CHAPTER 3

Alfred W. Crosby: Adapting Within a Matrix of Flora and Fauna

1 The Walt Whitman of World History

For his enduring neologisms, because of his ability to find the extraordinary within the ordinary, and due to the "generosity of his range," Kevin Reilly, in his foreword to *Germs, Seeds, and Animals*, says of Crosby that "we might well think of him as the Walt Whitman of world history." Reilly is paying tribute to Alfred W. Crosby, a historical geographer who lectured at Washington State University, Yale University, and the University of Helsinki before being appointed Professor Emeritus of History, Geography, and American Studies at the University of Texas at Austin. Crosby wrote informative narratives of the 1918 influenza epidemic (2003), while also authoring *Children Under the Sun: A History of Humanity's Unappeasable Appetite for Energy* (2006). More representative of the tenor of his career, Crosby provided a thorough re-examination of history based on ecological principles, which might be called *Ecological History* (Crosby 1972, 1986, 2015). Within the framework of ecological history, Crosby most elegantly and consistently treated interactions between cultures. Crusades, landings, invasions, colonization, settlement-none of this, Crosby made us to understand, could be rendered intelligible without reference to ecology.

The *Age of Exploration* marks a transition. European expansion was abortive before Columbus sailed the ocean blue in 1492, but successful thenceforward. The Norse voyages and the Crusades (Crosby 1986) are exemplars of failed forays into foreign lands. Nordic explorations

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sent forth neither expeditions nor settlers in sufficient numbers to sustain a colony in Vinland (Crosby 1986). Furthermore, the population size of the Norsemen in Europe hindered the spread of *crowd disease*, while the northerly ecology hindered the spread of *zoonotic disease*. In consequence, rather than Eurasian pathogens affecting native communities, as would happen in the Age of Exploration, the Norsemen often fell victim to American diseases (Crosby 1986). The incessant attack of a still vigorous Native American culture was yet another source of Norsemen mortality. Similar circumstances surrounded the ill-omened series of medieval crusades. Even though the number of pilgrims, merchants, mercenaries, knights, and nobles swelling the ranks of the crusades was vastly superior compared to the few Norsemen who settled in North America, according to Crosby (1986), the outcome remained the same. Except for less than a hundred years, and a few principalities and counties, the Europeans were unable to maintain ongoing control in the Levant (Crosby 1986). Specifically, four factors are associated with the eventual downfall of the Latin power and possessions in the Levant: (1) unwillingness to marry and breed with the local population, such as Levantine Christians; (2) the pervasiveness of vector-transmitted diseases such as malaria; (3) the existence of novel crowd diseases; and (4) a comparable level of sociopolitical complexity between Caliphates, Sultanates, and Latin Christian invaders.

A series of later local conquests foreshadowed a change of fortune. Portugal and Spain were chief among European nations successfully conquering isolated communities, such as the islands of Madeira and Porto Santo, the Azores, and the Canary Islands. Opposite earlier experiences, ecological disturbance now paved the way to conquest. However, this change of fortune was relative; rather than having immediate success, Portuguese and Spanish settlers faced considerable challenges, and in some instances, these challenges were ironically the product of their own ecological alteration. For instance, Crosby (1986) described how, after the Portuguese released domesticated rabbits, they became pestilential competitors for cultivated crops, as in nineteenth-century Australia and twentieth-century America. Eventually, the settlers were forced to abandon the colony and settle in the nearby island of Madeira, where the local environment was adequate for sugarcane and other export crops. As Crosby (1986) describes, Europeans more decisively rode a cresting wave of ecological fortunes during the Spanish conquest of the Canarian Guanches. This is one of the first accounts of a society facing extinction

after contact with Europeans. Although the Guanchian economy relied on agropastoral practices, no reports of crowd diseases were known before the Spanish voyages (Crosby 1986). The geographical isolation, added to the small population size of approximately 100,000 natives spread across the archipelago, proved protective factors against the occurrence of major epidemics[1] (Crosby 1986). In contrast to the Guanches who became almost extinct, the Spanish population grew within that insular island ecology, alongside their domesticated flora and fauna, newly introduced vermin, and invasive weeds. Similar events transpired decades later in the Americas, the outcome of which Crosby would spend a career describing and explaining (Crosby 1972).

2 The Columbian Exchange

In the Age of Exploration, ecological fortunes inverted, such that, what was once a headwind acting against expansion, became a tailwind facilitating centuries of colonization and conquest. As Crosby details, the conquest of the Americas was not solely the product of European technology, but rather extended from recurrent biotic incursions leading to the eventual displacement or disappearance of endemic taxa (Crosby 1972, 1986, 1993). These ecological invasions included an array of non-human species ranging from domesticated animals and plants to vermin, weeds, and pathogens (Crosby 1993). At the end of this ecological clash, the Old and New World became ecologically homogenized with much of the original variation now lost, except for remote tropical regions that still preserve high ethnic and biological diversity (Crosby 1986). This homogenization, involving the transmission of species between ecologies, has been called the *Columbian Exchange* (Crosby 1972). From hence, Crosby viewed European imperialism as the outcome of an underlying ecological imperialism. However, if the ecology of the Neo-Europes, so successfully exploited by European colonizers, was salubrious, bounteous, and advantageous, why did native communities living in these regions remain at a pre-state level (pre-Columbian Amerindian states were located far from these locations before the Columbian exchange)? To answer this question, we have to follow Crosby back into prehistory, past the point where human societies began to differ in political complexity.

Based on the paleoanthropological literature, Crosby (1986) concluded that as late as 100,000 BC, no significant differences existed among human populations (i.e., anatomically modern *Homo sapiens*).

Furthermore, this pattern may have persisted until 45,000 BC, a period that has been associated with human global migrations and the increase in cultural expressions (i.e., behaviorally modern *Homo sapiens*). Moreover, sociopolitical and cultural complexity probably only became pronounced around 10,000 BC. At least by that time, Eurasian populations of mammalian megafauna began to dwindle and then disappear; and whither it went, so did the possibility of continuing to lead a hunter-gatherer existence. Climate fluctuations at the end of the Pleistocene may have combined with habitat alteration, and interspecific parasite transmission from human to animal, to hasten the rate of megafaunal extinction (Crosby 1972, 1986).[2] All the same, these extinctions assuredly occurred in tandem with, and were causally aided by, human migrations (Crosby 1986). Whatever the proportional contributions among the cacophony of causes, with recurrent extinction events of Eurasian megafauna, Eurasian hunter-gatherers were forced to either abandon their local territories or adopt alternative subsistence economies. Communities unable to relocate apace with decreasing populations of megafauna became reliant on fallback foods, such that, with time, small game and plants became staple foods. It was from such Malthusian constraints that sociopolitical complexity extends. Hunter-gatherers turned husbandmen and herdsmen, and thus came the *Neolithic Revolution*, which witnessed the rise of settled societies surviving on cultivated cereal crops. Before the Neolithic Revolution marked the end of Paleolithic ways, human groups displayed similar levels of sociopolitical complexity—complexity which was restricted on the one hand by incessant mobility, and on the other hand by the small group sizes that necessarily followed from range requirements prior to intensive land management.

Even as we can intelligibly date its advent to 10,000 BC, the Neolithic Revolution affected societies to greater and lesser extents, descending upon some full and fast, and on others partially and slowly.[3] According to Crosby, the differential descent of Neolithic ways was due to geographical factors. Considering each continent to roughly resemble an ellipse, the major axis of Eurasia runs horizontally from West to East, whereas that of Americas runs vertically from North to South, an argument further developed by Jared Diamond (1997). With that in mind, we turn to four consequences of Neolithic revolutionary change as they differently affected Eurasian and American peoples. First, these continental features

allowed Eurasian farmers and herders to successfully relocate cultivars far from the region of original domestication with higher relative success rates (Crosby 1986). After all, relocating a plant 1000 miles along an East–West axis risks unsuitable soil ecology and moisture presence; but, in addition to these factors, relocating a plant 1000 miles along a North–South axis risks unsuitable seasonality and temperature extremes. As such, Amerindian societies faced the geographical challenge of transferring their symbiotes across the long, narrow American continents extending North to South across innumerable lines of latitude (Crosby 1986). According to Crosby, a second significant difference between domestication in Eurasia and the Americas was the total number of animal domesticates. Except for the dog, which was domesticated before the Neolithic Revolution, the number of livestock species domesticated in Eurasia was higher compared to the Americas (Crosby 1986). Between 10,000 and 4000 BC, Old World animal domesticates included cats, donkeys, horses, sheep, goats, pigs, cattle, reindeer, geese, chickens, ducks, and the water buffalo, among others, whereas the Americas were restricted to llamas, guinea pigs, turkeys, and a few additional inconsequential species (Crosby 1972, 1986). Therefore, a vast array of floral and faunal domesticates allowed the concentrated cohabitation of thousands of individuals, facilitating the rise of towns and eventually city-states (Crosby 1986). Crosby (1986) relentlessly oriented scholarly attention to the fact that farmers and herders modify their local ecologies, directly by replacing forests with farming and grazing land, and indirectly by displacing local flora with exotic weeds and non-native animals disruptive to the trophic chain and ecological balance created by endemic species (Crosby 1972, 1986). The third and final point relates to disease. Agriculture served as a magnet for vermin and pests, both of which increasingly came to live in proximity to humans (Crosby 1986), which as we have already seen, were increasingly aggregating into towns and cities along with their domesticates. Disease flourished in these newfound assemblages of densely concentrated species. Again, however, Eurasian and Amerindian populations were differently affected. Old World societies suffered from pathogens such as smallpox, chicken pox, measles, rubella, diphtheria, whooping cough, scarlet fever, dysentery, bubonic plague, influenza, malaria, yellow fever, and much else (Crosby 1972, 1993). Alternatively, Amerindian diseases were largely restricted to intestinal parasites, yaws, syphilis, hepatitis, encephalitis, polio, and tuberculosis.

When European and Amerindian societies eventually clashed during the Age of Discovery, disease was at the vanguard. Crosby (1993) referred to the outburst of Old World communicable diseases *as virgin-soil epidemics* (VSEs). Visitation, migration, warfare, dispossession, murder, oppression, overwork, and malnutrition promoted the persistence and transmission of these pathogens (Crosby 1972, 1986, 1993). Taken alone, smallpox decimated North American natives. In the 1630s, smallpox killed half of the Huron and Iroquois populations, whereas in the eighteenth century it eliminated half of the Cherokees, and Catawbas (Crosby 1993). Crosby (1972) provides grim estimates concerning the lethality of these diseases at large. Between 1616 and 1622, multiple indigenous settlements, including villages near Plymouth Bay, were left abandoned (Crosby 1972). Between 1780 and 1851, the Dakota suffered at least nine epidemics among which were smallpox, measles, cholera, and whooping cough (Crosby 1993). Crosby mentions how, in some Amerindian cultures, the terror of contagion was such that individuals displaying early symptoms of smallpox or other Old World pathogens committed suicide, as did several Cherokees in 1738. Similarly, in 1837, in the midst of a smallpox outbreak, many Blackfeet opted for a similar resolution (Crosby 1993). All told, between 50 and 90% of the Amerindian population died of foreign pathogens (Crosby 1972, 1993), such that the impact of these VSEs on Amerindian populations easily outstripped plague-induced mortality visited upon European populations. For Crosby (1972), the effects of VSEs extend beyond the expected increase in death rates. By affecting almost every individual in the population, VSEs had a significant negative impact upon social organization. Crops, herds, and trades were left unattended, and the few unaffected people were unable to support the afflicted. Therefore, individuals requiring a minimal level of care to survive died from either resource scarcity or lack of assistance (Crosby 1993). Moreover, diseased individuals became more vulnerable to other pathogens (Crosby 1972). Since VSEs affected both commoners and nobles, social disruption was amplified after the death of military, political, and religious leaders (Crosby 1972, 1993).

3 Symbiotic Portmanteau Assemblages

The scholarly community is indebted to Crosby for having traced the differential development of the Neolithic Revolution through a causal chain through to disease, and thereafter for applying this knowledge in explanation of the Columbian Exchange. Crosby's ecological history delivered

one further culminating insight, ordering all his particular researches under an organizing principle termed *portmanteau assemblages* (Crosby 1986). Portmanteau assemblages refer to a matrix of coadapted ecological associations between humans and domesticated flora and fauna, vermin, weeds, and pathogens, which act together as a unit in competition with rival assemblages upon contact. It is to this unifying concept of portmanteau assemblages that we turn with our life history framework. Before doing so, we beg leave to make one slight alteration. It seems fitting to amend the original expression, again *portmanteau biota*, to *Symbiotic Portmanteau Assemblages* (SPAs). The change jettisons what we see as artificial anthropocentrism implicit in the original idiom. While Crosby's original term denotes evolved mutualisms, and even evolved mutualisms among nonhuman species, our revised term more fully recognizes that mutualisms often spread forth absent human intervention. This includes relationships between exotic herbivores and exotic weeds, as well as between exotic weeds and exotic pollinators.

Ahead of viewing the clash of SPAs during the Columbian Exchange, we emphasize three generalities. First, populations stop spreading at the frontiers of their SPAs. In other words, the ultimate demographic limits of any Neolithic Expansion mapped onto the ultimate biogeographical limits of its SPA. As much is evident in examining boundaries among the major human *genetic clusters* as they are distributed across continents. With that said, it is important to distinguish between the truly *native* flora and fauna of a region, and the SPAs associated with the so-called indigenous societies.[4] Second, it is important to recognize that the competitive strength of one human society with respect to another is largely based on the relative strength of their SPAs. Biologically productive SPAs generate a resource base sufficient to support "large, dense, sedentary, and stratified societies," which thereby develop superior subsistence and military technologies. From hence, one may argue, all human *civilizations* and *empires* are ultimately based on SPAs as their *sine qua non*. Third, all human post-Neolithic SPAs always were, and continue to be, *invasive* assemblages of species. SPAs evolved over multiple millennia by human–nonhuman coevolutionary processes as *constructed niches*.

Now to turn to the Columbian Exchange in an attempt to understand this unequal contest. All post-Neolithic societies necessarily possess their own SPAs. One SPA can replace another SPA only where it is ecologically supported. Eurasian SPAs expanded at the expense of American SPAs most rapidly and roundly on *isothermal lines*. In other words, the *Niña*, *Pinta*, and *Santa Maria*, together with all the ships sailing in their

wake, carried Eurasian SPAs across an ocean of longitude to destinations of similar latitude. Eurasian SPAs displaced indigenous American SPAs most readily in the *Neo-Europes*, geographical territories located below the Tropic of Capricorn and above the Tropic of Cancer, including the temperate zones of Chile, Uruguay, Argentina, Australia, New Zealand, Canada, and the USA (Crosby 1986). This tells us where and why Eurasian SPAs could compete, but not why they dominated. We are thus left with the inevitable question: *What characteristics allowed one SPA to "competitively exclude" another*? Although our list is not exhaustive, Fig. 1 works toward an answer to the question above by presenting conceptual schematics concerning the complexity of various SPAs.

As can be seen, relative to American SPAs, Eurasian SPAs are more complex agglomerations of interdependent species. Within that matrix are many food and forage crops that combine with meat and milk animals to sustain beyond subsistence. There is then a caloric foundation for capital accrual and technological complexity. From hence came technological innovations in shipbuilding and weapons manufacturing that, respectively, brought Europeans to American shores and aided in their conquest of Amerindians. At the same time, within the Eurasian SPA are crowd diseases that became endemic, but which proved epidemic for Amerindians. Indeed, disease proved the principal agent of lethality and societal disruption (Crosby 1972, 1993). To illustrate the point, smallpox reached the Island of Española in 1518, from whence it was carried to Puerto Rico and Cuba (Crosby 1972). After afflicting and decimating the insular populations, a soldier in Cortes's army transported this *Shirt of Nessus* to Mexico. In the mainland, that pathogen significantly weakened the Aztecs before and during the Spanish conquest.[5] A similar pattern occurred in Guatemala, with at least two outbreaks between 1520 and 1521 severely affecting the Mayan communities in the region (Crosby 1972). During this time, the disease was transported to South America, swiftly propagating through the continent. Although it is still debated whether the Inca Huayna Capac was killed by an endemic or an invasive disease,[6] his death, compounded by the concomitant deaths of key political and military figures (Crosby 1972), inaugurated a disruptive Civil War between Huayna Capac's sons, Huascar, and Atahualpa (Diamond 1997). Other pre-Columbian societies in South America were also afflicted by various epidemics, such as that which killed thousands native to Río de la Plata in 1560, and that which, two years later, befell pre-Columbian communities

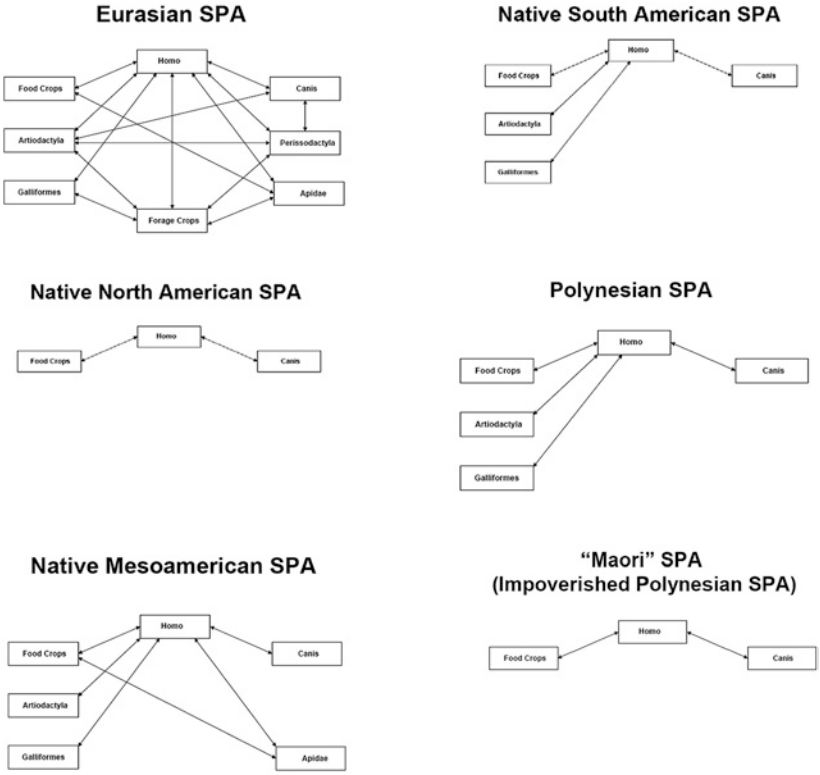

Fig. 1 Conceptual schematics for three major symbiotic portmanteau assemblages

in Brazil (Crosby 1972). Thus, we can envision Hernán Cortés casting anchor and rowing ashore with cocked pistol and drawn sword ready to finalize a conquest that would be all but won by the diseases he harbored in his person, and the pigs he stowed in his hull.

SPAs drive life histories, with their constituent elements affecting constituent life history traits. This is because SPAs subsume ecological factors that directly calibrate life histories. As will be pursued in Chapters 5 and 9, mortality regime influences population mean life history speed, and, as we have seen, SPAs include lethal predators, parasites, and pathogens. As will be pursued in Chapters 4 and 6, population density regulates population mean life history speed, and, as we have seen,

SPAs include flora and fauna that either support density by their abundance, or preclude density by their parsimony. With respect to the Columbian Exchange, the act of invasion, so destructive of Amerindians together with their SPAs and sociopolitical structures, systematically selected for relatively *fast life history* survivors. This is significant to the unequal outcome of the Columbian Exchange insofar as our reading of the historical record suggests that *slow life history* populations tend to outcompete relatively *fast life history* populations, all else being equal.

4 Europeans and Amerindian Life Histories Before and After the Columbian Exchange

We end by reviewing those indirect markers of life history suggestive of life history speed differences between European and Amerindian populations, before and after contact.

Contemporary paleopathological examinations support Crosby's observations concerning the lethality of crowd diseases. However, recent publications offer an in-depth perspective on the morbidity patterns in Amerindian societies and their corresponding life histories prior to the European conquest (Alchon 2002; Martin and Osterholtz 2016; Storey 1985; Verano 1997; Wilson 2014), information that was either unavailable or limited at the time Crosby published his work. Although pre-Columbian societies were not exposed to temperate crowd diseases, skeletal analyses across Pre-Columbian sites support the notion that Amerindian communities did experience infections (Grob 2009; Martin and Osterholtz 2016), with risk factors, such as population size, or the presence of urban centers, facilitating the propagation and persistence of certain parasites (Drake and Oxenham 2013; Steckel et al. 2002). The archaeological data has also been used to calculate life expectancy at birth, as well as fertility and mortality rates (McCaa 2005). For example, according to recent examinations, Coastal Ecuadorian communities (900 BC–400 AD) experienced a life expectancy at birth ranging from 29 to 34 years, and a maximum longevity ranging from 48 to 58 years, with over 20% of the remains of 93 individuals examined exhibiting skeletal evidence of infections (Ubelaker and Newson 2005). With respect to the Amerindians in the Ecuadorian prehistoric highlands, the skeletal evidence points to a life expectancy at birth of 28 years and a maximum longevity of 53 years. Relative to the Coast, the highlands had a lower percentage (9.9) of skeletal remains displaying any evidence of infections (Ubelaker and Newson 2005).

Due to the fact that life history is also affected by resource abundance, osteological markers, such as the occurrence of *porotic hyperostosis* and *cribra orbitalia* (Steckel et al. 2005), provide additional information regarding the nutritional status of the individuals examined. These skeletal conditions are associated with a maize-based diet, anemia, and the occurrence of intestinal parasites like hookworms (Ubelaker and Newson 2005). A similar pattern was observed in the Mexican Basin wherein Tlatilco (1400–900 BC), Cuicuilco (600–150 BC), Tlajinga (250–600 AD), and Cholula (900–1500 AD) all contained populations reaching moderate fertility levels, and exhibiting a life expectancy at birth between 20 and 40 years old (Morfin et al. 2005). Osteological examinations also indicate some degree of variation in infection rates. According to Morfin and colleagues (2005), cross-population differences may be due to the effects of population density, as well as the precarious sanitary conditions associated with urbanization. Remains collected from classic and post-classic Mayan sites (800–1000 AD), such as Copán, Jaina, and Xcaret, further demonstrate the nutritional stress experienced by individuals living in pre-Columbian settlements (Storey et al. 2005).

Colonizing Americans of European ancestry fared better in some health indicators and worse in others. Although these Euro-Americans had a higher stature, and fewer instances of anemia and hypoplasias, they also exhibited poor dental health and higher incidence of traumas (Steckel and Rose 2005). In some regions, life expectancy for colonizing Europeans was slightly higher than that of the preceding Amerindian communities. For example, Euro-Americans in the Ecuadorean highlands (1540–1858 AD) reached a life expectancy at birth of 34 years, a maximum longevity of 58 years, and an average age-at-death of 32 years (Ubelaker and Newson 2005). Therefore, prior to the Columbian exchange, between Amerindian and the eventual European settlers, some life history indicators did not differ significantly, whereas others display a minor variation. This slight difference, however, became considerably noticeable after the European contact, with health declining, mortality rates rising and life expectancy at birth collapsing (Crosby 1972, 1986, 1993; Steckel 2005). Overall, the evidence supports Crosby's position. Life in pre-Columbian Americas was not ideal, with population size and urbanization impacting the health of its inhabitants through the mediums of malnutrition and infectious disease (Steckel et al. 2002; Steckel and Rose 2005).[7] We would add, however, Eurasian SPAs created a selective regime exclusively affecting Amerindians, which greatly

accelerated life history speed, exaggerating preexisting life history variation between European and Amerindian populations through hundreds of years of colonization.

Notwithstanding the above-described insights provided by disease prevalence and longevity data, further analyses are required to substantiate Amerindian life history traits as they varied before and after European contact. Still, the current evidence indicates Eurasian SPAs not only facilitated the conquest and colonization of the Americas, as evidenced by the prosperity of European settlements, but that they also impacted the life history of indigenous populations, inflicting a destabilizing effect that lingered for more than 600 years. Thus far, the signature of that destabilization is read in indicators of social, political, and economic development, as well as in prevailing life history strategies (Figueredo et al. 2017; Peñaherrera-Aguirre et al. 2018; Thornhill and Fincher 2014). Crosby's ecological interpretation of history provides a strong scaffold to empirically test the pervasive effects of the Neolithic Revolution, as well as the causal pathways through which ecology influences the wealth and political stability of contemporary nation-states.

Notes

1. At the end of the Spanish campaign, epidemic-induced mortality edged toward twenty percent, although Crosby (1986) recognized this estimate may be unreliable.
2. Even though most paleontological or historical reviews do not associate the disappearance of the Pleistocene megafauna with the Columbian exchange, Crosby (1972, 1986) considered the former provided additional evidence regarding the impact of an invasive species upon a native ecology.
3. When we return to Crosby's Columbian Exchange, for instance, we will see that, relative to Eurasia, the Neolithic Revolution came late to the Americas (Crosby 1986).
4. In a way, no human society outside Africa is truly "indigenous."
5. For example, after the successful campaign of Cuitláhuac against Cortes, the Mexican lord was killed by the disease (Crosby 1972).
6. Historical accounts suggest it was an Old World pathogen such as smallpox or measles (Crosby 1972).
7. For example, medical examinations in Waorani populations in Ecuador (Kaplan et al. 1980) concluded that before contact epidemics were nonexistent and diseases were non-lethal. This supported the historical trend of negative health outcomes associated with state-level organizations; nevertheless, negative health outcomes were rapidly exacerbated after 1492 (Steckel 2005).

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