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2

Demographic Growth: Between Choice and Constraint

1 Constraint, Choice, Adaptation

We have established a few points of reference: demographic growth takes place with varying degrees of intensity and within a fairly large strategic space, large enough so that rates of growth or decline can lead a population to rapid expansion or extinction. The upper limits of this strategic space are defined by reproductive capacity and survival and so by the biological characteristics of the human species. In the long run, demographic growth moves in tandem with the growth of available resources, the latter imposing an impassable limit on the former. These resources, of course, are not static, but expand in response to incessant human activity. New lands are settled and put to use; knowledge increases and new technology is developed. In a later chapter we shall discuss which is the engine and which the caboose between resources and population – that is, whether the development of the first pulls along the second or vice versa; whether the availability of an additional unit of food and energy allows one more individual to survive or, instead, the fact of there being another pair of hands leads to the production of that extra unit; or, finally, whether they do not both function a little as engine and a little as caboose according to the historical situation.

For the moment, we shall turn our attention to another problem already mentioned in chapter 1. We have identified three great population cycles: from the first humans to the beginning of the Neolithic era, from the Neolithic era to the Industrial Revolution, and from the Industrial Revolution to the present

day. The transitional phases between these entailed the breakdown of fragile equilibriums between population and resources. However, as we have seen for European populations, demographic growth proceeded irregularly within these cycles as well. Periods of growth alternated with others of stagnation and decline. What were the causes?

In order to provide a theoretical picture, we may conceive of demographic growth as taking place within two great systems of forces, those of constraint and those of choice. The forces of constraint include climate, disease, land, energy, food, space, and settlement patterns. These forces have variable degrees of interdependency, but they do share two characteristics: their importance in relation to demographic change and their own slow rates of change. With regard to demographic change, the mechanisms are intuitive and well demonstrated. Human settlement patterns (density and mobility) depend on geographic space, as does the availability of land. Food, raw materials, and energy resources all come from the land and are important determinants of human survival. Climate in turn determines the fertility of the soil, imposes limits on human settlement, and is linked to patterns of disease. Diseases, in turn, linked to nutrition, directly affect reproduction and survival. And space and settlement patterns are linked to population density and the communicability of diseases. These few comments should already make clear the complexity of the relations which link together the great categories of the forces of constraint as they relate to demographic growth.

The second common characteristic of the forces of constraint is their permanence (space and climate) or slow rate of change (land, energy, food, disease, settlement patterns) in relation to the time frame of demographic analysis (a generation or the average length of a human life). These forces are relatively fixed and can be modified by human intervention only slowly. Obviously, food and energy supplies can be increased as a result of new cultivation and new techniques and technology; improved clothing and housing can blunt the effects of climate; and measures to prevent infection and the spread of diseases can limit their impact. However, the cultivation of previously uncultivated land, the development and spread of new technology, the proliferation of better styles of housing, and methods of disease control are not developed from one day to the next, but over long periods of time. In the short and medium term (and often in the long term as well) populations must adapt to and live with the forces of constraint.

The process of adaptation requires a degree of behavioral flexibility in order that population adjusts its size and rate of growth to the forces of constraint described above. These behavioral changes are partially automatic, partially socially determined, and partially the result of explicit choices. For example,

confronted with a shortage of food, body growth (height and weight) slows, producing adults with reduced nutritional needs but equal efficiency. This sort of adaptation to available resources is invoked, for example, to explain the small body size of the *Indios* of the Andes. Naturally, if this shortage becomes a serious lack then mortality increases, the population declines or disappears, and no adaptation is possible. Another type of adaptation – almost automatic and in any case independent of human action – is the permanent or semi-permanent immunity that develops in those infected by certain pathogens, such as smallpox and measles.

Adaptation, however, operates above all by means of those mechanisms which we discussed at length in chapter 1. The age of access to reproduction (marriage) and the proportion of individuals who enter into this state have for most of human history been the principal means of controlling growth. Prior to the diffusion in the eighteenth century of what has become the primary instrument of control – the voluntary limitation of births – a number of other components had an influence on the fertility of couples and newborn survival: sexual taboos, duration of breast-feeding, and the frequency of abortion and infanticide, whether direct or in the subtler forms of exposure and abandonment. Finally, a form of adaptation to environment and resources that has been practiced by populations in every epoch and climate is migration, whether to escape an existing situation or to find a new one.

The environment, then, imposes checks on growth by means of the forces of constraint. These checks can be relaxed by human action in the long run and their effect softened in the medium and short run. The mechanisms for reestablishing equilibrium are in part automatic, but for the most part are the product of choice (nuptiality, fertility, migration). This is not to say, as is often rashly asserted, that populations are provided with providential regulating mechanisms that maintain size and growth within dimensions compatible with available resources. Many populations have disappeared and others have grown to such a degree that equilibrium could not be restored.

2 From Hunters to Farmers: The Neolithic Demographic Transition

The tenth millennium BC witnessed the beginning of the Neolithic revolution "that transformed human economy [and] gave man control over his own food supply. Man began to plant, cultivate, and improve by selection edible grasses, roots and trees. And he succeeded in taming and firmly attaching to his person certain species of animal in return for the fodder he was able to offer."[1] In

short, hunters and gatherers became farmers and, with time, switched from a nomadic to a sedentary lifestyle. This transition, naturally, developed gradually and irregularly, and isolated groups that survive by hunting and gathering still exist today; it occurred independently at times and in places separated by thousands of years and kilometers, in the Near East, China, and Mesoamerica.[2] The causes of this transition are complex, and we shall discuss their demographic aspects below. Even given the difficulty of making a quantitative assessment, it is certain that population increased, as revealed by the spread of human population and its increased density.[3] Biraben estimates that prior to the introduction of agriculture the human species numbered about 6 million individuals and these became about 250 million by the beginning of the present era.[4] The corresponding rate of growth is 0.37 per 1,000, less than 1 percent of the rate attained in recent years by many developing countries but many times greater than that hypothesized between the appearance of the first humans and 10,000 BC.[5] One point, however, remains indisputable (though its interpretation is debated): with the spread of agriculture, population increased steadily and by several orders of magnitude and the ceiling imposed by the ecosystem on the hunter-gatherers was raised dramatically.

In spite of general agreement regarding the quantitative nature of prehistoric population growth, anthropologists and demographers have long debated its causes and mechanisms. One interpretation concentrates more on the way in which the acceleration came about rather than its cause. Clearly there is little sense in talking about a world population or the populations of large geographical areas in the Paleolithic period. We are dealing instead with a collection of small, relatively autonomous, and highly vulnerable groups, each numbering perhaps a few hundred individuals and existing in a precarious balance with its environment. For groups of this sort, a decline in size below a certain level (say, 100–200 members), whatever the cause, compromises the reproductivity and survival of the collectivity. Alternatively, a growth in numbers can lead to splitting and the creation of a new group. The aggregate growth or decline of population, then, is a function of the "birth" and "death" of these elementary nuclei. In a successful period, the balance between births and deaths is positive and the population grows; in an unsuccessful one, the balance is negative and population declines. Figure 2.1a (the *x*-axis corresponds to the level of success; the *y*-axis to the number of nuclei) includes three possible models: curve A describes a situation in which the successes dominate; C the reverse; and B an equilibrium. The corresponding aggregate growth rates will be positive, negative, and zero. Changes in climate, environment, or disease then will cause the curve to shift either to the left or the right. Figure 2.1b shows what may have happened with the

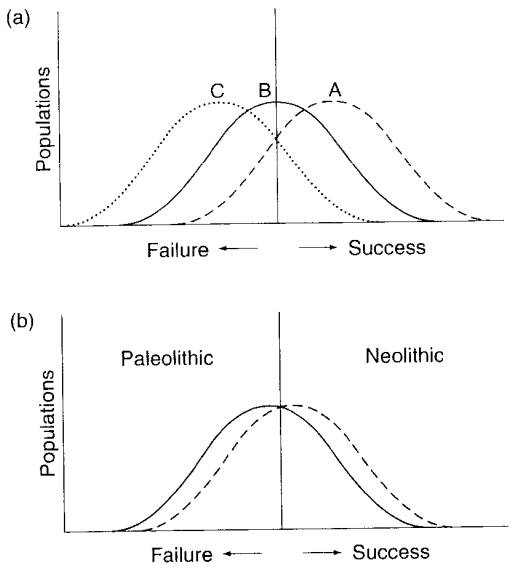

Figure 2.1 Failure and success of individual populations – a model

transition from the Paleolithic to the Neolithic Age: greater "stability" of the conditions of survival shifted the curve from left to right and so sped up the rate of growth.[6]

In addition to this "technical" hypothesis, there are at least two diametrically opposed theories that attempt to explain the causes behind this acceleration of population growth. The "classic" theory claims that growth accelerated owing to improved survival, the consequence of better nutrition made possible by the agricultural system.[7] A more recent theory suggests instead that dependence on crops that varied little lowered the quality of nutrition, that sedentary habits and higher density increased the risk of transmitting infectious diseases and so also their frequency, while the reduced "cost" of raising children resulted in higher fertility. In other words, the introduction of agriculture brought about an increase in mortality, but also an even greater increase in fertility, with the result that the growth rate sped up.[8] In an extremely synthesized form, these are the postulates on which the two theories are based. It is worthwhile to briefly consider the arguments in favor of each.

The classic theory is based on a simple but convincing argument. Settlement and the beginning of agricultural cultivation and animal domestication permitted a more regular food supply and protected populations that lived off the fruits of the ecosystem from the nutritional stress associated with climatic

instability and the changing of the seasons. The cultivation of wheat, barley, millet, corn, or rice – highly nutritional grains that are easily stored – greatly expanded the availability of food and helped to overcome periods of want.[9] Health and survival improved, mortality declined, and the potential for growth increased and stabilized.

In recent decades this theory has been questioned and the problem recast in new terms: In sedentary agricultural populations both mortality and fertility increased, but fertility increased more than mortality, and this explains demographic growth.[10] Yet why should mortality have been higher among farmers than among hunters? Two groups of causes are usually cited in response to this question. The first is based upon the assertion that nutritional levels, from a qualitative (and some claim also quantitative) point of view, worsened with the agricultural transition. The diet of the hunter-gatherers, which consisted of roots, greens, berries, fruits, and game, was probably more complete than the fare of the sedentary farmers, which, while adequate calorifically, was meager and monotonous because of the heavy dependence upon grains.[11] Proof is found in the study of skeletal remains: body size, height, and bone thickness all seem to have declined when hunters settled and became farmers.[12] Armelagos and his colleagues come to the conclusion that: "The shift in subsistence pattern had a significant impact on the biological adaptation of prehistoric Nubians. The development of agriculture resulted in a reduction in facial dimensions and concomitant changes in cranial morphology. In addition, the intensification of agriculture led to nutritional deprivation. The pattern of bone growth and development, the occurrence of iron-deficiency anemia (as evidenced by porotic hyperostosis), microdefects in dentition, and premature osteoporosis in juveniles and young adult females all suggest that later Nubian populations involved in intensive agriculture were experiencing nutritional deficiencies."[13] I have cited the preceding passage not because the experience of the Nubians is applicable to all other types of transition (assuming that remains from the various epochs were representative, that there was no immigration, and no errors were made in evaluating the remains), but in order to illustrate the sort of evidence offered in support of the nutritional hypothesis.

The second argument in favor of this theory is of a different and perhaps more convincing nature. The stable settlement of population created the conditions necessary for the onset, spread, and survival of parasites and infectious diseases, which were unknown or rare among mobile and low-density populations.[14] Higher demographic concentration acts as a "reservoir" for pathogens, which remain in a latent state awaiting an opportune moment to resurface. The spread of diseases transmitted by physical contact is favored by increased density, and this density in turn increases the contamination of the soil and water, facilitating

reinfection. The replacement of the mobile and temporary shelters of nomadic populations with permanent ones encouraged contacts with parasites and other carriers of infectious diseases. In addition, settlement increases the transmissibility of infections brought on by carriers whose life cycle is otherwise interrupted by frequent human movements; this is the case, for example, with fleas, whose larvae grow in nests, beds, or dwellings rather than on the bodies of animals or human beings. With settlement, many animals, domesticated or not, come to occupy a stable place in the human ecological niche, raising the possibility of infection from specifically animal pathogens and increasing the incidence of parasitism. Agricultural technology may also have been responsible for the spread of certain diseases such as, for example, malaria, which benefited from irrigation and the artificial creation of pools of stagnant water.[15] As confirmation of the lower incidence of acute infectious diseases among pre-agricultural populations, studies of, for example, Australian Aborigines isolated from contact with the white population are cited.[16] In general, the small dimensions and mobility of present-day hunting and gathering groups seem to provide a defense against parasites, just as their relative isolation appears to check the spread of epidemics.[17] It should be recalled, however, that many scholars maintain that the biological complexity of the ecosystem (complex in the tropics and simple in desert or arctic areas) is directly related to the variety and incidence of infections affecting populations.[18]

On the whole, then, a more meager and less varied diet and conditions favorable to infectious diseases would seem to justify the hypothesis of higher mortality among farmers relative to their hunting ancestors.[19] But if mortality was higher among farmers, then their more rapid population growth can only have been the result of higher fertility. The latter hypothesis finds support in the social modifications attendant upon the transition from hunting to farming. The high mobility of hunter-gatherers, continually moving in a vast hunting ground, made the transport of dependent children both burdensome and dangerous for the mother. For this reason, the birth interval must have been fairly long, so that a new birth came only when the previous child was capable of taking care of itself. In a settled society this necessity became less pressing, the "cost" of children in terms of parental investment declined, and their economic contribution in the form of housework, fieldwork, and animal care increased.[20]

The hypothesis that fertility increases with the transition from hunting to agriculture is something more than conjecture. It has, in fact, been confirmed by several studies of present-day populations. Between 1963 and 1973 a group of scholars led by R. B. Lee studied the !Kung San, a nomadic population that lived by hunting and gathering in northern Botswana (southern Africa) and was

at that time beginning a gradual process of settlement.[21] Lee's group observed that about half of the !Kung's edible vegetables were gathered by the women, who in the course of a year traveled several thousand kilometers. During most of their movements these women carried their children under 4 years of age with them. The age of puberty among the !Kung women was late, between 15 and 17, and a long period of postpuberty sterility followed, so that the first birth came between 18 and 22, followed by birth intervals of three to five years. These intervals[22] are very long for a population not practicing modern birth control and were the result of continuing breast-feeding until as late as the third or fourth year. Body growth of the babies was slow, a notable adaptive advantage since it allowed their easier transportation during the long daily movements of the mothers. Consequently, the average number of children per woman was fairly low (4.7). Low fertility of this sort, imposed by the habits of hunter-gatherer populations, is also characteristic of other groups, such as the African Pygmies.[23] Still more interesting is the fact that in the process of settlement !Kung San fertility seems to have increased. In fact, the settled women had birth intervals (36 months) significantly shorter than their hunter-gatherer counterparts (44 months),[24] just as postulated by the supporters of the theory that fertility increases with the transition from hunting and gathering to farming. The comparison between historical and present-day populations gives similar results. Two recent studies reveal differences between the total fertility rates (TFR) of hunter-gatherers (foragers) (5.7 and 5.6) and agriculturalists (6.3 and 6.6).[25]

The postulates of the two theories are summarized in figure 2.2. The evidence in their support is for the most part conjectural, and the gathering of data is slow and often contradictory. Both theories assert that the level of nutrition changed, but in opposite ways. Even if it is true that hunter-gatherers enjoyed a more varied diet (present-day hunter-gatherers seem to be only rarely malnourished), it is hard to imagine that the nutritional level declined with the transition to agriculture. One need only keep in mind the possibility of expanding cultivation, of accumulating reserves, of complementing the products of the earth with those obtained by hunting and fishing, of improving the techniques of food preparation and conservation. It may be, on the other hand, that the level of nutrition had less of an influence on mortality than is suggested by either of these theories, since it is only in cases of extreme need and malnutrition that the risk of contracting and succumbing to certain infectious diseases increases.[26] The hypothesis that the frequency and transmission of infectious diseases increased in higher-density and more permanent populations is better founded, though the matter is too complex to allow simplification.[27]

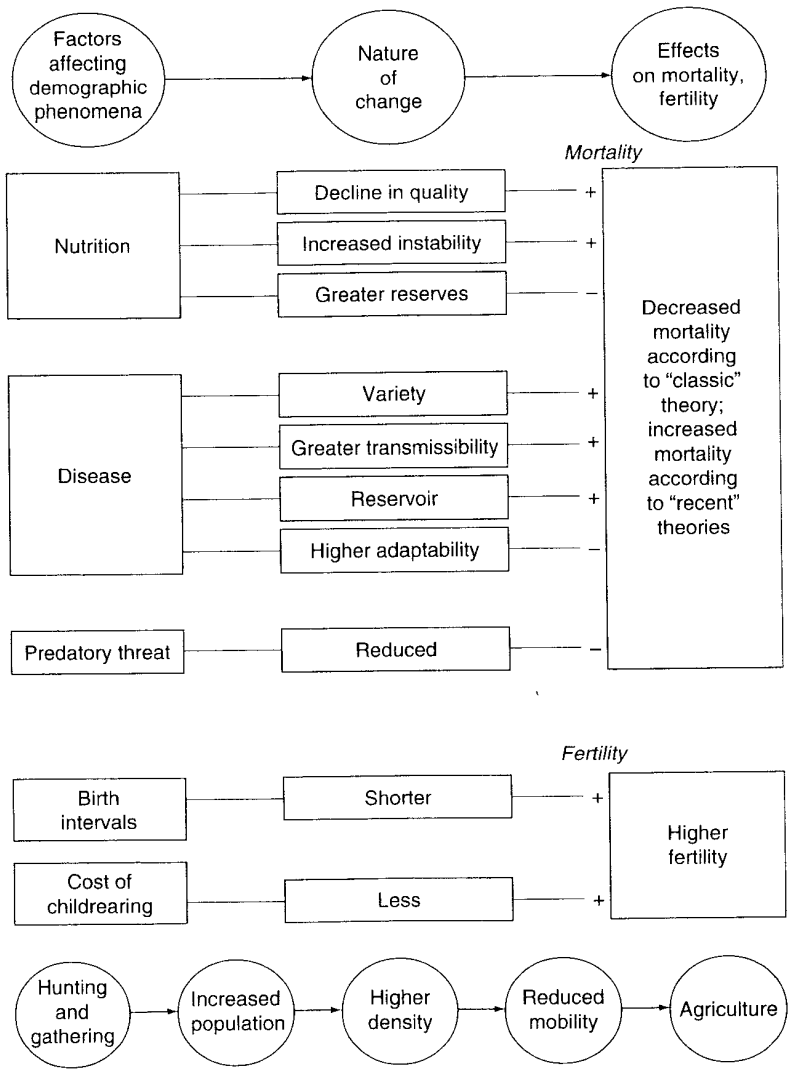

Figure 2.2 Presumed demographic effects accompanying the transition from hunting and gathering to agriculture

With regard to fertility, the evidence from present-day preagricultural groups argues convincingly in favor of the possibility that the transition to settled agriculture entailed increased prolificity. Moreover, Childe, an advocate

of the classic theory, noted that in an agricultural society "children become economically useful; to hunters children are liable to be a burden."[28]

3 Black Death and Demographic Decline in Europe

Around the year 1000 the population of Europe began a phase of growth which would last three centuries. The data are scarce and fragmentary, but sufficient to reveal the symptoms of solid demographic growth. Settlements multiplied, new cities were founded, abandoned areas were inhabited, and cultivation expanded to progressively less fertile lands. In the course of these centuries European population increased by a factor of two or three, testimony to a growth potential which frequent crises could not suppress. Toward the end of the thirteenth century and in the first decades of the fourteenth there is clear evidence that this cycle of growth was losing steam: crises became more frequent, settlements ceased to expand, and here and there population stagnated. This slowdown was the result of complex causes, probably connected to an agricultural economy made less vigorous by the depletion of the best land and a halt in technological progress and subject to more frequent shortages due to unfavorable climatic conditions.[29] It might have been a passing phase, a period of adjustment as population sought a more favorable balance with resources, to be followed by another cycle of growth. Instead, toward the middle of the fourteenth century a devastating and long-term catastrophe occurred which caused population to decline, according to the estimates of table 1.3, by almost a third between 1340 and 1400, only to continue to decline during the first half of the following century before beginning to recover. This recovery would not carry population to its precrisis level until the mid-sixteenth century.

The catastrophe was the plague; between its first appearance in Sicily, in 1347, and 1352 when it spread through Russia, it traversed the entire continent. Figure 2.3 shows its expansion: by the end of 1348 it had reached Italy, the Iberian Peninsula, part of France, and southern England; by the end of 1349, Norway, the rest of France, the Rhine valley, Switzerland, Austria, and the Dalmatian coast; between 1350 and 1352, it moved eastward, from Germany to Poland to Russia. In a Europe whose population numbered about 80 million, the number of deaths claimed by the plague represented a significant fraction. Much has been written about the plague, both about its first appearance and its successive waves (of which more is said below).[30] I shall limit discussion here to the essentials of its

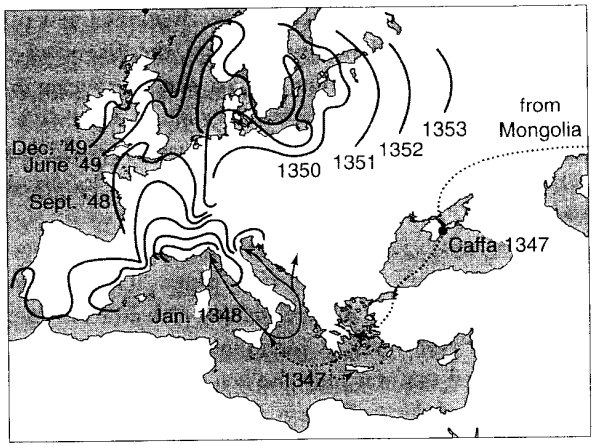

Figure 2.3 Spread of the plague in Europe, 1347–53
Source: C. McEvedy and R. Jones, *Atlas of World Population History* (Penguin, Harmondsworth, 1978), p. 25

nature, intensity, and chronology in order to attack the heart of the question, which does not so much concern description as an evaluation of the long-term effects of the plague on growth; the identification, in its most extreme and catastrophic form, of one of the most violent checks to demographic growth; and the individuation of the mechanisms of reaction and compensation activated by the catastrophe.

The bacillus responsible for the plague is called *yersinia pestis* (discovered in 1894 by Yersin in Hong Kong). It is usually transmitted by fleas carried by rats and mice.[31] The bacillus does not kill the flea, which bites and so infects its host (the mouse). When the mouse dies, the flea must find a new host (another mouse, or a human) and so spreads the infection. Transmitted epidermally, plague has an incubation period of one to six days. The flea bite results in swelling of the lymph glands of the neck, underarms, and groin (buboes). Symptoms of the disease include high fever, coma, cardiac failure, and inflammation of the internal organs. Normally two-thirds to four-fifths of those infected die.[32] The plague was easily transmitted, even over long distances, together with goods carrying infected mice or fleas (clothing, personal objects, foodstuffs).

No one is naturally immune to the plague. Those who contract the disease and survive acquire short-term immunity. Nonetheless, the possibility that successive waves of the plague progressively selected individuals who were for some reason less susceptible to the disease cannot be ruled out, though these processes must evolve over long periods in order to have a perceptible effect.

The plague that appeared in Europe in 1347, while not a new phenomenon, had been absent for six or seven centuries, since the plague of the Justinian period. The latter spread through the eastern Mediterranean in 541–4 and afflicted Italy and especially Mediterranean Europe in successive waves from 558–61 until 599–600. It remained in the East until the middle of the eighth century, generating successive epidemics which, though localized, continued to affect Europe.[33]

In September 1347 the unloading of several Genoese galleys in Messina interrupted long centuries of bacteriological peace. These ships came from ports on the Black Sea where the plague, having arrived from the East, raged. In the space of four or five years, as mentioned above, the disease traversed the entire continent; and this was only the first of a series of epidemic waves. In Italy (and progress was little different in the rest of Europe) these waves came in 1360–3, 1371–4, 1381–4, 1388–90, and 1398–1400. In the fifteenth century they were still occurring frequently, but with less synchronicity and severity.[34] Measurement of the mortality of the various epidemic waves is uncertain due to the lack of precise data. Nonetheless, there were for many areas annual series of deaths from which we can discern the levels of mortality in normal and plague years. In Siena, for example, the plague of 1348 caused 11 times more deaths than normal. In the other five epidemics of that same century the death total increase varied between five and ten times the norm. Imagining that normal mortality was about 35 per thousand, then an increase of elevenfold would mean about 420 per thousand, or the death of more than four persons in ten. A tenfold increase means, approximately, the elimination of one-third of the population, an increase of fivefold the elimination of one-sixth.

For several parts of Tuscany between 1340 and 1400 I have calculated that on average a serious mortality crisis – defined as an increase in deaths at least three times the normal – occurred every 11 years; the average increase in deaths was at least sevenfold. In the period 1400–50 these crises occurred on average every 13 years and deaths increased fivefold. In the following half century (1450–1500) the average frequency declined to 37 years and the average increase to fourfold.[35] With the passage of time, both the frequency and the intensity of the crises declined, as did the geographic synchronization of their occurrence. Keep in mind that Tuscany is an exceptional case only for the abundance of historical sources to be found there.

The following two centuries were not spared the devastation of the plague, from the cycle of 1522–30 (made worse by the wars that followed the fall of Charles VIII) to that of 1575–77 (especially in the north), 1630–1 (in the center-north), and 1656–7 (especially in the center-south).[36] Although these

bouts of plague were terrible (Cipolla calculates that more than a quarter of the center-north population struck by the 1630–1 plague was wiped out),[37] they were no longer the dominating catastrophes they had been in previous centuries. Other crises (typhus, for example) competed with the plague for the prize. With some variations the Italian experience applies to Europe as a whole. After the epidemic of 1663–70 which hit England (the London plague of 1664 described by Defoe), northern France, the Low Countries, and the Rhine Valley, the plague disappeared from Europe as a general geographic event, save for an appearance in Provence in 1720–2 and in a few other limited areas.[38]

Returning to our central concern, in the century that followed the Black Death of 1348 European population declined both as a result of the first and, from a literary point of view, most famous explosion and also the relentless cycles that followed. Only in the sixteenth century would European population once again attain the numerical level of 1340, while the plague would continue to play a role as a check on population growth until its virtual disappearance in the second half of the seventeenth century. There are no precise data on the scale of the decline between the period before 1348 and the population nadir reached during the first half of the fifteenth century, but a loss of 30 to 40 percent is corroborated by local studies in Piedmont and Tuscany,[39] and in France, Spain, England, and Germany. Cities emptied within oversized urban boundaries, abandoned villages and deserted countryside rendered concrete testimony, while a labor shortage caused salaries to rise and the abundance of available land lowered the price of food.

The plague constitutes a population check largely exogenous, or external, to the sociodemographic system. It acted independently of modes of social organization, levels of development, density of settlement, and so on. The ability of the plague to infect and kill bore no relation to one's state of health, age, or level of nutrition. It struck urban and rural populations with equal violence and, with the exception of a few isolated areas, density levels presented no obstacle to its spread. The movement of people and goods was sufficient to carry it from one end of the continent to the other. In the long run, of course, societies took measures to defend themselves. The quarantine and isolation of infected or suspect individuals and goods, the shutting up of plague victims' homes, and a few public health measures may partially explain the disappearance of the plague from the European continent.[40] Nonetheless, for over three centuries the plague made itself at home there.

Unlike the victims of many other diseases, the few individuals who contracted the plague and survived did not acquire long-term immunity. It is not

reasonable, then, to attribute the gradual decline of the plague solely to the existence of a larger immunized portion of the population. The process of *Durchseuchung*, according to which "the accidentally less susceptible survive, and through generations a gradual alteration of the relationship between parasite and host becomes established,"[41] may have had some effect; and "had the disease continued, constantly present, and attacking a large portion of the new generations as they appeared, it might gradually have assumed an endemic, sporadic form, with relatively low mortality."[42]

A disease of such ferocity could have, after repeated attacks, completely eliminated the populations which it infected. This did not happen, and with time the frequency, if not always the intensity, of the crises declined. Neither the specific explanations discussed above (social adjustment, immunity, selection) nor others (either social or ecological transformations) are sufficient to explain this phenomenon. For reasons not entirely clear the plague underwent a process of mutual adaptation between pathogen (*yersinia*), carrier (flea), and host-victim (human).

As occurs for other sorts of mortality crises, there was also a process of sociodemographic adaptation and response to the plague, both in the short and medium to long term. In the short term a sudden and large increase in mortality has a double effect. The spread of the disease lowers the frequency of conceptions, births (for choice, necessity, and psychobiological reasons), and marriages. The decline in births accentuates the negative demographic action of the epidemic. Moreover, high mortality ends marriages and breaks up or destroys family units. At the end of the crisis there is a rebound effect which, while not sufficient to compensate for the lost lives and births, nonetheless attenuates their effect. Marriages which had been postponed during the crisis are celebrated and the marriage rate among the widowed increases. In some cases a fertility increase among couples has even been noted. These several factors combine to produce a temporary increase in overall fertility. Mortality, also, is often below normal after a crisis owing to the reduced representation of infant age groups and the selective effects linked to the epidemic. The balance between births and deaths improves and for a few years some of the previous losses are made up. A new crisis can, of course, soon restart the cycle, as in the century after 1348, or it can do so after a longer interval, as in the sixteenth and seventeenth centuries.[43]

In the long term other factors intervene. Depopulation caused by the plague in Europe created abundant available land and a labor shortage. New family units acquired the resources they needed to establish themselves more easily. The checks to marriage generally relaxed and nuptiality increased, stimulating population growth. One may, for example, explain in this way the low age at marriage in early fifteenth-century Tuscany.[44] Both long- and short-term responses tend to minimize the damage done to society and population by *yersinia*, flea, and mouse.

4 The Tragedy of the American *Indios*: Old Microbes and New Populations

"Thrice happy are those, that inhabiting some yet undiscovered island in the midst of the ocean, have never been brought into contaminating contact with the white man."[45] So wrote the young Melville in 1845 on returning from the Marquesas Islands. The tragic effects of contact between white Europeans – whether conquerors, colonists, explorers, or sailors – and the indigenous populations of the New World, the Pacific, and Oceania were evident from the time of the earliest explorations. Historical documentation is abundant, and we have only to choose our examples.

As is well known, Columbus landed in Santo Domingo (christened at the time Hispaniola) in 1492. The number of inhabitants at the time is of course unknown, but it seemed densely populated to the first visitors, "like the countryside of Córdoba."[46] Authors writing a quarter of a century or so later report an original population of one million or more, supposedly "counted" by Columbus or his brother Bartolomé in 1495 or 1496 when they tried to impose a gold tribute on the natives. Las Casas – the colonist who became a Dominican friar and staunch defender of the *Indios* – would eventually increase this number to 3 or 4 million. Modern scholars, since the 1950s, give estimates as widely different as 60,000 and 8 million. Recent estimates, following different strategies (such as the carrying capacity of the island; the production of gold and the possible productivity of native manpower – one-third of which was sent to the mines; the number of communities and the distribution of villages, etc.), seem to point to a contact population of 200,000–300,000 people, subdivided into several hundred communities, each headed by a cacique. In 1514, the *Repartimiento* – or the allotment of natives to the colonists for personal service, labor in the fields, cattle raising, and gold mining – counted only 26,000 people of both sexes and all ages.[47] After the smallpox epidemic of 1518–19 only a few thousand were left and the natives were heading toward extinction. By mid-century the community had been wiped out; natives still survived as servants of the Spaniards, with a high rate of mixing with the Spaniards themselves, with black slaves carried from Africa, and with other *Indios* taken from the other islands or the mainland.

What determined the abrupt decline of the Taino population in the three decades following the Conquest and their practical extinction 20 years later? As we shall discuss below, one main cause of population decline in the New World was the fact that the native population lacked immunity with respect to many pathologies, unknown in America but common in Eurasia and to which the European settler was well adapted. Diseases relatively harmless in Europe became deadly for the natives: this is called the "virgin soil" effect. The paradigm of a "virgin soil" population and of its vulnerability to new pathologies provides an apparently efficient and convincing answer, but for the Hispaniola case has two drawbacks. The first is that there is no historical proof of major epidemics on the island before the smallpox epidemic of 1518–19, when the population was already reduced to 10,000 or less. Contemporary witnesses often made reference to a general situation of very precarious survival, weakness of the population, and continuing high mortality – but not to sweeping and lethal epidemics. The second drawback is that the "virgin soil" paradigm tends to obscure all other factors of population decline, such as the hampering of reproduction owing to deep societal dislocation.

Starting in the second decade of the sixteenth century, when the negative consequences of the decline of the native population for the economy of the island became evident, the debate on the causes of the ongoing demographic catastrophe was rather intense: Las Casas and the Dominicans were active figures in the debate, but so were religious men of other orders; many high administrators and officials; a competent historian like Oviedo who resided in the island. Greed for gold and the *encomienda* (the practice of allotting the natives to the colonists as indentured labor) are believed to be the principal causes. Greed for gold: too many *Indios* in the mines and for too long periods (up to 10 months per year); neglect of other productive activities; overwork; lack of food; unsuitable climate and environment in the mines; maltreatment; separation from their families. All these reasons led to high mortality among them and to low fertility of their women. The *encomienda* system: the *Indios* were shifted from one part to another of the island; they were frequently moved from one master to another; communal life was disrupted; the *encomenderos*, fearing to lose their *Indios*, exploited and overworked them; concubinage; maltreatment. Under these conditions *Indios* often escaped to the mountains where, in a hostile environment and away from their normal sources of subsistence, survival was difficult; they committed suicide; they rose in open rebellion; they were victims of violence.

These explanations proposed by competent – although at times biased – eyewitnesses can be summarized as follows: the Spanish conquest caused a deep economic and social dislocation that created the conditions for high mortality and reduced fertility. Economic dislocation was determined by the "procurement," in favor of the Spanish masters, of native labor subtracted from normal subsistence activities and employed in the production of food, goods, and services for the newcomers and, later, also in the production of gold. Labor employed in the mines had, in its turn, to be supported by native labor working in the fields. This double "attack" on the traditional patterns of production and consumption was deadly for a society based on a subsistence economy and unaccustomed to accumulation. It meant increased work and decreased consumption, and a dramatic worsening of living conditions with an increased vulnerability to scarcity. Although only a few hundred Spaniards were living on the island until the beginning of the sixteenth century, their demands for food, labor, and services were a very heavy burden on the relatively small Taino society.

Social dislocation derived from the *encomienda* system: *Indios* were shifted from one place to the other and from master to master; their traditional system of life – including communal safety nets – was shattered; some of the women were attracted into the conquerors' reproductive system (in 1514 there were 83 adult women for every 100 adult men in the native communities); communities, clans, families, couples were divided or separated.

These general causes had a profound impact on the demography of the Taino. Unions were more difficult and precarious; fertility declined. In 1514 children below age 14 made up only 10 percent of the total population, a situation consistent with a rapidly declining population. Living conditions worsened and survival deteriorated, and new diseases (before smallpox), although not responsible for major epidemics, certainly added complexity to the island's microbial world, increasing current mortality. Together with the economic and social systems, the demographic system of the Taino also collapsed. Cuba, Puerto Rico, Jamaica – less populated than Hispaniola – suffered the same disaster.

Elsewhere on the mainland of America contact with the European intruders had catastrophic consequences, but the natives were not wiped out. Preconquest estimates are based on conjecture and have led experts to widely different population figures, ranging from a minimum of 8 million to a maximum of 113 million for the entire continent; a recent revision of regional-specific evaluation put the total at 54 million. In the case of central Mexico – the area of the Aztecs and the most populous of the continent – Cook and Borah give a figure of 6.3 million *Indios* in 1548, which subsequently declined to 1.9 million in 1580 and 1 million in 1605.[48] In Incan Peru, the other important demographic concentration of the continent, estimates based on the visit of the Viceroy Toledo in 1572, subsequently updated, report 1.3 million *Indios* subject to

tribute; their number was reduced to 0.6 million by 1620 (table 2.1).[49] Further to the north in Canada, Charbonneau has calculated that there existed no fewer than 300,000 Indians at the beginning of the seventeenth century; that number was reduced to less than one-third two centuries later. Thornton claims that in the three centuries after 1500 the Indians of the area that became the United States were reduced from 5 million to 60,000.[50] For all of these groups demographic decline from the moment of contact with Europeans seems to have been the rule. There are also more recent examples: Darwin refers to the disappearance of the inhabitants of Tasmania;[51] the Maoris experienced rapid demographic decline from the time of the voyages of Captain Cook to the end of the following century;[52] and the Australian Aborigines presumably suffered a similar fate. The indigenous population of Tierra del Fuego, 7,000–9,000 in 1871, is now almost extinct.[53] In the Amazon basin there are groups which, due to their extreme isolation, have only in the last century come into contact with colonists or explorers and have died off before the eyes of contemporary observers.[54]

The above examples should suffice. The demographic collapse of indigenous populations as a result of contact with groups of European origin is a widespread and well-documented phenomenon throughout America and Oceania. The timing, scale, and duration of the decline of course vary according to the historical situation, but the basic mechanism is fairly simple. Indigenous populations were, so to speak, virgin soil for many infectious diseases which they had never before encountered. It would be interesting to study the reverse

Table 2.1 Population of central Mexico (1532–1608)

Year	Population (thousands)			Annual population growth rate[a]		
	Plateau	Coast	Total	Plateau	Coast	Total
1532	11,226	5,645	16,871	–	–	–
1548	4,765	1,535	6,300	−5.4	−8.1	−6.2
1568	2,231	418	2,649	−3.8	−6.5	−4.3
1580	1,631	260	1,891	−2.6	−4.0	−2.8
1595	1,125	247	1,372	−2.5	−0.3	−2.1
1608	852	217	1,069	−2.1	−1.0	−1.9
1532–1608	–	–	–	−3.4	−4.3	−3.6
1548–1608	–	–	–	−2.9	−3.3	−3.0

Notes: [a]For the period since the previous date.

Source: S. F. Cook and W. Borah, *Essays in Population History. Mexico and the Caribbean*, 3 vols. (University of California Press, Berkeley, 1971), vol. 1, p. 82.

effect of contact, or the impact of indigenous diseases on European colonists, a subject that has received little attention. Once the pathogen had passed – by way of explorer, *conquistador*, or colonist – from the original population (exposed to the disease for many generations) to the virgin population, it spread with a virulence basically ascribable to three factors:

1 Infectious diseases immunize (whether for short or long periods) those individuals who have contracted the illness and recovered. As a result, while the disease continues to work its way through the population (either because it is endemic or else continually reintroduced), there is always a larger or smaller immunized portion that resists infection and so limits the damage. On the other hand, all the members of a virgin population are theoretically susceptible, and so the introduction of a new disease produces immense losses in the initial phase.
2 Theory says that in a nonvirgin population, the disease tends, over generations, to select the more resistant individuals. In the absence of this factor, the disease attacks the virgin population more ferociously.
3 That process of mutual adaptation over time between pathogen (virus, microbe, parasite) and host – a complex and not entirely understood process which attenuates the virulence of the disease – has not taken place in the case of the virgin population. Syphilis, malaria, measles, and influenza are diseases that seem to grow less harsh with time. It is said that a pathogen is not interested in killing the host upon which it depends for survival, but rather in coexisting with it and not causing too much harm; hence the selection of less lethal strains. In virgin populations, this coexistence has obviously not had time to develop.

The process of "microbian unification" of the world – a globalization of disease, to put it in a more modern way – was not the sole factor of the catastrophic fall of American populations. Beside the new pathologies, Europeans brought technologies and know-how that were far superior to those of the natives. The conquistadors were moved not only by the spirit of adventure but also by the quest for riches as a compensation for the high risks they were taking. After the second Atlantic crossing, Columbus found not one single survivor of the 39 men of the first settlement he had left behind in the island ten months before; out of the 1,500 members of Columbus' second expedition that had left Cádiz on September 25, 1493 only half survived when the Admiral returned to Spain two and a half years later; of the 2,500 men and women that arrived at Hispaniola in 1502 with Ovando, the new Governor of the island, 1,000 died in the following year according to las Casas' testimony; of the 2,000 companions of Cortés in the various stages of the Conquest of Mexico, perhaps half survived. These experiences were replicated in Central America, in Peru, in the Río de la Plata estuary, and in Brazil.[55]

The initial phase of the Conquest was a deeply brutal affair: people got rich through the mobilization of Indian labor employed in the search for gold, the production of subsistence, for personal service of the Spaniards. The reward of the conquistadors was the *Repartimento* (allotment) of the *Indios*, which amounted to a forcible confiscation of Indian labor. In Hispaniola, up to one-third of adult natives were mobilized in the search for gold in the river beds, far from their community of origin (which was often dismembered and assigned to different masters). The same happened in other gold-yielding areas, in Mesoamerica as in the Andean region. Elsewhere no gold could be found, and the prosperity of the first colonists was based on the abundance of native labor and its mobilization for the construction of urban infrastructure – roads and civil and religious buildings; for the transportation of goods – for the production of food for a growing Spanish population of administrators, clergy, merchants, and craftsmen; for sustaining military expeditions; and for the general functioning of the complex Iberian society which had been transplanted to America. In many areas of the continent Conquest implied war, with its related consequences of destruction, famines, and hunger. For 20 years Peru was devastated by the wars of Conquest and the civil wars among Spanish factions. The armies were small, consisting of a few hundred or, at the most, one or two thousand soldiers, but supported by native allies several times their number.[56] Everywhere, Spanish and Portuguese colonists attracted to their circle native women as concubines or wives, subtracted from Indian society and from the natives' reproductive pool. Everywhere, forced migration and social and economic dislocation upset the balance of native society. The European impact went well beyond the transmission of new pathologies that were not the sole factors of population decline. We have seen, earlier in this chapter, that Europe, devastated by half a dozen waves of the deadliest epidemic of all – the plague, much more lethal than the new diseases that struck America – lost perhaps one-third of its original population, but avoided catastrophe through vigorous recovery after each epidemic episode. But in native societies, the combination of new diseases and the destructuring of society paralyzed the forces that ensured demographic recovery; reproduction was impaired and the decline in births combined its negative effects with those of high mortality.

Different contexts for the Conquest meant different destinies for native societies. As we observed earlier, the Taino of the Greater Antilles were already on the path to extinction when the first epidemic, smallpox, hit the islands in 1518–19. The brutal impact of the Conquest – together with the uprooting of communities, forced labor, subtraction of native women, and diffused violence – had an impact stronger than that of disease. In the southern hemisphere, in the vast region then called Paraguay – in the basin formed by the Paraná and Uruguay rivers – the Guaraní congregated in the 30 Jesuit Missions underwent a demographic expansion in the seventeenth century and in the first part of the eighteenth. The fathers protected them against the slave-seeking expeditions organized by the Brazilians from the São Paulo region, as well as against the exploitation of the Spanish colonists. The fathers encouraged the Guaraní to abandon their seminomadic and promiscuous life, and imposed on them monogamy and marriage at the age of puberty, thus maximizing their fertility. In spite of the recurrent and destructive waves of epidemics (one every 15 years, on average), the Guaraní population recovered after crises and resumed their growth.[57] Between these opposite extremes – the Taino and the Guaraní – there was a great variety of situations: in the Andean region of the Inca empire (Ecuador, Peru, Bolivia), the effect of wars and conflicts was prevalent in determining population decline during the first decades after the fall of the Inca empire; in Mexico, on the other hand, where the "pacification" following the Aztecs' demise was rapid, and the economic and social impact of the Conquest on the natives was not as burdensome as in Peru, epidemics had a primary role in determining high mortality. It is possible that the radial conformation of central Mexico, with lines of communication departing from Technochtitlán (later Mexico City) and leading to the four corners of the empire, accelerated the diffusion of the new diseases; on the other hand, the comb-like configuration of the Inca empire, with its backbone along the Andes and deep valleys running perpendicular to the ocean, had an opposite effect.

Finally, both in Mexico and Peru, the demographic collapse was stronger in the low-lying coastal areas than in the highlands, owing to both epidemiological and social causes. The impact of new pathologies was accentuated by the hot climate, as happened for malaria in the Gulf of Mexico; conflicts and the concentration of the Spaniards devastated a fragile habitat and determined the expulsion or demise of the native settlers, as happened in Peru. Everywhere, denser and more structured societies had more chances of survival than less complex ones, based on subsistence economies and unable to produce surpluses and invest.[58] To sum up, the new microbes explain only part of the catastrophe; other factors must be looked for in the variable process of Conquest and in the social, cultural, and geographical peculiarities of the subjugated native societies.

5 Africa, America, and the Slave Trade

Well-founded estimates show that between 1500 and 1870 – when the trade was finally abolished – 9.5 million Africans were deported to America as slaves. These were the survivors of a number, a few millions larger, of women, men,

Table 2.2 Slaves taken to America (1500–1800) and population of African origin in America (1800) (thousands)

	Slaves taken to America (1500–1800)	Population of African origin in America, c. 1800	Ratio between population of African origin in America and slaves taken to America
	(1)	(2)	(2):(1)
USA	348	1,002	2.9
Hispanic mainland	750	920	1.2
Brazil	2,261	1,988	0.9
Caribbean	3,889	1,692	0.4
English and Dutch islands	2,060	570	0.3
French islands	1,415	732	0.5
Spanish islands (Cuba)	414	390	0.9
Total	7,248	5,602	0.8

Sources: For estimates of the slave trade, Philip Curtin, *The Atlantic Slave Trade. A Census* (University of Wisconsin Press, Madison), p. 268. For estimates of the population of African origin in 1800, see M. Livi-Bacci, "500 anni di demografia," in *Popolazione e Storia* 1 (2001), pp. 17–20.

and children abducted from their villages, many of whom died while being transferred to the coast, or waiting for embarkation on a slave ship, or on board during the long overseas voyage. Of the survivors, about 1.5 million were taken to America before 1700, 5.5 million between 1700 and 1800, and 2.5 after that date.[59] This was a demographic drain that affected mainly West Africa and which combined its effects with those of the slave trade that involved even greater numbers of Africans, northbound and eastbound, along the trading routes of Arab merchants. The consequences of this demographic drain remain to be studied, but it is a common opinion that it may have had relevant depressing effects on the population of West Africa. A diverse, almost paradoxical interpretation maintains that this forcible subtraction of conspicuous human resources might have enhanced the living conditions and survival prospects of the populations of origin. However, there is evidence that the populations who paid this enormous tribute to the slave trade were stagnating, if not declining, during the eighteenth century, when the trade was at its height and depleted the young age groups – more men than women – of full reproductive age.

While the effects of the slave trade on the populations of origin still require study, much more is known about the demographic regime of the African communities in the New World. We can obtain a synthetic overview of the demography of the African in America through the comparison between the cumulative inflow of slaves in the three centuries preceding 1800 and the stock of the population of African origin in 1800. This stock comprised Africans brought to America and surviving in 1800; their descendants; and the descendants of all other extinct slaves. If the ratio between the stock and the cumulated inflow is below 1, this is an unequivocal sign that the population is unable to reproduce itself. Let us now consider table 2.2, which shows the stock of the population of African origin in 1800 and cumulative forced African immigration into America between 1500 and 1800: for the entire continent, the former (5.6 million) is lower than the latter (7 million), with a ratio of 0.8. In the Caribbean islands the African population was 1.7 million, a number less than half the cumulative inflow of 3.9 million slaves (ratio 0.43). In Brazil the African population was 2 million, but the total number of slaves received was 2.3 (ratio 0.87). The residual one million slaves were brought to Hispanic America and to what became the United States, where they found better survival and reproductive conditions (ratio stock/flow 1).

In Brazil, and even more so in the Caribbean islands, that together absorbed by far the greatest number of slaves, the demographic system of the population of African origin was fueled by the continuous recruitment of slaves that filled the enormous gaps left by a very high mortality only partially compensated by a

weak birth rate. As a consequence the ratio stock/flow was below 1, with a minimum of 0.3 in the English Caribbean. In the United States the ratio was well above 1: reproduction of the slave population was high (*TFR* of about 8 children per woman) and the mean age at first birth was below 20, the duration of breast-feeding and birth intervals shorter than in Africa. The slave system did not interfere excessively with marriages and unions, although posing some de facto obstacles. On the other hand mortality, although higher than among the whites, was much lower than among the slaves in Brazil and in the Caribbean islands. All things considered, the demographic system of the North American population was consistent with a high natural growth.

The causes of the African tragedy in the Caribbean and in Brazil – destinations of six out of seven slave ships – can be found in the living conditions dictated by the loss of freedom, in the way Africans were captured and transported, in the relentless laboring in the sugar plantations, in the adverse conditions under which the adaptation to a new environment, climate, and diets took place. For some Caribbean islands there is firm evidence that fertility was much lower than in the United States, because unions were less frequent, birth intervals longer, the duration of reproductive lifespan lower. There is also evidence of a formidable mortality, particularly high during the period of acclimatization – it was common opinion that between one-fifth and one-third of the newly arrived slaves died within three years.[60] In Brazil it was the common belief at the time that the duration of the active life of a young slave was between 7 and 15 years, and these numbers have acquired the status of incontrovertible truth by force of repetition. The 1872 Census – it is the end of the slave era, but the data reflect a situation that must have been very similar to that of the past – allows an estimate of life expectancy of slaves of 18 years, against 27 for the entire Brazilian population; these values can be compared with an e_0 of 35 for the slave population of the United States at the middle of the nineteenth century.[61]

If the high mortality of the slave population is out of the question, the debate about its specific determinants is open. There is ample documentation about the heavy labor regime in the sugar plantations – which until the end of the eighteenth century was the main crop – under the rigid and merciless control of supervisors. The operations involved required high input of labor: planting and weeding the fields; cutting, transporting, and crushing the canes; the distillation of molasses; cutting and carrying large quantities of wood for great distances in order to fuel the cauldrons. Operations took place throughout the entire year, and with a production cycle of 9 months that implied the continuous activity of mills and cauldrons, and the work of men and women, from sunrise to sunset and, in the peak periods, through the night.[62] Although it was not in the masters' interests to waste their precious human capital, it has been observed that two years of work repaid the capital invested in buying a slave and that in five years the initial investment came to double.[63] It was inevitable that masters tried to earn the maximum from a minimum of years of the slave's work. While the diet was adequate, the level of hygiene in the slaves' compounds (*senzala*, or large rectangular sleeping quarters where men were separated from women) was appalling, and the care, if not the cure, of the sick and disabled from the part of the masters was certainly poor.

The high mortality rate was not compensated by the low birth rate, depressed by the asymmetrical sex ratio of the slaves taken from Africa (two males for every female). The testimony of the masters, of clergy, of travelers and observers are unanimous: they all lament the small number of births. Survival and reproduction were compromised not only by the regime of hard labor – particularly in the sugar plantations in Brazil and the Caribbean – but also by the obstacles to marriages and unions. Giovanni Antonio Andreoni, a Jesuit of Italian origin, renamed "Antonil," perhaps the most acute and perceptive observer of Brazil in the early eighteenth century, wrote that "Many masters are opposed to their slaves' marriages, and not only they do not object to their illicit unions, but openly consent to them or even start them by saying 'you, João, in due time will marry Maria' and from that moment on they let them stay together as if they were husband and wife... others, after that the slaves have married, set them apart in such a way that for long years they remain alone, and this goes against our conscience."[64] The problem was that the masters, although they consented to free unions or even occasional unions, did not encourage (and often discouraged) the marriage of their slaves, jeopardizing the stability and reproduction of the couple, an important factor of the negative balance between births and deaths. In the following century, Saint-Hilaire observed: "when the campaign in favour of the abolition of the slave trade initiated in Brazil, the Government intimated to the masters of Campos to let their slaves be married; some obeyed the intimation, but others answered that there was no point to give a husband to African women that could not raise their children. Soon after giving birth to a child these women were forced to work in the sugar plantations under a scorching sun and when, after being separated from their child for part of the day, they were permitted to be reunited with them, their milk was insufficient: how could the poor creatures survive the cruel miseries of which their masters' avarice surrounded their cradles?"[65] Until there was ample supply of slaves on the market, and their price was low, it was more convenient to buy them than sustain the costs of reproduction and child rearing. Other factors came into play, such as the intrusion of the masters in the sexual lives of their women slaves (and the birth of mulattoes who still retained their slave status) and their

"subtraction" from the marriage and reproductive pool; or the fact that contacts between slaves of different masters were prohibited or made difficult, thus limiting mating choices. It is thought, also, that the African traditions not favorable to monogamy encouraged temporary unions at the expense of the more stable ones.

6 The French Canadians: A Demographic Success Story

Having recounted two catastrophic cases of infectious disease-related mortality – the plague and the virtual extermination of the *Indios* – let us turn to a demographic success. A few thousand pioneers arrived in the Canadian province of Québec, centered on the St Lawrence basin and five times the size of Italy, in the seventeenth century. Most of the present-day population of 6.5 million trace their ancestry to this original group. Faced with a harsh and inhospitable climate, a few courageous individuals quickly adapted and, thanks to abundant natural resources and available land, rapidly multiplied. In 1776 Adam Smith wrote: "The most decisive mark of the prosperity of any country is the increase of the number of its inhabitants ... In the British colonies in North America, it has been found that they double in twenty or five-and-twenty years. Nor in the present times is this increase principally owing to the continual importation of new inhabitants, but to the great multiplication of the species. Those who live to old age, it is said, frequently see there from fifty to a hundred, and sometimes many more, descendants from their own body."[66] Others, from Benjamin Franklin to Thomas Malthus, made similar observations. We shall see that their claims are essentially correct and explain in large part the demographic increase of a few tens of thousands of colonists in North America who, between the eighteenth century and the end of the nineteenth, became 80 million.

In addition to the vigor of pioneers and colonists, a continual flow of immigration contributed to the demographic success of most of the European populations of North America and Oceania. It has been calculated that in the period 1840–1940 a migratory surplus accounted for almost 40 percent of total growth in Argentina, almost 30 percent in the United States, and a little more than 15 percent in Brazil and Canada,[67] while in French Canada there was consistently net outmigration.[68]

The reasons for choosing French Canada as our example are twofold. First, from the eighteenth century onward immigration had little effect on population growth, and second, the Canadian sources are remarkably rich and have been skillfully exploited, allowing analysis of the demographic reasons for the success of the French in America.

Jacques Cartier explored the St Lawrence in 1534, and during the following century a French settlement developed there. Québec was founded in 1608; the Company of 100 *Associés* was formed in 1627 for the purpose of colonization; and in 1663 the royal government took over direction of the colonization process.[69] By 1680 the settlement was well established on the banks of the St Lawrence and numbered 10,000 individuals divided among 14 parishes. In the following 100 years the initial nucleus multiplied elevenfold (from 12,000 in 1684 to 132,000 in 1784, with an average annual growth rate of 2.4 percent), almost entirely owing to natural increase.[70]

From the foundation of Québec, in 1608, to 1700, total immigration amounted to about 15,000, a tiny fraction of the French population of the day (barely eight emigrants per one million inhabitants), while nearby England, with one-third the population, sent 380,000 emigrants to the New World between 1630 and 1700.[71] Careful research has established that barely one-third of those who immigrated before 1700 (4,997 individuals) successfully established a family in the colony. The others either returned to France, died before marrying, or (in very few cases) remained unmarried. Counting only the true biological "pioneers" who started families before 1680 (a few of these married before immigrating while the majority did so after), we have 3,380 individuals (1,425 women), from whom descend, as already mentioned, the vast majority of French Canadians. Analysis of this group of pioneers and their descendants (see also chapter 1, section 3) allows examination of the demographic characteristics of the French Canadians and therefore the reasons for their success. These are essentially three: (1) high nuptiality, especially owing to the young age at marriage; (2) high natural fertility; and (3) relatively low mortality.

Table 2.3 records several demographic measures for both the pioneers and the population remaining in France. The women who came to Nouvelle France married on average more than two years earlier than their French sisters. In addition, remarriage was much more frequent among the former and, given the high mortality of that period, widowhood at a young age was not uncommon. Within their earlier and more frequent marriages the Canadian women enjoyed higher fertility, due to a shorter interval between pregnancies (25 months versus 29 in France), and more numerous offspring. Finally, pioneer life expectancy, calculated at age 20, was significantly higher (almost five years) than in France.

Although they do not explain the situation completely, there are selective factors underlying these behavioral differences. Those who left on a long and difficult journey to an inhospitable land undoubtedly possessed courage,

Table 2.3 Comparison of the demographic behavior of French Canadian pioneers and the contemporary French population

Demographic index	Pioneers	French	Pioneer/French ratio
Mean age at first marriage (M)	28.8	25.0	1.15
Mean age at first marriage (F)	20.9	23.0	0.91
Percentage of second marriages (M)[a]	70.0	67.8	1.03
Percentage of second marriages (F)[a]	70.4	48.8	1.44
Completed fertility[b]	6.88	6.39	1.08
Life expectancy at age 20	38.8	34.2	1.13

Notes: [a] Percentage of widows and widowers remarried by age 50.
[b] Sum of legitimate fertility rates, from 25 to 50 years of age, for women married prior to age 25.
Source: H. Charbonneau et al., *Naissance d'une population. Les Français établis au Canada au XVII^e siècle* (Presses de l'Université de Montréal, Montréal, 1987).

initiative, and a sound constitution. The long, hard weeks of the transatlantic voyage exercised further selection, as mortality on board was high. Many of those who were unable to adapt returned home. This selection, which always accompanies migratory movements, certainly explains the lower mortality and perhaps also the higher fertility of the Canadians. At least during the early phases, low population density must also have contributed to keep down mortality by checking the spread of infection and epidemic. The young marriage age for women (which was initially as low as 15 or 16)[72] and the frequency of second marriages owe much to the sexual imbalance created by the greater immigration of males. It was again Adam Smith who observed that: "A young widow with four or five young children, who, among the middling or inferior ranks of people in Europe, would have so little chance for a second husband, is there [in North America] frequently courted as a sort of fortune. The value of children is the greatest of all encouragements to marriage."[73]

The advantageous conditions in which the pioneers found themselves allowed each couple to have an average of 6.3 children, of whom 4.2 married, with the result that the population doubled in less than 30 years.[74] The 4-plus children of the pioneers had in turn 28 children, so that each pioneer had on average 34 offspring between children and grandchildren. About a third of the pioneers had more than 50 children and grandchildren, just as Smith wrote in the passage cited earlier.[75]

Subsequent generations continued to enjoy high levels of reproductivity and rapid growth. For while age at marriage for women slowly began to rise as society became more established,[76] at the same time the fertility of the daughters of the pioneers, born in Canada and so full participants in the new society, was even higher than that of their mothers (which had in turn been higher than that

of the women who remained in France). A few numerical examples: the average number of offspring for women who married between 15 and 19 years of age in northwest France (the area from which most of the pioneers emigrated) was 9.5; for the pioneers it was 10.1, while for the women born in Canada it was 11.4. For women marrying between 20 and 24, the respective figures were 7.6, 8.1, and 9.5; and for those marrying between 25 and 29, 5.6, 5.7, and 6.3.[77] The fertility of the Canadians remained high throughout the eighteenth century and is among the highest ever encountered.[78] With regard to mortality the situation seems to have been better in the seventeenth than in the eighteenth century, perhaps as a result of increasing density and the declining influence of migrational selection. Nonetheless, Canadian mortality seems to have remained a little better than that of northwest France.[79]

An initial selection mechanism, social cohesiveness, and favorable environmental factors were the basis of the demographic success of French migration to Canada. A few thousand pioneers at the beginning of the seventeenth century grew in half a century to 50,000,[80] initiating the demographic growth shown in table 2.4. It is interesting to note that while the French Canadian population grew rapidly, that of France (many times larger) grew slowly or stagnated, and the indigenous Indian population, stricken by disease and geographically displaced by colonial expansion, declined. There is a parallel, not to be interpreted mechanically, between these demographic adjustments and those of animal populations which, emigrating from a saturated area, establish themselves in a new environment at the expense of other species

Table 2.4 French Canadian immigration and population (1608–1949)

Period	Immigrants settled	Average population (thousands)	Immigrants as % of average population	Contribution of pioneers at end of period (%)[a]
1608–79	3,380	–	–	100
1680–99	1,289	13	10.0	86
1700–29	1,477	24	6.0	80
1730–59	4,000	53	7.5	72
1760–99	4,000	137	3.0	70
1800–99	10,000	925	1.0	69
1900–49	25,000	2,450	1.0	68

Note: [a] The data in this column should be understood as an estimate of the contribution of the pioneers to the gene pool of the entire French Canadian population at the end of each period.
Source: H. Charbonneau et al., *Naissance d'une population. Les Français au Canada au XVII^e siècle* (Presses de l'Université de Montréal, Montréal, 1987), p. 1.

with which they compete. The different fates of the indigenous and colonizing populations – demographic crisis for the indigenous versus success for the colonizers – were a function not only of new diseases, but also of different levels of social and technological organization. The Europeans controlled energy sources (horse, animal traction, and sail) and technologies (iron and steel tools and weapons, the wheel, explosives) that far outperformed those of the indigenous populations. They were better clothed and housed and were in any case accustomed to cold or temperate climates. In addition, the animals they imported (horses, cattle, sheep, goats) adapted to the new environment with astonishing ease and reproduced rapidly, as did their plants (and weeds).[81]

7 Ireland and Japan: Two Islands, Two Histories

In the long run, population and resources develop along more or less parallel lines. However, if we switch from a time frame of several centuries to one of shorter duration, this parallelism is not always so easy to identify. This situation comes about because the human species is extremely adaptable and able both to withstand periods of want and also to accumulate large quantities of resources. Nor is it the case that demographic variation always reflects, in a period short enough to render causality obvious, the variations in available resources (which we shall consider here, for the sake of convenience, as independent of human intervention). Furthermore, some of the factors influencing demographic change, above all mortality (see sections 3 and 4 of this chapter), are independent of resource availability. In some cases, however, the interrelationship between resources and demography is clearly evident. If we accept the authoritative interpretations offered, the examples of Ireland and Japan – two islands distant from one another both in culture and space – between the seventeenth and nineteenth centuries represent this relationship well.

Ireland has always been one of the poorest countries of western Europe. Its population, subjugated by the English, deprived of independence and autonomy, and subject to an agricultural tributary economy dominated by absentee landlords, suffered a backward existence. In spite of poverty it grew rapidly – even more rapidly than nearby England, which was by far the most demographically dynamic of the large countries of Europe. Between the end of the seventeenth century and the census of 1841 – a few years before the Great Famine that would alter Irish demography dramatically – the Irish grew from just over two million to over eight million (table 2.5). Japan, although closing itself off to foreign influence, experienced a significant internal revival from the

beginning of the Tokugawa era in the early seventeenth century. Population tripled in 120 years and then entered a long period of stagnation until the second third of the nineteenth century. What were the reasons for rapid growth in both cases, and then catastrophe in Ireland and stagnation in Japan?

The case of Ireland was considered by Connell[82] over forty years ago, and his analysis has withstood the scrutiny of subsequent studies fairly well. Connell's thesis basically is that a natural tendency of the Irish to marry early was inhibited by the difficulty of obtaining land on which to build a house and start a family. This obstacle was removed in the second half of the eighteenth century by a series of complex factors – among them the great success of the potato – which allowed the extension and breaking up of farmland. As a result nuptiality increased and, together with a high level of natural fertility and a not too high level of mortality, this resulted in a high rate of growth. Finally, this equilibrium became precarious as a result of excessive growth until the Great Famine of 1846–7 permanently upset the previous demographic order.

The data in table 2.5 show rapid Irish demographic growth: in the century prior to 1845 the population grew at an annual rate of 1.3 percent as compared to 1 percent in England. These are the data on which Connell bases his

Table 2.5 Population of Ireland and Japan (seventeenth–nineteenth centuries)

Year	Population (millions)	Annual growth rate (%)
Ireland		
1687	2.167	–
1712	2.791	1.01
1754	3.191	0.32
1791	4.753	1.08
1821	6.882	1.19
1831	7.767	1.33
1841	8.175	0.51
1687–1754		0.58
1754–1841		1.08
Japan		
1600	10–18	–
1720	30	0.92–0.43
1875	35	0.10

Sources: For Ireland, K. H. Connell, *The Population of Ireland (1750–1845)* (Clarendon Press, Oxford, 1950); for the period 1687–1791, estimates; for 1821–41, census data. For Japan, A. Hayami, "Mouvement de longue durée et structures japonaises de la population à l'époque Tokugawa," *Annales de démographie historique 1971* (Mouton, Paris, 1972).

interpretation. They are the product of dependable censuses only for the period 1821–41; the earlier values are an elaboration of the reports made by collectors of "hearth money" (a sort of family tax).

Connell writes: "In the late eighteenth and early nineteenth centuries it is clear that the Irish were insistently urged and tempted to marry early: the wretchedness and hopelessness of their living conditions, their improvident temperament, the unattractiveness of remaining single, perhaps the persuasion of their spiritual leaders, all acted in this direction."[83] But did the material means exist to permit early marriage? The poor rural population of the island did not share the idea, common to large sectors of European population, of putting off marriage for the purpose of accumulating capital and attaining a better standard of living.[84] The large landowners tended to limit their tenants to a subsistence existence by adjusting rents, and so rendered difficult any improvement in the standard of living. The cost of marriage was small; a new dwelling, usually little more than a shack, could be constructed in a few days with the help of friends and family; and furniture was simple and rudimentary.[85] The real problem in a society of tenant farmers was the availability of a plot on which to establish a new household. As long as this was difficult (for example, dependent on the death of the father), nuptiality was checked. However, toward the end of the eighteenth century conditions changed. The conversion of pasture to cultivated plots and the cultivation of new lands (reclaimed swamps and mountains) – promoted by reforms of the Irish Parliament and by the demand in England, which was at war with France, for foodstuffs – removed this check.[86] Land subdivision increased still more as a result of the introduction and spread of the potato, which quickly became the primary, and often almost sole, food of the Irish.[87] The special role of the potato, perhaps introduced by Sir Walter Raleigh at the end of the sixteenth century and then gradually adopted, was decisive for two reasons. The first was its high productivity. As the population became ever more dependent upon the potato, "land which formerly had been adequate for only one family's subsistence could be parceled among sons or other subtenants,"[88] since "an acre of potatoes sufficed to feed a family of six and the livestock."[89] The second reason was the high nutritional value of the potato, consumed in incredible proportions as part of a diet which also included a considerable amount of milk.[90] Arthur Young, traveling in King's County, observed: "their food is potatoes and milk for ten months and potatoes and salt for the remaining two."[91] A barrel of 280 lb (127 kg) of potatoes fed a family of five for a week at an average daily consumption of 8 lb (3.6 kg) per person, including infants and children. Connell estimates daily consumption at 10 lb between 1780 and the Great Famine, while Salaman suggests 12 lb per adult at the end of the eighteenth

century, "a quantity exceeded in the next century."[92] It should be added that a diet of 4 kg of potatoes and half a liter of milk contains more than sufficient caloric and nutritional value for an adult male.[93] So while one may accuse the potato of having impoverished the Irish peasantry, one cannot accuse it of having exposed them to higher mortality. The availability of new land and the fragmentation of existing plots, made more productive due to potato cultivation, made possible the low age at marriage and high nuptiality of the Irish. These factors, combined with high natural fertility[94] and moderate mortality, produced a high rate of growth in the period leading up to the Great Famine.[95]

Sustained demographic growth (the population doubled between 1781 and 1841) in a rural society for which land, even though made more productive by the introduction of the potato, was the limiting factor of production could not go on indefinitely. Already in the decade before 1841 there is evidence of a gradual rise in the age at marriage and increased emigration. These developments did not, however, avert catastrophe: in 1845 a fungus, *phytophtora infestans*, badly damaged the potato harvest; in 1846 it destroyed it entirely.[96] The winter of 1846–7 brought famine, poverty, desperate and massive emigration, and epidemics of fevers and typhus. It has been estimated that the Great Famine, together with associated epidemics, caused between 1.1 and 1.5 million more deaths than normal.[97] Emigration became an exodus, and 200,000 people per year left Ireland between 1847 and 1854.[98]

The Great Famine marked the end of a demographic regime. The potato contributed to rapid demographic growth, but also rendered precarious the diet of a population that depended upon it alone for its nutritional needs. During the following decades a new regime of land use and ownership and a new nuptial order (late marriage and high rates of spinsterhood and bachelorhood), supported by the large landowners and the clergy, together with massive emigration resulted in a steady decline in population. The average age at first marriage increased from 23–24 between 1831 and 1841 – apparently a level already above that of previous decades – to 27–28 at the end of the century. The proportion of married women of childbearing age declined sharply between 1841 and the end of the century,[99] when about a fifth of the population aged 50 had never married. The island's population declined rapidly from 8.2 million in 1841 to 4.5 million in 1901.

According to the interpretation of one of the most authoritative scholars of Japanese demographic and social history,[100] the case of Japan resembles that of Ireland in the initial phase, though of course the setting is much different. The Tokugawa regime, which stretched over more than two and a half centuries from 1603 to 1867 and the beginning of Meiji-era modernization, was characterized by domestic peace, closure to both the outside world and Christian

penetration, a revival of Confucianism, and political stability. However, during this long period "society prepared itself for modernization, ... economically motivated behavior gradually modified the lifestyle of the population ... Initially production, which served to pay off property taxes and meet individual needs, had poverty as its inevitable accompaniment, ... but when the principal end of production became selling, then suffering became the work by means of which one was able to prosper and improve the qualities of one's life."[101] The amount of cultivated land doubled and agricultural techniques changed from extensive to intensive. Traditional social structures altered: large family groups, including many relatives and servants who were generally not able to marry, were broken up and many independent families established. In the county of Suwa, for example, average family size declined from 7 in the period 1671–1700 to 4.9 in 1751–1800.[102] The servant class of the Genin,[103] only a small fraction of which ever married, was transformed into a class of tenant farmers characterized by normal demographic behavior.

The freeing up of economic resources (new lands, new agricultural technology) was accompanied by sustained demographic growth. Hayami estimates a population of no more than 10 million at the beginning of the seventeenth century, which grew rapidly to 30 million by 1720 (the uncertainty of the sources induces him to adopt a safety margin of plus or minus 5 million), maintaining an average annual rate of growth of between 0.8 and 1 percent for over a century.[104] In the following century and a half this galloping growth slowed to a trot: in 1870, just after the fall of the Tokugawa regime, the population was about 35 million, having grown since 1720 at the reduced annual rate of 0.2 percent. The causes and mechanisms of this stagnation are the subject of considerable debate. There is definite evidence of intentional control of the "production" of children, not so much by delaying marriage but by the practices of abortion and infanticide, and of a "destructive" role played by the cities with regard to the rural population surplus (Edo, today Tokyo, was the largest city in the world at the beginning of the nineteenth century). Detailed studies of several Tokugawa-era villages supply ample documentation, as a complement to literary and legal reports, attesting to the widespread practice of abortion and infanticide in all social classes.[105] In the village of Yokouchi, for example, women born before 1700 and married at 20 years of age bore on average 5.5 children, while those married at the same age but born between 1750 and 1800 averaged barely 3.2.[106] Beyond infanticide and abortion, another interesting explanation for the slow population growth of the late Tokugawa epoch and the Meiji epoch that followed is the well-documented agricultural transformation that took place and led to an ever greater intensification of farming methods. This transformation improved the general conditions of rural life but also brought with it a notable

increase in workloads for men and even more for women. This trend "must have had unfavourable effects on marital fertility, as well as on infant and maternal mortality, and thereby must have counterbalanced some of the favourable demographic effects of long-term agrarian development."[107] Whatever the explanation of the demographic stagnation, Japanese society gradually discovered mechanisms to limit demographic growth as the expansion of cultivation encountered natural and insuperable limits.

The Japanese demographic system differed from the Irish in its response to the gradual pressure applied to available resources. In Ireland the system collapsed with the Great Famine and the Great Emigration: this double shock opened the way to changes in the nuptial regime (high ages at marriage and large numbers of unmarried), a less painful adjustment. In Japan the response was gradual and not the result of traumatic events.

8 On the Threshold of the Contemporary World: China and Europe

With the eighteenth century a large part of the world seems to enter a phase of demographic acceleration. The word "seems" is appropriate because, if we exclude Europe and America, quantitative information is scanty almost everywhere; however, if we give credit to the estimates in table 1.3, the world population increased 40 percent between 1700 and 1800; a similar increase had been achieved in the two centuries before 1700. While in Africa it is believed that the population was stagnating, estimates indicate a doubling of the population in America, and substantive increases in Europe (54 percent) and Asia (46 percent). What determined this acceleration? How, and for what reasons, did the demographic system undergo a change?

We will examine here the parallel cases of Europe and China. There is some agreement in the literature that, during the eighteenth century, there was considerable population growth in China – numbers more than doubled from about 160 million in 1700 to about 330 in 1800 – but that this dynamism lost some of its momentum in the following century, particularly after 1850. The growth in the eighteenth century is attributed by many to a favorable phase of economic expansion reflected in the increase in land values and of agricultural production and favored by a reduction of the fiscal pressure on the population.[108]

As a consequence there was a general increase in the standard of living that stimulated demographic expansion. It is a rather summary explanation of Malthusian nature and one that implicitly considers that demographic behaviors are shaped by living conditions. A few contemporary authors have

underlined the plasticity of the Chinese demographic system able to adapt to external constraints with a variety of mechanisms.[109] In the first place, infanticide permitted the regulation, at family level, of the number and gender composition of offspring. Infanticide of baby girls, in the majority of cases; the incidence was high, reaching 10 percent for the children of women belonging to the imperial lineage, but much higher among children of women of inferior rank. In a sample of peasants born between 1774 and 1873 it has been estimated that between one-fifth and one-quarter of baby girls fell victim to infanticide.[110] The interpretation is that infanticide was a response to the fluctuations of living conditions.

Selective infanticide, and the higher mortality of surviving baby girls owing to child neglect, generated distortions of the marriage market for the scarcity of eligible women; their scarcity was made worse by a not rare polygyny and by the low frequency of remarriage among the young widows. The result was that almost all women married very young, while men married substantially later and a high proportion remained unmarried. The proportion of women between age 15 and age 50 who were married was much higher than in Europe (typically 90 percent against 60 percent or less). This system of almost universal marriage for women was itself articulated in a variety of institutional forms adaptable to different circumstances: beside the largely dominant patrilocal form (the new couple co-resided with the husband's family), there were alternative forms of uxorilocal type, forms of levirate (for the very poor), polygyny (for the wealthy), and adoptions of baby girls who became spouses of a member of the adoptive family.

The high proportion of married women was balanced by a level of fertility – within marriage – lower than in Europe. The total number of children born to women married at age 20 (and remaining married until age 50) was around 6, against 7.5 or more for European women.[111] Birth intervals were longer than for European women and the age at birth of the last child lower. Not extraneous to the low marital fertility may have been a philosophical and religious tradition prescribing sexual continence for the spouses. Finally, adoption had a relevance in the Chinese family system and a not negligible proportion of children – up to 10 percent – were raised by the adoptive family. Adoptions were extended to adolescents and even adults. "Thus the Chinese demographic system was characterized by a multiplicity of choices that balanced romance with arranged marriage, marital passion with marital restraint, and parental love with the decision to kill or give away children, and the adoption of other children ... Chinese individuals constantly adjusted their demographic behavior according to collective circumstances to maximise collective utility."[112]

During the first part of the nineteenth century, the Chinese population continued its fast growth (from 330 to 430 million) but at a lower rate, while rebellions and bloody conflicts (the Taiping War between 1851 and 1864 was particularly destructive) and the hardship of famines caused a violent setback in the third quarter of the century and a slow successive recovery. During the nineteenth century, owing to the limitation of land, of decreasing returns from agriculture, of lack of innovation and delay in the adoption of the fruits of the technological revolution, the impoverished population adopted preventive and repressive checks to demographic growth.[113] For some authors, the plasticity of the Chinese demographic system – based also on the destructive practice of infanticide – played the roles of "accelerator" of growth in the eighteenth century and of "brake" in the nineteenth. This interpretation is not shared by others, for whom the second part of the nineteenth century was dominated by the destructive impact of subsistence crises and ensuing high mortality, and who assign a minor role to the endogenous, self-regulatory action of the population. China, at the end of the nineteenth century, appears to be far from modernity, even in its demographic profile.

The demographic acceleration of Europe in the eighteenth century, reinforced in the nineteenth, was caused by factors different from those of contemporary China. In the early phase the forces of constraint were still strong. Birth control was still virtually unknown except in a few isolated cases, like France, and medical and sanitary measures had made little headway against high mortality. Then, between 1750 and 1850 European population growth accelerated. The annual rate of growth, barely 0.15 percent between 1600 and 1750, grew to 0.63 percent between 1750 and 1850 (see table 1.3). This acceleration involved all the major countries (see table 2.6), though it was greater in some (for example, England) than in others (France). However, in spite of the disappearance of the plague and the success in combating smallpox (Jenner discovered a vaccine in 1797), the period between the mid-eighteenth and mid-nineteenth centuries was not free of troubles. The French Revolution and Napoleonic wars devastated Europe for 20 years; the last great subsistence crisis – the 1816–17 famine accompanied by an outbreak of typhus – hit all of Europe;[114] and a previously unknown pestilence, cholera, ravaged the continent. Nonetheless, population grew vigorously and spilled over, with the beginning of large-scale transoceanic migration, to the Americas.

A debate – which is still open – has developed regarding the causes of demographic acceleration from the mid-eighteenth century, in part because the demographic mechanisms themselves are not entirely understood. In some cases growth was due to increased fertility resulting from increased nuptiality, while in others, the majority, mortality decline was the principal factor.

Table 2.6 Growth of selected European populations (1600–1850)

Country	Population (millions)			Indexed growth			Density (inhabitants per km^2)	Distribution (%)		
	1600	1750	1850	1750 (1600 = 100)	1850 (1750 = 100)	1850 (1600 = 100)	(1750)	1600	1750	1850
England	4.1	5.8	16.6	141	286	405	48	7	8	14
Netherlands	1.5	1.9	3.1	127	163	207	63	3	3	2
Germany	12.0	15.0	27.0	125	180	225	42	21	21	22
France	19.6	24.6	36.3	126	148	185	45	34	34	30
Italy	13.5	15.8	24.7	117	156	183	52	24	22	20
Spain	6.7	8.6	14.8	128	172	221	17	12	12	12
	57.4	71.7	122.5	125	171	213		100	100	100

Note: Estimates are for present-day borders. For France, Italy, and Spain, the estimates for the given dates are the author's and are based on estimates for nearby dates given in the works cited.

Sources: Data derived or based on the following works: England: E. A. Wrigley and R. Schofield, *The Population History of England 1541–1871* (Edward Arnold, London, 1981, reissued Cambridge University Press, 1987), pp. 532–4; Netherlands: B. H. Slicher van Bath, "Historical Demography and the Social and Economic Development of the Netherlands," *Daedalus* (Spring, 1968), p. 609; Germany: C. McEvedy and R. Jones, *Atlas of World Population History* (Penguin, London, 1978), pp. 67–70; France: J. Dupâquier and B. Lepetit, "La Pueplade," in J. Dupâquier, ed., *Histoire de la population Française, vol. 2: de la Renaissance à 1789* (PUF, Paris, 1988): Italy: L. Del Panta, M. Livi-Bacci, G. Pinto and E. Sonnino, *La popolazione Italiana dal Mediocvo a oggi* (Laterza, Roma-Bari, 1996); Spain: J. Nadal, *La población Española* (Ariel, Barcelona, 1984).

In the case of England, the country that experienced the greatest demographic growth in the period, recent studies[115] ascribe the demographic acceleration of the second half of the eighteenth century more to fertility increase (aided by nuptiality increase) than to mortality decrease. Apparently the Industrial Revolution generated a notable increase in the demand for labor, which in turn stimulated nuptiality and so fertility (the latter was not yet subject to "control" within marriage). However, mortality also declined, and the combined effect resulted in sustained demographic growth and the tripling of population in a century. We shall return to England when analyzing the relationship between demographic and economic systems in chapter 3.

In much of Europe the transition from the eighteenth to the nineteenth century brought with it a decline in mortality. This improvement is evident above all in the lower frequency of mortality crises resulting from epidemic outbreaks and, at times, famine and want. As an example, in a group of 404 English parishes the frequency of months marked by severe mortality was 1.3 percent in the first half of the eighteenth century, 0.9 percent in the second half, and 0.6 in the first quarter of the nineteenth,[116] a sign of the rapid decline of crisis frequency. In France the incidence of severe crises declined dramatically between the first and second halves of the eighteenth century, so much so that one speaks of the end of *ancien régime* crises, like that, for example, after the harsh winter of 1709 which resulted in a million deaths more than normal or the equally severe crises of 1693–4 and 1739–41.[117] In other parts of Europe – Germany, Italy, Spain – the decline occurs later and less suddenly.

The causes for the attenuation of the great mortality crises are at once biological, economic, and social. The biological effect of mutual adaptation between pathogen and host (see sections 3 and 4 above), furthered by increased population density and mobility, cannot be ruled out as a cause for the reduced virulence of certain diseases. Social causes, instead, include the reduced transmissibility of infection as a result of improved private and public hygiene. Finally, economic causes pertain not only to agricultural progress, but also to the improved system of transportation, and so of the distribution of goods, between areas of abundance and areas of want.

The disappearance of crisis years alone, however, does not explain European mortality decline. Life expectancy at birth, for example, increased in England from 33 to 40 years between 1740–9 and 1840–9, in France the same period witnessed an increase from 25 to 40, in Sweden from 37 to 45 (between 1750–9 and 1840–9), and in Denmark from 35 to 44 (between 1780–9 and 1840–9).[118] Clearly mortality decline, whether "crisis" or "normal," was responsible for accelerated demographic growth. One of the theories that has gained favor in recent years is the "nutritional" theory championed by McKeown,[119] according

to which eighteenth-century demographic acceleration was due to mortality decline; mortality decline, however, cannot be explained by medical advances (ineffective, except for the smallpox vaccine, until the end of the nineteenth century), or by changes in public or private hygiene (which in some cases, for example the large cities, probably deteriorated), or by other causes. The true cause, according to McLean, was the improvement of the population's nutritional level, which increased organic "resistance" to infection. This improvement came about as a result of the progress made in agricultural productivity thanks to the introduction of new, more abundant, crops, from corn to potatoes.

This theory is countered by a number of considerations which make us look to other causes. In the first place, the link between nutrition and resistance to infection holds primarily in cases of severe malnutrition; and while these were frequent during periods of want, in normal years the diet of European populations seems to have been adequate.[120] Second, the latter half of the eighteenth century and the first decades of the nineteenth, the period during which this mortality "transition" began, do not appear to have been such a fortunate epoch. It is true that new crops spread. By the second half of the eighteenth century the potato, its diffusion furthered by the severe famine of 1770–2 in the center-north, had overcome its strongest European doubters and would soon be widespread. A field planted with potatoes could feed twice or thrice the population of a similar field of grain. Versatile buckwheat could be planted late in the season, should the winter crop fail. Corn spread in Spain in the seventeenth century and then passed to southwest France, the Po Valley in northern Italy, and on to the Balkans. As with the potato, its cultivation spread as a result of the subsistence crisis of 1816–17.[121] In many cases, however, the introduction of new crops did not improve per capita consumption. Often, as in Ireland with the potato, the new crops served to feed the additional population but led to the abandonment of more esteemed foods, like grains, and so made for a poorer diet. Cobbett's invective regarding his travels in Ireland is famous in this regard: "It is both my pleasure and my duty to discourage in any way I can the cultivation of this damned root, being convinced that it has done more harm to mankind than the sword and the pestilence united."[122] In England and also in Flanders, there are indications that as potato consumption increased, that of grains declined. In those regions where corn met with greatest success, especially Italy, it became the principal foodstuff and was responsible for the terrible spread of pellagra.[123]

Other, indirect, considerations also cast doubt on the nutritional hypothesis. For one, real wages in general declined throughout Europe during the eighteenth century and into the first decades of the nineteenth.[124] Real-wage decline is an indication of diminished buying power on the part of salaried workers (and

perhaps other groups as well), who in this period spent about four-fifths of their wages on food. Another indication is variation in average height, which seems in this same period to have declined in England, in the Hapsburg Empire, and in Sweden. Height is fairly sensitive to changes in nutritional levels, and its decline or stagnation is certainly not a sign of nutritional improvement.[125] Finally, mortality improvement benefited primarily the young (as is always the case when it is due to a decline in infectious disease mortality, a relatively less important cause of death at older ages) and infants. Until weaning, which occurred fairly late, generally between age 1 and 2, babies were fed mother's milk and so their nutritional level was generally independent of agricultural production and levels of consumption. But infant mortality declined as well – not because of better nutrition, but because of improved child-rearing methods and better protection from the surrounding environment.

Mortality decline was certainly due to many causes (see chapter 4, section 2) and perhaps none, taken singly, predominated. However, even given a generous reading, the nutritional hypothesis stands up to scrutiny less well than others. It is nonetheless the case that increased agricultural production accompanied European demographic expansion (population almost doubled in a century), even if nutritional levels did not improve notably. While the possibility of farming new lands – once pasture, swamp, or wild – together with improved technology and the introduction of new crops may not have been responsible for mortality decline, these elements did allow the agricultural population to expand, forming new centers and increasing nuptiality levels. The growth of the industrial sector, urbanization, and a general increase in demand for nonagricultural labor assisted this process and created an outlet for the rural population.