1

INTRODUCTION

The Biological Conquest of the New World

What happened after the military defeat of the Aztecs, the Incas, and the myriad towns and city states of the New World? How did the Spaniards and the Europeans who followed them into the New World extend their control over the countryside? This more prosaic, less swashbuckling, less colorful aspect of conquest is crucial for a lasting result, and overall the Europeans were as successful in this as they had been in the military conquests.

The Europeans' success can, in great part, be ascribed to the fact that they did not come alone to the New World, but brought with them animals and plants; weeds, seeds, and diseases. In Alfred Crosby's evocative terminology they traveled with their "portmanteau biota."[1] The Spaniards, for example, did not travel with just their horses and war dogs – they also brought more ordinary animals such as pigs, chickens, sheep, goats, and cattle. They imported grains like wheat and barley, as well as fruit trees, grapevines, and flowers. Weeds came attached to fur and hair and in the seedstock; and pests such as rats came in ships' holds. The conquistadors also carried with them Old World pathogens. The invaders had brought with them more means than they knew to conquer a continent.

The introduced species did not discreetly move into unoccupied niches – they exploded into huge populations that in one way or another transformed the biological and social regimes of the New

[1] Crosby, *Ecological Imperialism*, p. 89. Crosby suggests that the secret of the Europeans' success lies in the "ecological component" of European imperialism. In several books and articles he has described how the Europeans left on their voyages with the means to reproduce their culture and their landscapes wherever they landed. The demographic and environmental changes brought about by the ensuing introduction of alien Old World species constituted a major element of the conquest and domination of the New World; see Crosby, *Ecological Imperialism, Columbian Exchange*, "Ecological Imperialism."

World. The success of the biological conquest of the New World, of "ecological imperialism,"[2] depended to a great degree on the comprehensiveness of the portmanteau biota (i.e. the number and variety of species) and the extraordinary facility with which they expanded into and transformed the New World environments. It also depended on the transformation of indigenous landscapes and societies, and the formation of new systems of production. The extreme rapidity of the changes, their immense scale, and above all the combination of many different types of change brought about by the multiplicity of introduced species made the Europeans almost invincible.

The thesis of ecological imperialism is supported by clear evidence that the Europeans did best in temperate regions where climates similar to Europe meant that their grazing animals and crops were able to thrive, and where the indigenous populations were sparse at contact. Those regions where Europeans have been most successful, such as Argentina, Canada, and the United States, are today distinguished by populations of predominantly European extraction, by the economic predominance of Old World flora and fauna (wheat, cattle, sheep), and by European-like landscapes and societies.[3] The apparent lack of success in those areas where the Europeans' portmanteau biota did not flourish, the hot, humid tropics for example, or where dense indigenous populations far outnumbered them, as in Mexico, also seems to support this thesis; the tropics are still, after all, dominated by New World peoples, flora, and fauna.

But the apparent environmental continuity in the American tropics is misleading. Despite that the Europeans did not biologically dominate in much of what we know today as Latin America, they did manage to politically dominate vast areas of the hinterlands of the high civilizations in Mexico and the Andes in a remarkably short time, and to control, albeit more slowly and somewhat insecurely, much of the tropical lowlands. It is clear, moreover, that although European-like landscapes did not develop in the hinterlands of Latin America's high civilizations, the biological status quo was not maintained either. The indigenous species of the New World did not triumph over the invaders as in Asia, where the Europeans and their animals and plants barely gained a foothold.[4] On the contrary, the native biological re-

[2] Rappaport, "The Flow of Energy," p. 275. Crosby, *Ecological Imperialism* especially, pp. 1–7.

[3] Crosby calls these regions "neo-Europes"; *Ecological Imperialism,* p. 2.

[4] In Chapter 6 of *Ecological Imperialism,* Crosby discusses the various reasons Europeans and their portmanteau biota were unsuccessful in the humid tropics and in the densely populated zones, except as traders or as extractors of primary products.

gimes underwent radical changes following the introduction of Old World species, and new landscapes that we now think of as typically New World were formed.

The expansion of Old World grazing animals and the demographic collapse of the indigenous populations were major processes in this transformation. Diseases endemic to Europe such as smallpox, measles, and influenza, when introduced into the New World exploded into terrifying and unpredictable epidemics that swept through the Americas leaving communities decimated. The epidemics were repeated regularly throughout the first hundred years and reduced the indigenous populations to ever-lower plateaus; sporadic outbursts continued throughout the colonial period. The combination of the virulent nature of the epidemics themselves and the collapse of the indigenous populations meant that the Europeans were able to move quickly into even densely populated and highly organized regions. An epidemic of smallpox decimated the defending population of the city of Tenochtitlán, contributing to the fall of the Aztec Empire in 1521. Another epidemic in the Andes paved the way for the Spanish conquest of the Inca. It is possible, as well, that epidemic disease swept ahead of the Europeans into the interior of North America, clearing the way for the European conquest.[5] The demographic collapse was such an effective ally that some Europeans saw the epidemics as divine intervention on their behalf, as witness the statement made by John Winthrop, first governor of Massachusetts Bay Colony: "For the natives, they are neere all dead of small Poxe, so as the Lord hathe cleared our title to what we possess."[6] In apparent confirmation of this point of view, the introduced grazing animals increased exponentially (at least at first) to truly extraordinary numbers; as they expanded into the countryside, they transformed the ecosystems of the New World and played a crucial role in the domination of the countryside by the Spaniards.

How, exactly, *did* these alien species – the disease organisms and the grazing animals – expand into the New World ecosystems? Did

[5] The precontact indigenous population of North America and the extent of its collapse is a hotly debated topic, as is the means by which it was infected; see, for example, the debate carried on in the *Latin American Population History Bulletin* by Whitmore and Henige.

[6] Cited in Crosby, *Ecological Imperialism*, p. 208. See Crosby's discussion of the role of epidemic disease in the defeat of the Aztec and Inca Empires, and his discussion of the diseases introduced into the New World, and the Pacific, in Chapter 2 of *The Columbian Exchange* and Chapter 9 of *Ecological Imperialism*. See also McNeill, *Plagues and Peoples*.

they have some sort of competitive advantage? Were New World species somehow inferior, not as tough or aggressive? The answers to these questions can be found in two biological processes with wonderfully exotic names: virgin soil epidemics – the process by which disease organisms move into new populations; and ungulate irruptions – or, how grazing animals move into new ecosystems. The great advantage of both these processes as explanatory tools is that they are universal phenomena. They are not exclusive to the New World, they do not depend on genetic differences, nor can they be ascribed to imagined cultural or physical superiority. They occur wherever and whenever the circumstances are suitable.

Virgin Soil Epidemics

Virgin soil epidemics are characterized by an immunologically defenseless host population (hence their name), extremely rapid spread, and almost universal infection. Old-World pathogens were successful because the New World populations had never been infected by them and had no defenses. They spread with shocking speed, infecting entire communities and resulting in appalling death rates. All these new diseases were repeated every few years until the indigenous populations gained some immunity, a process that seems to have taken four to six generations. The successive epidemics resulted in a massive demographic collapse: the estimated population decline in Mexico, for example, was 90–95 percent between 1519, when the Spaniards arrived, and 1620, when the indigenous population began its slow recovery.[7]

In an article on virgin soil epidemics in America, Alfred Crosby discusses several factors that account for the high mortality rate among the New World indigenes. First, he points out that our designation of these diseases as mild childhood infections gives a misleading idea of their virulence. Modern medicine does not cure diseases such as measles and influenza; it can keep down the normally high mortality rates characteristic of these diseases only by defending the infected individual against other infections. Where help is not available, the

[7] See Crosby, "Virgin Soil Epidemics," for a succinct description of the New World virgin soil epidemics and the consequences for the indigenous population of North America. See also Crosby's *Columbian Exchange* and Chapter 9 of *Ecological Imperialism*. See Whitmore, "Population Decline," for a recent evaluation of the demographic collapse and an argument for the lower figure of 90 percent; and David Henige "Native American Population," for a discussion of the debate over the original population and its collapse.

mortality rates are very high, even in populations where these diseases are endemic. Second, the diseases carried to the New World, such as smallpox, measles, influenza, plague, and tuberculosis,[8] are characterized by very high mortality rates in the age group 15–40 years; that is, the group most involved in the production and preparation of food, shelter, and so on. When a high percentage of this group dies, those who might otherwise survive are neglected and die from untreated complications or starvation. Third, the Amerindians were rarely infected by a single disease; it was much more likely that they would be faced with a barrage of new infections. Where several virgin soil epidemics occur at the same time, the mortality rate soars; it also rises where other infections exacerbate the effects of the new infection. Modern experience has demonstrated that repeated virgin soil epidemics can effectively destroy societies. Fourth, epidemic disease was spread by apparently healthy people fleeing their villages, only to carry the contagion to new communities, and by a complete lack of quarantine. Finally, Crosby notes that a fatalistic attitude toward the inevitability of death often meant the loss of entire families.[9]

The demographic collapse of the New World populations was reflected in a declining labor pool, altered settlement patterns, and changes in the exploitation of the natural resources.[10] In agricultural

[8] For a discussion of why the same or similar diseases had not evolved in the New World, see Crosby, Chapter 11 of *Ecological Imperialism* and Chapter 2 of *The Columbian Exchange*.

[9] Crosby, "Virgin Soil Epidemics," p. 29.

[10] The demographic collapse was clearly one of the major forces shaping the colonial societies. The historiography of sixteenth-century Mexico includes a broad range of studies that have as their focus the epidemics and their social and economic consequences. Scholars have used biological, environmental, cultural, and social factors to demonstrate the size and health of the New World populations at contact. See, for example, Cook and Borah, *Essays in Population History*. See also Dobyns, "Estimating Aboriginal American Population: An Appraisal of Techniques with a New Hemispheric Estimate"; Whitmore, "Population Decline"; and Zambardino, "Mexico; Population in the Sixteenth Century: Demographic Anomaly or Mathematical Illusion?" For a discussion of the arguments concerning the susceptibility of the aboriginal populations to the Eurasian disease organisms, and the nature and course of the epidemics, see Crosby, *The Columbian Exchange;* also McNeill, *Plagues and Peoples*.

A number of social and economic historians have addressed the consequences of the demographic collapse for the evolution of the colonial political economy, taking as their focus the role played by a rapidly dwindling labor pool in the formation of the colonial systems of production. See, for example, Assadourian, "La despoblación indígena en Perú y Nueva España durante el siglo xvi y la formación de la economía colonial"; Bakewell, *Silver Mining and Society;* Borah, *New Spain's Century of Depression;* Chevalier, *La formación;* Florescano, *Estructuras y problemas agrarias* and "La formación

regions, for example, cultivated fields were reduced and fallow ones extended. In a seminal study of land exploitation in sixteenth-century Mexico, Lesley Byrd Simpson proposed that the lands freed by the demographic collapse of the indigenous populations allowed for the expansion of the domestic grazing animals introduced by the Spanish. In a famous graph, Simpson inversely correlated the human population decline with a steady increase in the animal population up to about 1620, when the Indian population began to stabilize.[11] The animal and human populations are seen as dependent variables, both competing for space. As will be demonstrated later in this book, however, the densities of the two populations in fact changed independently of one another: the animal populations peaked in advance of the decline of the human populations, then crashed before the human populations reached the nadir of their collapse. The decline of the human populations did not trigger the extraordinary increase of the introduced grazing animals; rather, the abundance of New World vegetation and the complete absence of competition from indigenous domesticated grazing animals, except in the Andes, did.

Ungulate Irruptions

Whenever ungulates (herbivores with hard horny hooves[12]) are faced with more food than is needed to replace their numbers in the next generation, an ungulate irruption is the result. The animals react to the excess of food in a manner similar to pathogens encountering virgin soil populations: they increase exponentially until they overshoot the capacity of the plant communities to sustain them (the carrying capacity); their populations crash, then reach an accommodation with the now-reduced subsistance base at a lower density. The plant

de los trabajadores en la época colonial"; Frank, *Mexican Agriculture;* Gibson, *Aztecs;* Konrad, *A Jesuit Hacienda;* MacLeod, *Spanish Central America;* Taylor, *Landlord and Peasant.*

The striking variability in the relations of production uncovered by these studies, together with evidence of the growth and differentiation of the nonindigenous populations, the development of commercial agriculture, and the growth of regional markets and commerce – to name a few of the processes involved in the evolution of the colonial political economy – have radically changed our ideas about the nature and complexity of the colonial regime.

[11] Simpson, *Exploitation of Land.*

[12] Undomesticated ungulates include deer, caribou, and bison. Goats, pigs, sheep, cattle, donkeys, mules, and horses are the common domesticated ungulates of the Old World.

communities follow a reciprocal trajectory: the original standing crop of vegetation is severely reduced by grazing, reaching its lowest density and height just before the animal populations reach their greatest density; when the animal populations crash and grazing pressure is removed, the plant communities begin to recover, reaching an accommodation with the animal population at a lower density, height, and species diversity than that present at the beginning of the process. Animal and plant communities will oscillate around this level of accommodation unless there is some radical change in the conditions of plant growth leading to a marked increase in the carrying capacity,[13] at which time the whole process will begin again. The increase of the animal populations is known as an ungulate irruption; the combined reciprocal trajectories of the plant and animal populations are known as an irruptive oscillation (see Figure 2:1).[14] The entire process is extremely rapid, taking between thirty-five and forty years.[15] (The details of the stages making up an irruptive oscillation will be discussed in more detail in Chapter 2.)

During the course of an ungulate irruption plant communities are changed beyond recognition. Selective browsing simplifies species diversity and reduces the height and density of the vegetation; species unable to withstand the pressures of heavy grazing are relegated to relic stands in out-of-the-way places, and are replaced by others that are either browse-resistant or unpalatable. A new biological regime develops that is reflected in a radically changed landscape.[16] These changes occur whether humans are present or not. Nevertheless, as with virgin soil epidemics, the outcome of the introduction of Old World ungulates into the New World was influenced by human initiative – that is, by ideas, and by the cultures that shaped them.[17]

[13] Carl L. Johannessen writes that the "carrying capacity of the range may be described as the number of animals it can support in health, during the period when grass is palatable and nutritious, without reducing forage production in subsequent years . . . Overgrazing occurs when the number of stock exceeds the carrying capacity of the range." *Savannas of Interior Honduras*, p. 106.

[14] See N. Leader-Williams, *Reindeer on South Georgia*, pp. 19–24 for a discussion of the model of ungulate irruptions and supporting research. I am indebted to my colleague in biology, Dawn Bazely, for bringing the literature on ungulate irruptions to my notice.

[15] Caughley, "Overpopulation," p. 10.

[16] Caughley, "Wildlife Management," p. 197; Leader-Williams, *Reindeer*, p. 241.

[17] Domestic stock undergo the same general process of irruption, crash and accommodation with their subsistance base as do nondomesticated stock; plant communities follow a reciprocal trajectory as in nondomestic ungulate irruptions.

Ideas and Environmental Change

The members of the portmanteau biota, it must be remembered, did not come alone, they came with humans. The ungulates that irrupted into the New World environments were domestic grazing animals that were part and parcel of a culturally defined system of animal and range management – pastoralism. Their diet, their daily wanderings in search of food and water, even their life span, were often subject to human choice and decision making. The lands they grazed also were subject to human choice. Humans are not content to simply graze their animals; they invariably manipulate the environment in order to achieve the maximum return from them. The form the manipulation takes is dictated by both culture and past experience. Where pastoralism is introduced for the first time, therefore, the cultural and social landscape is transformed along with the biological regime. This was especially true in the New World where (apart from in the Andes) society had evolved in the absence of domestic grazing animals. Pastoralism had no recognizable social counterparts in the preconquest world outside of the Andes, and its introduction involved not only the addition of exotic species but also a completely alien perception of the natural resources and their use; indeed, it involved the formation of completely new systems of production. The landscapes not only looked different, with new and different animals that radically changed the vegetative cover, but access to and exploitation of the natural resources were changed as well.

When considering the implications of the introduction of pastoralism, the problem is to ascertain what was "natural" environmental change and what was human-induced; and, where environmental change was the result of human action, to elucidate the ideas behind the actions. The biologists who study ungulate irruptions know only too well how difficult it is to separate the effects of human action from purely biological processes. For that reason studies of ungulate irruptions have been carried out on remote islands using nondomesticated ungulate populations in an attempt to exclude human influence and to control the parameters of the study.[18] These studies demon-

[18] See Bergerud, Jakinchuk and Carruthers, "The Buffalo of the North," and Peek, "Natural Regulation of Ungulates" on the difficulty of isolating human influence; see also Leader-Williams, *Reindeer*, pp. 244–5, 271, for a discussion of the utility of island studies.

strate that almost invariably the result of human interference in irruptive oscillations is environmental degradation such as erosion or the irretrievable loss of plant species.

Environmental degradation is not a necessary consequence of ungulate irruptions. Plant communities, for example, will regenerate if nondomesticated ungulates are removed, and erosion can generally be ascribed to friable soils, steep slopes, and rainfall. Where domestic stock is involved, however, the vegetation changes may be irreversible because pastoralists "sometimes hold stock at densities higher than would be possible if the stock arranged their own bionomics."[19] That is, pastoralists amplify the effects of the irruption of the animal populations, accelerating the degradation of vegetation. Humans may further destabilize the ecosystem by manipulation of the physical environment of pastoralism, for example by deforestation to free lands for grazing, burning in order to stimulate grass growth, and by other activities such as plowing, logging, or road building. The result is a loss of plant species, extinction of animals, or erosion.[20]

The introduction of grazing animals into new environments produces what we can think of as universal baseline changes in the biological regime. Environmental transformation over and above these changes can generally be ascribed to human activity interacting with the physical characteristics of specific regions. In the New World, therefore, there was a continuum of environmental responses to the introduction of Old World domesticates that ranged from changes in the biological regime associated with feral animals to changes associated with the introduction of pastoralism in combination with other activities such as cropping, mining, logging, lime manufacture, charcoal making, road building, and so on. In the present study I use the model of ungulate irruptions first as an independent model for comparison with historical case studies of the introduction of pastoralism in order to clarify the causes of environmental degradation in a region notorious for its degraded landscape; second, to demonstrate the reasons for overgrazing and the perceptions that shaped the Spaniards' actions and the environmental and social consequences of them; and third, to show how a rapidly changing environment influences perception and choice.

[19] Caughley, "Overpopulation," p. 14.

[20] Howard, "Introduced Browsing Animals and Habitat Stability in New Zealand," pp. 425, 429; Peek, "Natural regulation," pp. 218, 219, 224; Caughley, "Overpopulation," p. 14.

Colonial Society and Environmental Change

Whereas the biological changes brought about by the introduction of Old World species into New World ecosystems are examples of universal phenomena, the social context and consequences of these changes belong to a specific historical process: the European conquest of the New World and the evolution of European colonies.

Traditional histories of the New World colonies viewed local developments as the outcome of events in Europe, each colony being shaped by its relationship with its "mother country." But research carried out over the past twenty to thirty years has uncovered complex socioeconomic systems whose center of gravity was America rather than Spain, and that have resulted in an awareness of the role played by local realities in shaping colonial regimes. As a result, our understanding of the internal development of individual colonies and their position vis-à-vis other Latin American regions, as well as to Spain, has changed enormously. Colonial Mexico, for instance, is no longer viewed primarily as a source of Spanish silver; it is also seen as the center of a large trading region that included the Caribbean and extended south to Peru and west to the Philippines. The society that emerged out of the chaos of the conquest period was diverse, healthy, remarkably stable, and expansionist to boot.

The Eurocentric, essentially imperialist approach of the traditional histories is not yet dead, however – it lives on in new and more sophisticated guises. One of these "new" explanations is modern world-system theory.[21] In this approach the colonies are no longer seen as discrete units; rather, they are grouped together in the periphery of an evolving world system. Instead of being shaped by a specific relationship with their metropolis, the individual colonies are thought to have been shaped by their relationship with the center of the world system, Europe, for the greater part of the history of this system. The basic premise of modern world-system theory is that an international system of unequal exchange exists whereby the natural resources and labor force of the peripheral nations are exploited for the benefit of the center. Theorists argue that this system of unequal exchange, and the underlying distinction between the center and the periphery, is a distinguishing characteristic of the modern world system dating from its inception in the early modern era. The study of

[21] See Immanual Wallerstein, *The Modern World-System: Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century*, and *The Modern World-System II: Mercantilism and the Consolidation of the European World-Economy*.