

instance, that Kentucky blue grass, dandelions, and daisies, so familiar in contemporary North American landscapes, are all of Old World origin. Similarly, runaway swine, cattle, and horses developed into vast wild herds in the New World with results that were sometimes destructive to the vegetable cover and soon led to serious erosion of topsoil.¹ American food plants had far-reaching importance for the peoples of Europe, Asia, and Africa after 1500, but few organisms of American provenance were successful in competing in the wild with Old World life-forms—though some examples do exist, e.g., the spread of the plant louse, *phylloxera*, that nearly destroyed European vineyards in the 1880s.

The undeveloped level of Amerindian disease was, therefore, only one aspect of a more general biological vulnerability, but one that had peculiarly drastic consequences for human life. Precise information about disease in the Americas before Columbus is difficult to come by. Bone lesions can be found on pre-Columbian skeletons indicating some sort of infection. These have sometimes been interpreted as syphilitic by doctors seeking to confirm the Amerindian origins of that disease. But such identifications are controversial, since the way one micro-organism attacks a bone is very similar to the way another is likely to do so; and tissue reactions to such invasions are also similar, no matter what the infectious agent may be.² Unambiguous proof of the presence of intestinal worms and protozoa has been discovered at pre-Columbian burial sites, but even so the array of parasitic worms fell considerably short of varieties abounding in the Old World.³

Indication of disease and epidemic death have been found in Aztec codices; but these seem related to famine and crop failure and may not have been the result of the sort of human-to-human infectious chain that existed in the Old World. Moreover, disasters came far apart in time, only three being discernible in surviving texts.⁴ After the Spanish conquest, old men even denied that disease had existed in any form in the days of their youth.⁵ It looks, therefore, as though Amerindian communities suffered little from disease, even though in both Mexico and Peru, the size and density of settlement had reached far beyond the critical threshold at

V Transoceanic Exchanges, 1500-1700

In the preceding chapters, little has been said about the New World and its disease experience. Absence of written records and the limited results attained by medical study of skeletal remains from Amerindian archaeological sites make such lopsidedness inevitable. Nevertheless, in view of what happened after the Spaniards inaugurated free exchange of infections between the Old World and the New, it seems certain that Amerindian encounters with disease before Columbus had been unimportant from an epidemiological point of view. The inhabitants of the New World were bearers of no serious new infection transferable to the European and African populations that intruded upon their territory—unless, as some still think, syphilis was of Amerindian origin—whereas the abrupt confrontation with the long array of infections that European and African populations had encountered piecemeal across some four thousand years of civilized history provoked massive demographic disaster among Amerindians.

Reasons for this disbalance are not far to seek. The New World was, by comparison with the mass and ecological complexity of the Old, no more than an enormous island. Forms of life were, in general, more highly evolved in Eurasia and Africa, having responded to a wider range of variability arising in the larger land mass. Consequently, plants and animals from the Old World introduced by Europeans to the Americas often displaced native American species, and disturbed pre-existing ecological balances in explosive and, at least initially, highly unstable ways. We seldom realize, for

which contagious disease organisms could sustain a simple human-to-human chain of infection indefinitely. In this, as in some other respects, the Amerindian civilizations seem comparable to ancient Sumer and Egypt, rather than to the epidemiologically scarred and toughened communities of sixteenth-century Spain and Africa.

Several centuries—perhaps more than a thousand years—had passed since favored regions of Mexico and Peru had begun to carry human populations dense enough to sustain human-to-human disease chains indefinitely. Yet such infections do not seem to have established themselves. Presumably the reason was that the domesticable animals available to the Amerindians did not themselves carry herd infections of a sort that could transfer their parasitism to human populations when those populations became sufficiently large. This sort of transfer is what must have happened in the Old World, where massive herds of wild cattle and horses, dispersed across the steppe and forest lands of Eurasia, were sufficiently numerous and made close enough contact with one another in a wild state to be able to sustain infections that passed from animal to animal without any sort of intermediate host. By comparison, wild llamas and alpacas lived high in the Andes in small and dispersed groups. These were too few and too isolated to sustain such infections in the wild. There seems to be no plausible reconstruction of the style of life of the wild ancestors of the guinea pig—the other distinctive Amerindian domesticated animal. And as for dogs, mankind's oldest domesticated animal, though they today share many infections with humans, it is clear enough that in their wild state they, too, must have existed in relatively small and isolated packs. Thus with the possible exception of the guinea pig, the Amerindians' domesticated species, like the human hunting bands that had initially penetrated the Americas, were incapable of supporting infectious chains of the sort characteristic of civilized diseases. No wonder, then, that once contact had been established, Amerindian populations of Mexico and Peru became the victims, on a mass scale, of the common childhood diseases of Europe and Africa.⁶

The scope of the resultant disaster reflected the fact that

both central Mexico and the heartlands of the Inca empire were very densely settled at the time of the European discovery of America. The two most important American food crops, maize and potatoes, were more productive of calories per acre than any Old World crops except rice. This allowed denser populations per square mile of cultivated ground in the Americas than was attainable anywhere in the Old World outside of the East Asian rice paddy region.

Moreover, Amerindian customary ways of preparing maize for food obviated some of the nutritional disadvantages of a diet in which that cereal plays the principal role. The kernels were soaked in a lime solution, which broke down some of the molecules of the maize in a way that allowed human digestion to synthesize needed vitamins that are absent from the maize itself. Without such treatment, a diet of maize leads to niacin deficiency. Symptoms of this deficiency, known as pellagra, were often seriously debilitating among European and African populations that took to maize cultivation. But Amerindians escaped pellagra by soaking maize to make "hominy grits," and by supplementing their diet with beans in those regions where hunting was no longer possible because human populations had become too dense.⁷

Ecological adjustment in Mexico and Peru showed signs of strain, even before the Spaniards arrived and upset everything so radically. In Mexico, erosion was already a serious problem; and in some irrigated coastal areas of Peru, salting of the soil seems to have led to population collapse not long before Pizarro appeared.⁸ Everything points to the conclusion that Amerindian populations were pressing hard against the limits set by available cultivable land in both Mexico and Peru when the Spaniards arrived. Moreover, the absence of any considerable number of domesticated animals meant that there was a smaller margin between the sum of agricultural productivity in the Americas and direct human consumption than was commonly the case in the Old World. In time of crop failure or other kind of food crisis, Eurasian flocks and herds constituted a sort of food bank. They could be slaughtered and eaten; and in times and places when overpopulation started to be felt, human beings always displace herds by turning pastureland into cropland—at least for a while. No

such cushion existed in the Americas, where domesticated animals played a merely marginal part in human food patterns.

All these factors therefore conspired to make Amerindian populations radically vulnerable to the disease organisms Spaniards and, before long, also Africans, brought with them across the ocean. The magnitude of the resultant disaster has only recently become clear. Learned opinion before World War II systematically underestimated Amerindian populations, putting the total somewhere between eight and fourteen million at the time Columbus landed in Hispaniola.⁹ Recent estimates, however, based on sampling of tribute lists, missionary reports and elaborate statistical arguments, have multiplied such earlier estimates tenfold and more, putting Amerindian population on the eve of the conquest at about one hundred million, with twenty-five to thirty million of this total assignable to the Mexican and an approximately equal number to the Andean civilizations. Relatively dense populations also apparently existed in the connecting Central American lands.¹⁰

Starting from such levels, population decay was catastrophic. By 1568, less than fifty years from the time Cortez inaugurated epidemiological as well as other exchanges between Amerindian and European populations, the population of central Mexico had shrunk to about three million, i.e., to about one tenth of what had been there when Cortez landed.¹¹ Decay continued, though at a reduced rate, for another fifty years. Population reached a low point of about 1.6 million by 1620. Recovery did not definitely set in for another thirty years or so and remained very slow until the eighteenth century.

Similarly drastic destruction of pre-existing Amerindian societies also occurred in other parts of the Americas, continuing even into the twentieth century. Disaster is to be expected whenever some previously remote and isolated tribe comes into contact with the outside world and there encounters a series of destructive and demoralizing epidemics. A relatively recent case history will illustrate how ruthless and seemingly irresistible such process can be. In 1903 a South American tribe, the Cayapo, accepted a missionary—a single priest—who bent every effort to safeguard his flock from the

evils and dangers of civilization. When he arrived the tribe was between six thousand and eight thousand strong, yet only five hundred survived in 1918. By 1927 only twenty-seven were alive and in 1950 two or three individuals tracing descent to the Cayapo still existed, but the tribe had totally disappeared—and this despite the best intentions and a deliberate attempt to shield the Indians from disease as well as other risks of outside contacts.¹²

Other examples of swift and irretrievable disaster abound. In 1942-43, for instance, the opening of the Alcan highway exposed a remote Indian community in Alaska to measles, German measles, dysentery, whooping cough, mumps, tonsillitis, meningitis, and catarrhal jaundice in a single year! Yet thanks to airlift into modern hospitals, only 7 of 130 individuals actually died. A little more than a century before, in 1837, the Mandan tribe of the high plains found itself cooped up in two defended camps by their Sioux enemies when epidemic broke out. As a result their numbers were reduced from about 2,000 to a mere 30-40 survivors in a matter of weeks; and those survivors were promptly captured by enemies so that the Mandan tribe ceased to exist.¹³

In an age of almost world-wide population growth, it is hard for us to imagine such catastrophes. Even without total disruption of the sort that came to the Mandan and Cayapo, a 90 per cent drop in population within 120 years (i.e., across five to six human generations), as happened in Mexico and Peru, carries with it drastic psychological and cultural consequences. Faith in established institutions and beliefs cannot easily withstand such disaster; skills and knowledge disappear. This, indeed, was what allowed the Spaniards to go as far as they did in transferring their culture and language to the New World, making it normative even in regions where millions of Indians had previously lived according to standards and customs of their own.

Labor shortage and economic retrogression was another obvious concomitant. The development of forms of compulsory labor and dispersal from cities (where disease losses concentrate) to rural estates are necessary responses if social hierarchies are to survive at all. Late Roman institutions and those of seventeenth-century Mexico have an uncanny likeness in

this respect, which Spain's heritage of the Roman law only partially explains. Landlords and tax collectors, facing a radically decaying population from which to derive support, can be counted on to react in parallel fashion; and this seems to be what happened in both the late Roman and the seventeenth-century Spanish empires.

It is not really surprising, therefore, to discover how much alike the late Roman system of compulsory labor and Mexican debt peonage were in practice, even though legal forms were different. The rise of haciendas in seventeenth-century Mexico exactly parallels the rise of villas in late Roman times. Both societies also saw a massive emptying out of older urban centers. To be sure, there were differences. Rome faced a serious problem of border defense, whereas the Spanish empire of the New World was threatened only by sea and was therefore spared the expense of trying to maintain any but the most sketchy sort of armed forces on its landward frontiers. On the other hand, Roman encounters with epidemic disease were undoubtedly less crippling than the concentrated exposure to the Old World's full repertory of infections proved to be for Amerindians. Consequently, Roman authorities had a less radically decaying population base upon which to draw than the labor force that remained available for the support of the Spanish imperial structure in the New World.

Wholesale demoralization and simple surrender of will to live certainly played a large part in the destruction of Amerindian communities. Numerous recorded instances of failure to tend newborn babies so that they died unnecessarily, as well as outright suicide, attest the intensity of Amerindian bewilderment and despair. European military action and harsh treatment of laborers gathered forcibly for some large-scale undertaking also had a role in uprooting and destroying old social structures. But human violence and disregard, however brutal, was not the major factor causing Amerindian populations to melt away as they did. After all, it was not in the interest of the Spaniards and other Europeans to allow potential taxpayers and the Indian work force to diminish. The main destructive role was certainly played by epidemic disease.

The first encounter came in 1518 when smallpox reached Hispaniola and attacked the Indian population so virulently that Bartolome de Las Casas believed only a thousand survived. From Hispaniola, smallpox traveled to Mexico, arriving with the relief expedition that joined Cortez in 1520. As a result, at the very crisis of the conquest, when Montezuma had been killed and the Aztecs were girding themselves for an attack on the Spaniards, smallpox raged in Tenochtitlán. The leader of the assault, along with innumerable followers, died within hours of compelling the Spaniards to retreat from their city. Instead of following up on the initial success and harrying the tiny band of Spaniards from the land, therefore, as might have been expected had the smallpox not paralyzed effective action, the Aztecs lapsed into a stunned inactivity. Cortez thus was able to rally his forces, gather allies from among the Aztecs' subject peoples, and return for the final siege and destruction of the capital.

Clearly, if smallpox had not come when it did, the Spanish victory could not have been achieved in Mexico. The same was true of Pizarro's filibuster into Peru. For the smallpox epidemic in Mexico did not confine its ravages to Aztec territory. Instead, it spread to Guatemala, where it appeared in 1520, and continued southward, penetrating the Inca domain in 1525 or 1526. Consequences there were just as drastic as among the Aztecs. The reigning Inca died of the disease while away from his capital on campaign in the North. His designated heir also died, leaving no legitimate successor. Civil war ensued, and it was amid this wreckage of the Inca political structure that Pizarro and his crew of roughnecks made their way to Cuzco and plundered its treasures. He met no serious military resistance at all.

Two points seem particularly worth emphasizing here. First, Spaniards and Indians readily agreed that epidemic disease was a particularly dreadful and unambiguous form of divine punishment. Interpretation of pestilence as a sign of God's displeasure was a part of the Spanish inheritance, enshrined in the Old Testament and in the whole Christian tradition. The Amerindians, lacking all experience of anything remotely like the initial series of lethal epidemics, concurred. Their religious doctrines recognized that superhuman

power lodged in deities whose behavior toward men was often angry. It was natural, therefore, for them to assign an unexampled effect to a supernatural cause, quite apart from the Spanish missionary efforts that urged the same interpretation of the catastrophe upon dazed and demoralized converts.

Secondly, the Spaniards were nearly immune from the terrible disease that raged so mercilessly among the Indians. They had almost always been exposed in childhood and so developed effective immunity. Given the interpretation of the cause of pestilence accepted by both parties, such a manifestation of divine partiality for the invaders was conclusive. The gods of the Aztecs as much as the God of the Christians seemed to agree that the white newcomers had divine approval for all they did. And while God thus seemed to favor the whites, regardless of their mortality and piety or lack thereof, his wrath was visited upon the Indians with an unrelenting harshness that often puzzled and distressed the Christian missionaries who soon took charge of the moral and religious life of their converts along the frontiers of Spain's American dominions.

From the Amerindian point of view, stunned acquiescence in Spanish superiority was the only possible response. No matter how few their numbers or how brutal and squalid their behavior, the Spaniards prevailed. Native authority structures crumbled; the old gods seemed to have abdicated. The situation was ripe for the mass conversions recorded so proudly by Christian missionaries. Docility to the commands of priests, viceroys, landowners, mining entrepreneurs, tax collectors, and anyone else who spoke with a loud voice and had a white skin was another inevitable consequence. When the divine and natural orders were both unambiguous in declaring against native tradition and belief, what ground for resistance remained? The extraordinary ease of Spanish conquests and the success a few hundred men had in securing control of vast areas and millions of persons is unintelligible on any other basis.

Even after the initial ravages of smallpox had passed, having killed something like one third of the total population, nothing approaching epidemiological stability prevailed. Mea-

sles followed hard upon the heels of smallpox, spreading through Mexico and Peru in 1530-31. Deaths were frequent, as is to be expected when such a disease encounters a virgin population dense enough to keep the chain of infection going. Still another epidemic came fifteen years later, in 1546, whose character is unclear. Perhaps it was typhus.¹⁴ Probably typhus was a new disease among Europeans, too; at least the medical men who first described it clearly enough to make diagnosis possible thought it was new when it broke out among troops fighting in Spain, in 1490.¹⁵

Hence if the pestilence of 1546 in the Americas was in fact typhus, the Amerindians were beginning to participate in epidemic diseases that also affected the populations of the Old World. This becomes unambiguous in course of the next American disease disaster: an influenza epidemic that raged in 1558-59. This epidemic, which broke out in Europe in 1556 and lasted on and off till 1560, had serious demographic consequences on both sides of the Atlantic. One estimate places die-off in England from the influenza at no less than 20 per cent of the entire population, for instance¹⁶; and comparable losses occurred elsewhere in Europe. Whether the influenza outbreak of the 1550s was a genuinely global phenomenon, like its more recent parallel, 1918-19, cannot be said for sure, but Japanese records also mention an outbreak of "coughing violence" in 1556 from which "very many died."¹⁷

The incorporation of Amerindian populations into the circle of epidemic disease that happened to be current in Eurasia in the sixteenth century did not relieve them of special exposure to still other infections coming across the ocean. Relatively trifling endemic afflictions of the Old World regularly became death-dealing epidemics among New World populations that were totally lacking in acquired resistances. Thus diphtheria, mumps, and recurrent outbreaks of the first two great killers, smallpox and measles, appeared at intervals throughout the sixteenth and seventeenth centuries. Whenever a new region or hitherto isolated Amerindian population came into regular contact with the outside world, the cycle of repeated infections picked up renewed force, mowing down the helpless inhabitants. The peninsula of Lower California,