghamshire); WAM, 8803 (Kinsbourne).
18. Bodleian Library (henceforth, BodL), Ch Ch DD27 (manor of Maids Moreton, Buckinghamshire).
19. WAM, 8766.
20. WAM, 25423 (Birbook, Essex).
21. These figures are slightly different from those calculated by Bruce Campbell,
   who favoured the figures of 39% below average in 1315, 63% below average in 1316, and 10% below average in 1317. The discrepancy derives from the difference in manorial sample, methodology, and my inclusion of 'minor' crops (rye, wheat-rye mixture, winter barley, legumes, legume-oat mixtures, and oat-barley mixture).
23. Riley, 1876, 93.
27. V.K3oZnbhCM9 (last accessed 19 November 2015).