CHAPTER 7

Famine, Pestilence, War, and Death: John Maxwell Landers' Four Horseman Spurring Humans Faster Along the Life History Continuum

1 The Historical Evolution of Urban Populations

"What is now known about the pre-nineteenth century urban population of Europe?" This important question was asked by Professor *Jan De Vries*, and the answer he provided, "surprisingly little," unleashed the motive force of renowned British historian and anthropologist *John Maxwell Landers*. Born in 1952, Landers was educated at *Haberdashers' Aske's School Elstree, Southgate Technical College*, a subsidiary of *Hertford College, Oxford*. From thence, he obtained a bachelor's and master's degree in the Human Sciences. Landers then pursued graduate work in historical demography at the *Cambridge Group for the History of Population and Social Structure*, before receiving his Ph.D. in 1984 from *Churchill College, Cambridge*. After serving a stint as a demand analyst for the planning division of *Shell UK Ltd.*, Landers joined the Anthropology Department of *University College London* as a Lecturer in Biological Anthropology. From 1991 to 2005, he was a University Lecturer in Historical Demography and Fellow of *All Souls College, Oxford*. Landers is now a Doctor of Letters of the *University of Oxford* and a *Fellow of the Royal Historical Society*.

Through all this, Landers labored to supplement "the meagerness of the existing literature" with respect to "the historical evolution of urban population" (De Vries 1984; p. 17). The course of his career was canalized; its trajectory already evident in his dissertation title: *Some Problems in the Historical Demography of London, 1675–1825*. In analyses

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of historical demography that spanned two millennia, Landers strove to understand changing social organization, urban or otherwise; both within-populations across time and through cross-population comparisons. Along with Vernon Reynolds, Landers (1990) edited, *Fertility and Resources*,[1] while also editing, *Historical Epidemiology and The Health Transition* (1993).[2] Landers (1993) thereafter examined historical urban demography in a slate of peer-reviewed articles, ultimately leading to the publication of his first book, *Death and the Metropolis: Studies in the Demographic History of London, 1670–1830*. Therein, Landers elucidated a series of demographic events culminating in outsized mortality rates. Within the *long eighteenth century*, 1675–1825, Landers cast infectious disease as a driver of biodemographic and social characteristics,[3] even as he focused on proximate mechanisms to the relative exclusion of distal implications. His first realization was that demographic changes, such as historical variations in mortality, could not be explained simply in terms of changing real incomes. Intuiting underlying complexities, the models proposed by Landers can be seen as a cascade, with, for instance, migration transmitting parasites to urban areas that functioned as endemic foci of infection, which, in turn, altered age-specific mortality.[4]

2 Fertility, Infection, Technology, War, and Death

The most relevant further thrust into interdisciplinarity came in 2003, with the publication of, *The Field and the Forge: Population, Production, and Power in the Pre-Industrial West*. The title, *The Field and the Forge*, is shorthand for pre-modern *organic* societies versus modern *mineral* societies; or one might say, the farm versus the factory. Thus, Landers' (2003) thesis relies on Wrigley's (1990) prior distinction between *organic* and *mineral* economies. Within that dichotomized structure, organic economies depended on vegetation and animals for both energy and raw materials. Consequently, organic economies were bounded by seasonal and agricultural rhythms and subject to Malthusian checks. Everything followed from energy constraints. Energetic restriction limited specialization, metalworking, transport, and, more distally, the ability for societies to internally stratify and differentiate from one another. This cascade of consequences is explained directly by Landers (2003; p. 17):

> The fact that workers could bring so little energy to bear meant that productivity was correspondingly low, and low productivity made for general scarcity, which condemned the majority of the population to poverty and ensured that the demand for non-subsistence goods remained weak.

Beyond hard limitations on surplus production imposed by organic economies, governments struggled to tax and take what surplus was produced. For governments constrained by the niggardliness of organic economies could not afford the bureaucratic infrastructure that might otherwise have raised revenues by means of efficiently taxing available wealth. Extending both from inefficiencies in production and taxation, governments labored to maintain a military arm strong enough to coerce what obedience was not freely granted. Trade and transportation were likewise constrained. Yet, most fundamentally, restricted energy within organic societies imposed demographic constraints that interpolated intervals of cessation and contraction upon trajectories of growth. Black coal would change all. Post-Industrial Revolution mineral economies, extracting the energy of anthracite and making with it iron and steel, broke through the ceiling of energetic constraint. Escape velocity had been reached. Unmoored from energetic constraints, all aforementioned concomitant constraints were lifted.[5]

The organic–mineral distinction is sometimes depicted as simplistic,[6] though it may be more productively seen as heuristically valuable for its guiding function. Like any heuristic, it has boundaries to its application and exceptions to its generalities. As reviewed by Goldstone (2002), pre-industrial Europe and Northeast Asia were unmistakably differentiated in, for instance, their activities and occupations. Even then, these societies supported large urban centers, extensive manufactures, intricate webs of internal trade, far-flung networks of external trade, high levels of complexity, and abundant human capital—all in spite of restricted energy inputs. Thus, while having heuristic value, the organic–mineral distinction insufficiently explains pre-industrial demographics, necessitating supplementary analyses of other ecological factors. The case of Medieval Europe is central to understanding this argument, and comparatively rich in data, permitting an analysis that may exemplify an evolutionary understanding of pre-industrial biodemography.

Any effort to expand on Landers' cascade of consequences requires ecological variables predating, in a chain of causation, economic, militaristic, and technological changes. And so, even as we recognize the importance of the proximate causes populating The Field and the Forge, we presently attempt to review ultimate causes, adding primary links to the causal chain. Importantly, Landers recognized this distinction between *proximate* and *ultimate* determinants of demographic phenomena. Furthermore, he explicitly acknowledged that historical analysis necessarily centers on proximate explanation, while implicitly acknowledging its inability come to grips with ultimate explanations: "…in historical studies, we generally lack the information required to fit the model in its entirety, but we can still identify the effects of a number of proximate determinants." By leaving aside ultimate causes, and thus evolutionary reasoning, Landers discussed demographic (e.g., fertility) strategies as *rational*, *effective,* or *beneficial* within an economically informed energetic framework. Productive as this inquiry was, an evolutionary analysis with a focus on life history strategy, is clearly needed. With it, one can avoid relying on purely economic or cultural explanations of family planning choices, for instance.[7]

3 Climate, Life History, and Demography: Evolutionary Links

In climatology, it is well recognized that there are entire cascades of consequences issuing from a single event. Take volcanism for instance. Volcanic activity often perturbs atmospheric conditions, thereby influencing oceanic currents, which, in turn, may well affect circumpolar ice caps; still further, the resultant release of freshwater can affect oceanic salinity, with resultant changes in oceanic currents and coastal land temperatures. The indirect effects of such phenomena upon plant life are also so well known that data from both *paleo-palynology*, the study of ancient pollen, and *paleo-dendrochronology*, the study of ancient tree ring growth, are routinely used as reliable and valid markers of climate change. However, what is somewhat less well-recognized is that indirect effects do not stop there. The implications of plant growth for human agricultural production are self-evident, and the alteration to the ecological carrying capacity of the environment is a logically necessary consequence. Growth or decline in human population density must automatically ensue, especially in principally agrarian societies. Furthermore, intraspecific competition for limited resources is obviously exacerbated during times of resource scarcity. In humans, this competition might take the form of elevated intergroup conflict, such as organized warfare.

These latter relations are studied within the emerging application of life history evolution known as *social biogeography* (Figueredo et al. 2017). The basic principle of the cascade of consequences has been summarized succinctly as follows:

1. *Physical ecology*
2. *Community ecology*
3. *Social ecology*
4. *Cultural ecology*
5. *Cognitive ecology*

Thus, changes in the climate (physical ecology) trigger changes in populations of human cultivars as well as parasites (community ecology). From thence, the cumulative effects of climate change, food abundance, and parasite load produce changes in the structure and function of human societies with respect to their social, cultural, and cognitive ecologies.

Using that social biogeographical framework, we now follow the cascade of consequences as it played out within medieval history, before the transition to mineral economies. The *High Middle Ages* roughly coincide with what has been called the *Medieval Warm Period*,[8] AD 950–1250 (Lamb 1965, 1995; Mann et al. 2009; Sicre et al. 2008). This period was characterized by diminished volcanic activity, which facilitated a rise in average temperatures throughout much of the world. In Europe, this warming led to widespread, bountiful harvests and, accordingly, increases in human population size (Fagan 2008).[9] However, while containing this warm interlude, the Middle Ages at large were bounded by episodes of consequential climate change. The *Early Middle Ages* were inaugurated by a massive volcanic eruption occurring in AD 535–536, occasioning years of climatic change (Gunn 2000; Keys 2000). Originating in the Indonesian Archipelago, specifically from either Mount Toba or Krakatoa, this explosive eruption discharged colossal quantities of dust, ash, and acid into the atmosphere, producing a veil of aerosol particles obscuring much of the sun's incoming radiation.[10] Reduced insolation produced extreme cold and, consequently, widespread crop failures throughout the Northern Hemisphere for nearly a decade, with more persistent *global cooling* lingering for the next three centuries. Ironically, the very period that has been metaphorically referred to as the *Dark Ages* turns out to have been literally *dark* at the outset. Similarly, multiple convergent lines evidence suggests that the so-called *Little Ice Age* (Fagan 1999), coinciding with the start of the *Late Middle Ages* and leading into the Early Modern Era, was triggered by a 50-year-long episode (AD 1275–1325) of volcanic activity (Larsen et al. 2008; Miller et al. 2012). The atmospheric aerosols from these volcanic explosions again produced ice-cap expansion and anomalously colder summers. As before, the more severe effects were abrupt and immediate, but persistent climatic effects lingered for centuries, probably maintained by the sea-ice/ocean positive feedback loops.

The cascading consequences initiated by global cooling subsequent to the catastrophe of AD 535 are detected in tree ring thickness of bristlecone pines in Western North America (Salzer and Hughes 2007). Likewise, this change in climate caused unprecedented droughts in Mesoamerica, contributing to the collapse of the theretofore flourishing *Toltec* city-state of *Teotihuacan* (Keys 2000). Then, there were famines in the north of China potentiating the near-depopulation, by as much as seventy-five percent, of the *Wei Empire*—the causal ripple of which may explain subsequent shifts in the surviving population toward Buddhism, as the *Mandate of Heaven* had been evidently lost by the ruling elites (Gunn 2000). In the century that followed that catastrophe, the newly reunited Roman Empire of the Circum-Mediterranean region lost fully half of its territory (Keys 2000). The weakening of the population by hunger due to food scarcity, plus more localized disruptions of rodent populations, led to the outbreak of *Bubonic Plague*, which had hitherto been endemic and isolated, but which became epidemic and pandemic. At one point, the *Plague of Justinian* was killing up to ten thousand people a day in Constantinople and, at least according to Procopius, is estimated to have ultimately killed anywhere from fifty to one hundred million people throughout Europe and the Eastern Mediterranean region. Furthermore, Procopius (550/1935) also documents the outbreak of various wars and social disturbances during that period.[11] The climate change occurring during the beginning of the Late Middle Ages in Europe followed suit. Torrential downpours occurring during the summers and autumns of AD 1314–1315 caused massive flooding, leaving crops rotted in the fields. These same floods drowned livestock and thereafter actuated the *Great Cattle Plague* of AD 1315–1321, an epidemic of bovine Rinderpest affecting weakened cattle, which reportedly killed over sixty percent of the surviving cows and heifers. These disasters cumulatively led to what has been called the *Great Famine* of AD 1315–1317[12] which may have killed between ten and twenty-five percent of the populations of many European towns and cities. The resultant weakening of the human population by famine is believed to have set the stage for the *Black Death* epidemic of AD 1348–1351 (Jordan 1997), which was yet another outbreak of Bubonic Plague, variously estimated to have killed between one-third and two-thirds of the population of Europe.

But wait, there's more! A variety of authors have documented the adverse effects of the associated famine and pestilence upon the structure and function of the European societies of the Late Middle Ages, with organized warfare degenerating into brigandage and general lawlessness as social order and political authority deteriorated (Froissart 1404/1858; Goldsmith 1995; Huizinga 1924; Jordan 1997; Rosen 2014). Some have even concluded from all this that climate change almost routinely triggers social conflict and even genocide (Alvarez 2017). For example, using legal records, Gurr (1981) reconstructed homicide rates through English history. According to his calculations, during the thirteenth century, English cities, such as London and Bristol, had homicide rates below 15 per 100,000 individuals. This pattern changed drastically in the fourteenth century, with London increasing its rate to 44 per 100,000, whereas Oxford reached a rate of 110 per 100,000[13] (Gurr 1981). More recent examinations support Gurr's conclusions. For example, Eisner (2003) collected enough historical data from England, Scandinavia, The Netherlands, Belgium, Switzerland, Germany, and Italy[14] to create a *History of Homicide Database*. This database relied on national statistics, offering annual causes of death including homicide, and direct judicial or constabulary information concerning alleged murders. Eisner's (2003) calculations concluded that the average homicide rate during the thirteenth century and the fourteenth century was of 32 per 100,000 people.[15] Although Eisner provides averages for both centuries, the secular trend indicates an increase in homicide rates from the thirteenth century to the fourteenth century—a pattern consistent with Gurr's observations. Similarly, a slight increase was observed during the fifteenth century, with an average rate of 41 per 100,000 (Eisner 2003). Interestingly, even though the murder rate then decreased, during the fourteenth century, at the time of the crisis of the Late Middle Ages, it rose to 1178. With respect to battle deaths, the pattern indicated a general decrease in mortality rates (Eisner 2011).

Although one may consider the wealth associated with aristocracy, including monarchs, would offer a general protection against lethal violence, historical reconstructions indicate otherwise. For instance, 26 percent of Male English Aristocrats died due to violent causes between 1330 and 1479 (Hollingsworth 1965). Similarly, Eisner (2011) found the average regicide rate for the Early Medieval Period reached 1615 per 100,000 ruler-years. This value fell to 1221 per 100,000 ruler-years during the High Middle Ages and fell to 848 per 100,000 in the Late Middle Ages. As with the Four Horsemen of the Book of Revelations, *Famine*, *Pestilence*, *War*, and *Death*, it appears that these ostensibly unrelated calamities routinely follow closely upon one another, in a tragic cascade of consequences.

Returning more directly to the main point of this chapter—integrating Landers' work on medieval era demography into our chosen meta-theory—we do well to recall the preceding two chapters wherein the major driving forces of life history evolution were reviewed. Although the single selective pressure shaping life history strategies was originally believed to be population density, it was later overshadowed by the effects of extrinsic morbidity and mortality, especially among adults (Ellis et al. 2009). Recall, in this technical usage, *extrinsic* means uncontrollable by any genetically evolvable mechanism of the affected organisms. Unpredictable and unstable environmental hazards thus have a tendency to render the schedule of morbidity and mortality uncontrollable at nearly any age. Given these considerations, it is easy to predict that the famine, pestilence, war, and death, imposed in such abundance during the Early and Late Middle Ages, would bias natural selection to favor faster life history strategies for the duration of the affected historical period. As with the complex interplay among the forces unleashed by volcanic activity, sea ice, and ocean currents, there are also positive feedback loops at work that augment the complexity of human social biogeography.

It turns out that *fLH*-selected and s*LH*-selected human populations construct substantially different societies (Figueredo et al. 2017). Most s*LH*-selected societies are designed to be more socially egalitarian, communitarian, peaceful, and orderly, sporting a proliferation of cooperative networks and specialized division of labor that vastly enhance their economic productivities beyond what one would expect from an equal number of rugged, self-reliant individualists. In contrast, *fLH*-selected societies more closely resemble a Hobbesian *bellum omnium contra* *omnes*, with little social or economic cooperation, weakened to nonexistent central authority, and generally lower levels of rule governance among the population. Such *fLH*-selected societies are thus generally deficient in stable social institutions extending beyond the reach of kin networks, economic specialization and productivity, embodied human capital, and general cognitive development. The social, political, and economic chaos that predominates in *fLH*-selected societies thus feeds back upon itself. Faster life history strategies are further favored by evolutionary selection via: (1) the uncontrollable hazards to human development of economic deprivation and malnourishment; (2) hazards to health of untreated parasitic infections; (3) hazards to life and property due to unbridled criminality; and (4) hazards to the very fabric of society by the despotic kleptocracies that flourish in the absence of democratic institutions. The climatic shifts bracketing the High Middle Ages, in their punctuated alterations to the selective regime prevailing within Eurasia during the Neolithic, demonstrate the ecological substrate upon which *sLH*-selected societies ultimately depend. The historical record teems with examples of disintegrating social fabric following from twin eruptions of extrinsic mortality, the effects of which were to temporarily and partially expose Eurasia to relatively more *fLH*-selected mortality regimes. These two climatic perturbations undercut the stability upon which complex, stratified, centralized, and redistributive societies rested.

4 Evidence from Nordic History

In demonstrating the recovery of social stability within the Medieval Warm Period, we provide further supporting documentation regarding the effect of climatic variation on social complexity as exampled by Nordic societies. In the Nordic Lands, during the Early Middle Ages, warfare was largely reduced to raiding among rival chiefdoms over ephemeral plunder, devoid of any longer-range objectives or political consolidations. Lawlessness was rampant, as illustrated by the original meaning of the word *Viking*, which essentially means *pirate*. Contrast that with the behavior of the same ethnic group under the selective regime of the Medieval Warm Period, with its milder climate and boosted agricultural production. In doing so, consider the career of the Norwegian King *Haraldr Hárfagri* (*Fairhair* or *Finehair*; AD 850–932), who unified and pacified the Kingdom of Norway, as documented by Sturluson (1230/1976a). Throughout most of the following century, the Kings of Norway that succeeded him sought to consolidate these gains and establish Christianity throughout the realm. Under Harald's great great-great-grandchild, the Norwegian King *Saint Olaf II Haraldsson* (AD 995–1030), a Christian legal system and an ecclesiastical organization with a proper financial system was established. Furthermore, Saint Olaf established peace and security, renewed and enforced old laws, and simultaneously reduced corruption and intimidation (Jones 1984; Sturluson 1230/1976b).[16] The return to better and more stable societal organization once again enabled an anthropogenic selective regime favoring the *sLH*-selected. Again, this ethno-cultural group is but one instance of a general trend unfolding throughout Europe during the Medieval Warm Period.

Next, we briefly cite evidence of heightened mortality at the end of the Medieval Warm Period. Even though lethal violence is associated with reproductive success in some small-scale societies (Chagnon 1988; Escasa et al. 2010), it is resource monopolization that generated fitness differentials during the Middle Ages. Thus, Europeans involved in violent conflict experienced lower, not higher, reproductive success relative to that of commoners thriving as merchants (Clark 2008).[17] Following Hollingsworth's reconstructions (1965), Clark (2008) compared the life expectancy of English aristocrats between the fourteenth and the fifteenth century, documenting a spike in mortality. According to Clark, mortality due to violence not only impacted life expectancy for young aristocrats, but also affected the fertility rates of this group. Violence undermined whatever reproductive advantage that might otherwise have accrued to wealth and nobility. It was not until the eighteenth century, when homicides' rates and battle deaths declined, that aristocrats outcompeted the fertility of commoners (Clark 2008). Therefore, we have evidence, not only of heightened mortality as the Medieval Warm Period gave way to the Little Ice Age, but resultant effects on elite fertility, from which we can justifiably infer life history effects.

Chapter 4 has dilated upon the importance of soil and climate in producing Eurasian agricultural yields—yields, we point out, that afforded some measure of abundance above and beyond subsistence even before the transition to mineral economies. Chapter 5 explained Eurasian physical and community ecological factors by which intrinsic mortality predominated over extrinsic mortality. Chapter 6 then explained the relevance of densely assembled populations. Recall then, climatic conditions prevailing within the Early and Late Middle Ages disrupted all such factors. These factors are ultimate causes! They are drivers of life history evolution. As they changed, so did the population mean life history trajectory for European populations. We have here, within the historical record, an approximate *repeated measures design*—an experimental design wherein changes to a baseline are measured, as an independent variable is repeatedly introduced and removed. The climatic effects of the Early and Late Middle Ages are the most severe disruptions to the climatic stability prevailing after the last glacial maximum and through the Neolithic Era. Population life history means, inferred through the foregoing review of social history, can be seen chasing after these climatic variations as they shifted first this way, and then that, and then back again. All these considerations clearly apply to the social conditions in the Early and Late Middle Ages. We propose that these changes were, at least in part, due to the slowing of life history strategies consequent to the reduction in the extrinsic morbidity and mortality of the European population. The coming transition from organic to mineral economies emphasized by Landers remains greatly important, especially for its effects on absolute demographic increase; yet, this is postscript instead of preface.

Notes

1. *Fertility and Resources* is subtitled, *Thirty-First Symposium Volume of the Society for the Study of Human Biology.*
2. The broad-scoped and multi-disciplinary book titled, *Fertility and Resources: Thirty-First Symposium Volume of the Society for the Study of Human Biology*, following a symposium that took place at Magdalen College, Oxford, in April 1989, organized by the editors. The symposium itself was divided into the sections of control and distribution of fertility, fertility trends, fertility, and cultural factors. While the book was not organized into subsections, it had a broad scope that encompassed several fertility-related themes: (1) broad principles behind animal fertility variation; (2) discussion of fertility trends in pre-industrial Europe; and (3) reports and analyses of modern patterns of fertility in Third World countries.
3. The main idea of Landers' thesis within this work parallels evolutionary works by Corey Fincher, Randy Thornhill, Charles Nunn, and Sonia Altizer (cf. Nunn and Altizer 2006; Thornhill and Fincher 2014).
4. The cascade proceeds with recursive effects, as in time the development of resistance in urban centers can render new immigrants more susceptible to contamination than the average local metropolitan individual. Thus,

population dynamics are of central importance to Landers' thesis, given that he recognizes that population differences exist and affect their interaction and consequences to each. The topic of between-population differences would be explored more profusely in his later publications.

5. As warfare is commonly thought of as a destructive phenomenon, it may seem paradoxical at first that, by Landers' reckoning, it was warfare that evoked mineral economies. However, the genuine paradox is found in the self-defeating strategy of expansion. Organic economies, ever hungry for *energy inputs*, turned to territorial expansion to take what they could not produce. While they sometimes had sufficient energy inputs to field armies of conquest for the purposes of territorial expansion, organic economies did not naturally have, nor did conquest provide, energy inputs sufficient for sustainable growth. Given restricted energy inputs, military expenditure drains economies, while creating casualties and destroying estates, both of which were, because of these self-same energy inputs, prohibitively expensive to replace. It appears to Landers that the only escape was to developing mineral economies, which at once augmented the effectiveness of armies and navies, while making it less necessary to use those armies and navies to confiscate resources from rivals. Again, we stumble upon a cascade effect in pre-industrial societies: from the harshness of organic economy and the necessity for more resources to warfare, to unsustainable growth, and ultimately to the development of mineral economies. The scramble for energy inputs among rival societies produced *Red Queen Effects* by ratcheted up competition leading toward mineral economies. Several times, Landers used the term Red Queen, as below:

   > Sometimes total output was increased by allowing more of a given factor, such as labor, to be applied productively at lower unit returns. Such Red Queen innovation was common in pre-industrial agriculture because demand pressure often made it necessary to raise total production at the price of declining returns. (Landers 2003; p. 49)

   > This is a term traced to Lewis Carroll, whose fictional Red Queen explains that one has to run ever faster simply to stay in the same place. This is the nature of evolutionary competition, as animals become locked in arms races, each evolving adaptations to keep ahead of the other. Often, relative positions stay the same. Though applied most often to interacting organisms, Red Queen Effects can be applied to groups. Though this is a fascinating line of historical pursuit, and one we were also tempted toward by Toynbee, it is better broached within a book on group selection.

6. While he may have garnered critics who perceived this work and his broad collection as somewhat disjointed or difficult to demonstrate conclusively (e.g., Moakyr 2005), Landers' efforts are more commonly seen as an original view on history. As Landers (1992, p. 47) himself pointed out, although certain analyses may be at first perceived as simplistic or Eurocentric, "it remains true that the range of possible relationships between demographic variables and their determinants is not unlimited and that it can be usefully elucidated by historical studies." Thus, Landers examined historical examples, not to understand only those particular cases, but rather to identify patterns, forces, and pressures that, while not repeating exactly in the same way, permit us to understand trends in the stages of how societies develop, thus aiming to establish the "limits of the possible, and the contours of the probable […] than to truly historical concerns with the specificity of time and place" (Landers 1992, p. 47).
7. For instance, "smaller families" are chosen so that "parents could concentrate more attention on each child" (Landers 1990, p. 94). This is certainly partially true, though such choices may themselves be consciously and unconsciously influenced by other factors—in addition to being related to evolved life history strategy.
8. The Medieval Warm Period is at least characteristic of the North Atlantic.
9. Unfortunately, this global warming also produced massive *mega-droughts* in other regions of the world, such as Western North America, West Africa, and Equatorial East Africa (Herweijer et al. 2006; Seager et al. 2007; Shanahan et al. 2009).
10. The energy released by that explosion is estimated to have been equivalent to have been about two billion times that of the atomic blast that destroyed Hiroshima. The mysterious "dry fog" that it produced was reported by multiple chroniclers from Europe to China (e.g., Procopius of Caesarea 550/1916).
11. Such effects were not unique to that singular event. In a study of a range of small to complex societies in Ancient Mexico and Central America, the effects of multiple instances of explosive volcanism of varying severities were explored (Sheets 2012). Thirty-six cases were sampled, spanning a range of social complexity and political organization from egalitarian communities of hunter-gatherers and horticultural villagers to sociopolitically stratified states. All were adversely affected by the climatic and ecological dislocations caused by the explosive eruptions.
12. The temporal extent of the Great Famine is sometimes extended by historians as far as AD 1322.
13. It is estimated that one-third of the homicides in Oxford were perpetrated between unacquainted low-status males.
14. Of note, the author considered the Italian estimates as unreliable.

15. When looking to individual countries featured in this analysis, England exhibited the lowest rate out of the seven countries (23 per 100,000 individuals), whereas The Netherlands and Belgium had the highest (47 per 100,000).
16. To continue with the example of the Norse (Chibnall 2006):
    - Although since about AD 820 the Vikings had been raiding along the Seine, in AD 911 the Norse leader Rollo established a legitimate Duchy of Normandy in the north of France by a treaty with King Charles III of West Francia and agreed to end his brigandage henceforth;
    - In AD 1060, these same Normans initiated the conquest of Sicily and established first a principality and then by AD 1091 a full-fledged Norman Kingdom of Sicily;
    - In AD 1066, these same Normans initiated and completed the conquest of England and established a lasting and stable monarchy under William the Bastard.

17. Conflict's fitness payoffs and life history effects, as they differed in northerly and southerly climates, will be taken up in Chapter 12.

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