CHAPTER

# 1

# The Biological Transformation of Modern Times

## POPULATION EXPLOSION, 1800–2000

Any educated person today has seen a graph of estimated world population since the year 1 BCE (chart 1.1). Nothing illustrates more efficiently the uniqueness of the period since the middle of the nineteenth century. From the point of view of the human species as a biological phenomenon, the past 150 years have been unprecedented and revolutionary. World population probably doubled between 1000 and 1500; it roughly doubled again in the three hundred years to 1800; doubled in the following hundred years; doubled in about the next seventy years; and doubled in the thirty years leading to the beginning of our century. World population in 2000 was almost four times what it had been in 1900, and more than six times what it had been in 1800.[1]

In those few cases in which historical demographers can make an educated guess as to populations even before the year 1 BCE, we can construct an even more remarkable story. Up until 1600 the population of Egypt was subject to massive fluctuations for close to 6,000 years, due to plagues, wars and the famines they caused, and dislocations of the regional trade network and the economic crises they produced; in 1600 it may have been roughly similar in size to what it was 3,400 years earlier. Since then, however, it has risen steadily and rapidly and is now about thirty-five times that size.[2] The population of the basin of Mexico followed a similar pattern: in the middle of the seventeenth century it may have been about what it was in 300 BCE; by the middle of the 1980s it was two hundred times as large.[3]

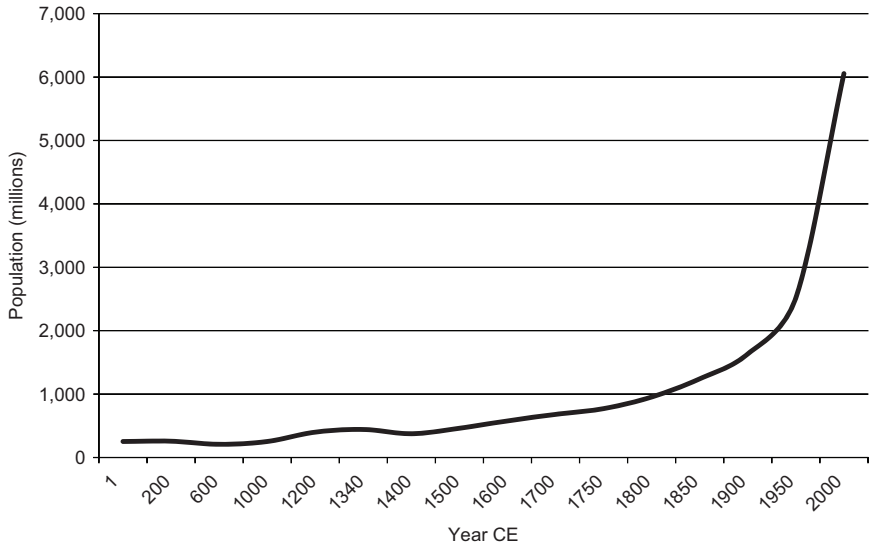


**Chart 1.1** World Population, 1–2000 CE.

Growth in population has been unevenly distributed, with different regions growing at different rates in different periods (charts 1.2 and 1.3). In global terms the story of world population can be divided into two halves. In the period starting around 1700 until about 1915, Europeans multiplied very quickly and poured millions of immigrants into North and South America. Then, after 1900, population growth in Africa and Asia outstripped that in the Euro-American world. Between 1850 and 1900 the population of Europe and the Americas grew almost four times as fast as that of Asia and Africa; between 1950 and 2000 the population of Asia and African grew more than twice as fast as that of Europe and the Americas. As a result, the proportion of world population living in Europe and the Americas surged from about 20 percent in 1700 to 36.5 percent in 1900, and it has since fallen rapidly, to 27 percent.

Three processes explain this pattern, starting fairly weakly before about 1750 and becoming stronger at an accelerating pace since then. Together, these processes have created what historians usually call the demographic transition of modern times: from high fertility and high mortality to low fertility and low mortality.

First, beginning as early as the seventeenth century, important advances in agricultural technology and practices helped to improve human nutrition in key population centers around the world. Those advances included new crop rotation systems, which helped to avoid the rapid depletion of soil nutrients; the greater use of animals as a source of labor and fertilizer; new crops, including not only those adopted from the New World (such as the potato and maize/

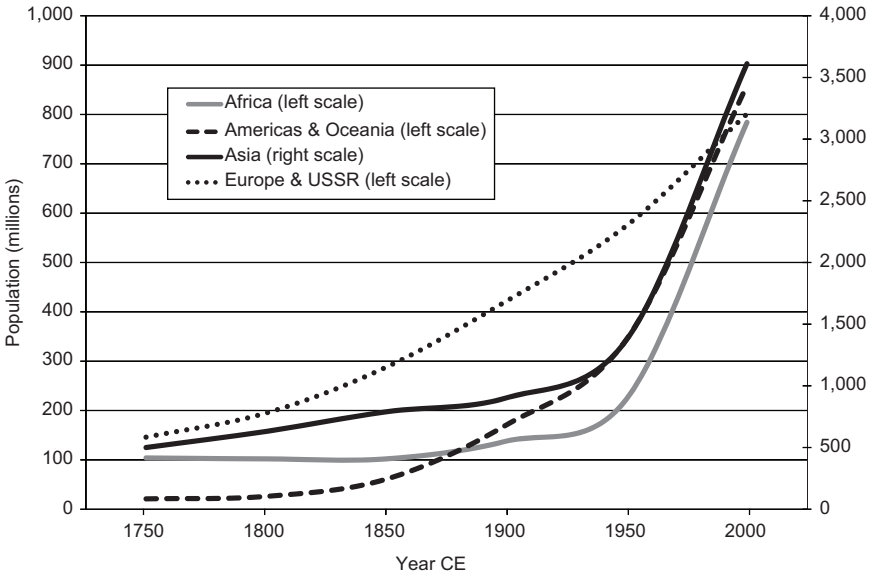


**Chart 1.2** Comparative Regional Population Growth.

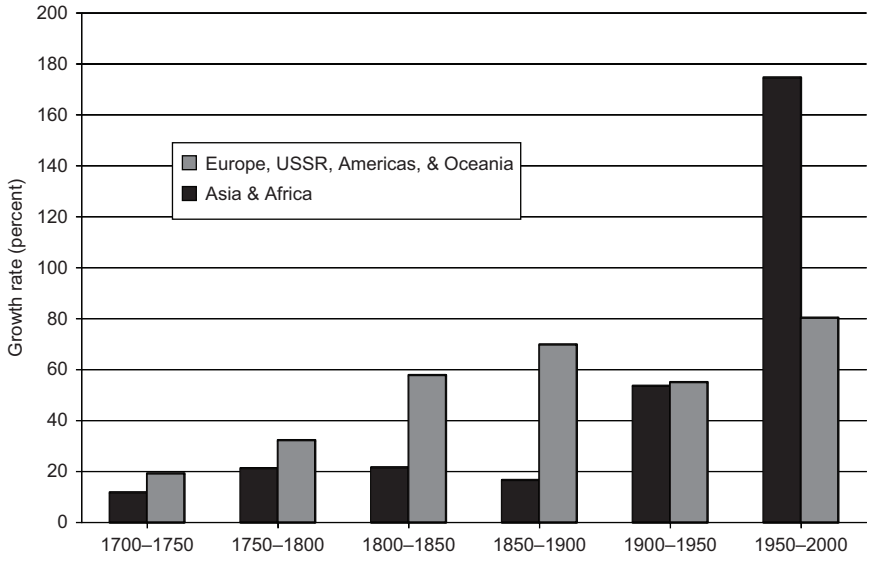


**Chart 1.3** Comparative Regional Population Growth Rates, 1700–2000.

corn) but also new varieties bred for greater productivity; the improvement of domestic animal breeds and their broader distribution around the world; improved drainage and water control techniques that helped expand arable land; and new implements that improved the efficiency of cultivation. In parts of Western Europe, for example, agricultural surpluses above the requirements of producers themselves may have doubled in the course of the eighteenth century, from a quarter to a half of total production. Similar, if less dramatic, improvements helped to support China's rapidly expanding population as well—in fact, some of the implements important in Europe may have been borrowed from China in the course of the seventeenth century. In both parts of the world, improved famine control through state intervention helped to smooth population fluctuations and avoid severe setbacks in growth.[4]

Second, at least as important were extraordinary advances in the prevention of disease. Until the mid-nineteenth century, progress in this respect was slow because it was not yet known what caused contagious diseases. With the emergence of germ theory and then the identification of particular microbes as the specific cause of a growing number of diseases late in the century and into the early twentieth century, preventive health measures took an enormous leap forward. Beginning in the 1850s, for example, major cities around the world began to build sewage systems, leading to sharp reductions in deaths from cholera, dysentery, typhus, and other diseases spread by excrement. Cities also began to build filtration plants to purify water supply. After 1910, chlorination of water further reduced bacterial load in municipal water supplies. In the 1930s, cities began building sewage treatment plants to cut off infection at the source.

All of these advances have helped to eliminate epidemic outbreaks, particularly of intestinal diseases such as cholera, especially in urban centers, where high population density had made them particularly lethal. But more important for overall population growth, they have helped to reduce the background level of infant mortality, because infants are especially vulnerable to such infections. Chart 1.4 shows infant mortality plotted against the percentage of the population served by a sewage system, in fifty-five nations in the 1980s. The message is stark: under the right conditions, simply providing sewerage can reduce infant mortality by 90 to 99 percent. Pasteurization to prevent gastrointestinal diseases from bad milk or other drinks was developed by Louis Pasteur in France in 1862; since then it has spread rapidly throughout the world and has been critical in reducing infant mortality. Finally, while antiseptics have been part of folk medicine traditions around the globe for centuries, if not millennia, more effective chemical antiseptics were developed in the 1840s and 1850s, and especially by Joseph Lister in 1867. While their most spectacular successes came in the area of surgery, they also helped to radically reduce maternal and infant mortality at childbirth.[5]

The deployment of such methods has been uneven and is by no means completed. As of 1980, half the world's population had no wastewater treatment.[6]

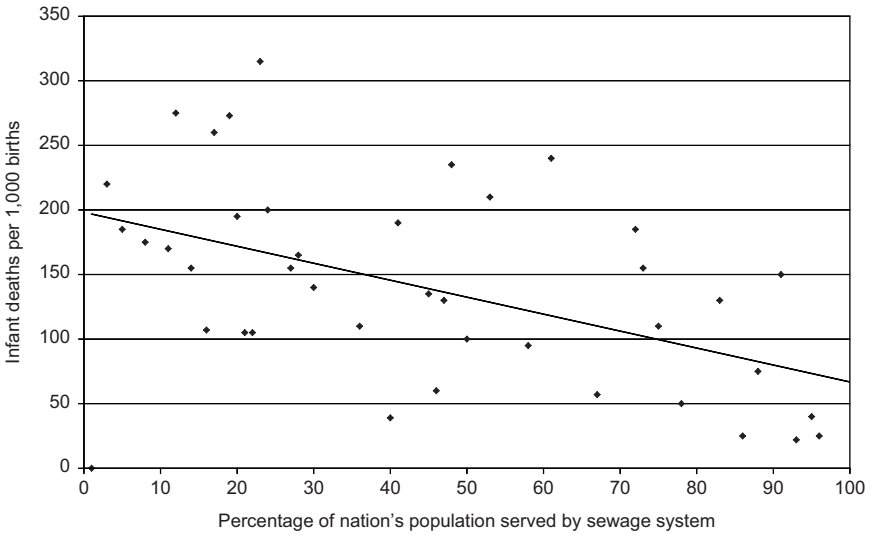


**Chart 1.4** Infant Mortality and Sewage Systems in Fifty-Five Nations (1980s trend line).

For the most part, clean water was secured first in Europe and North America, then progressively in other parts of the world. For that reason, the decline of disease mortality, and the consequent acceleration of population growth, has been uneven and slow. Nevertheless, over time, infant mortality rates around the world have converged (chart 1.5).

While hygienic techniques were the most critical factors affecting population in the middle decades of the nineteenth century, other forms of prevention and prophylaxis were also important. A crucial preventive measure was the use of quinine to inhibit malarial infection, the single biggest killer in tropical regions. Quinine is found in the bark of the South American cinchona tree, which Europeans "discovered" in use among the Quechua people in Peru in the seventeenth century. Gradually, methods of purification and use were perfected, and by the last third of the nineteenth century quinine was being systematically cultivated and widely used. Even more important was the discovery in the late 1890s that mosquitos are the specific disease vector of malaria; thereafter swamp drainage and other mosquito-control techniques in some regions helped to control malaria and other mosquito-borne diseases. Similar successes were scored against yellow fever and a handful of other major killers in tropical and subtropical environments.[7] Of still broader significance was vaccination, which had been practiced in basic form in India and China for several centuries, was transmitted via the Ottoman Empire to Europe in the early eighteenth century, and was eventually perfected in the 1880s in France and

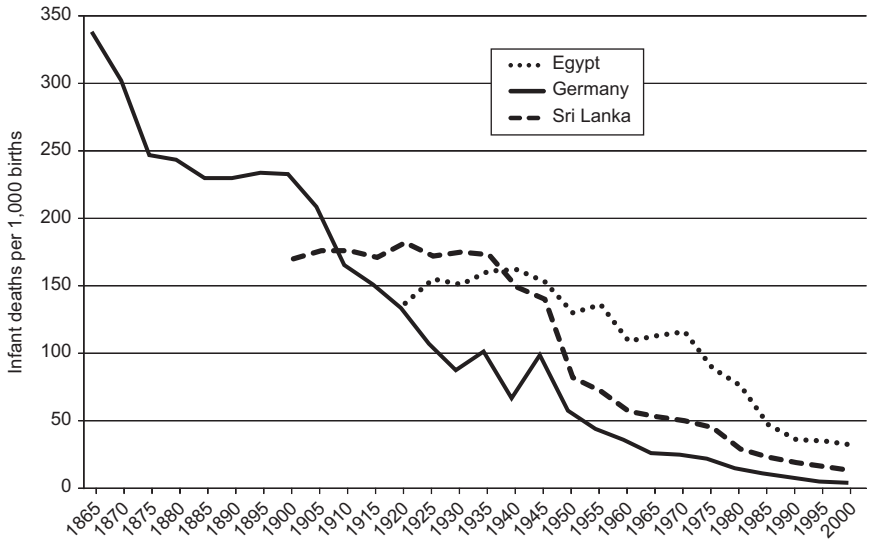


**Chart 1.5** Comparative Infant Mortality in Africa (Egypt), Western Europe (Germany), and Asia (Sri Lanka), 1865–2000.

Germany. The germ theory of disease triumphed in the late 1870s in European medicine, and from the 1880s the specific microbes that cause individual diseases began to be identified. Immunization through inoculation began to bring some key diseases under control.

While these preventive measures were decisive in the first century of population expansion, from the mid-twentieth century, modern scientific medicine began to develop effective therapies for many of the greatest microbial killers. The decisive instance was the development of antibiotics—with the first sulfa drugs developed in the early 1930s (in Germany) and penicillin in the early 1940s (in Britain). Both were brought into widespread use after 1945. These drugs were particularly important in reducing both childhood and adult mortality caused by endemic diseases such as pneumonia and tuberculosis, which were major killers well into the mid-twentieth century.[8]

The chronology of the widespread adoption of all these methods and drugs was the same as that for water purification—first Europe and North America and spreading from there to the rest of the world. The global pattern in the decline of overall mortality is therefore the same as in the case of infant mortality (chart 1.6). Mortality began to fall in Europe in the 1870s, and in Asia, Latin America, and Africa between 1910 and 1930, and is converging now around the whole planet on a very low level. To give just one example, in 1910 mortality in Mexico was 33.5 per 1,000 inhabitants, while that in the United Kingdom was only 13.5—a gap of 20 per 1,000. By 1990 the level in Mexico was

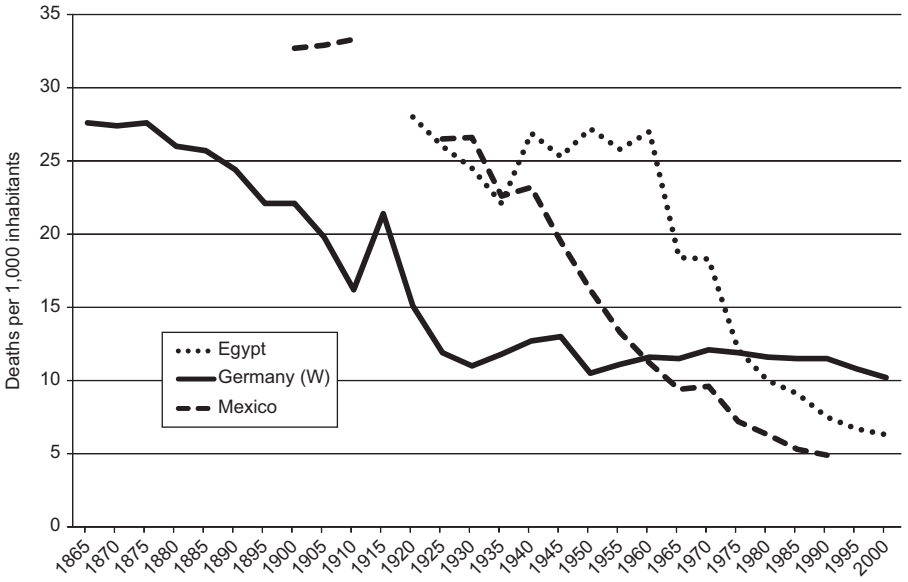


**Chart 1.6** Comparative Mortality Rates in Africa (Egypt), Western Europe (Germany), and Latin America (Mexico).

4.9; in the United Kingdom, 11.1. (The higher rate in developed countries today is explained by the greater average age of people in those countries.)

The pattern in the development of life expectancy is the same, as one would expect (chart 1.7). Everywhere in the developed world, life expectancy is converging on the upper seventies. People in Western Europe, the United States, Canada, and a few other places still live much longer than most people anywhere else. In the case of Africa, in fact, the gap has actually grown. For most of the world, though, that gap is now closing rapidly. The gap between Western Europe and India rose from eighteen to thirty-five years between 1820 and 1950, but it has now closed again to eighteen years. The gap between China and Western Europe has narrowed from twenty-four years in 1900 to seven years today.

The second part of the demographic transition, the decline in fertility, is somewhat harder to explain. Historically, fertility decline appears to be roughly correlated to economic growth, and particularly to the growth of industry. This has led some historians to argue that the rising demand for more skilled and often more sustained labor in industrial jobs has put a premium on investment in human capital—in other words, in the health and education of children, rather than in sheer numbers. The correlation between the spread of compulsory public education and declining fertility indicates that this has not always been a purely individual decision, but rather a political and societal one as well.

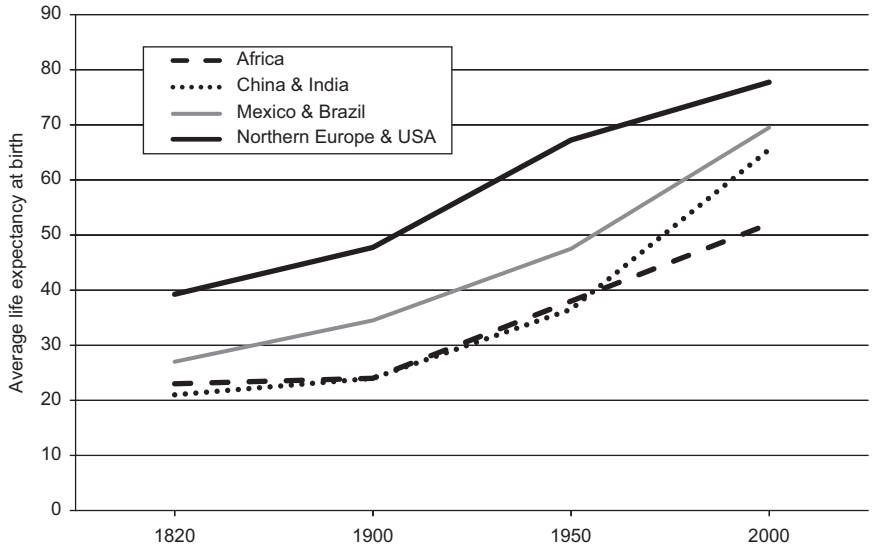


**Chart 1.7** Average Life Expectancy by Region, 1820–2000.

The spread and extension of schooling—and of child labor laws—raise the net cost of children, since children cannot work and attend school at the same time. Rising opportunities for paid labor for women (for example in textile factories, an important early industrial sector whose labor force was disproportionately female) form another likely factor. Longer life expectancy, better health, more opportunities to put aside money in savings, and early social insurance programs (including health, disability, and retirement programs) may have helped make children less essential to familial strategies of "income smoothing" over the life span. Growing urbanization and participation in the money economy may also play a role, in part by reducing the value to the family of children's unpaid labor (for example, in tending animals or weeding crops).[9] In the initial stages of fertility decline, methods of contraception were fairly rudimentary; but over time the development and improvement of condoms, diaphragms, and ultimately, technologies like the contraceptive pill probably played an important role as well.

Whereas all these factors are primarily economic or technological, other historians stress political, cultural, and even psychological factors. Most basically, one historian has argued that "control over death promoted the emergence of rational attitudes," spurred the decline of traditional fatalism, and facilitated the birth of the idea of progress. Greater confidence that they were not going to die might encourage people to make long-term investments, for example, or to limit their fertility in order to maximize their ability to seize on

new economic opportunities.[10] The growth of public schooling was not just an economic strategy; it was also a tool of political nation-building (as by teaching a national language to children who spoke regional dialects, or by teaching them patriotic stories about their country's greatness). Rising literacy helped to spread knowledge about contraception; another historian has even suggested that "fertility was talked down," though perhaps "written down" would be as accurate.[11] Early European studies emphasized the role of important cultural and social changes reflected in or created by the late eighteenth-century "Atlantic revolutions" (particularly in what became the United States and in France) and the subsequent rise of political liberalism and cultural individualism. The disruption of social structures by political upheavals and by economic change may have encouraged people to believe that they could achieve upward social mobility—and to adopt fertility restriction as one strategy for doing so. As one early theorist put it, "Democratic civilization lowers fertility."[12]

Whatever the causes, a crucial feature of the demographic transition was that in most societies mortality fell first, followed after a delay of up to a century by a decline in fertility. In fact, in many societies the decline in mortality was actually accompanied at first by a rise in fertility. The reasons for that coincidence are complex. Customs and expectations regarding the number of children a family needs to secure the desired size probably take at least a generation to catch up to falling infant and child mortality. It takes time for contraceptive knowledge to spread. In many societies it has taken at least a generation for important moral, religious, and cultural taboos against interfering with fertility to erode. Again, falling mortality was usually accompanied by economic (particularly industrial) growth and an increase in per capita income, which may have meant that more families felt they could afford more children. Better nutrition due to rising incomes probably brought higher biological fertility too. Finally, effective means of contraception were for many decades relatively expensive; it took time to build the affluence that allowed the mass of the population access to them. In contrast, the techniques that reduce mortality are relatively cheap and uncontroversial and are often introduced by political bodies (usually cities). They have consequently been deployed relatively rapidly across the whole world.

The lag between the drop in mortality and that in fertility explains why Europe flooded the world with immigrants between about 1800 and 1914: mortality was falling precipitously, but fertility was not—yet. Then, between the 1880s and the 1920s, fertility in Europe began to drop as well, first in France, the United Kingdom, and Germany, and a decade or two later in Southern and Southeastern Europe. The same pattern holds for Japan, the United States, and Australia: by the third or fourth decade of the twentieth century, fertility rates around the developed world were falling quite quickly. Today, natural population increase—fertility minus mortality—is close to or below zero throughout the developed world.

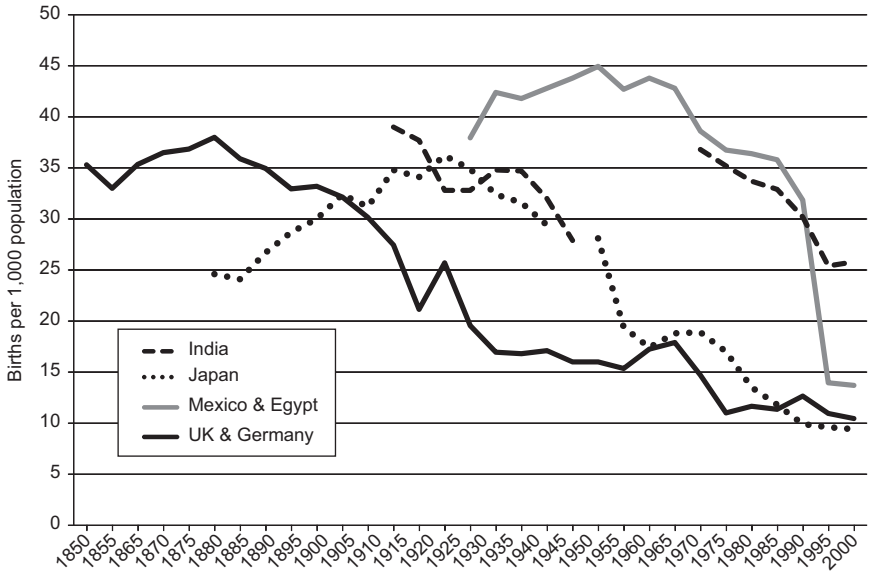


**Chart 1.8** Comparative Fertility Rates in the Developed (Germany, UK average) and Developing (Egypt, India, Mexico, Japan average) World, 1850–2000.

Starting early in the twentieth century and at an accelerating pace since 1950, less developed countries have adopted modern public health and medical practices and technologies. The same pattern has been repeated in these countries, with mortality dropping first, followed later by fertility (chart 1.8). The result has been massive population growth in much of the less developed world—similar to the rate of population growth in the developed world some decades earlier, but outstripping it because the maturing of basic preventive technologies and economies of scale have made it relatively cheaper to achieve lower mortality rates than it was fifty or one hundred years ago.

Some comparisons of demographic development in various countries reveal how extreme the resulting patterns have become. The gap between fertility and mortality—the rate of population growth—in Mexico and Egypt from the 1960s through the 1980s, for example, was roughly twice what it had been in the United Kingdom a century earlier (chart 1.9). In the 1890s the German population was growing ten times as fast as the Mexican population, because fertility rates in the two countries were quite similar but mortality rates were radically different; but by 1990 Germany had zero population growth, while Mexico was at about 3 percent annually. In 1870 Germany had a population four times that of Mexico; by 1985, the two populations were roughly the same size. The same sort of comparison can be made between many richer and poorer countries. Japan, for example, had a population in 1875 three and a

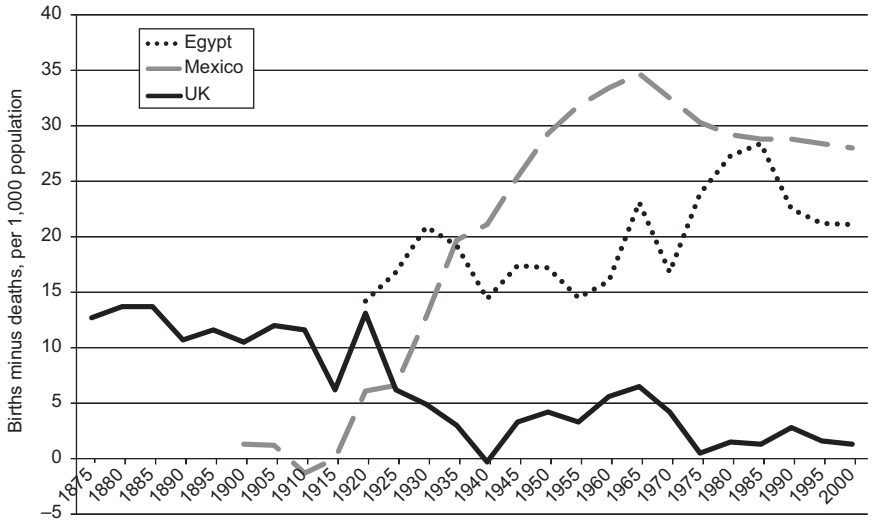


**Chart 1.9** Comparative Population Growth Rates in Egypt, Mexico, and the United Kingdom, 1875–2000.

half times that of Brazil; by 1980 Brazil's population was slightly larger than Japan's.

Most of Europe, North America, and Japan passed through this demographic transition between the late nineteenth and the late twentieth century; by the early twenty-first century natural (nonimmigration) population growth was near or below zero in those regions. Most of the rest of the world passed through a similar transition beginning in the early or mid-twentieth century. By the 1990s fertility in the less developed world was falling precipitously—a development discussed in chapter 9.

This broad pattern of demographic development—two waves of rapid population expansion, in different periods, in two "halves" of the world—amply demonstrates the importance of technological change in shaping the broad pattern of world history over the past 150 years. The development and deployment of scientific knowledge of disease, of effective preventive measures, and finally of effective therapies have been fundamental to this expansion. Again, this has not been the only factor involved—advances in agriculture and increases in per capita income have also played a role (though technological change has been a crucial factor in driving those developments, too); so too have changes in income distribution, laws governing inheritance, and policies regarding such matters as the relative value of public health and the availability of contraceptives. The precise timing of demographic transitions has varied from place to place even within particular regions, for historical reasons that are evidently quite complex. While the British and German populations

boomed through most of the nineteenth century, for example, that of France was almost stagnant. Nevertheless, the development of world population has been made possible to great extent by technologies as simple as sewers. The overall result has been dramatic.

## EXPANSION INTO CHALLENGING BIOMES, 1800–2000

> The Great Spirit made us, the Indians, and gave us this land we live in. He gave us the buffalo, the antelope, and the deer for food and clothing. We moved in our hunting grounds from the Minnesota to the Platte and from the Mississippi to the great mountains. No one put bounds about us. We were as free as the winds. . . . Then the white man came and took our lands from us. . . . Now where the buffalo ranged there are wires on posts that mark the land where the white man labors and sweats to get food from the earth; and in the place of the buffalo there are cattle that must be cared for to keep them alive; and where the Lakota could ride as he wished from the rising to the setting of the sun for days and days on his own lands, now he must go on roads made by the white man.[13]
>
> Chief Red Cloud of the Lakota Sioux, 1903

A second process drove world population growth after about 1800: migration. Over the course of the past two centuries, in a series of overlapping waves or phases, humans have settled in high density a range of natural environments that posed challenges which until 1800 had permitted only very low concentrations of population. We might call them biomes, or particular regimes of climate and vegetation.

The first of these waves settled the world's dry grasslands. These include a vast range of more or less similar environments, which have different names in different regions—such as the steppe of southern Russia and Central Asia, the Great Plains of the American Midwest and prairies of Canada, the pampas in Argentina, the dry plains of southeastern Australia, the plains and grasslands of Algeria, the high veldt of South Africa, the cold and dry plains of Inner Mongolia and Manchuria, the Central Valley of California, the Punjab in northern India, and the cold grasslands on the island of Hokkaido in northern Japan.

All of these areas were inhabited in 1800 by relatively thin populations using relatively low-impact technologies—like Red Cloud's Native American people, the Lakota Sioux. Some were primarily nomadic or seminomadic hunter-gatherers, such as the Great Plains tribes. Others were primarily pastoralists—animal raisers rather than crop growers—who practiced transhumance, moving their animals from one area to another and then back, as seasonal rainfall dictated. Beginning in the late eighteenth and early nineteenth century, the development of a whole range of new technologies made it possible to settle these areas in much greater density, by making settled pastoralism and agriculture feasible. The result was a series of massive waves of settlement that flowed out

from the older centers of population into the dry grasslands—and overwhelmed their established populations.

The first region to be affected was southern Russia where farmers from the old forested and hilly core of central Russia, as well as from similar regions in Germany, Poland, and Southeastern Europe, flooded onto the steppe from the late eighteenth century on. That wave of settlement continued for a hundred years and more, moving farther and farther east and south and into ever drier plains, until it hit its limit in the 1950s under Soviet rule. Slightly later, from the 1810s, a similar movement brought massive settlement to the pampas of Argentina, first as pasture and then as cropland.[14] In the 1830s and 1840s, a wave of settlement by the Boers—Dutch and French settlers who had moved to the Cape Province as early as the seventeenth century—moved up into the veldt of Natal, the Transvaal, and the Orange River country, in what is now the Republic of South Africa. In the United States, the wave of European settlement that had filled the Ohio and Mississippi valleys and the flatlands along the north and west shore of the Caribbean (for example, in Alabama, Louisiana, and East Texas) was succeeded in the middle of the century by a new wave that flooded into the dry Great Plains—present Iowa, Kansas, Oklahoma, Nebraska, and West Texas. This movement was encouraged by the Homestead Act of 1862, which made land available to settlers at cheap prices. The same process was repeated about a decade later on the cold prairie of central Canada, encouraged by the Dominion Lands Act of 1872, similar to the US Homestead Act.[15] Systematic encouragement of settlement by the Japanese government, also from the 1870s, helped to create a similar wave of settlement on the northernmost Japanese island of Hokkaido, whose Japanese population was 60,000 in 1860 and 2.4 million in 1920.[16] Siberia, the Kazakh steppe, Manchuria, and Inner Mongolia became home to millions of Russians and Chinese, particularly after the 1890s. In the Punjab, in northeastern India, arid grassland gave way to crops as irrigation was expanded from the late 1880s.[17]

In many cases these movements of people were encouraged by government policy. The Homestead Act, the Dominion Lands Act, similar legislation for Hokkaido, special privileges granted to German and Russian settlers in southern Russia, and official recruitment or assisted immigration into Argentina and Brazil (in which governments in the receiving countries paid for or subsidized the cost of the ocean journey to their shores) all played important roles.[18] In South Africa the so-called Great Trek of the Boers up from the Cape Province into the Transvaal and the Orange River area was driven in part by their desire to escape British suzerainty—partly because the British outlawed slavery in 1833.[19]

Even more important, in many cases the indigenous inhabitants of these grasslands were killed, expelled, or relocated by major military campaigns launched by the states that now claimed their lands. In other cases more or less informal militias of settlers attacked indigenous populations themselves. The expansion of dense settlement and large populations into challenging biomes

was not an automatic process. The people already living in those biomes had to be forced to give up their land through a massive and deliberate application of coercive and not infrequently genocidal violence.

The Russian state, for example, defeated and absorbed the Cossacks of the southern steppe over a period of some 150 years from the early eighteenth century, with many becoming part of a special military class or caste in service to the same state that had crushed their political independence. The Boers collided with the Zulus in Natal, to the east of the Cape Province, at the end of the 1820s, defeating them in bitter warfare before moving up into the high veldt of the interior in the 1840s. The indigenous population in Australia was subjected to genocidal violence from the 1820s on; that of California from the 1850s (not counting the earlier history of Spanish mission settlement). In the Great Plains, the Sioux were defeated and expropriated after a series of wars: the Dakota War in 1862, Red Cloud's War in 1866–1868, and the Great Sioux War in 1876–1877, with George Armstrong Custer's defeat at the Little Bighorn forming part of the final chapter of that process. The Argentine government launched a major campaign of pacification, expropriation, and extermination against the inhabitants of the southern pampas in 1879, seizing and then selling some 20 million hectares (close to 47 million acres) of land in Patagonia by 1882. At the same time, the Russian state was busy expropriating nomads and pastoralists across the dry steppes of Russian Central Asia, transferring land ownership to a wave of peasant settlers. And Hokkaido's native Ainu population, expropriated and forced to give up many traditional hunting and fishing practices, dropped from almost 67,000 in 1871 to below 18,000 in 1901.[20]

In short, the appropriation of the world's grasslands by settled farmers was often an extraordinarily violent process. One critical reason was that as domestic livestock replaced the game on which indigenous communities depended, they were forced to raid farmers' herds. Farmers and governments often responded with disproportionate violence. In 1851, for example, the governor of California argued for a "war of extermination" against indigenous people in that state, "until the Indian race becomes extinct." From the end of the 1840s through the 1870s in California, settler militias launched murderous raids on "Indian" villages in response to theft of cattle, killing men, women, and children and enslaving survivors. In one instance in 1859, a raid in retaliation for the killing of one horse claimed the lives of 240 members of the Yuki people in Northern California. Later that year, after the U.S. Army refused to participate in exterminating the Yuki, the state governor paid a private paramilitary group to carry out that action. Survivors were confined to a reservation where, between 1873 and 1910, four-fifths of them died. Such episodes were neither new nor unique to North America. While the violence of the 1850s and 1860s was more concentrated, it was a continuation of patterns established as early as the 1630s; and there were similar genocidal campaigns in, for example, Australia, South Africa, and Patagonia.[21]

People were not the only victims of such exterminatory campaigns. Large predators in particular were no less in the way of the settlement of the world's grasslands than were the indigenous human communities. As indigenous game was replaced by domesticated cattle, predators too were forced to raid famers' herds. They too were targeted for deliberate extermination by settlers and governments using guns, traps, and poison. In South Africa, for example, the introduction of bounties on predators in the Cape Colony in 1889 raised the number of jackals killed from 1,512 in that year to 60,863 ten years later, baboons from 1,394 to 21,321, and leopards from 22 to 569. In Japan in the 1870s, American advisers familiar with the necessary techniques were invited to help exterminate the Hokkaido wolf in order to make room for ranching.[22] From the early twentieth century until the late 1930s state and federal authorities in the United States waged a veritable war against predators across the American West, using bounties, poison, and trained government hunters to attempt to wipe out bears, wolves, mountain lions, bobcats, and coyotes.[23]

In the early stages of settlement, useful animals suffered even greater massacres, as hunters, trappers, and settlers trapped, shot, and poisoned game for fur, leather, fats and oils, or meat. Of perhaps 30 million bison that lived on the plains and prairies of North America before the arrival of guns and railroads, about a thousand were left by 1900. Far from being horrified, most contemporary nonindigenous observers were delighted, since the slaughter both cleared the way for more commercially valuable cattle and deprived the Native peoples of the plains of their livelihood's key source. As one government spokesman remarked in 1893, "We were never able to control the savages until their supply of meat was cut off. We have had no trouble worth speaking of since 1883."[24] The population of North American passenger pigeons may have been 5 billion as late as the 1860s; by 1914 it was zero.[25] Similar population collapses occurred around the world, particularly in grassland and prairie regions.[26]

While there were economic reasons for these campaigns, especially in the early stages a kind of mindless joy in killing appears to have played an important role as well. A good example is Samuel White Baker, an Englishman whose family wealth was founded in part on a sugar estate on Mauritius, an island colony in the Indian Ocean. Born in 1821, Baker moved to Mauritius in 1845 to run the family plantation business there; but he found it boring because there was very little to kill. In 1846 he moved to Ceylon (now Sri Lanka), attracted by the idea of killing elephants. He proceeded to do that with great energy: on one hunt he killed thirty-one elephants in five days; on another he killed fourteen in one day. For the next five decades he traveled the world, killing things. He shot bears, deer, boars, wolves, partridges, and ducks in Turkey and Hungary; tigers and antelope in India; hippopotamuses, wild asses, pigeons, hares, rhinoceroses, and antelope in the Sudan; elks, grizzly bears, and bison in the Rocky Mountains; elks and boars in Scotland; foxes and deer in England; and snipe, ducks, partridges, rabbits, and larks on Cyprus. Along the way he

established a cattle farm in Sri Lanka; bought and married a Hungarian slave woman in Ottoman Romania; helped conquer the South Sudan for Egypt; wrote several books about the animals he shot; and became hunting buddies with Maharajah Duleep Singh, whom the British had exiled to Scotland after conquering his kingdom in the Punjab in 1849 and who was a splendid chap who once shot 769 partridges in one day. Toward the end of his life Baker became a conservationist, "aware," as his biographer wrote, "that the slaughter had to stop while there was some game left."[27]

By the early twentieth century this kind of violence prompted some to question the fundamental assumption that both people and nature had the purpose only of serving the accumulation of wealth and power. An early example was the German scientist Ludwig Klages, who wrote in 1913 that the previous century had shown that the whole principle of "'progress' is the lust for power and nothing else," that it was a "sick destructive joke" and had yielded "horrendous results." Human beings had somehow convinced themselves that "every increase in mankind's power entails an equivalent increase in mankind's *value,*" encouraging a blind faith in a completely utilitarian and fundamentally violent approach both to the natural world and to people. As "soon as the man of 'progress' arrives on the scene," he lamented, "he announces his masterful presence by spreading death. . . . An unparalleled orgy of destruction has seized mankind," a frenzied "lust for murder." The "final goal of 'progress' is nothing less than the destruction of life"—of forests, animals, and even mankind's own cultural diversity and spiritual wealth. The only hope for the world was a reawakening of the "knowledge of the world-weaving power of all-embracing love"—including love for nature.[28]

Fifty years later, many would come to see critiques like Klages's as prophetic. Around 1900, however, ideas like his were far less influential than more moderate critiques, which held that the world was indeed a resource for "civilized" humanity but that it had to be managed better. As early as the 1860s and 1870s, scientists and governments in various parts of the world were beginning to argue that natural resources had to be husbanded carefully to ensure they were not simply destroyed outright. This idea gave rise to the idea of conservation and of scientific resource management—what one historian called the "Gospel of Efficiency" in the use of resources. Forestry experts from Germany to colonial India and Australia argued for better management of forests; California established a Board of Fish Commissioners in 1870 to preserve the state's extraordinarily rich fisheries; nature preserves and national parks were created starting in the 1870s in the United States, Australia, Europe, and elsewhere; societies for the protection of wildlife were formed as well, such as the Society for the Preservation of the Fauna of the Empire and the Royal Society for the Protection of Birds in Britain in 1903 and 1904, respectively.[29] The aim of most of this regulatory activity was economic: to determine and then produce a "maximum sustainable yield" of a given resource, ensuring its long-term

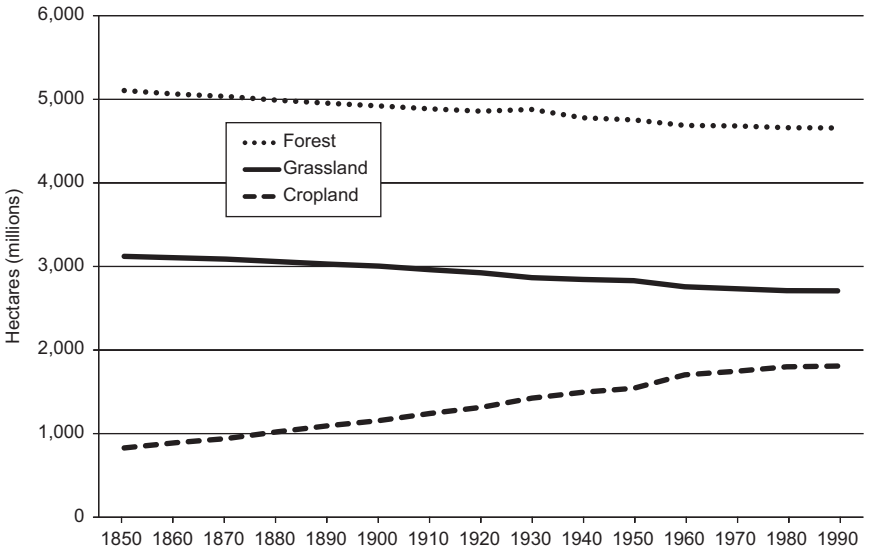


**Chart 1.10** World Land Use, 1850–1990.

contribution to human welfare and national wealth. Some conservationists did emphasize not only efficiency and the elimination of wasteful practices but also aesthetic and spiritual values—for example, opportunities for recreation—or preserving broad access, rather than short-term profit for particular individuals or companies. But the emphasis was usually on the usefulness of nature to humans—and specifically to "civilized" humans.[30]

In short, the idea of conservation was a critique not of violence in general, but only of wasteful violence. Most saw the expansion of settled agriculture across the world's grasslands, for example, as evidence of the unparalleled progress and success of humanity in their time. And many argued that the extermination of so-called "primitive" peoples and of "noxious" animals was both desirable and inevitable. The disappearance of peoples and species might inspire a certain melancholy, but it was the price paid for the transformation of the dangerous, sterile, empty wilderness into a prosperous garden and habitation of civilization.[31]

In fact, with indigenous populations cleared off the land, in each case settlers introduced a radical change in the pattern of land use. This process was in fact so gigantic that we can represent it statistically, in square miles (or, rather, hectares) of land cover. Above all, there was a rapid decline in open grasslands and a corresponding rise in land devoted to cropland and pasturage (chart 1.10).[32] The world's forests as a proportion of land cover fell fairly steadily, too. In contrast, world cropland almost doubled between 1850 and 1950.[33]

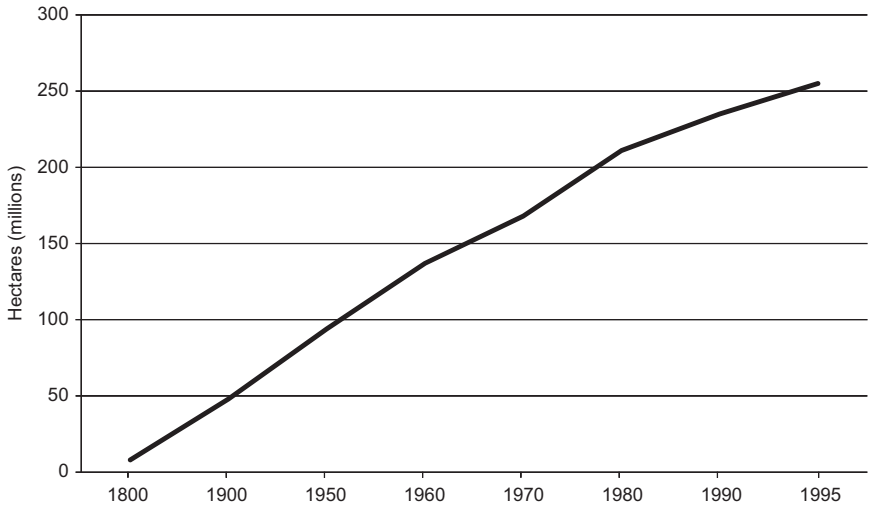


**Chart 1.11** World Lands under Irrigation, 1800–1995.

What made the world's grasslands an attractive target for settlement was the development of new agricultural technologies that turned them into highly productive farming and herding lands. Critical advances were made in irrigation, which permitted the use for crops and animals of lands with quite low rainfall, or rainfall with a radical seasonal distribution (a good example is the Central Valley of California). An early innovation was the modern windmill, which could draw water from aquifers up to thirty feet below the surface. By the 1930s, gasoline- and natural gas–powered pumps could draw water from much deeper, and a second surge occurred in irrigation.[34] Steel and then plastic tubing also played a key role, as did concrete, which made canals more efficient and cheaper. Overall, the amount of irrigated land in the world has skyrocketed over the past 150 years, as more and more dry plains areas have been brought into cultivation (chart 1.11).

In most of these dry grasslands, however, heavier plows with iron and steel plowshares were also critical, because older, lighter plows were not strong enough to permit plowing of dense sod. Eventually, in the mid-twentieth century, the use of tractors would permit a further massive expansion of cultivation in grasslands—leading to a second surge in conversion of grassland to cropland (chart 1.12).[35] Barbed wire, which helped control herds on the vast grazing lands needed to support animals on dry pasturage, was also critical—with the key patents taken out in Ohio and Illinois in 1867 and 1874, respectively. Argentina, for example, imported 5.5 million kilograms of barbed wire in 1876, 13.5 million in 1880, and 40 million in 1889—a development that was,

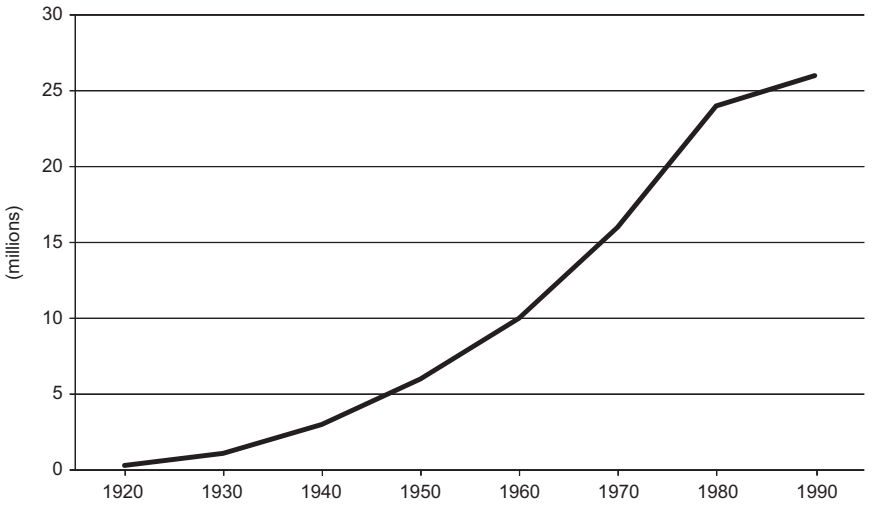


**Chart 1.12** World Number of Tractors in Use, 1920–1990.

obviously, part of the effort to bring into production all the land seized by military force after 1879.[36]

The key technologies that permitted all of these transformations, however, were actually not agricultural, but transportation technologies—above all, the railroad, and to a lesser extent the steamship. Railroads began to be laid in earnest in the 1840s, and expanded extremely rapidly thereafter for a hundred years (chart 1.13). Railways and steamships were critical because the settlement of the world's grasslands was driven in large part by the demand for food generated by rapid population growth in the old "core" areas of human settlement—Europe, the Eastern Seaboard of North America, China, and India. The world's grasslands could feed the old "core" populations only if the food could be moved from farms, often in deep continental interiors, to markets, often across oceans. This was a massive transportation challenge, which the railway solved. Moving bulk goods by rail is far cheaper than moving them by road—or at least it was until the invention of internal combustion engines. As for ocean transport, steamships helped to make that cheaper and more efficient, particularly in the 1860s and 1870s, when technical improvements reduced their fuel consumption by a factor of up to five. And the creation of the Suez Canal in 1869 and the Panama Canal in 1914 reduced global freight route distances and travel times. Freight costs between North America and Britain, for example, dropped by about 70 percent between 1840 and 1910. The Suez Canal cut the distance of ocean travel from Britain to India by half. The world's shipping tonnage rose from some 4 million tons in 1800 to about 47 million in 1913; and

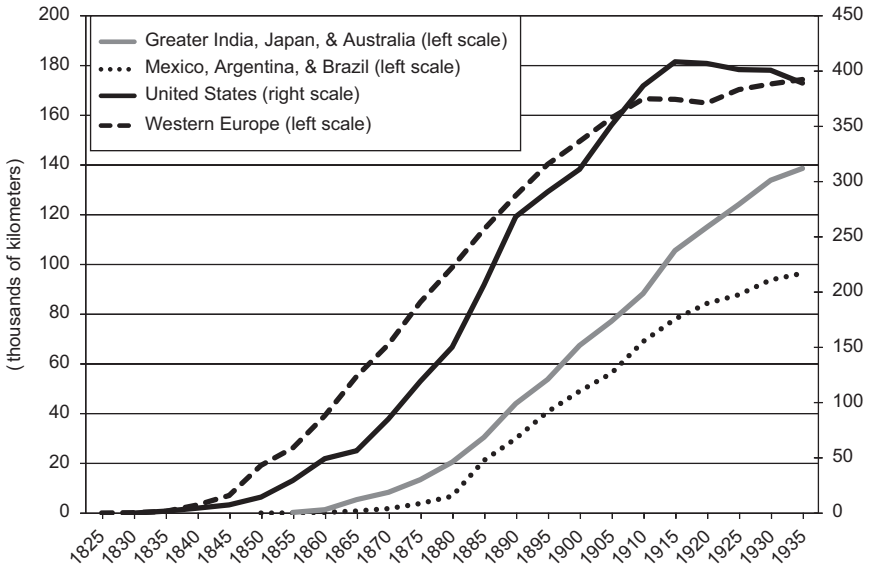


**Chart 1.13** World Railroad Track in Use, 1825–1935. Western Europe includes the France, Germany, Italy, Spain, and the United Kingdom.

total shipping grew even more, because steam- or diesel-driven ships moved considerably faster than sailing ships and so carried more freight annually per ton of capacity.[37] Finally, by the 1870s and 1880s, the development of effective refrigeration permitted the movement not only of grain but also of meat and dairy products across great distances on land and by sea. By the 1920s, to give just one example, 80 percent of the meat consumed in London was imported, most of it from Argentina.[38]

As important as the settlement of the world's grasslands was, however, this was not the only "challenging biome" that saw massive human settlement. A second kind of environment, settled slightly later, consisted of mountainous and high-plateau regions, such as those found in Tibet, Peru, Ethiopia, Turkey or Anatolia, and the Colorado Plateau. A third, settled intensively in the last two decades of the nineteenth century and the first decades of the twentieth, was arid steppe and semidesert regions, such as parts of Mongolia, the Sahel in North Africa, dry Central Asia, and the dry and desert West of the United States (Utah, Colorado, West Texas, New Mexico, and the Imperial Valley in California).

Ultimately much more important, however, was the settlement of tropical biomes—first a number of important river delta floodplains, and then of lowland tropical rainforests. The former process took off a good four to six decades after the movement onto the world's grasslands was launched, in the 1870s and

1880s. Those decades saw massive settlement and development of major river deltas, particularly in South and Southeast Asia—the Irrawaddy in Burma (Myanmar), the Chao Phraya in Thailand, the Ganges and Brahmaputra in India, and the Mekong in Viet Nam. But something similar took place in other, temperate (nontropical) areas as well—for example, in the delta of the San Joaquin River in California starting in 1874. These deltas came to play an important role in the world economy as rice-exporting regions by the 1890s and 1900s.[39] A bit later, after the turn of the century, the great rainforest regions began to see similar rapid development—for example, in Brazil, Indonesia, and Nigeria.

No less than in grasslands, arid, and mountain regions, technological developments played a crucial role in the settlement of the tropics (and of temperate river deltas). Railways were critical, enabling producers to get their goods to market. Equally important was flood control, which turned swamp and flood basin in the great river deltas into rich rice-growing land. But less obvious technologies were also important. Quinine, for example, was important for tropical development since those same flood basins that were so fertile for rice growing were also outstanding producers of mosquitoes, and hence of malaria. The development of those river deltas, therefore, had to await the development of giant quinine plantations in colonial Asia and the industrial production of purified quinine. Until the 1880s, 95 percent of world quinine supply came from South America and was collected in the wild; thereafter the Dutch and British established plantations in Sri Lanka, India, and Indonesia, and by the 1920s Indonesia produced 90 percent of a tremendously expanded world output.[40] Another example is the chainsaw, first produced in 1917, after the development of efficient small internal combustion engines. The chainsaw allowed people to cut down trees up to one hundred times faster than they could with handsaws and axes, permitting rapid land clearance in heavily forested areas. This was crucial for the opening up of tropical rainforest regions for agriculture or pastoralism. Fertilizers, too, were particularly important in cleared-rainforest areas, where soils were often poor.[41]

The history of world population distribution reflects this phased conquest of different environments (chart 1.14). The aggregate population of the old core areas of human population in China and Europe—largely mixed grassland and forested hills—is still larger than that of all other regions; but the population of other kinds of terrains has surged much faster, particularly since 1900. We can trace this pattern in the case of individual regions, as well. In South America, for example, the population of Argentina (with a geography dominated by grasslands) at first grew much faster than Brazil (mostly tropical), up until about 1940; but then, in the second half of the century, the population of Brazil grew faster than that of Argentina. In India, the relatively dry United Provinces (now Uttar Pradesh) grew faster in the early twentieth century that did the lowland delta of Bengal and Bangladesh; but after about 1930 the tropical lowland delta population grew faster.

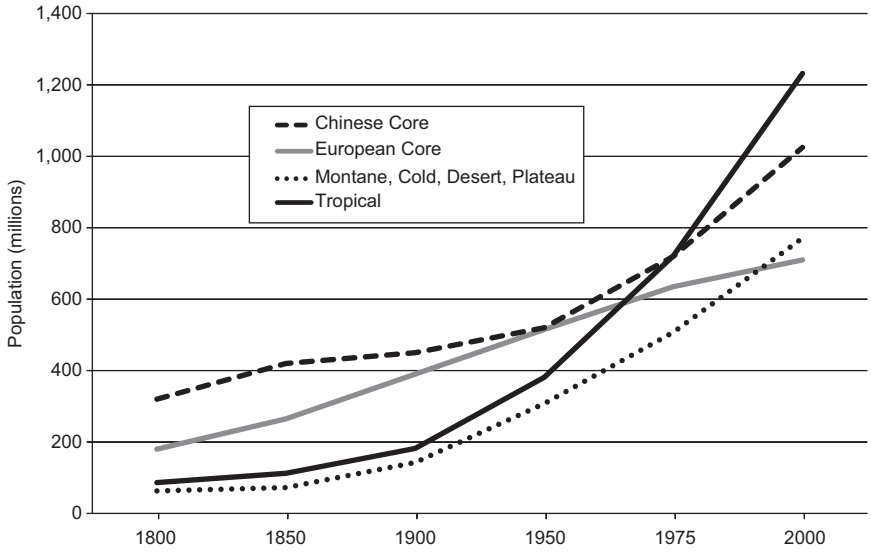


**Chart 1.14** Comparative Biome Populations, 1800–2000. Figures do not add up to total world population, because many countries cannot usefully be classified as fitting into only one biome.

Since 1850, then, the center of gravity of the human population has steadily shifted from the old centers of human population toward more challenging biomes, which have been substantially re-engineered to support high population densities. People made wet areas drier and dry areas wetter; they eliminated certain fauna and replaced them with others; and they cleared masses of old vegetation to make way for new. Last but not least, they displaced or killed entire communities of people who, over periods of centuries and even millennia, had maintained a rough equilibrium with those biomes.

## A CENTURY OF MASS MIGRATIONS, 1840–1940

> The history of early Russia is the history of a country which is colonizing itself. Because of this there was a constant powerful movement of population across enormous spaces. . . . The settler does not remain long [in any one place]: as soon as he is constrained to work harder, he goes off to settle new areas . . . land property has no value, for the important factor is population. To people the land as quickly as possible, to summon people from all over to new regions, to lure them with all sorts of privileges; to set off for new and better regions, regions more peaceful and tranquil, with more favorable conditions . . . all these are the principal questions of a country colonizing itself.[42]
>
> Sergei Solov'ev, *Istoriia Rossii* (History of Russia)

Re-engineering entire biomes and turning them into rich food-producing regions required a lot of people. Where did all those people come from? For one thing, there was rapid natural increase in some of the newly settled environments—cheap land and abundant natural resources meant high fertility, relatively good nutrition, and low mortality. But, particularly in the early period of expansion, the much stronger cause of population gain was mass migrations of people from the old core zones of human settlement. These mass migrations are an extraordinary feature of the past two centuries of human history, a period in which tens of millions of people have moved from their country, continent, or even hemisphere of birth to new ones.

All told, in the century from the 1840s to the 1940s, on the order of 150 million people moved, permanently or temporarily, great distances from the old core regions of human population to areas previously less densely inhabited. Since the world population in 1800 was probably just under a billion, this is a huge proportion of the people who lived over the next century. Certainly in absolute terms this was the largest migration in human history.

We return to the topic of migration in chapter 9, as there was a second wave of migration after World War II, one that flowed mostly in the other direction, from Asia, Africa, and Latin America to North America and Europe (as well as the Middle East). That second wave, obviously, was powered mainly by an overall shift in global demographic patterns. But it was also quite different in structure and origins from the first wave, in the previous century.

In the first wave of mass migration, from the mid-nineteenth to the mid-twentieth century, almost 75 million people migrated from Europe, 50 to 55 million from China, and 30 to 35 million from India (chart 1.15). About 60 million left Europe for the Americas; about 50 million left from China, Korea, Japan, and Russia for Siberia, Mongolia, and Manchuria; about 50 million left from India and South China for Southeast Asia. Africa, which had been a major source of migrants in the eighteenth century due to the slave trade, saw a smaller number move in the nineteenth century—about 3 million people. Internal migrations were on the same scale, though harder to count: some 75 million Europeans, up to 40 million Chinese, and 35 million Americans moved significant distances within those regions.[43]

This first period of mass migration has a clear chronological structure. The forced migration of Africans was confined almost exclusively to the first half of the nineteenth century, because slavery in the Americas was abolished in the middle of the century. Later in the century, the direction of population flow was even reversed in the case of Africa, with about 3 million French and Italians moving to North Africa, and roughly a million Europeans, Chinese, Indians, and Middle Easterners to South and East Africa.

In contrast, Europeans began to migrate to the Americas in large numbers just about at the time slavery was beginning its decline, starting with some 1.8 million Irish people emigrating during the great potato famine between 1845

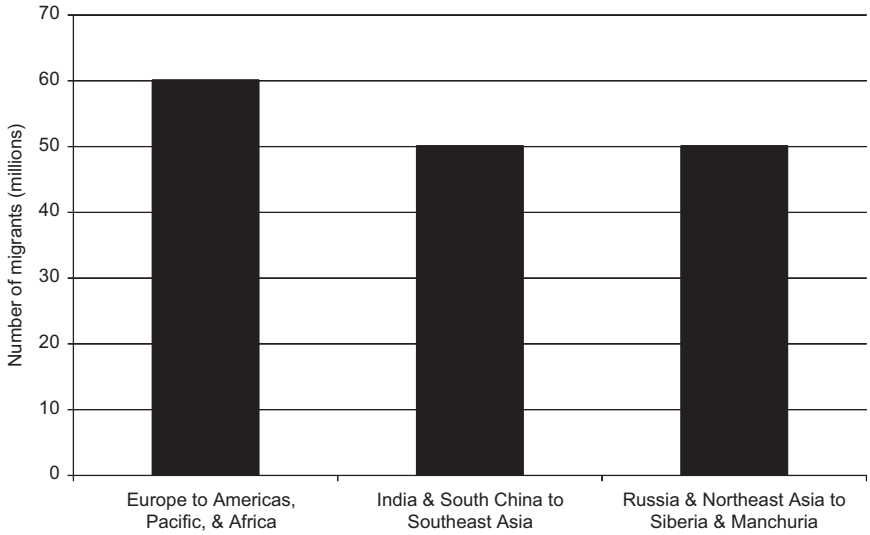


**Chart 1.15** World Migration, 1846–1940.

and 1855. Thereafter, the number of European emigrants rose annually from the 1870s. At the peak of this migration in 1913, a whopping 2.1 million people crossed the Atlantic—close to one half of 1 percent of the entire European population, in one year.[44] Different groups left at different times. Britain, Scandinavia, and Central Europe saw massive emigration from the middle of the nineteenth century right through the 1910s, but then it slowed down. Southern and Eastern Europe had moderate migration rates up until the 1890s, then accelerating rates right up until World War I. In the decade between 1906 and 1915, over half a million Italians left the country every year.[45] Of almost 75 million European migrants, about 70 percent went to the United States and Canada. More than 15 percent (13 million) were Russians who went to Siberia and Central Asia; over 10 percent went to Latin America; under 10 percent went to Australia, New Zealand, and South Africa.[46]

European migration slowed drastically after World War I; in contrast, emigration from Russia, China, and India continued to grow after 1914. Over the whole period, about 15 million Chinese went to Southeast Asia and Indonesia, and another 4 million to the Philippines, Australia, New Zealand, California, Hawai'i, and Latin America. About 30 million Chinese moved to Mongolia, Manchuria, and Siberia. Some 30 million Indians emigrated during this century and a half, as well—most of them not very far, with about 15 million going to Burma (now Myanmar) and 8 million to Ceylon (now Sri Lanka). But 4 to 5 million went as far as Malaysia; and 1 to 2 million went to Africa, the Pacific islands (including Australia and New Zealand), and even Latin America.[47] Over

a million Japanese emigrated between 1885 and 1925, about a third of them to Hawai'i and the United States, another third to Korea and Siberia, and smaller numbers to China, Brazil, and Peru.[48]

There was one very profound difference between European and Asian migration patterns. Of the European emigrants 30 to 40 percent actually returned to their countries of origin over the course of these 150 years. Fewer returned earlier on; more after 1900; and the rate of return varied greatly by destination region. Only about 10 percent returned from Australia, about a third from North America, and about half from Latin America. In contrast, however, about 70 percent of Chinese emigrants and probably an even higher proportion of Indian emigrants ultimately went home. For this reason, some historians have come to refer to two patterns of population movement: emigration, which was most common in Europe; and sojourning, most common in Asia.[49]

There were two primary reasons for this difference. Particularly in North America and Australia disease and genocidal violence almost eliminated the people who had previously occupied the land, so that many European settlers acquired landed property and built lasting communities of people from the same countries or even villages of origin. Many of these people in fact came with the intention of staying, and 30 to 40 percent were women. Something similar happened in Siberia. In contrast, most Chinese and Indian immigrants went to countries with reasonably dense populations, did not acquire land, and in fact never expected to stay. Only 10 to 15 percent were women; people did not migrate as families, expecting to settle down. Many young men were sent by their extended families to take advantage of particular labor opportunities, earn some cash, and bring it back to add to the family wealth. Some Indian and Chinese migrants—perhaps 10 percent in each case—were indentured laborers. They signed work contracts for a limited number of years and often worked in isolated plantations, mines, and construction gangs in conditions often approaching those of slavery—complete with barrackslike housing, poor food and medical care, and even corporal punishment for infractions of work rules or for breach of contract.[50]

Again, as in the case of European migrants, this pattern varied from one place to another, depending on opportunities and conditions. Of the 2.6 million Indians who went to Burma between 1852 and 1887, for example, three-quarters returned home; of the 150,000 who went to South Africa before 1911, only half came back.[51]

A different mechanism operated in Latin America. There, the particular political, social, and economic conditions prevailing in many areas (such as Argentina and Brazil) resulted in the concentration of land ownership in the hands of wealthy elites who had settled well before the great wave of immigration got under way in the 1880s. A higher proportion of later immigrants came to work on farms and plantations to save some money and return to make better lives in Europe. Where there were greater opportunities to become

wealthier than they had been in their home country, people tended to stay—hence the high rate of retention in Australia and the United States. Latin American standards of living, at least for the mass of the populace, were not significantly better than in poorer parts of Europe, such as Spain and southern Italy. Incomes being more equal, other incentives (such as family ties or access to locally controlled resources) created higher rates of return. This is a mechanism that may have played a role in high rates of return in Asia, as well, since the gap in standards of living between China and India on the one hand and Southeast Asia on the other was also small.

A third mechanism encouraged high rates of return, specifically among Chinese migrants: racism. On the one hand, between the late nineteenth and the early decades of the twentieth centuries, a number of societies passed exclusionary legislation that made it extremely difficult for Chinese immigrants to stay and become citizens. After some decades of using rising entry fees to limit Chinese immigration, the United States passed an outright ban (the Chinese Exclusion Act) in 1882 (the Japanese and other Asians were excluded in 1924); Australia followed suit in 1901, as did Canada in 1923.[52] On the other hand, a number of countries attempted as a matter of public policy to attract European settlers. For example, they sent out recruiting missions to inform potential immigrants of opportunities in Argentina, Brazil, California, Australia, and Canada; some established subsidies for the cost of passage, particularly for people possessing skills their economies needed; and some established labor agencies to connect immigrants with jobs.

There is a specific reason for this contrast: in the course of the nineteenth century, racism became a powerful ideology having a greater and greater impact on public policy. This topic is discussed in chapter 4.

The result of all these trends by 1950 was that whereas the descendants of European immigrants to the Americas and the Pacific numbered 250 to 300 million, those of Indian and Chinese immigrants to Southeast Asia and the Pacific numbered only 15 or 16 million.[53] This pattern decisively shaped twentieth-century political history in that it changed the global balance of power profoundly. When the modern world exploded in world war between 1914 and 1945, those societies that had established relatively densely populated and economically dynamic offshoots had a decisive strategic advantage. Most of those offshoot societies were politically independent by then, but they had close cultural, economic, political, military, and often personal ties to the countries of their origin.

The societies dominated by the descendants of emigrants from Britain—the United States, Canada, Australia, New Zealand, and South Africa—form the prime example. They constituted a globe-spanning community of heritage that could muster overwhelming economic power by the middle of the twentieth century because they controlled the resources of two entire continents (North America and Australia), the richest part of a third (South Africa), and until

1947 most of the Indian subcontinent as well.[54] Other states were aware of the potential advantages of establishing such empires of settlement. German strategic thinkers and racialist national chauvinists at the turn of the twentieth century, for example, deplored the fact that in contrast to Britain, Germany had during the previous century "lost" millions of emigrants (above all to the United States).

Yet, while people of British descent wielded great political, social, and economic power in North America, Australia, New Zealand, and South Africa, these were true immigrant societies, with populations of highly diverse origins. One critical reason for this fact was that global migration patterns reflected the need to match the skills of people—migrants—to the requirements of settlement. In most cases matching skills to resources mattered more than ethnicity in determining who went where.

A striking example of this pattern is that of the migration of ethnic German inhabitants of the southern plains of the Russian Empire. These "Volga Germans" originated with seven thousand families that migrated in the 1760s from central and southern Germany to the steppe, or grasslands, in southern Russia on the Volga River. They came in response to a shortage of land in Germany and to Russian government incentives for settlement on this land. Those incentives included free land, taken from the native inhabitants, and exemption from military service.[55] By the 1870s and 1880s, however, these ethnic German subjects faced the revocation of their privileges and growing pressure from the central government's "Russification" campaign, which sought to create a more culturally, linguistically, and even religiously homogenous population. In response, about 150,000 of them left the Russian Empire. The question was, Where to go? Volga German communities sent scouts out to various parts of the New World to find likely homes. The places they liked best, not surprisingly, were rather like the southern Russian steppe: the pampas; the cold northern Great Plains, in Kansas and Nebraska; and the Canadian prairie still farther north—all environments that matched their skills and knowledge relatively well.

Volga Germans settled in all three places. And they brought with them not only the grassland farming skills they had developed in Russia but even some of the same varieties of grain they had grown there—notably hard red winter wheat, or "Turkey" wheat. Large-scale wheat farming was just beginning to be seriously established in all three areas in the 1860s; and these migrants brought important resources to the project of developing these regions, and shaped them in lasting ways. By the 1920s, about 80 percent of the wheat grown in Kansas and Nebraska was descended from the Russian variety the emigrants had brought with them; and that variety was more common in the United States than any other, accounting for about 30 percent of all wheat grown in the country.[56] But the Volga Germans were an important presence also in Argentina; in fact, there were even contacts between the US and Argentine groups. One Volga German went first to Argentina, but couldn't stand the fact that, as

he put it, "everything seemed upside down" there. The sun stood north in the sky during the day, and the cold wind came from the south. So he moved to Saskatchewan, in Canada, where things felt homier.[57]

The point of this example is that, to a remarkable extent, nineteenth-century mass migration made the settlement of the world's grasslands one integrated global process—one in which the same knowledge sets, technologies, and organisms (crops and animals), and in some cases even the same individuals, were involved, on a global scale. Another example is provided by Mennonite Germans from further south and west in the Russian Empire. Often called Black Sea Germans, they settled in the same grassland areas (though they preferred slightly warmer parts of those regions). A third group consisted of the Ukrainians who settled in large numbers in southern Saskatchewan between the 1880s and 1890s.

There was a similar global redistribution of people with expertise in pastoralism—raising sheep and cows. Many Argentines today have Irish or Basque family names, for example, because they are descended from Irish and Basque shepherds recruited during Argentina's wool boom in the middle decades of the nineteenth century. Many Basque place- and family names can be found in in eastern California and Nevada for the same reason. And some of the wealthiest landowning families in Argentina have English last names because they are descended from British stockbreeders who brought their knowledge of scientific animal husbandry, and their animals, with them in the later nineteenth century.

Fishing offers yet another example. Portugal experienced rapidly rising emigration through the entire period before World War I, reaching almost 1 percent per year just before the war. About 85 percent of these emigrants went to Brazil; but Portuguese fisherman settled on coastlines in almost every part of the world, including Northern California, Australia and New Zealand, Hawai'i, and New England.[58]

California was a striking microcosm of the process by which immigrants were sorted by region and skill. Hawai'ian sailors and laborers played an important role in the early history of post-Mexican California. Welsh and Chinese coal miners and Cornish tin miners worked in the goldfields of California in the 1850s. Italian and Portuguese fishermen settled all along the Northern California coast. Dairy farmers of northern Italian origin are still a major factor in Marin and Sonoma Counties. Northern Italian and Italian-Swiss winegrowers established powerful dynasties in the Central Valley—including the Mondavi and Gallo families, whose names are known worldwide. Japanese horticultural workers, who learned their skills in a land-poor, intensive-agriculture economy, played a critical role in the settlement of the Santa Clara Valley and the Central Valley in the late nineteenth century. Chinese workers accustomed to highly cooperative heavy-labor techniques built the western end of the first transcontinental railway; soon after it was completed in 1869, they turned to building the elaborate water-control system that made the delta

of the Sacramento River an agricultural powerhouse. They were well prepared for that work, since most of them came from the Pearl River Delta in Guangdong Province, where a similar system had been built.[59]

California was typical in this respect. There are similar ethnic Italian, Greek, and Portuguese fishing and wine-making populations all over the Pacific and Atlantic—in Hawai'i, Australia, New Zealand, Peru, Chile, Argentina, and New England. Welsh and Chinese miners worked in the goldfields not only of California but also of Australia and New Zealand in the mid-nineteenth century. Japanese horticulturalists were critical in shaping the Hawai'ian economy and played a role in Latin America as well; by 1933, for example, Japanese farmers produced three-quarters of the tea, over half the silk, and almost half the cotton grown in Brazil. German, Polish, and Czech coal miners—alongside those from Wales, Cornwall, and the North of England—played important roles in building the US coal-mining industry in, for example, Pennsylvania and West Virginia. Indian indentured laborers were brought to Fiji, Surinam, East Africa, South Africa, and Australia in the 1870s and 1880s to develop the sugar industry in those areas, based on skills they brought with them. All these people moved to places similar to their homes and continued working in the trades in which they were skilled.[60]

It was not simply luck that matched people and skills to environments and resources on a global scale. This was a pattern deliberately fostered. Specific opportunities drove mass migration, but mass migration was also a product of deliberate recruitment in which those who owned or controlled particular economic resources sought to attract the people who could exploit them effectively. This was not merely a blind movement of masses of people—an unplanned, random, individual process. People went where they knew their skills were needed; and governments, corporations, nongovernmental agencies, and individual entrepreneurs made deliberate, self-conscious efforts to create a global economy, and a global distribution of people and skills, that could effectively exploit the resources of the entire planet.

Chapter 2 turns to that project.