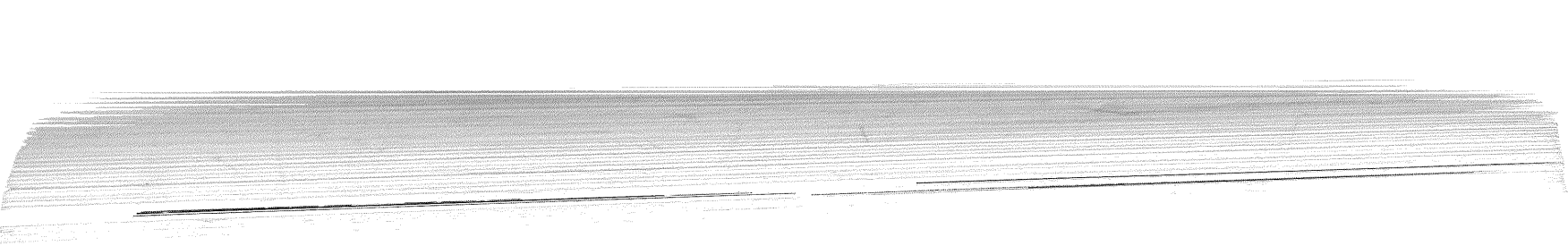


CHAPTER 10

Malthus in Africa: Rwanda's Genocide

A dilemma ■ Events in Rwanda ■ More than ethnic hatred ■ Buildup in Kanama ■ Explosion in Kanama ■ Why it happened ■

When my twin sons were 10 years old and again when they were 15, my wife and I took them on family vacations to East Africa. Like many other tourists, the four of us were overwhelmed by our firsthand experience of Africa's famous large animals, landscapes, and people. No matter how often we had already seen wildebeest moving across the TV screen of *National Geographic* specials viewed in the comfort of our living rooms, we were unprepared for the sight, sound, and smell of millions of them on the Serengeti Plains, as we sat in a Land Rover surrounded by a herd stretching from our vehicle to the horizon in all directions. Nor had television prepared us for the immense size of Ngorongoro Crater's flat and treeless floor, and for the steepness and height of its inner walls down which one drives from a tourist hotel perched on the rim to reach that floor.

East Africa's people also overwhelmed us, with their friendliness, warmth to our children, colorful clothes—and their sheer numbers. To read in the abstract about "the population explosion" is one thing; it is quite another thing to encounter, day after day, lines of African children along the roadside, many of them about the same size and age as my sons, calling out to passing tourist vehicles for a pencil that they could use in school. The impact of those numbers of people on the landscape is visible even along stretches of road where the people are off doing something else. In pastures the grass is sparse and grazed closely by herds of cattle, sheep, and goats. One sees fresh erosion gullies, in whose bottoms run streams brown with mud washed down from the denuded pastures.

All of those children add up to rates of human population growth in East Africa that are among the highest in the world: recently, 4.1% per year in Kenya, resulting in the population doubling every 17 years. That population explosion has arisen despite Africa's being the continent inhabited by

humans much longer than any other, so that one might naïvely have expected Africa's population to have leveled off long ago. In fact, it has been exploding recently for many reasons: the adoption of crops native to the New World (especially corn, beans, sweet potatoes, and manioc, alias cassava), broadening the agricultural base and increasing food production beyond that previously possible with native African crops alone; improved hygiene, preventive medicine, vaccinations of mothers and children, antibiotics, and some control of malaria and other endemic African diseases; and national unification and the fixing of national boundaries, thereby opening to settlement some areas that were formerly no-man's lands fought over by adjacent smaller polities.

Population problems such as those of East Africa are often referred to as "Malthusian," because in 1798 the English economist and demographer Thomas Malthus published a famous book in which he argued that human population growth would tend to outrun the growth of food production. That's because (Malthus reasoned) population growth proceeds exponentially, while food production increases only arithmetically. For instance, if a population's doubling time is 35 years, then a population of 100 people in the year 2000, if it continues to grow with that same doubling time, will have doubled in the year 2035 to 200 people, who will in turn double to 400 people in 2070, who will double to 800 people in the year 2105, and so on. But improvements in food production add rather than multiply: this breakthrough increases wheat yields by 25%, that breakthrough increases yields by an additional 20%, etc. That is, there is a basic difference between how population grows and how food production grows. When population grows, the extra people added to the population also themselves reproduce—as in compound interest, where the interest itself draws interest. That allows exponential growth. In contrast, an increase in food yield does not then further increase yields, but instead leads only to arithmetic growth in food production. Hence a population will tend to expand to consume all available food and never leave a surplus, unless population growth itself is halted by famine, war, or disease, or else by people making preventive choices (e.g., contraception or postponing marriage). The notion, still widespread today, that we can promote human happiness *merely* by increasing food production, without a simultaneous reining-in of population growth, is doomed to end in frustration—or so said Malthus.

The validity of his pessimistic argument has been much debated. Indeed, there are modern countries that have drastically reduced their population growth by means of voluntary (e.g., Italy and Japan) or

government-ordered (China) birth control. But modern Rwanda illustrates a case where Malthus's worst-case scenario does seem to have been right. More generally, both Malthus's supporters and his detractors could agree that population and environmental problems created by non-sustainable resource use will ultimately get solved in one way or another: if not by pleasant means of our own choice, then by unpleasant and unchosen means, such as the ones that Malthus initially envisioned.

A few months ago, while I was teaching a course to UCLA undergraduates on environmental problems of societies, I came to discuss the difficulties that regularly confront societies trying to reach agreements about environmental disputes. One of my students responded by noting that disputes could be, and frequently were, solved in the course of conflict. By that, the student didn't mean that he favored murder as a means of settling disputes. Instead, he was merely observing that environmental problems often do create conflicts among people, that conflicts in the U.S. often become resolved in court, that the courts provide a perfectly acceptable means of dispute resolution, and hence that students preparing themselves for a career of resolving environmental problems need to become familiar with the judicial system. The case of Rwanda is again instructive: my student was fundamentally correct about the frequency of resolution by conflict, but the conflict may assume nastier forms than courtroom processes.

In recent decades, Rwanda and neighboring Burundi have become synonymous in our minds with two things: high population, and genocide (Plate 21). They are the two most densely populated countries in Africa, and among the most densely populated in the world: Rwanda's average population density is triple even that of Africa's third most densely populated country (Nigeria), and 10 times that of neighboring Tanzania. Genocide in Rwanda produced the third largest body count among the world's genocides since 1950, topped only by the killings of the 1970s in Cambodia and of 1971 in Bangladesh (at the time East Pakistan). Because Rwanda's total population is 10 times smaller than that of Bangladesh, the scale of Rwanda's genocide, measured in proportion to the total population killed, far exceeds that of Bangladesh and stands second only to Cambodia's. Burundi's genocide was on a smaller scale than Rwanda's, yielding "only" a few hundred thousand victims. That still suffices to place Burundi seventh in the world since 1950 in its number of victims of genocide, and tied for fourth place in proportion of the population killed.

We have come to associate genocide in Rwanda and Burundi with ethnic violence. Before we can understand what else besides ethnic violence was also involved, we need to begin with some background on the genocide's course, the history leading up to it, and their usual interpretation that I shall now sketch, which runs as follows. (I shall mention later some respects in which this usual interpretation is wrong, incomplete, or oversimplified.) The populations of both countries consist of only two major groups, called the Hutu (originally about 85% of the population) and the Tutsi (about 15%). To a considerable degree, the two groups traditionally had filled different economic roles, the Hutu being principally farmers, the Tutsi pastoralists. It is often stated that the two groups look different, Hutu being on the average shorter, stockier, darker, flat-nosed, thick-lipped, and square-jawed, while Tutsi are taller, more slender, paler-skinned, thin-lipped, and narrow-chinned. The Hutu are usually assumed to have settled Rwanda and Burundi first, from the south and west, while the Tutsi are a Nilotic people who are assumed to have arrived later from the north and east and who established themselves as overlords over the Hutu. When German (1897) and then Belgian (1916) colonial governments took over, they found it expedient to govern through Tutsi intermediaries, whom they considered racially superior to Hutu because of the Tutsi's paler skins and supposedly more European or "Hamitic" appearance. In the 1930s the Belgians required everybody to start carrying an identity card classifying themselves as Hutu or Tutsi, thereby markedly increasing the ethnic distinction that had already existed.

Independence came to both countries in 1962. As independence approached, Hutu in both countries began struggling to overthrow Tutsi domination and to replace it with Hutu domination. Small incidents of violence escalated into spirals of killings of Tutsi by Hutu and of Hutu by Tutsi. The outcome in Burundi was that the Tutsi succeeded in retaining their domination, after Hutu rebellions in 1965 and 1970–72 followed by Tutsi killings of a few hundred thousand Hutu. (There is inevitably much uncertainty about this estimated number and many of the following numbers of deaths and exiles.) In Rwanda, however, the Hutu gained the upper hand and killed 20,000 (or perhaps only 10,000?) Tutsi in 1963. Over the course of the next two decades up to a million Rwandans, especially Tutsi, fled into exile in neighboring countries, from which they periodically attempted to invade Rwanda, resulting in further retaliatory killings of Tutsi by Hutu, until in 1973 the Hutu general Habyarimana staged a coup against

the previous Hutu-dominated government and decided to leave the Tutsi in peace.

Under Habyarimana, Rwanda prospered for 15 years and became a favorite recipient of foreign aid from overseas donors, who could point to a peaceful country with improving health, education, and economic indicators. Unfortunately, Rwanda's economic improvement became halted by drought and accumulating environmental problems (especially deforestation, soil erosion, and soil fertility losses), capped in 1989 by a steep decline in world prices for Rwanda's principal exports of coffee and tea, austerity measures imposed by the World Bank, and a drought in the south. Habyarimana took yet another attempted Tutsi invasion of northeastern Rwanda from neighboring Uganda in October 1990 as the pretext for rounding up or killing Hutu dissidents and Tutsi all over Rwanda, in order to strengthen his own faction's hold on the country. The civil wars displaced a million Rwandans into settlement camps, from which desperate young men were easily recruited into militias. In 1993 a peace agreement signed at Arusha called for power-sharing and a multi-power government. Still, businessmen close to Habyarimana imported 581,000 machetes for distribution to Hutu for killing Tutsi, because machetes were cheaper than guns.

However, Habyarimana's actions against Tutsi, and his newfound toleration of killings of Tutsi, proved insufficient for Hutu extremists (i.e., Hutu even more extreme than Habyarimana), who feared having their power diluted as a result of the Arusha agreement. They began training their militias, importing weapons, and preparing to exterminate Tutsi. Rwandan Hutu fears of Tutsi grew out of the long history of Tutsi domination of Hutu, the various Tutsi-led invasions of Rwanda, and Tutsi mass killings of Hutu and murder of individual Hutu political leaders in neighboring Burundi. Those Hutu fears increased in 1993, when extremist Tutsi army officers in Burundi murdered Burundi's Hutu president, provoking killings of Burundi Tutsi by Hutu, provoking in turn more extensive killings of Burundi Hutu by Tutsi.

Matters came to a head on the evening of April 6, 1994, when the Rwandan presidential jet plane, carrying Rwanda's President Habyarimana and also (as a last-minute passenger) Burundi's new provisional president back from a meeting in Tanzania, was shot down by two missiles as it came in to land at the airport of Kigali, Rwanda's capital, killing everyone on board. The missiles were fired from immediately outside the airport perimeter. It remains uncertain to this day by whom or why Habyarimana's plane was shot down; several groups had alternative motives for killing him. Whoever

were the perpetrators, Hutu extremists within an hour of the plane's downing began carrying out plans evidently already prepared in detail to kill the Hutu prime minister and other moderate or at least less extreme members of the democratic opposition, and Tutsi. Once Hutu opposition had been eliminated, the extremists took over the government and radio and set out to exterminate Rwanda's Tutsi, who still numbered about a million even after all the previous killings and escapes into exile.

The lead in the killings was initially taken by Hutu army extremists, using guns. They soon turned to efficiently organizing Hutu civilians, distributing weapons, setting up roadblocks, killing Tutsi identified at the roadblocks, broadcasting radio appeals to every Hutu to kill every "cockroach" (as Tutsi were termed), urging Tutsi to gather supposedly for protection at safe places where they could then be killed, and tracking down surviving Tutsi. When international protests against the killings eventually began to surface, the government and radio changed the tone of their propaganda, from exhortations to kill cockroaches to urging Rwandans to practice self-defense and to protect themselves against Rwanda's common enemies. Moderate Hutu government officials who tried to prevent killings were intimidated, bypassed, replaced, or killed. The largest massacres, each of hundreds or thousands of Tutsi at one site, took place when Tutsi took refuge in churches, schools, hospitals, government offices, or those other supposed safe places and were then surrounded and hacked or burned to death. The genocide involved large-scale Hutu civilian participation, though it is debated whether as many as one-third or just some lesser proportion of Hutu civilians joined in killing Tutsi. After the army's initial killings with guns in each area, subsequent killings used low-tech means, mainly machetes or else clubs studded with nails. The killings involved much savagery, including chopping off arms and legs of intended victims, chopping breasts off women, throwing children down into wells, and widespread rape.

While the killings were organized by the extremist Hutu government and largely carried out by Hutu civilians, institutions and outsiders from whom one might have expected better behavior played an important permissive role. In particular, numerous leaders of Rwanda's Catholic Church either failed to protect Tutsi or else actively assembled them and turned them over to killers. The United Nations already had a small peacekeeping force in Rwanda, which it proceeded to order to retreat; the French government sent a peacekeeping force, which sided with the genocidal Hutu gov-

ernment and against invading rebels; and the United States government declined to intervene. In explanation of these policies, the U.N., French government, and U.S. government all referred to "chaos," "a confusing situation," and "tribal conflict," as if this were just one more tribal conflict of a type considered normal and acceptable in Africa, and ignoring evidence for the meticulous orchestration of the killings by the Rwandan government.

Within six weeks, an estimated 800,000 Tutsi, representing about three-quarters of the Tutsi then remaining in Rwanda, or 11% of Rwanda's total population, had been killed. A Tutsi-led rebel army termed the Rwandan Patriotic Front (RPF) began military operations against the government within a day of the start of the genocide. The genocide ended in each part of Rwanda only with the arrival of that RPF army, which declared complete victory on July 18, 1994. It is generally agreed that the RPF army was disciplined and did not enlist civilians to murder, but it did carry out reprisal killings on a much smaller scale than the genocide to which it was responding (estimated number of reprisal victims, "only" 25,000 to 60,000). The RPF set up a new government, emphasized national conciliation and unity, and urged Rwandans to think of themselves as Rwandans rather than as Hutu or Tutsi. About 135,000 Rwandans were eventually imprisoned on suspicion of being guilty of genocide, but few of the prisoners have been tried or convicted. After the RPF victory, about 2,000,000 people (mostly Hutu) fled into exile in neighboring countries (especially the Congo and Tanzania), while about 750,000 former exiles (mostly Tutsi) returned to Rwanda from neighboring countries to which they had fled (Plate 22).

The usual accounts of the genocides in Rwanda and Burundi portray them as the result of pre-existing ethnic hatreds fanned by cynical politicians for their own ends. As summed up in the book *Leave None to Tell the Story: Genocide in Rwanda,* published by the organization Human Rights Watch, "this genocide was not an uncontrollable outburst of rage by a people consumed by 'ancient tribal hatreds.' . . . This genocide resulted from the deliberate choice of a modern elite to foster hatred and fear to keep itself in power. This small, privileged group first set the majority against the minority to counter a growing political opposition within Rwanda. Then, faced with RPF success on the battlefield and at the negotiating table, these few powerholders transformed the strategy of ethnic division into genocide.

They believed that the extermination campaign would restore the solidarity of the Hutu under their leadership and help them win the war . . ." The evidence is overwhelming that this view is correct and accounts in large degree for Rwanda's tragedy.

But there is also evidence that other considerations contributed as well. Rwanda contained a third ethnic group, variously known as the Twa or pygmies, who numbered only 1% of the population, were at the bottom of the social scale and power structure, and did not constitute a threat to anybody—yet most of them, too, were massacred in the 1994 killings. The 1994 explosion was not just Hutu versus Tutsi, but the competing factions were in reality more complex: there were three rival factions composed predominantly or solely of Hutu, one of which may have been the one to trigger the explosion by killing the Hutu president from another faction; and the invading RPF army of exiles, though led by Tutsi, also contained Hutu. The distinction between Hutu and Tutsi is not nearly as sharp as often portrayed. The two groups speak the same language, attended the same churches and schools and bars, lived together in the same village under the same chiefs, and worked together in the same offices. Hutu and Tutsi intermarried, and (before Belgians introduced identity cards) sometimes switched their ethnic identity. While Hutu and Tutsi look different on the average, many individuals are impossible to assign to either of the two groups based on appearance. About one-quarter of all Rwandans have both Hutu and Tutsi among their great-grandparents. (In fact, there is some question whether the traditional account of the Hutu and Tutsi having different origins is correct, or whether instead the two groups just differentiated economically and socially within Rwanda and Burundi out of a common stock.) This intergradation gave rise to tens of thousands of personal tragedies during the 1994 killings, as Hutu tried to protect their Tutsi spouses, relatives, friends, colleagues, and patrons, or tried to buy off would-be killers of those loved ones with money. The two groups were so intertwined in Rwandan society that in 1994 doctors ended up killing their patients and vice versa, teachers killed their students and vice versa, and neighbors and office colleagues killed each other. Individual Hutu killed some Tutsi while protecting other Tutsi. We cannot avoid asking ourselves: how, under those circumstances, were so many Rwandans so readily manipulated by extremist leaders into killing each other with the utmost savagery?

Especially puzzling, if one believes that there was nothing more to the genocide than Hutu-versus-Tutsi ethnic hatred fanned by politicians, are

events in northwestern Rwanda. There, in a community where virtually everybody was Hutu and there was only a single Tutsi, mass killings still took place—of Hutu by other Hutu. While the proportional death toll there, estimated as "at least 5% of the population," may have been somewhat lower than that overall in Rwanda (11%), it still takes some explaining why a Hutu community would kill at least 5% of its members in the absence of ethnic motives. Elsewhere in Rwanda, as the 1994 genocide proceeded and as the number of Tutsi declined, Hutu turned to attacking each other.

All these facts illustrate why we need to search for other contributing factors in addition to ethnic hatred.

To begin our search, let's again consider Rwanda's high population density that I mentioned previously. Rwanda (and Burundi) was already densely populated in the 19th century before European arrival, because of its twin advantages of moderate rainfall and an altitude too high for malaria and the tsetse fly. Rwanda's population subsequently grew, albeit with ups and downs, at an average rate of over 3% per year, for essentially the same reasons as in neighboring Kenya and Tanzania (New World crops, public health, medicine, and stable political borders). By 1990, even after the killings and mass exilings of the previous decades, Rwanda's average population density was 760 people per square mile, higher than that of the United Kingdom (610) and approaching that of Holland (950). But the United Kingdom and Holland have highly efficient mechanized agriculture, such that only a few percent of the population working as farmers can produce food for everyone else. Rwandan agriculture is much less efficient and unmechanized; farmers depend on handheld hoes, picks, and machetes; and most people have to remain farmers, producing little or no surplus that could support others.

As Rwanda's population rose after independence, the country carried on with its traditional agricultural methods and failed to modernize, to introduce more productive crop varieties, to expand its agricultural exports, or to institute effective family planning. Instead, the growing population was accommodated just by clearing forests and draining marshes to gain new farmland, shortening fallow periods, and trying to extract two or three consecutive crops from a field within one year. When so many Tutsi fled or were killed in the 1960s and in 1973, the availability of their former lands for redistribution fanned the dream that each Hutu farmer could now, at last, have enough land to feed himself and his family comfortably. By 1985, all

arable land outside of national parks was being cultivated. As both population and agricultural production increased, per-capita food production rose from 1966 to 1981 but then dropped back to the level where it had stood in the early 1960s. That, exactly, is the Malthusian dilemma: more food, but also more people, hence no improvement in food per person.

Friends of mine who visited Rwanda in 1984 sensed an ecological disaster in the making. The whole country looked like a garden and banana plantation. Steep hills were being farmed right up to their crests. Even the most elementary measures that could have minimized soil erosion, such as terracing, plowing along contours rather than straight up and down hills, and providing some fallow cover of vegetation rather than leaving fields bare between crops, were not being practiced. As a result, there was much soil erosion, and the rivers carried heavy loads of mud. One Rwandan wrote me, "Farmers can wake up in the morning and find that their entire field (or at least its topsoil and crops) has been washed away overnight, or that their neighbor's field and rocks have now been washed down to cover their own field." Forest clearance led to drying-up of streams, and more irregular rainfall. By the late 1980s famines began to reappear. In 1989 there were more severe food shortages resulting from a drought, brought on by a combination of regional or global climate change plus local effects of deforestation.

The effect of all those environmental and population changes on an area of northwestern Rwanda (Kanama commune) inhabited just by Hutu was studied in detail by two Belgian economists, Catherine André and Jean-Philippe Platteau. André, who was Platteau's student, lived there for a total of 16 months during two visits in 1988 and 1993, while the situation was deteriorating but before the genocide's explosion. She interviewed members of most households in the area. For each household interviewed in each of those two years, she ascertained the number of people living in the household, the total area of land that it owned, and the amount of income that its members earned from jobs off the farm. She also tabulated sales or transfers of land, and disputes requiring mediation. After the genocide of 1994, she tracked down news of survivors and sought to detect any pattern to which particular Hutu ended up being killed by other Hutu. André and Platteau then processed this mass of data together to figure out what it all meant.

Kanama has very fertile volcanic soil, so that its population density is high even by the standards of densely populated Rwanda: 1,740 people per square mile in 1988, rising to 2,040 in 1993. (That's higher even than the value for Bangladesh, the world's most densely populated agricultural nation.) Those high population densities translated into very small farms: a

median farm size of only 0.89 acre in 1988, declining to 0.72 acre in 1993. Each farm was divided into (on average) 10 separate parcels, so that farmers were tilling absurdly small parcels averaging only 0.09 acre in 1988 and 0.07 acre in 1993.

Because all land in the commune was already occupied, young people found it difficult to marry, leave home, acquire a farm, and set up their own household. Increasingly, young people postponed marriage and continued to live at home with their parents. For instance, in the 20- to 25-year-old age bracket, the percentage of young women living at home rose between 1988 and 1993 from 39% to 67%, and the percentage of young men rose from 71% to 100%: not a single man in his early 20s lived independently of his parents by 1993. That obviously contributed to the lethal family tensions that exploded in 1994, as I shall explain below. With more young people staying home, the average number of people per farm household increased (between 1988 and 1993) from 4.9 to 5.3, so that the land shortage was even tighter than indicated by the decrease in farm size from 0.89 to 0.72 acre. When one divides decreasing farm area by increasing number of people in the household, one finds that each person was living off of only one-fifth of an acre in 1988, declining to one-seventh of an acre in 1993.

Not surprisingly, it proved impossible for most people in Kanama to feed themselves on so little land. Even when measured against the low calorie intake considered adequate in Rwanda, the average household got only 77% of its calorie needs from its farm. The rest of its food had to be bought with income earned off the farm, at jobs such as carpentry, brick-making, sawing wood, and trade. Two-thirds of households held such jobs, while one-third didn't. The percentage of the population consuming less than 1,600 calories per day (i.e., what is considered below the famine level) was 9% in 1982, rising to 40% in 1990 and some unknown higher percentage thereafter.

All of these numbers that I have quoted so far for Kanama are average numbers, which conceal inequalities. Some people owned larger farms than others, and that inequality increased from 1988 to 1993. Let's define a "very big" farm as larger than 2.5 acres, and a "very small" farm as smaller than 0.6 acre. (Think back to Chapter 1 to appreciate the tragic absurdity of those numbers: I mentioned there that in Montana a 40-acre farm used to be considered necessary to support a family, but even that is now inadequate.) Both the percentage of very big farms and the percentage of very small farms increased between 1988 and 1993, from 5 to 8% and from 36 to 45% respectively. That is, Kanama farm society was becoming increasingly

divided between the rich haves and the poor have-nots, with decreasing numbers of people in the middle. Older heads of households tended to be richer and to have larger farms: those in the age ranges 50–59 and 20–29 years old had average farm sizes of 2.05 acres and only 0.37 acre respectively. Of course, family size was larger for the older household heads, so they needed more land, but they still had three times more land per household member than did young household heads.

Paradoxically, off-farm income was earned disproportionately by owners of large farms: the average size of farms that did earn such income was 1.3 acres, compared to only half an acre for farms lacking such income. That difference is paradoxical because the smaller farms are the ones whose household members have less farmland per person to feed themselves, and which thus need more off-farm income. That concentration of off-farm income on the larger farms contributed to the increasing division of Kanama society between haves and have-nots, with the rich becoming richer and the poor becoming poorer. In Rwanda, it's supposedly illegal for owners of small farms to sell any of their land. In fact, it does happen. Investigation of land sales showed that owners of the smallest farms sold land mainly when they needed money for an emergency involving food, health, lawsuit costs, bribes, a baptism, wedding, funeral, or excessive drinking. In contrast, owners of large farms sold for reasons such as to increase farm efficiency (e.g., selling a distant parcel of land in order to buy a parcel nearer to the farmhouse).

The extra off-farm income of larger farms allowed them to buy land from smaller farms, with the result that large farms tended to buy land and become larger, while small farms tended to sell land and become smaller. Almost no large farm sold land without buying any, but 35% of the smallest farms in 1988, and 49% of them in 1993, sold without buying. If one breaks down land sales according to off-farm income, all farms with off-farm income bought land, and none sold land without buying; but only 13% of farms lacking off-farm income bought land, and 65% of them sold land without buying. Again, note the paradox: already-tiny farms, which desperately needed more land, in fact became smaller, by selling land in emergencies to large farms financing their purchases with off-farm income. Remember again that what I term "large farms" are large only by Rwanda standards: "large" means "larger than a mere 1 or 2 acres."

Thus, at Kanama most people were impoverished, hungry, and desperate, but some people were more impoverished, hungry, and desperate than

others, and most people were becoming more desperate while a few were becoming less desperate. Not surprisingly, this situation gave rise to frequent serious conflicts that the parties involved could not resolve by themselves, and that they either referred to traditional village conflict mediators or (less often) brought to the courts. Each year, households reported on the average more than one such serious conflict requiring outside resolution. André and Platteau surveyed the causes of 226 such conflicts, as described either by the mediators or by the householders. According to both types of informants, land disputes lay at the root of most serious conflicts: either because the conflict was directly over land (43% of all cases); or because it was a husband/wife, family, or personal dispute often stemming ultimately from a land dispute (I'll give examples in the next two paragraphs); or else because the dispute involved theft by very poor people, known locally as "hunger thieves," who owned almost no land and were without off-farm income and who lived by stealing for lack of other options (7% of all disputes, and 10% of all households).

Those land disputes undermined the cohesion of Rwandan society's traditional fabric. Traditionally, richer landowners were expected to help their poorer relatives. This system was breaking down, because even the landowners who were richer than other landowners were still too poor to be able to spare anything for poorer relatives. That loss of protection especially victimized vulnerable groups in the society: separated or divorced women, widows, orphans, and younger half-siblings. When ex-husbands ceased to provide for their separated or divorced wives, the women would formerly have returned to their natal family for support, but now their own brothers opposed their return, which would make the brothers or the brothers' children even poorer. The women might then seek to return to their natal family only with their daughters, because Rwandan inheritance was traditionally by sons, and the woman's brothers wouldn't see her daughters as competing with their own children. The woman would leave her sons with their father (her divorced husband), but his relatives might then refuse land to her sons, especially if their father died or ceased protecting them. Similarly, a widow would find herself without support from either her husband's family (her brothers-in-law) or from her own brothers, who again saw the widow's children as competing for land with their children. Orphans were traditionally cared for by paternal grandparents; when those grandparents died, the orphans' uncles (the brothers of their deceased father) now sought to disinherit or evict the orphans. Children of polygamous marriages, or

of broken marriages in which the man subsequently remarried and had children by a new wife, found themselves disinherited or evicted by their half-brothers.

The most painful and socially disruptive land disputes were those pitting fathers against sons. Traditionally, when a father died, his land all passed to his oldest son, who was expected to manage the land for the whole family and to provide his younger brothers with enough land for their subsistence. As land became scarce, fathers gradually switched to the custom of dividing their land among all sons, in order to reduce the potential for intrafamily conflict after the father's death. But different sons urged on their father different competing proposals for dividing the land. Younger sons became bitter if older brothers, who got married first, received a disproportionately large share—e.g., because the father had had to sell off some land by the time younger sons got married. Younger sons instead demanded strictly equal divisions; they objected to their father giving their older brother a present of land on that brother's marriage. The youngest son, who traditionally was the one expected to care for his parents in their old age, needed or demanded an extra share of land in order to carry out that traditional responsibility. Brothers were suspicious of, and sought to evict, sisters or younger brothers who received from the father any present of land, which the brothers suspected was being given in return for that sister or younger brother agreeing to care for the father in his old age. Sons complained that their father was retaining too much land to support himself in his old age, and they demanded more land now for themselves. Fathers in turn were justifiably terrified of being left with too little land in their old age, and they opposed their sons' demands. All of these types of conflicts ended up before mediators or the courts, with fathers suing sons and vice versa, sisters suing brothers, nephews suing uncles, and so on. These conflicts sabotaged family ties, and turned close relatives into competitors and bitter enemies.

That situation of chronic and escalating conflict forms the background against which the killings of 1994 took place. Even before 1994, Rwanda was experiencing rising levels of violence and theft, perpetrated especially by hungry landless young people without off-farm income. When one compares crime rates for people of age 21–25 among different parts of Rwanda, most of the regional differences prove to be correlated statistically with

population density and per-capita availability of calories: high population densities and worse starvation were associated with more crime.

After the explosion of 1994, André tried to track down the fates of Kanama's inhabitants. She found that 5.4% were reported to her as having died as a result of the war. That number is an underestimate of the total casualties, because there were some inhabitants about whose fates she could obtain no information. Hence it remains unknown whether the death rate approached the average value of 11% for Rwanda as a whole. What is clear is that the death rate in an area where the population consisted almost entirely of Hutu was at least half of the death rate in areas where Hutu were killing Tutsi plus other Hutu.

All but one of the known victims at Kanama fell into one of six categories. First, the single Tutsi at Kanama, a widowed woman, was killed. Whether that had much to do with her being Tutsi is unclear, because she furnished so many other motives for killing: she had inherited much land, she had been involved in many land disputes, she was the widow of a polygamous Hutu husband (hence viewed as a competitor of his other wives and their families), and her deceased husband had already been forced off his land by his half-brothers.

Two more categories of victims consisted of Hutu who were large landowners. The majority of them were men over the age of 50, hence at a prime age for father/son disputes over land. The minority were younger people who had aroused jealousy by being able to earn much off-farm income and using it to buy land.

A next category of victims consisted of "troublemakers" known for being involved in all sorts of land disputes and other conflicts.

Still another category was young men and children, particularly ones from impoverished backgrounds, who were driven by desperation to enlist in the warring militias and proceeded to kill each other. This category is especially likely to have been underestimated, because it was dangerous for André to ask too many questions about who had belonged to what militia.

Finally, the largest number of victims were especially malnourished people, or especially poor people with no or very little land and without off-farm income. They evidently died because of starvation, being too weak, or not having money to buy food or to pay the bribes required to buy their survival at roadblocks.

Thus, as André and Platteau note, "The 1994 events provided a unique opportunity to settle scores, or to reshuffle land properties, even among

Hutu villagers. . . . It is not rare, even today, to hear Rwandans argue that a war is necessary to wipe out an excess of population and to bring numbers into line with the available land resources."

That last quote of what Rwandans themselves say about the genocide surprised me. I had thought that it would be exceptional for people to recognize such a direct connection between population pressure and killings. I'm accustomed to thinking of population pressure, human environmental impacts, and drought as ultimate causes, which make people chronically desperate and are like the gunpowder inside the powder keg. One also needs a proximate cause: a match to light the keg. In most areas of Rwanda, that match was ethnic hatred whipped up by politicians cynically concerned with keeping themselves in power. (I say "most areas," because the large-scale killings of Hutu by Hutu at Kanama demonstrate a similar outcome even where everybody belonged to the same ethnic group.) As Gérard Prunier, a French scholar of East Africa, puts it, "The decision to kill was of course made by politicians, for political reasons. But at least part of the reason why it was carried out so thoroughly by the ordinary rank-and-file peasants in their ingo [= family compound] was feeling that there were too many people on too little land, and that with a reduction in their numbers, there would be more for the survivors."

The link that Prunier, and that André and Platteau, see behind population pressure and the Rwandan genocide has not gone unchallenged. In part, the challenges are reactions to oversimplified statements that critics with some justice lampooned as "ecological determinism." For instance, only 10 days after the genocide began, an article in an American newspaper linked Rwanda's dense population to the genocide by saying, "Rwandas [i.e., similar genocides] are endemic, built-in, even, to the world we inhabit." Naturally, that fatalistic oversimplified conclusion provokes negative reactions not only to it, but also to the more complex view that Prunier, André and Platteau, and I present, for three reasons.

First, any "explanation" of why a genocide happened can be misconstrued as "excusing" it. However, regardless of whether we arrive at an oversimplified one-factor explanation or an excessively complex 73-factor explanation for a genocide doesn't alter the personal responsibility of the perpetrators of the Rwandan genocide, as of other evil deeds, for their actions. This is a misunderstanding that arises regularly in discussions of the origins of evil: people recoil at any explanation, because they confuse expla-

nations with excuses. But it *is* important that we understand the origins of the Rwandan genocide—not so that we can exonerate the killers, but so that we can use that knowledge to decrease the risk of such things happening again in Rwanda or elsewhere. Similarly, there are people who have chosen to devote their lives or careers to understanding the origins of the Nazi Holocaust, or to understanding the minds of serial murderers and rapists. They have made that choice not in order to mitigate the responsibility of Hitler, serial murderers, and rapists, but because they want to know how those awful things came to be, and how we can best prevent recurrences.

Second, it is justifiable to reject the simplistic view that population pressure was the single cause of the Rwandan genocide. Other factors did contribute; in this chapter I have introduced ones that seem to me important, and experts on Rwanda have written entire books and articles on the subject, cited in my Further Readings at the back of this book. Just to reiterate: regardless of the order of their importance, those other factors included Rwanda's history of Tutsi domination of Hutu, Tutsi large-scale killings of Hutu in Burundi and small-scale ones in Rwanda, Tutsi invasions of Rwanda, Rwanda's economic crisis and its exacerbation by drought and world factors (especially by falling coffee prices and World Bank austerity measures), hundreds of thousands of desperate young Rwandan men displaced as refugees into settlement camps and ripe for recruitment by militias, and competition among Rwanda's rival political groups willing to stoop to anything to retain power. Population pressure joined with those other factors.

Finally, one should not misconstrue a role of population pressure among the Rwandan genocide's causes to mean that population pressure automatically leads to genocide anywhere around the world. To those who would object that there is not a *necessary* link between Malthusian population pressure and genocide, I would answer, "Of course!" Countries can be overpopulated without descending into genocide, as exemplified by Bangladesh (relatively free of large-scale killings since its genocidal slaughters of 1971) as well as by the Netherlands and multi-ethnic Belgium, despite all three of those countries being more densely populated than Rwanda. Conversely, genocide can arise for ultimate reasons other than overpopulation, as illustrated by Hitler's efforts to exterminate Jews and Gypsies during World War II, or by the genocide of the 1970s in Cambodia, with only one-sixth of Rwanda's population density.

Instead, I conclude that population pressure was *one* of the important factors behind the Rwandan genocide, that Malthus's worst-case scenario

may sometimes be realized, and that Rwanda may be a distressing model of that scenario in operation. Severe problems of overpopulation, environmental impact, and climate change cannot persist indefinitely: sooner or later they are likely to resolve themselves, whether in the manner of Rwanda or in some other manner not of our devising, if we don't succeed in solving them by our own actions. In the case of Rwanda's collapse we can put faces and motives on the unpleasant solution; I would guess that similar motives were operating, without our being able to associate them with faces, in the collapses of Easter Island, Mangareva, and the Maya that I described in Part 2 of this book. Similar motives may operate again in the future, in some other countries that, like Rwanda, fail to solve their underlying problems. They may operate again in Rwanda itself, where population today is still increasing at 3% per year, women are giving birth to their first child at age 15, the average family has between five and eight children, and a visitor's sense is of being surrounded by a sea of children.

The term "Malthusian crisis" is impersonal and abstract. It fails to evoke the horrible, savage, numbing details of what millions of Rwandans did, or had done to them. Let us give the last words to one observer, and to one survivor. The observer is, again, Gérard Prunier:

"All these people who were about to be killed had land and at times cows. And somebody had to get these lands and those cows after the owners were dead. In a poor and increasingly overpopulated country this was not a negligible incentive."

The survivor is a Tutsi teacher whom Prunier interviewed, and who survived only because he happened to be away from his house when killers arrived and murdered his wife and four of his five children:

"The people whose children had to walk barefoot to school killed the people who could buy shoes for theirs."

CHAPTER 11

One Island, Two Peoples, Two Histories: The Dominican Republic and Haiti

Differences ■ Histories ■ Causes of divergence ■ Dominican environmental impacts ■ Balaguer ■ The Dominican environment today ■ The future ■

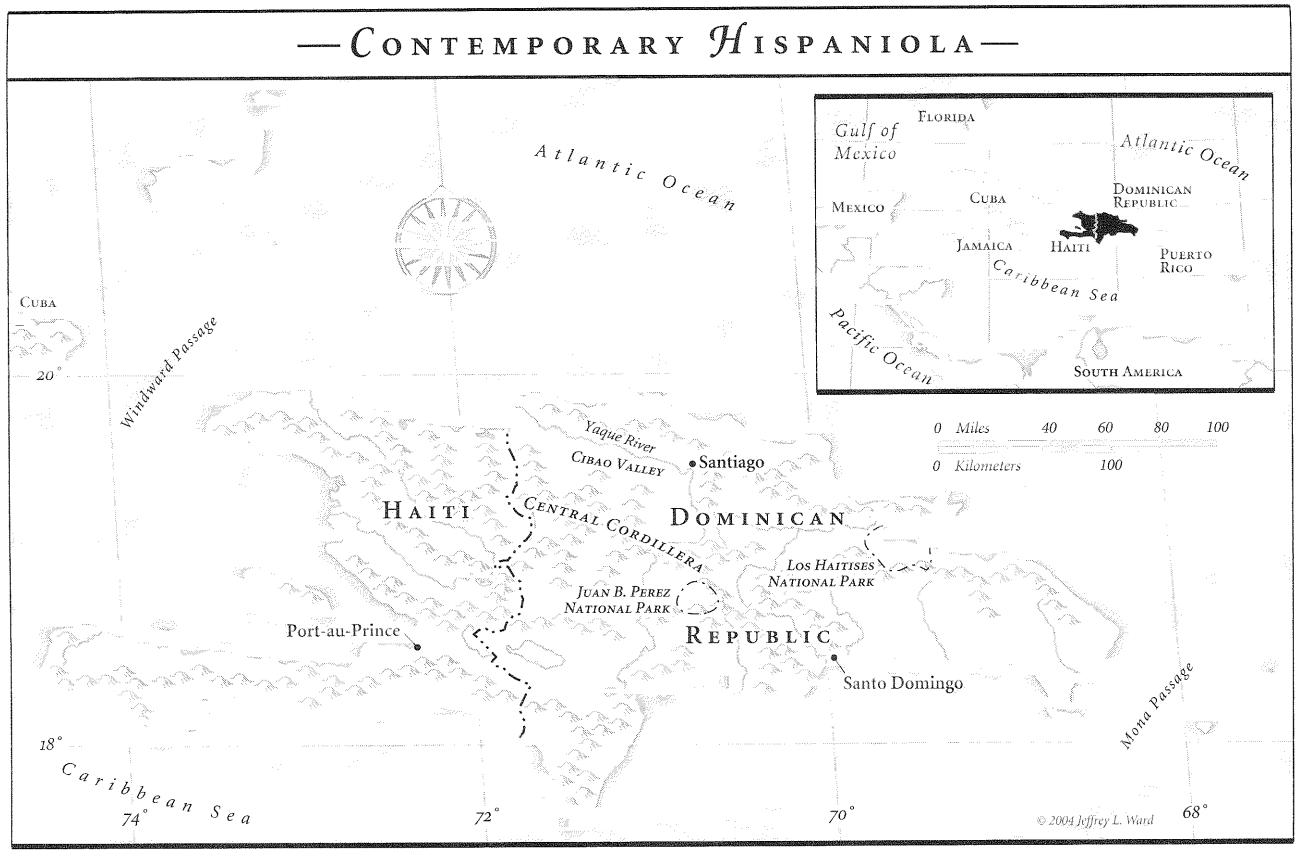
To anyone interested in understanding the modern world's problems, it's a dramatic challenge to understand the 120-mile-long border between the Dominican Republic and Haiti, the two nations dividing the large Caribbean island of Hispaniola that lies southeast of Florida (map, p. 331). From an airplane flying high overhead, the border looks like a sharp line with bends, cut arbitrarily across the island by a knife, and abruptly dividing a darker and greener landscape east of the line (the Dominican side) from a paler and browner landscape west of the line (the Haitian side). On the ground, one can stand on the border at many places, face east, and look into pine forest, then turn around, face west, and see nothing except fields almost devoid of trees.

That contrast visible at the border exemplifies a difference between the two countries as a whole. Originally, both parts of the island were largely forested: the first European visitors noted as Hispaniola's most striking characteristic the exuberance of its forests, full of trees with valuable wood. Both countries have lost forest cover, but Haiti has lost far more (Plates 23, 24), to the point where it now supports just seven substantial patches of forest, only two of which are protected as national parks, both of them subject to illegal logging. Today, 28% of the Dominican Republic is still forested, but only 1% of Haiti. I was surprised at the extent of woodlands even in the area comprising the Dominican Republic's richest farmland, lying between its two largest cities of Santo Domingo and Santiago. In Haiti and the Dominican Republic just as elsewhere in the world, the consequences of all that deforestation include loss of timber and other forest building materials, soil erosion, loss of soil fertility, sediment loads in the rivers, loss of watershed protection and hence of potential hydroelectric power, and decreased

rainfall. All of those problems are more severe in Haiti than in the Dominican Republic. In Haiti, more urgent than any of those just-mentioned consequences is the problem of the loss of wood for making charcoal, Haiti's main fuel for cooking.

The difference in forest cover between the two countries is paralleled by differences in their economies. Both Haiti and the Dominican Republic are poor countries, suffering from the usual disadvantages of most of the world's other tropical countries that were former European colonies: corrupt or weak governments, serious problems of public health, and lower agricultural productivity than in the temperate zones. On all those counts, though, Haiti's difficulties are much more serious than those of the Dominican Republic. It is the poorest country in the New World, and one of the poorest in the world outside of Africa. Its perennially corrupt government offers minimal public services; much or most of the population lives chronically or periodically without public electricity, water, sewage, medical care, and schooling. Haiti is among the most overpopulated countries of the New World, much more so than the Dominican Republic, with barely one-third of Hispaniola's land area but nearly two-thirds of its population (about 10 million), and an average population density approaching 1,000 per square mile. Most of those people are subsistence farmers. The market economy is modest, consisting principally of some coffee and sugar production for export, a mere 20,000 people employed at low wages in free trade zones making clothing and some other export goods, a few vacation enclaves on the coast where foreign tourists can isolate themselves from Haiti's problems, and a large but unquantified trade in drugs being transshipped from Colombia to the U.S. (That's why Haiti is sometimes referred to as a "narcostate.") There is extreme polarization between the masses of poor people living in rural areas or in the slums of the capital of Port-au-Prince, and a tiny population of rich elite in the cooler mountain suburb of Pétionville a half hour drive from the center of Port-au-Prince, enjoying expensive French restaurants with fine wines. Haiti's rate of population growth, and its rates of infection with AIDS, tuberculosis, and malaria, are among the highest in the New World. The question that all visitors to Haiti ask themselves is whether there is any hope for the country, and the usual answer is "no."

The Dominican Republic is also a developing country sharing Haiti's problems, but it is more developed and the problems are less acute. Per-capita income is five times higher, and the population density and population growth rate are lower. For the past 38 years the Dominican Republic


—Contemporary Hispaniola—
Atlantic Ocean
Cuba
Windward Passage
20°
Yaque River
Cibao Valley
Santiago
Haiti
Central Cordillera
Dominican
Republic
Los Haitises
National Park
Juan B. Perez
National Park
Port-au-Prince
Santo Domingo
Mona Passage
18°
Caribbean Sea
74°
72°
70°
68°
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0 Miles 40 60 80 100
0 Kilometers 100
Florida
Gulf of
Mexico
Atlantic Ocean
Mexico
Cuba
Dominican
Republic
Jamaica
Haiti
Puerto
Rico
Caribbean Sea
Pacific Ocean
South America

has been at least nominally a democracy without any military coup, and with some presidential elections from 1978 onwards resulting in the defeat of the incumbent and the inauguration of a challenger, along with others marred by fraud and intimidation. Within the booming economy, industries earning foreign exchange include an iron and nickel mine, until recently a gold mine, and formerly a bauxite mine; industrial free trade zones that employ 200,000 workers and export overseas; agricultural exports that include coffee, cacao, tobacco, cigars, fresh flowers, and avocados (the Dominican Republic is the world's third largest exporter of avocados); telecommunications; and a large tourist industry. Several dozen dams generate hydroelectric power. As American sports fans know, the Dominican Republic also produces and exports great baseball players. (I wrote the first draft of this chapter in a state of shock, having just watched the great Dominican pitcher Pedro Martínez, pitching for my favorite team the Boston Red Sox, go down to defeat in extra innings at the hands of their nemesis the New York Yankees in the last game of the 2003 American League Championship Series.) Others on the long list of Dominican baseball players who have gone on to achieve fame in the U.S. include the Alou brothers, Joaquín Andujar, George Bell, Adrian Beltre, Rico Carty, Mariano Duncan, Tony Fernández, Pedro Guerrero, Juan Marichal, José Offerman, Tony Peña, Alex Rodríguez, Juan Samuel, Ozzie Virgil, and of course the "*jonrón* king" Sammy Sosa. As one drives along the Dominican Republic's roads, one cannot go far without seeing a road sign pointing to the nearest stadium for *béisbol,* as the sport is known locally.

The contrasts between the two countries are also reflected in their national park systems. That of Haiti is tiny, consisting of just four parks threatened with encroachment by peasants felling the trees to make charcoal. In contrast, the natural reserve system of the Dominican Republic is relatively the most comprehensive and largest in the Americas, encompassing 32% of the country's land area in 74 parks or reserves, and it incorporates all important types of habitat. Of course the system also suffers from an abundance of problems and a deficiency of funding, but it is nevertheless impressive for a poor country with other problems and priorities. Behind the reserve system stands a vigorous indigenous conservation movement with many non-governmental organizations staffed by Dominicans themselves, rather than foisted on the country by foreign advisors.

All those dissimilarities in forest cover, economy, and natural reserve system arose despite the fact that the two countries share the same island. They also share histories of European colonialism and American occupa-

tions, overwhelmingly Catholic religion coexisting with a voodoo pantheon (more notably in Haiti), and mixed African-European ancestry (with a higher proportion of African ancestry in Haiti). For three periods of their history they were joined as a single colony or country.

The differences that exist despite those similarities become even more striking when one reflects that Haiti used to be much richer and more powerful than its neighbor. In the 19th century it launched several major invasions of the Dominican Republic and annexed it for 22 years. Why were the outcomes so different in the two countries, and why was it Haiti rather than the Dominican Republic that went into steep decline? Some environmental differences do exist between the two halves of the island and made some contribution to the outcomes, but that is the smaller part of the explanation. Most of the explanation has instead to do with differences between the two peoples in their histories, attitudes, self-defined identity, and institutions, as well as between their recent leaders of government. For anyone inclined to caricature environmental history as "environmental determinism," the contrasting histories of the Dominican Republic and Haiti provide a useful antidote. Yes, environmental problems do constrain human societies, but the societies' responses also make a difference. So, too, for better or for worse, do the actions and inactions of their leaders.

This chapter will begin by tracing the differing trajectories of political and economic history by which the Dominican Republic and Haiti arrived at their current differences, and the reasons behind those different trajectories. Then I shall discuss the development of Dominican environmental policies, which prove to be a mix of bottom-up and top-down initiatives. The chapter will conclude by examining the current status of environmental problems, the future and hopes of each side of the island, and their effects on each other and on the world.

When Christopher Columbus arrived at Hispaniola during his first transatlantic voyage in the year A.D. 1492, the island had already been settled by Native Americans for about 5,000 years. The occupants in Columbus's time were a group of Arawak Indians called Tainos who lived by farming, were organized into five chiefdoms, and numbered around half a million (the estimates range from 100,000 to 2,000,000). Columbus initially found them peaceful and friendly, until he and his Spaniards began mistreating them.

Unfortunately for the Tainos, they had gold, which the Spanish coveted but didn't want to go to the work of mining themselves. Hence the

conquerors divided up the island and its Indian population among individual Spaniards, who put the Indians to work as virtual slaves, accidentally infected them with Eurasian diseases, and murdered them. By the year 1519, 27 years after Columbus's arrival, that original population of half a million had been reduced to about 11,000, most of whom died that year of smallpox to bring the population down to 3,000, and those survivors gradually died out or became assimilated within the next few decades. That forced the Spaniards to look elsewhere for slave laborers.

Around 1520 the Spaniards discovered that Hispaniola was suitable for growing sugar, and so they began importing slaves from Africa. The island's sugar plantations made it a rich colony for much of the 16th century. However, the Spaniards' interest became diverted from Hispaniola for multiple reasons, including their discovery of far more populous and richer Indian societies on the American mainland, particularly in Mexico, Peru, and Bolivia, offering much larger Indian populations to exploit, politically more advanced societies to take over, and rich silver mines in Bolivia. Hence Spain turned its attention elsewhere and devoted little resources to Hispaniola, especially as buying and transporting slaves from Africa were expensive and as Native Americans could be obtained just for the cost of conquering them. In addition, English, French, and Dutch pirates overran the Caribbean and attacked Spanish settlements on Hispaniola and elsewhere. Spain itself gradually went into political and economic decline, to the benefit of the English, French, and Dutch.

Along with those French pirates, French traders and adventurers built up a settlement at the western end of Hispaniola, far from the eastern part where the Spanish were concentrated. France, now much richer and politically stronger than Spain, invested heavily in importing slaves and developing plantations in its western part of the island, to a degree that the Spanish could not afford, and the histories of the two parts of the island began to diverge. During the 1700s the Spanish colony had a low population, few slaves, and a small economy based on raising cattle and selling their hides, while the French colony had a much larger population, more slaves (700,000 in 1785, compared to only 30,000 in the Spanish part), a proportionately much lower non-slave population (only 10% compared to 85%), and an economy based on sugar plantations. French Saint-Domingue, as it was called, became the richest European colony in the New World and contributed one-quarter of France's wealth.

In 1795, Spain finally ceded its no-longer-valuable eastern part of the island to France, so that Hispaniola became briefly unified under France.

After a slave rebellion broke out in French Saint-Domingue in 1791 and 1801, the French sent an army that was defeated by the slave army plus the effects of heavy losses to diseases. In 1804, having sold its North American holdings to the United States as the Louisiana Purchase, France gave up and abandoned Hispaniola. Not surprisingly, French Hispaniola's former slaves, who renamed their country Haiti (the original Taino Indian name for the island), killed many of Haiti's whites, destroyed the plantations and their infrastructure in order to make it impossible to rebuild the plantation slave system, and divided the plantations into small family farms. While that was what the former slaves wanted for themselves as individuals, it proved in the long run disastrous for Haiti's agricultural productivity, exports, and economy when the farmers received little help from subsequent Haitian governments in their efforts to develop cash crops. Haiti also lost human resources with the killing of much of its white population and the emigration of the remainder.

Nevertheless, at the time Haiti achieved independence in 1804, it was still the richer, stronger, and more populous part of the island. In 1805 the Haitians twice invaded the eastern (former Spanish) part of the island, then known as Santo Domingo. Four years later, at their own request, the Spanish settlers reassumed their status as a colony of Spain, which however governed Santo Domingo ineptly and with so little interest that the settlers declared independence in 1821. They were promptly reannexed by the Haitians, who remained until they were expelled in 1844, after which the Haitians continued to launch invasions to conquer the east into the 1850s.

Thus, as of 1850 Haiti in the west controlled less area than its neighbor but had a larger population, a subsistence farming economy with little exporting, and a population composed of a majority of blacks of African descent and a minority of mulattoes (people of mixed ancestry). Although the mulatto elite spoke French and identified themselves closely with France, Haiti's experience and fear of slavery led to the adoption of a constitution forbidding foreigners to own land or to control means of production through investments. The large majority of Haitians spoke a language of their own that had evolved there from French, termed Creole. The Dominicans in the east had a larger area but smaller population, still had an economy based on cattle, welcomed and offered citizenship to immigrants, and spoke Spanish. Over the course of the 19th century, numerically small but economically significant immigrant groups in the Dominican Republic included Curaçao Jews, Canary Islanders, Lebanese, Palestinians, Cubans, Puerto Ricans, Germans, and Italians, to be joined by Austrian Jews,

Japanese, and more Spaniards after 1930. The political aspect in which Haiti and the Dominican Republic most resembled each other was in their political instability. Coups followed on each other frequently, and control passed or alternated between local leaders with their private armies. Out of Haiti's 22 presidents from 1843 to 1915, 21 were assassinated or driven out of office, while the Dominican Republic between 1844 and 1930 had 50 changes of president, including 30 revolutions. In each part of the island the presidents governed in order to enrich themselves and their followers.

Outside powers viewed and treated Haiti and the Dominican Republic differently. To European eyes, the oversimplified image was of the Dominican Republic as a Spanish-speaking, partly European society receptive to European immigrants and trade, while Haiti was seen as a Creole-speaking African society composed of ex-slaves and hostile to foreigners. With the help of invested capital from Europe and later from the U.S., the Dominican Republic began to develop a market export economy, Haiti far less so. That Dominican economy was based on cacao, tobacco, coffee, and (beginning in the 1870s) sugar plantations, which (ironically) had formerly characterized Haiti rather than the Dominican Republic. But both sides of the island continued to be characterized by political instability. A Dominican president towards the end of the 19th century borrowed and failed to repay so much money from European lenders that France, Italy, Belgium, and Germany all sent warships and threatened to occupy the country in order to collect their debts. To forestall that risk of European occupation, the United States took over the Dominican customs service, the sole source of government revenues, and allocated half of the receipts to pay those foreign debts. During World War I, concerned about risks to the Panama Canal posed by political unrest in the Caribbean, the United States imposed a military occupation on both parts of the island, which lasted from 1915 to 1934 in Haiti and from 1916 to 1924 in the Dominican Republic. Thereafter, both parts quickly reverted to their previous political instability and strife between competing would-be presidents.

Instability in both parts was ended, in the Dominican Republic long before Haiti, by the two most evil dictators in Latin America's long history of evil dictators. Rafael Trujillo was the Dominican chief of the national police and then the head of the army that the U.S. military government established and trained. After he took advantage of that position to get himself elected as president in 1930 and to become dictator, he proceeded to remain in power as a result of being very hardworking, a superior administrator, a shrewd judge of people, a clever politician, and absolutely ruthless—and of

appearing to act in the broad interests of much of Dominican society. He tortured or killed his possible opponents and imposed an all-intrusive police state.

At the same time, in an effort to modernize the Dominican Republic, Trujillo developed the economy, infrastructure, and industries, mostly running the country as his own private business. He and his family eventually came to own or control most of the country's economy. In particular, either directly or through relatives or allies as front men, Trujillo held national monopolies of beef export, cement, chocolate, cigarettes, coffee, insurance, milk, rice, salt, slaughterhouses, tobacco, and wood. He owned or controlled most forestry operations and sugar production, and owned airlines, banks, hotels, much land, and shipping lines. He took for himself a portion of prostitution earnings and 10% of all public employee salaries. He promoted himself ubiquitously: the capital city was renamed from Santo Domingo to Ciudad Trujillo (Trujillo City), the country's highest mountain was renamed from Pico Duarte to Pico Trujillo, the country's educational system inculcated giving thanks to Trujillo, and signs of thanks posted on every public water faucet proclaimed "Trujillo gives water." To reduce the possibility of a successful rebellion or invasion, the Trujillo government spent half of its budget on a huge army, navy, and air force, the largest in the Caribbean area, larger even than those of Mexico.

In the 1950s, however, several developments conspired to cause Trujillo to begin to lose the former support that he had maintained through his combination of terror methods, economic growth, and distributing land to peasants. The economy deteriorated through a combination of government overspending on a festival to celebrate the 25th anniversary of the Trujillo regime, overspending to buy up privately owned sugar mills and electricity plants, a decline in world prices for coffee and other Dominican exports, and a decision to make a major investment in state sugar production that proved economically unsuccessful. The government responded to an unsuccessful Cuban-backed invasion by Dominican exiles in 1959, and to Cuban radio broadcasts encouraging revolt, by increasing arrests, assassinations, and torture. On May 30, 1961, while traveling in a chauffeur-driven unaccompanied car late at night to visit his mistress, Trujillo was ambushed and assassinated in a dramatic car chase and gun battle by Dominicans, apparently with CIA support.

Throughout most of the Trujillo era in the Dominican Republic, Haiti continued to have an unstable succession of presidents until it too in 1957 passed under the control of its own evil dictator, François "Papa Doc"

Duvalier. While a physician and better educated than Trujillo, he proved to be an equally clever and ruthless politician, equally successful in terrorizing his country by secret police, and ended up killing far more of his countrymen than did Trujillo. Papa Doc Duvalier differed from Trujillo in his lack of interest in modernizing his country or in developing an industrial economy for his country or for himself. He died a natural death in 1971, to be succeeded by his son Jean-Claude "Baby Doc" Duvalier, who ruled until forced into exile in 1986.

Since the end of the Duvalier dictatorships, Haiti has resumed its former political instability, and its already weak economy has continued to shrink. It still exports coffee, but the amount exported has remained constant while the population has continued to grow. Its human development index, an index based on a combination of human lifespan and education and standard of living, is the lowest in the world outside Africa. After Trujillo's assassination, the Dominican Republic also remained politically unstable until 1966, including a civil war in 1965 that triggered the arrival again of U.S. marines and the beginning of large-scale Dominican emigration to the U.S. That period of instability ended with the election of Joaquín Balaguer, former president under Trujillo, to the presidency in 1966, helped by ex-Trujillo army officers who carried out a terrorist campaign against the opposing party. Balaguer, a distinctive person whom we shall consider at more length below, continued to dominate Dominican politics for the next 34 years, ruling as president from 1966 to 1978 and again from 1986 until 1996, and exercising much influence even while out of office from 1978 to 1986. His last decisive intervention into Dominican politics, his rescue of the country's natural reserve system, came in the year 2000 at the age of 94, when he was blind, sick, and two years short of his death.

During those post-Trujillo years from 1961 to the present, the Dominican Republic continued to industrialize and modernize. For a time its export economy depended heavily on sugar, which then yielded in importance to mining, free trade zone industrial exports, and non-sugar agricultural exports, as mentioned earlier in this chapter. Also important to the economies of both the Dominican Republic and Haiti has been the export of people. More than a million Haitians and a million Dominicans now living overseas, especially in the United States, send home earnings that account for a significant fraction of the economies of both countries. The Dominican Republic still rates as a poor country (per-capita income only $2,200 per year), but it exhibits many hallmarks of a growing economy that

were obvious during my visit, including a massive construction boom and urban traffic jams.

With that historical background, let's now return to one of those surprising differences with which this chapter began: why did the political, economic, and ecological histories of these two countries sharing the same island unfold so differently?

Part of the answer involves environmental differences. Hispaniola's rains come mainly from the east. Hence the Dominican (eastern) part of the island receives more rain and thus supports higher rates of plant growth. Hispaniola's highest mountains (over 10,000 feet high) are on the Dominican side, and the rivers from those high mountains mainly flow eastwards into the Dominican side. The Dominican side has broad valleys, plains, and plateaus, and much thicker soils; in particular, the Cibao Valley in the north is one of the richest agricultural areas in the world. In contrast, the Haitian side is drier because of that barrier of high mountains blocking rains from the east. Compared to the Dominican Republic, a higher percentage of Haiti's area is mountainous, the area of flat land good for intensive agriculture is much smaller, there is more limestone terrain, and the soils are thinner and less fertile and have a lower capacity for recovery. Note the paradox: the Haitian side of the island was less well endowed environmentally but developed a rich agricultural economy before the Dominican side. The explanation of this paradox is that Haiti's burst of agricultural wealth came at the expense of its environmental capital of forests and soils. This lesson—in effect, that an impressive-looking bank account may conceal a negative cash flow—is a theme to which we shall return in the last chapter.

While those environmental differences did contribute to the different economic trajectories of the two countries, a larger part of the explanation involved social and political differences, of which there were many that eventually penalized the Haitian economy relative to the Dominican economy. In that sense, the differing developments of the two countries were overdetermined: numerous separate factors coincided in tipping the result in the same direction.

One of those social and political differences involved the accident that Haiti was a colony of rich France and became the most valuable colony in France's overseas empire, while the Dominican Republic was a colony of Spain, which by the late 1500s was neglecting Hispaniola and was in eco-

nomic and political decline itself. Hence France could and chose to invest in developing intensive slave-based plantation agriculture in Haiti, which the Spanish could not or chose not to develop in their side of the island. France imported far more slaves into its colony than did Spain. As a result, Haiti had a population seven times higher than its neighbor during colonial times, and it still has a somewhat larger population today, about 10,000,000 versus 8,800,000. But Haiti's area is only slightly more than half of that of the Dominican Republic, so that Haiti with a larger population and smaller area has double the Republic's population density. The combination of that higher population density and lower rainfall was the main factor behind the more rapid deforestation and loss of soil fertility on the Haitian side. In addition, all of those French ships that brought slaves to Haiti returned to Europe with cargos of Haitian timber, so that Haiti's lowlands and mid-mountain slopes had been largely stripped of timber by the mid-19th century.

A second social and political factor is that the Dominican Republic, with its Spanish-speaking population of predominantly European ancestry, was both more receptive and more attractive to European immigrants and investors than was Haiti with its Creole-speaking population composed overwhelmingly of black former slaves. Hence European immigration and investment were negligible and restricted by the constitution in Haiti after 1804 but eventually became important in the Dominican Republic. Those Dominican immigrants included many middle-class businesspeople and skilled professionals who contributed to the country's development. The people of the Dominican Republic even *chose* to resume their status as a Spanish colony from 1812 to 1821, and its president *chose* to make his country a protectorate of Spain from 1861 to 1865.

Still another social difference contributing to the different economies is that, as a legacy of their country's slave history and slave revolt, most Haitians owned their own land, used it to feed themselves, and received no help from their government in developing cash crops for trade with overseas European countries, while the Dominican Republic eventually did develop an export economy and overseas trade. Haiti's elite identified strongly with France rather than with their own landscape, did not acquire land or develop commercial agriculture, and sought mainly to extract wealth from the peasants.

A recent cause of divergence lies in the differing aspirations of the two dictators: Trujillo sought to develop an industrial economy and modern state (for his own benefit), but Duvalier did not. This might perhaps be

viewed just as an idiosyncratic personal difference between the two dictators, but it may also mirror their different societies.

Finally, Haiti's problems of deforestation and poverty compared to those of the Dominican Republic have become compounded within the last 40 years. Because the Dominican Republic retained much forest cover and began to industrialize, the Trujillo regime initially planned, and the regimes of Balaguer and subsequent presidents constructed, dams to generate hydroelectric power. Balaguer launched a crash program to spare forest use for fuel by instead importing propane and liquefied natural gas. But Haiti's poverty forced its people to remain dependent on forest-derived charcoal from fuel, thereby accelerating the destruction of its last remaining forests.

Thus, there were many reasons why deforestation and other environmental problems began earlier, developed over a longer time, and proceeded further in Haiti than in the Dominican Republic. The reasons involved four of the factors in this book's five-factor framework: differences in human environmental impacts, in variously friendly policies or unfriendly policies of other countries, and in responses by the societies and their leaders. Of the case studies described in this book, the contrast between Haiti and the Dominican Republic discussed in this chapter, and the contrast between the fates of the Norse and the Inuit in Greenland discussed in Chapter 8, provide the clearest illustrations that a society's fate lies in its own hands and depends substantially on its own choices.

What about the Dominican Republic's own environmental problems, and what about the countermeasures that it adopted? To use the terminology that I introduced in Chapter 9, Dominican measures to protect the environment began from the bottom up, shifted to top-down control after 1930, and are now a mixture of both. Exploitation of valuable trees in the Republic increased in the 1860s and 1870s, resulting already then in some local depletion or extinction of valuable tree species. Rates of deforestation increased in the late 19th century due to forest clearance for sugar plantations and other cash crops, then continued to increase in the early 20th century as the demand for wood for railroad ties and for incipient urbanization rose. Soon after 1900 we encounter the first mentions of damage to forest in low-rainfall areas from harvesting wood for fuel, and of contamination of streams by agricultural activities along their banks. The first municipal regulation prohibiting logging and the contamination of streams was passed in 1901.

Bottom-up environmental protection was launched in a serious way between 1919 and 1930 in the area around Santiago, the Republic's second largest city and the center of its richest and most heavily exploited agricultural area. The lawyer Juan Bautista Pérez Rancier and the physician and surveyor Miguel Canela y Lázaro, struck by the sequence of logging and its associated road network leading to agricultural settlement and watershed damage, lobbied the Santiago Chamber of Commerce to buy land as a forest reserve, and they also sought to raise the necessary funds by public subscription. Success was achieved in 1927, when the Republic's secretary of agriculture contributed additional government funds to make possible the purchase of the first natural reserve, the Vedado del Yaque. The Yaque River is the country's largest river, and a *vedado* is an area of land to which entry is controlled or forbidden.

After 1930, the dictator Trujillo shifted the impetus for environmental management to a top-down approach. His regime expanded the area of the Vedado del Yaque, created other *vedados,* established in 1934 the first national park, set up a corps of forest guards to enforce protection of forests, suppressed the wasteful use of fire to burn forest in order to clear land for agriculture, and banned the cutting of pine trees without his permission in the area around Constanza in the Central Cordillera. Trujillo undertook these measures in the name of environmental protection, but he was probably motivated more strongly by economic considerations, including his own personal economic advantage. In 1937 his regime commissioned a famous Puerto Rican environmental scientist, Dr. Carlos Chardón, to survey the Dominican Republic's natural resources (its agricultural, mineral, and forestry potential). In particular, Chardón calculated the commercial logging potential of the Republic's pine forest, by far the most extensive pine forest in the Caribbean, to be around $40,000,000, a large sum in those days. On the basis of that report, Trujillo himself became involved in logging of pines, and came to own large areas of pine forest and to be the joint owner of the country's main sawmills. In their logging operations, Trujillo's foresters adopted the environmentally sound measure of leaving some mature trees standing as sources of seed for natural reforestation, and those big old trees can still be recognized today in the regenerated forest. Environmental measures under Trujillo in the 1950s included commissioning a Swedish study of the Republic's potential for building dams for hydroelectric power, the planning of such dams, the convening of the country's first environmental congress in 1958, and the establishment of more na-

tional parks, at least partly to protect watersheds that would be important for hydroelectric power generation.

Under his dictatorship, Trujillo (as usual, often acting with family members and allies as front men) carried out extensive logging himself, but his dictatorial government prevented others from logging and establishing unauthorized settlements. After Trujillo's death in 1961, that wall against widespread pillaging of the Dominican environment fell. Squatters occupied land and used forest fires to clear woodlands for agriculture; a disorganized large-scale immigration from the countryside into urban barrios sprung up; and four wealthy families of the Santiago area began logging at a rate faster than the rate under Trujillo. Two years after Trujillo's death, the democratically elected President Juan Bosch attempted to persuade loggers to spare the pine forests so that they could remain as watersheds for the planned Yaque and Nizao dams, but the loggers instead joined with other interests to overthrow Bosch. Rates of logging accelerated until the election of Joaquín Balaguer as president in 1966.

Balaguer recognized the country's urgent need for maintaining forested watersheds in order to meet the Republic's energy requirements through hydroelectric power, and to ensure a supply of water sufficient for industrial and domestic needs. Soon after becoming president, he took drastic action by banning all commercial logging in the country, and by closing all of the country's sawmills. That action provoked strong resistance by rich powerful families, who responded by pulling back their logging operations out of public view into more remote areas of forests, and by operating their sawmills at night. Balaguer reacted with the even more drastic step of taking responsibility for enforcing forest protection away from the Department of Agriculture, turning it over to the armed forces, and declaring illegal logging to be a crime against state security. To stop logging, the armed forces initiated a program of survey flights and military operations, which climaxed in 1967 in one of the landmark events of Dominican environmental history, a night raid by the military on a clandestine large logging camp. In the ensuing gunfight a dozen loggers were killed. That strong signal served as a shock to the loggers. While some illegal logging continued, it was met with further raids and shootings of loggers, and it decreased greatly during Balaguer's first period as president (1966 to 1978, comprising three consecutive terms in office).

That was only one of a host of Balaguer's far-reaching environmental measures. Some of the others were as follows. During the eight years when

Balaguer was out of office from 1978 to 1986, other presidents reopened some logging camps and sawmills, and allowed charcoal production from forests to increase. On the first day of his return to the presidency in 1986, Balaguer began issuing executive orders to close logging camps and sawmills again, and on the next day he deployed military helicopters to detect illegal logging and intrusions into national parks. Military operations resumed to capture and imprison loggers, and to remove poor squatters, plus rich agribusinesses and mansions (some of them belonging to Balaguer's own friends), from the parks. The most notorious of those operations took place in 1992 in Los Haitises National Park, 90% of whose forest had been destroyed; the army expelled thousands of squatters. In a further such operation two years later, personally directed by Balaguer, the army drove bulldozers through luxury houses built by wealthy Dominicans within Juan B. Pérez National Park. Balaguer banned the use of fire as an agricultural method, and even passed a law (which proved difficult to enforce) that every fence post should consist of live rooted trees rather than felled timber. As two sets of measures to undermine demand for Dominican tree products and to replace them with something else, he opened the market to wood imports from Chile, Honduras, and the U.S. (thereby eliminating most demand for Dominican timber in the country's stores); and he reduced traditional charcoal production from trees (the curse of Haiti) by contracting for liquefied natural gas imports from Venezuela, building several terminals to import that gas, subsidizing the cost of gas to the public to outcompete charcoal, and calling for the distribution without cost of propane stoves and cylinders in order to encourage people to shift from charcoal. He greatly expanded the natural reserve system, declared the country's first two coastal national parks, added two submerged banks in the ocean to Dominican territory as humpback whale sanctuaries, protected land within 20 yards of rivers and within 60 yards of the coast, protected wetlands, signed the Rio convention on the environment, and banned hunting for 10 years. He put pressure on industries to treat their wastes, launched with limited success some efforts to control air pollution, and slapped a big tax on mining companies. Among the many environmentally damaging proposals that he opposed or blocked were projects for a road to the port of Sanchez through a national park, a north–south road over the Central Cordillera, an international airport at Santiago, a superport, and a dam at Madrigal. He refused to repair an existing road over the highlands, with the result that it became nearly unusable. In Santa Domingo he founded the Aquarium, the Botanical Garden, and the Natural

History Museum and rebuilt the National Zoo, all of which have become major attractions.

As Balaguer's final political act at the age of 94, he teamed up with President-elect Mejia to block President Fernández's plan to reduce and weaken the natural reserve system. Balaguer and Mejia achieved that goal by a clever legislative maneuver in which they amended President Fernández's proposal with a rider that converted the natural reserve system from one existing only by executive order (hence subject to alterations such as those proposed by Fernández), to one established instead by law, in the condition that it had existed in 1996 at the close of Balaguer's last presidency and before Fernández's maneuvers. Thus, Balaguer ended his political career by saving the reserve system to which he had devoted so much attention.

All of those actions by Balaguer climaxed the era of top-down environmental management in the Dominican Republic. In the same era, bottom-up efforts also resumed after vanishing under Trujillo. During the 1970s and 1980s scientists did much inventorying of the country's coastal, marine, and terrestrial natural resources. As Dominicans slowly relearned the methods of private civic participation after decades without it under Trujillo, the 1980s saw the founding of many non-governmental organizations, including several dozen environmental organizations that have become increasingly effective. In contrast to the situation in many developing countries, where environmental efforts are mainly developed by affiliates of international environmental organizations, the bottom-up impetus in the Dominican Republic has come from local NGOs concerned with the environment. Along with universities and with the Dominican Academy of Sciences, these NGOs have now become the leaders of a homegrown Dominican environmental movement.

Why did Balaguer push such a broad range of measures on behalf of the environment? To many of us, it is difficult to reconcile that apparently strong and far-sighted commitment to the environment with his repellent qualities. For 31 years he served under dictator Rafael Trujillo and defended Trujillo's massacres of Haitians in 1937. He ended up as Trujillo's puppet president, but he also served Trujillo in positions where he exercised influence, such as secretary of state. Anyone willing to work with such an evil person as Trujillo immediately becomes suspect and tarnished by association. Balaguer also accumulated his own list of evil deeds after Trujillo's death—deeds that can be blamed only on Balaguer himself. While he won

the presidency honestly in the election of 1986, he resorted to fraud, violence, and intimidation to secure his election in 1966 and his reelection in 1970, 1974, 1990, and 1994. He operated his own squads of thugs to assassinate hundreds or perhaps thousands of members of the opposition. He ordered many forced removals of poor people from national parks, and he ordered or tolerated the shooting of illegal loggers. He tolerated widespread corruption. He belonged to Latin America's tradition of political strongmen or *caudillos*. Among the quotes attributed to him is: "The constitution is nothing more than a piece of paper."

Chapters 14 and 15 of this book will discuss the often-complicated reasons why people do or don't pursue environmentalist policies. While I was visiting the Dominican Republic, I was especially interested in learning, from those who had known Balaguer personally or lived through his presidencies, what could have motivated him. I asked every Dominican whom I interviewed their views of him. Among the 20 Dominicans whom I interviewed at length, I got 20 different answers. Many of them were people who had the strongest possible personal motives for loathing Balaguer: they had been imprisoned by him, or had been imprisoned and tortured by the Trujillo government that he served, or had close relatives and friends who had been killed.

Among this divergence of opinion, there were nevertheless numerous points mentioned independently by many of my informants. Balaguer was described as almost uniquely complex and puzzling. He wanted political power, and his pursuit of policies in which he believed was tempered by concern not to do things that would cost him his power (but he still often pushed dangerously close to that limit of losing power through unpopular policies). He was an extremely skilled, cynical, practical politician whose ability nobody else in the last 42 years of Dominican political history has come remotely close to matching, and who exemplified the adjective "Machiavellian." He constantly maintained a delicate balancing act between the military, the masses, and competing scheming groups of elites; he succeeded in forestalling military coups against him by fragmenting the military into competing groups; and he was able to inspire such fear even in military officers abusing forests and national parks that, in the sequel to a famous unplanned confrontation recorded on television in 1994, I was told that an army colonel who had opposed Balaguer's forest protection measures and whom Balaguer angrily summoned ended up urinating in his trousers in terror. In the picturesque words of one historian whom I interviewed, "Balaguer was a snake who shed and changed his skin as needed."

Under Balaguer there was a great deal of corruption that he tolerated, but he himself was not corrupt nor interested in personal wealth, unlike Trujillo. In his own words, "Corruption stops at the door of my office."

Finally, as one Dominican who had been both imprisoned and tortured summed it up for me, "Balaguer was an evil, but a necessary evil at that stage in Dominican history." By that phrase, my informant meant that, at the time Trujillo was assassinated in 1961, there were many Dominicans both overseas and in the country with worthy aspirations, but none of them had a fraction of Balaguer's practical experience in government. Through his actions, he is credited with having consolidated the Dominican middle class, Dominican capitalism, and the country as it exists today, and with having presided over a major improvement in the Dominican economy. Those outcomes inclined many Dominicans to put up with Balaguer's evil qualities.

In response to my question why Balaguer pursued his environmentalist policies, I encountered much more disagreement. Some Dominicans told me that they thought it was just a sham, either to win votes or to polish his international image. One person viewed Balaguer's evictions of squatters from national parks as just part of a broad plot to move peasants out of remote forests where they might hatch a pro-Castro rebellion; to depopulate public lands that could eventually be redeveloped as resorts owned by rich Dominicans, rich overseas resort developers, or military people; and to cement Balaguer's ties with the military.

While there may be some substance to all of those suspected motives, nevertheless the wide range of Balaguer's environmental actions, and the public unpopularity of some of them and public disinterest in others, make it difficult for me to view his policies as just a sham. Some of his environmental actions, especially his use of the military to relocate squatters, made him look very bad, cost him votes (albeit buffered by his rigging of elections), and cost him support of powerful members of the elite and military (although many others of his policies gained him their support). In the case of many of his environmental measures that I listed, I cannot discern a possible connection to wealthy resort developers, counterinsurgency measures, or currying favor with the army. Instead, Balaguer, as an experienced practical politician, seems to have pursued pro-environment policies as vigorously as he could get away with it, without losing too many votes or too many influential supporters or provoking a military coup against him.

Another issue raised by some of the Dominicans whom I interviewed was that Balaguer's environmental policies were selective, sometimes inef-

fective, and exhibited blind spots. He allowed his supporters to do things destructive to the environment, such as damaging riverbeds by extracting rock, gravel, sand, and other building materials. Some of his laws, such as those against hunting and air pollution and fence poles, didn't work. He sometimes drew back if he encountered opposition to his policies. An especially serious failing of his as an environmentalist was that he neglected to harmonize the needs of rural farmers with environmental concerns, and he could have done much more to foster popular support for the environment. But he still managed to undertake more diverse and more radical pro-environment actions than any other Dominican politician, or indeed than most modern politicians known to me in other countries.

On reflection, it seems to me that the most likely interpretation of Balaguer's policies is that he really did care about the environment, as he claimed. He mentioned it in almost every speech; he said that conserving forests, rivers, and mountains had been his dream since his childhood; and he stressed it in his first speeches on becoming president in 1966 and again in 1986, and in his last (1994) reinaugural speech. When President Fernández asserted that devoting 32% of the country's territory to protected areas was excessive, Balaguer responded that the whole country should be a protected area. But as for how he arrived at his pro-environment views, no two people gave me the same opinion. One person said that Balaguer might have been influenced by exposure to environmentalists during early years in his life that he spent in Europe; one noted that Balaguer was consistently anti-Haitian, and that he may have sought to improve the Dominican Republic's landscape in order to contrast it with Haiti's devastation; another thought that he had been influenced by his sisters, to whom he was close, and who were said to have been horrified by the deforestation and river siltation that they saw resulting from the Trujillo years; and still another person commented that Balaguer was already 60 years old when he ascended to the post-Trujillo presidency and 90 years old when he stepped down from it, so that he might have been motivated by the changes that he saw around him in his country during his long life.

I don't know the answers to these questions about Balaguer. Part of our problem in understanding him may be our own unrealistic expectations. We may subconsciously expect people to be homogeneously "good" or "bad," as if there were a single quality of virtue that should shine through every aspect of a person's behavior. If we find people virtuous or admirable in one respect, it troubles us to find them not so in another respect. It is difficult for us to acknowledge that people are not consistent, but are instead

mosaics of traits formed by different sets of experiences that often do not correlate with each other.

We may also be troubled that, if we really acknowledge Balaguer as an environmentalist, his evil traits would unfairly tarnish environmentalism. Yet, as one friend said to me, "Adolf Hitler loved dogs and brushed his teeth, but that doesn't mean that we should hate dogs and stop brushing our teeth." I also have to reflect on my own experiences while working in Indonesia from 1979 to 1996 under its military dictatorship. I loathed and feared that dictatorship because of its policies, and also for personal reasons: especially because of the things that it did to many of my New Guinea friends, and because of its soldiers almost killing me. I was therefore surprised to find that that dictatorship set up a comprehensive and effective national park system in Indonesian New Guinea. I arrived in Indonesian New Guinea after years of experience in the democracy of Papua New Guinea, and I expected to find environmental policies much more advanced under the virtuous democracy than under the evil dictatorship. Instead, I had to acknowledge that the reverse was true.

None of the Dominicans to whom I talked claimed to understand Balaguer. In referring to him, they used phrases such as "full of paradoxes," "controversial," and "enigmatic." One person applied to Balaguer the phrase that Winston Churchill used to describe Russia: "a riddle wrapped in a mystery inside an enigma." The struggle to understand Balaguer reminds me that history, as well as life itself, is complicated; neither life nor history is an enterprise for those who seek simplicity and consistency.

In light of that history of environmental impacts in the Dominican Republic, what is the current status of the country's environmental problems, and of its natural reserve system? The major problems fall into eight of the list of 12 categories of environmental problems that will be summarized in Chapter 16: problems involving forests, marine resources, soil, water, toxic substances, alien species, population growth, and population impact.

Deforestation of the pine forests became locally heavy under Trujillo, and then rampant in the five years immediately following his assassination. Balaguer's ban on logging was relaxed under some other recent presidents. The exodus of Dominicans from rural areas to the cities and overseas has decreased pressure on the forests, but deforestation is continuing especially near the Haitian border, where desperate Haitians cross the border from their almost completely deforested country in order to fell trees for

making charcoal and for clearing land to farm as squatters on the Dominican side. In the year 2000, the enforcement of forest protection reverted from the armed forces to the Ministry of the Environment, which is weaker and lacks the necessary funds, so that forest protection is now less effective than it was from 1967 to 2000.

Along most of the Republic's coastline, marine habitats and coral reefs have been heavily damaged and overfished.

Soil loss by erosion on deforested land has been massive. There is concern about that erosion leading to sediment buildup in the reservoirs behind the dams used to generate the country's hydroelectric power. Salinization has developed in some irrigated areas, such as at the Barahona Sugar Plantation.

Water quality in the country's rivers is now very poor because of sediment buildup from erosion, as well as toxic pollution and waste disposal. Rivers that until a few decades ago were clean and safe for swimming are now brown with sediment and unswimmable. Industries dump their wastes into streams, as do residents of urban barrios with inadequate or non-existent public waste disposal. Riverbeds have been heavily damaged by industrial dredging to extract materials for the construction industry.

Beginning in the 1970s, there have been massive applications of toxic pesticides, insecticides, and herbicides in rich agricultural areas, such as the Cibao Valley. The Dominican Republic has continued to use toxins that were banned in their overseas countries of manufacture long ago. That toxin use has been tolerated by the government, because Dominican agriculture is so profitable. Workers in rural areas, even children, routinely apply toxic agricultural products without face or hand protection. As a result, effects of agricultural toxins on human health have now been well documented. I was struck by the near-absence of birds in the Cibao Valley's rich agricultural areas: if the toxins are so bad for birds, they presumably are also bad for people. Other toxic problems arise from the large Falconbridge iron/nickel mine, whose smoke fills the air along parts of the highway between the country's two largest cities (Santo Domingo and Santiago). The Rosario gold mine has been temporarily closed down because the country lacks the technology to treat the mine's cyanide and acid effluents. Both Santo Domingo and Santiago have smog, resulting from mass transit using obsolete vehicles, increased energy consumption, and the abundance of private generators that people maintain in their homes and businesses because of the frequent power failures of the public electricity systems. (I experienced several power failures each day that I was in Santo Domingo, and af-

ter my return my Dominican friends wrote me that they were now suffering under 21-hour blackouts.)

As for alien species, in order to reforest logged lands and hurricane-damaged lands in recent decades, the country has resorted to alien tree species that grow more quickly than does the slow-growing native Dominican pine. Among the alien species that I saw in abundance were Honduras pine, casuarinas, several species of acacias, and teak. Some of those alien species have prospered, while others have failed. They raise concern because some of them are prone to diseases to which the native Dominican pine is resistant, so that reforested slopes could lose their cover again if their trees are attacked by disease.

While the country's rate of population increase has decreased, it is estimated as still around 1.6% per year.

More serious than the country's growing population is its rapidly growing per-capita human impact. (By that term, which will recur in the remainder of this book, I mean the average resource consumption and waste production of one person: much higher for modern First World citizens than for modern Third World citizens or for any people in the past. A society's total impact equals its per-capita impact multiplied by its number of people.) Overseas trips by Dominicans, visits to the country by tourists, and television make people well aware of the higher standard of living in Puerto Rico and the United States. Billboards advertising consumer products are everywhere, and I saw street vendors selling cell telephone equipment and CDs at any major intersection in the cities. The country is becoming increasingly dedicated to a consumerism that is not currently supported by the economy and resources of the Dominican Republic itself, and that depends partly on earnings sent home by Dominicans working overseas. All of those people acquiring large amounts of consumer products are putting out correspondingly large amounts of wastes that overwhelm municipal waste disposal systems. One can see the trash accumulating in the streams, along roads, along city streets, and in the countryside. As one Dominican said to me, "The apocalypse here will not take the form of an earthquake or hurricane, but of a world buried in garbage."

The country's natural reserve system of protected areas directly addresses all of these threats except for population growth and consumer impact. The system is a comprehensive one that consists of 74 reserves of various types (national parks, protected marine reserves, and so on) and covers a third of the country's land area. That is an impressive achievement for a densely populated small and poor country whose per-capita income is

only one-tenth that of the United States. Equally impressive is that that reserve system was not urged and designed by international environmental organizations but by Dominican NGOs. In my discussions at three of these Dominican organizations—the Academy of Sciences in Santo Domingo, the Fundación Moscoso Puello, and the Santo Domingo branch of The Nature Conservancy (the latter unique among my Dominican contacts in being affiliated with an international organization rather than purely local)—without exception every staff member whom I met was a Dominican. That situation contrasts with the situation to which I have become accustomed in Papua New Guinea, Indonesia, the Solomon Islands, and other developing countries, where scientists from overseas hold key positions and also serve as visiting consultants.

What about the future of the Dominican Republic? Will the reserve system survive under the pressures that it faces? Is there hope for the country?

On these questions I again encountered divergence of opinion among even my Dominican friends. Reasons for environmental pessimism begin with the fact that the reserve system is no longer backed by the iron fist of Joaquín Balaguer. It is underfunded, underpoliced, and has been only weakly supported by recent presidents, some of whom have tried to trim its area or even to sell it. The universities are staffed by few well-trained scientists, so that they in turn cannot educate a cadre of well-trained students. The government provides negligible support for scientific studies. Some of my friends were concerned that the Dominican reserves are turning into parks that exist more on paper than in reality.

On the other hand, a major reason for environmental optimism is the country's growing, well-organized, bottom-up environmental movement that is almost unprecedented in the developing world. It is willing and able to challenge the government; some of my friends in the NGOs were sent to jail for those challenges but won their release and resumed their challenges. The Dominican environmental movement is as determined and effective as in any other country with which I am familiar. Thus, as elsewhere in the world, I see in the Dominican Republic what one friend described as "an exponentially accelerating horse race of unpredictable outcome" between destructive and constructive forces. Both the threats to the environment, and the environmental movement opposing those threats, are gathering strength in the Dominican Republic, and we cannot foresee which will eventually prevail.

Similarly, the prospects of the country's economy and society arouse divergence of opinion. Five of my Dominican friends are now deeply pessimistic, virtually without hope. They feel especially discouraged by the weakness and corruptness of recent governments seemingly interested only in helping the ruling politicians and their friends, and by recent severe setbacks to the Dominican economy. Those setbacks include the virtually complete collapse of the formerly dominant sugar export market, the devaluation of the currency, increasing competition from other countries with lower labor costs for producing free trade zone export products, the collapses of two major banks, and government overborrowing and overspending. Consumerist aspirations are rampant and beyond levels that the country could support. In the opinion of my most pessimistic friends, the Dominican Republic is slipping downhill in the direction of Haiti's grinding desperation, but it is slipping more rapidly than Haiti did: the descent into economic decline that stretched over a century and a half in Haiti will be accomplished within a few decades in the Dominican Republic. According to this view, the Republic's capital city of Santo Domingo will come to rival the misery of Haiti's capital of Port-au-Prince, where most of the population lives below the poverty level in slums lacking public services, while the rich elite sip their French wines in their separate suburb.

That's the worst-case scenario. Others of my Dominican friends responded that they have seen governments come and go over the last 40 years. Yes, they said, the current government is especially weak and corrupt, but it will surely lose the next election, and all of the candidates to become the next president seem preferable to the current president. (In fact, the government did lose the election a few months after that conversation.) Fundamental facts about the Dominican Republic brightening its prospects are that it is a small country in which environmental problems become readily visible to everybody. It is also a "face-to-face society" where concerned and knowledgeable private individuals outside the government have ready access to government ministers, unlike the situation in the United States. Perhaps most important of all, one has to remember that the Dominican Republic is a resilient country that has survived a history of problems far more daunting than its present ones. It survived 22 years of Haitian occupation, then an almost uninterrupted succession of weak or corrupt presidents from 1844 until 1916 and again from 1924 to 1930, and American military occupations from 1916 to 1924 and from 1965 to 1966. It succeeded in rebuilding itself after 31 years under Rafael Trujillo, one of the most evil and destructive dictators in the world's recent history. From the

year 1900 to 2000, the Dominican Republic underwent more dramatic socioeconomic change than did almost any other country in the New World.

Because of globalization, what happens to the Dominican Republic affects not only Dominicans but also the rest of the world. It especially affects the United States lying only 600 miles away, and already home to a million Dominicans. New York City now supports the second largest Dominican population of any city in the world, second only to the Republic's own capital of Santo Domingo. There are also large overseas Dominican populations in Canada, the Netherlands, Spain, and Venezuela. The U.S. has already experienced how events in the Caribbean country immediately west of Hispaniola, namely, Cuba, threatened our survival in 1962. Hence the U.S. has a lot at stake in whether the Dominican Republic succeeds in solving its problems.

What about the future of Haiti? Already the poorest and one of the most overcrowded countries in the New World, Haiti is nevertheless continuing to become even poorer and more crowded, with a population growth rate of nearly 3% per year. Haiti is so poor, and so deficient in natural resources and in trained or educated human resources, that it really is difficult to see what might bring about improvement. If one instead looks to the outside world to help through government foreign aid, NGO initiatives, or private efforts, Haiti even lacks the capacity to utilize outside assistance effectively. For instance, the USAID program has put money into Haiti at seven times the rate at which it has put money into the Dominican Republic, but the results in Haiti have still been much more meager, because of the country's deficiency in people and organizations of its own that could utilize the aid. Everyone familiar with Haiti whom I asked about its prospects used the words "no hope" in their answer. Most of them answered simply that they saw no hope. Those who did see hope began by acknowledging that they were in a minority and that most people saw no hope, but they themselves then went on to name some reason why they clung to hope, such as the possibilities of reforestation spreading out from Haiti's existing small forest reserves, the existence of two agricultural areas in Haiti that do produce surplus food for internal export to the capital of Port-au-Prince and the tourist enclaves on the north coast, and Haiti's remarkable achievement in abolishing its army without descending into a constant morass of secession movements and local militias.

Just as the Dominican Republic's future affects others because of global-

ization, Haiti also affects others through globalization. Just as with Dominicans, that effect of globalization includes the effects of Haitians living overseas—in the United States, Cuba, Mexico, South America, Canada, the Bahamas, the Lesser Antilles, and France. Even more important, though, is the "globalization" of Haiti's problems within the island of Hispaniola, through Haiti's effects on the neighboring Dominican Republic. Near the Dominican border, Haitians commute from their homes to the Dominican side for jobs that at least provide them with meals, and for wood fuel to bring back to their deforested homes. Haitian squatters try to eke out a living as farmers on Dominican land near the border, even on poor-quality land that Dominican farmers scorn. More than a million people of Haitian background live and work in the Dominican Republic, mostly illegally, attracted by the better economic opportunities and greater availability of land in the Dominican Republic, even though the latter itself is a poor country. Hence the exodus of over a million Dominicans overseas has been matched by the arrival of as many Haitians, who now constitute about 12% of the population. Haitians take low-paying and hard jobs that few Dominicans currently want for themselves—especially in the construction industry, as agricultural workers, doing the back-breaking and painful work of cutting sugarcane, in the tourist industry, as watchmen, as domestic workers, and operating bicycle transport (pedaling bicycles while carrying and balancing huge quantities of goods for sale or delivery). The Dominican economy utilizes those Haitians as low-paid laborers, but Dominicans are reluctant in return to provide education, medical care, and housing when they are strapped for funds to provide those public services to themselves. Dominicans and Haitians in the Dominican Republic are divided not only economically but also culturally: they speak different languages, dress differently, eat different foods, and on the average look differently (Haitians tending to be darker-skinned and more African in appearance).

As I listened to my Dominican friends describing the situation of Haitians in the Dominican Republic, I became astonished by the close parallels with the situation of illegal immigrants from Mexico and other Latin American countries in the United States. I heard those sentences about "jobs that Dominicans don't want," "low-paying jobs but still better than what's available for them at home," "those Haitians bring AIDS, TB, and malaria," "they speak a different language and look darker-skinned," and "we have no obligation and can't afford to provide medical care, education, and housing to illegal immigrants." In those sentences, all I had to do was

to replace the words "Haitians" and "Dominicans" with "Latin American immigrants" and "American citizens," and the result would be a typical expression of American attitudes towards Latin American immigrants.

At the present rate at which Dominicans are leaving the Dominican Republic for the U.S. and Puerto Rico while Haitians are leaving Haiti for the Dominican Republic, the Republic is becoming a nation with an increasing Haitian minority, just as many parts of the United States are becoming increasingly "Hispanic" (i.e., Latin American). That makes it in the vital interests of the Dominican Republic for Haiti to solve its problems, just as it is in the vital interests of the United States for Latin America to solve its own problems. The Dominican Republic is affected more by Haiti than by any other country in the world.

Might the Dominican Republic play a constructive role in Haiti's future? At first glance, the Republic looks like a very unlikely source of solutions to Haiti's problems. The Republic is poor and has enough problems helping its own citizens. The two countries are separated by that cultural gulf that includes different languages and different self-images. There is a long, deeply rooted tradition of antagonism on both sides, with many Dominicans viewing Haiti as part of Africa and looking down on Haitians, and with many Haitians in turn suspicious of foreign meddling. Haitians and Dominicans cannot forget the history of cruelties that each country inflicted on the other. Dominicans remember Haiti's invasions of the Dominican Republic in the 19th century, including the 22-year occupation (forgetting that occupation's positive aspects, such as its abolition of slavery). Haitians remember Trujillo's worst single atrocity, his ordering the slaughter (by machete) of all 20,000 Haitians living in the northwestern Dominican Republic and parts of the Cibao Valley between October 2 and October 8, 1937. Today, there is little collaboration between the two governments, which tend to view each other warily or with hostility.

But none of these considerations changes two fundamental facts: that the Dominican environment merges continuously into the Haitian environment, and that Haiti is the country with the strongest effect upon the Dominican Republic. Some signs of collaboration between the two are starting to emerge. For example, while I was in the Dominican Republic, for the first time a group of Dominican scientists was about to travel to Haiti for joint meetings with Haitian scientists, and a return visit of the Haitian scientists to Santo Domingo was already scheduled. If the lot of Haiti is to improve at all, I don't see how that could happen without more involvement on the part of the Dominican Republic, even though that is undesired

and almost unthinkable to most Dominicans today. Ultimately, though, for the Republic not to be involved with Haiti is even more unthinkable. While the Republic's own resources are scarce, at minimum it could assume a larger role as a bridge, in ways to be explored, between the outside world and Haiti.

Will Dominicans come to share those views? In the past, the Dominican people have accomplished feats much more difficult than becoming constructively engaged with Haiti. Among the many unknowns hanging over the futures of my Dominican friends, I see that as the biggest one.

CHAPTER 12

China, Lurching Giant

China's significance ■ Background ■ Air, water, soil ■ Habitat, species, megaprojects ■ Consequences ■ Connections ■ The future ■

China is the world's most populous country, with about 1,300,000,000 people, or one-fifth of the world's total. In area it is the third largest country, and in plant species diversity the third richest. Its economy, already huge, is growing at the fastest rate of any major country: nearly 10% per year, which is four times the growth rate of First World economies. It has the world's highest production rate of steel, cement, aquacultured food, and television sets; both the highest production and the highest consumption of coal, fertilizers, and tobacco; it stands near the top in production of electricity and (soon) motor vehicles, and in consumption of timber; and it is now building the world's largest dam and largest water-diversion project.

Marring these superlatives and achievements, China's environmental problems are among the most severe of any major country, and are getting worse. The long list ranges from air pollution, biodiversity losses, cropland losses, desertification, disappearing wetlands, grassland degradation, and increasing scale and frequency of human-induced natural disasters, to invasive species, overgrazing, river flow cessation, salinization, soil erosion, trash accumulation, and water pollution and shortages. These and other environmental problems are causing enormous economic losses, social conflicts, and health problems within China. All these considerations alone would suffice to make the impact of China's environmental problems on just the Chinese people a subject of major concern.

But China's large population, economy, and area also guarantee that its environmental problems will not remain a domestic issue but will spill over to the rest of the world, which is increasingly affected through sharing the same planet, oceans, and atmosphere with China, and which in turn affects China's environment through globalization. China's recent entry into the World Trade Organization will expand those exchanges with other countries. For instance, China is already the largest contributor of sulfur oxides,

chlorofluorocarbons, other ozone-depleting substances, and (soon) carbon dioxide to the atmosphere; its dust and aerial pollutants are transported eastwards in the atmosphere to neighboring countries and even to North America; and it is one of the two leading importers of tropical rainforest timber, making it a driving force behind tropical deforestation.

Even more important than all those other impacts will be the proportionate increase in total human impact on the world's environments if China, with its large population, succeeds in its goal of achieving First World living standards—which also means catching up to the First World's per-capita environmental impact. As we shall see in this chapter and again in Chapter 16, those differences between First and Third World living standards, and the efforts of China and other developing countries to close that gap, have big consequences that unfortunately are usually ignored. China will also illustrate other themes of this book: the dozen groups of environmental problems facing the modern world, to be detailed in Chapter 16, and all of them serious or extreme in China; the effects of modern globalization on environmental problems; the importance of environmental issues for even the biggest of all modern societies, and not just for the small societies selected as illustrations in most of my book's other chapters; and realistic grounds for hope, despite a barrage of depressing statistics. After setting out some brief background information about China, I shall discuss the types of Chinese environmental impacts, their consequences for the Chinese people and for the rest of the world, and China's responses and future prognosis.

Let's begin with a quick overview of China's geography, population trends, and economy (map, p. 361). The Chinese environment is complex and locally fragile. Its diverse geography includes the world's highest plateau, some of the world's highest mountains, two of the world's longest rivers (the Yangtze and Yellow Rivers), many lakes, a long coastline, and a large continental shelf. Its diverse habitats range from glaciers and deserts to tropical rainforests. Within those ecosystems lie areas fragile for different reasons: for example, northern China has highly variable rainfall, plus simultaneous occurrences of winds and droughts, that make its high-altitude grasslands susceptible to dust storms and soil erosion, while conversely southern China is wet but has heavy rainstorms that cause erosion on slopes.

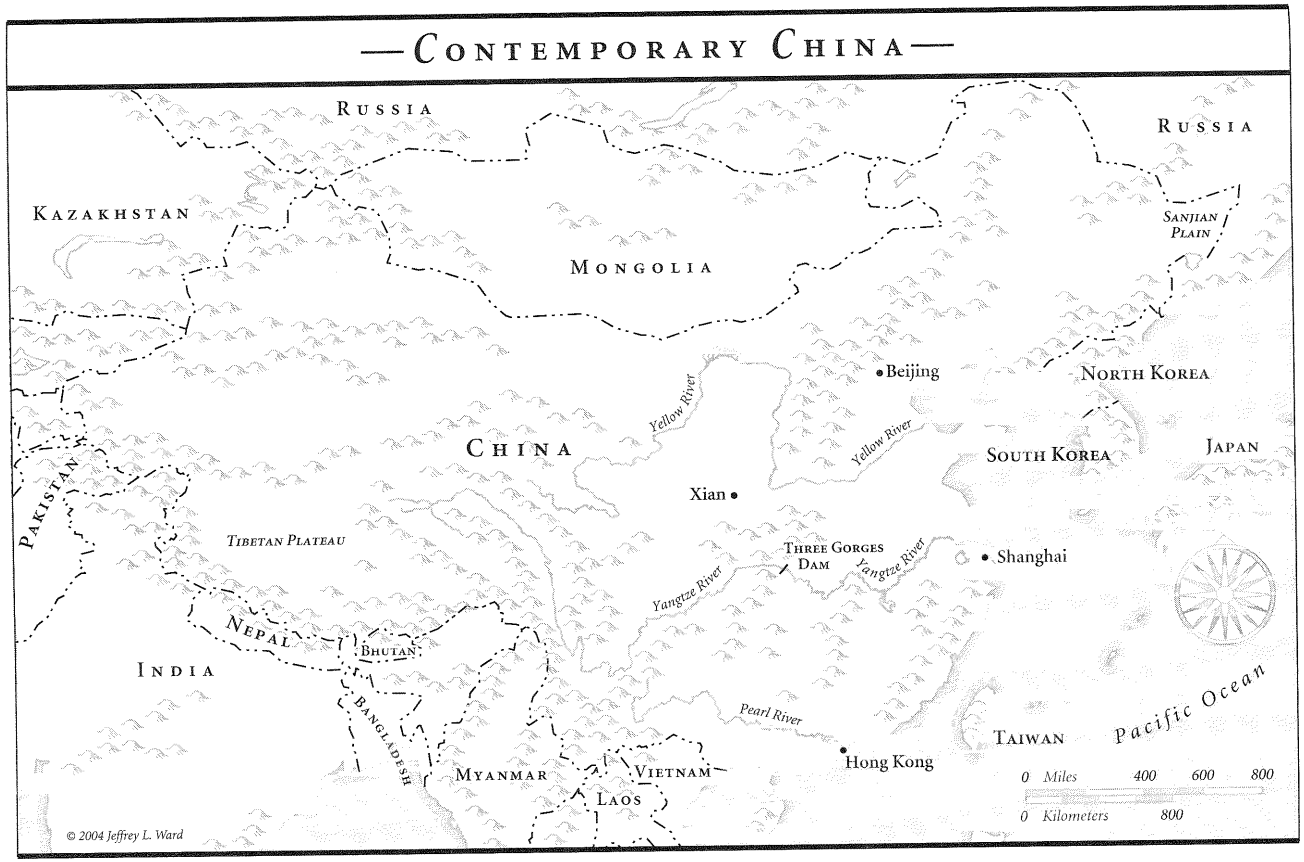
As for China's population, the two best-known facts about it are that it is the world's largest, and that the Chinese government (uniquely in the

modern world) instituted mandatory fertility control that dramatically decreased the population growth rate to 1.3% per year by the year 2001. That raises the question whether China's decision will be imitated by other countries, some of which, while recoiling in horror at that solution, may thereby find themselves drifting into even worse solutions to their population problems.

Less well known, but with significant consequences for China's human impacts, is that the number of China's households has nevertheless been growing at 3.5% per year over the last 15 years, more than double the growth rate of its population during the same period. That's because household size decreased from 4.5 people per house in 1985 to 3.5 in 2000 and is projected to decrease further to 2.7 by the year 2015. That decreased household size causes China today to have 80 million *more* households than it would otherwise have had, an increase exceeding the total number of households in Russia. The household size decrease results from social changes: especially, population aging, fewer children per couple, an increase in previously nearly non-existent divorce, and a decline in the former custom of multi-generation households with grandparents, parents, and children living under one roof. At the same time, per-capita floor area per house increased by nearly three-fold. The net result of those increases in the number and floor area of households is that China's human impact is increasing despite its low population growth rate.

The remaining feature of China's population trends worth stressing is rapid urbanization. From 1953 to 2001, while China's total population "only" doubled, the percentage of its population that is urban tripled from 13 to 38%, hence the urban population increased seven-fold to nearly half a billion. The number of cities quintupled to almost 700, and existing cities increased greatly in area.

For China's economy, the simplest short descriptor is "big and fast-growing." China is the world's largest producer and consumer of coal, accounting for one-quarter of the world's total. It is also the world's largest producer and consumer of fertilizer, accounting for 20% of world use, and for 90% of the global increase in fertilizer use since 1981, thanks to a quintupling of its own fertilizer use, now three times the world average per acre. As the second largest producer and consumer of pesticides, China accounts for 14% of the world total and has become a net exporter of pesticides. On top of that, China is the largest producer of steel, the largest user of agricultural films for mulching, the second largest producer of electricity and chemical textiles, and the third largest oil consumer. In the last two decades,


Contemporary China
Russia
Kazakhstan
Mongolia
Russia
Sanjian Plain
Beijing
North Korea
China
Yellow River
Yellow River
South Korea
Japan
Xian
Pakistan
Tibetan Plateau
Three Gorges Dam
Yangtze River
Yangtze River
Shanghai
Nepal
Bhutan
India
Bangladesh
Pearl River
Taiwan
Pacific Ocean
Hong Kong
Myanmar
Vietnam
Laos
0 Miles 400 600 800
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while its production of steel, steel products, cement, plastics, and chemical fiber were increasing 5-, 7, 10-, 19-, and 30-fold respectively, its washing machine output increased 34,000 times.

Pork used to be overwhelmingly the main meat in China. With increasing affluence, demand for beef, lamb, and chicken products has increased rapidly, to the point where per-capita egg consumption now equals that of the First World. Per-capita consumption of meat, eggs, and milk increased four-fold between 1978 and 2001. That means much more agricultural waste, because it takes 10 or 20 pounds of plants to produce one pound of meat. The annual output of animal droppings on land is already three times the output of industrial solid wastes, to which should be added the increase in fish droppings and fish food and fertilizer for aquaculture, tending to increase terrestrial and aquatic pollution respectively.

China's transportation network and vehicle fleet have grown explosively. Between 1952 and 1997 the length of railroads, motor roads, and airline routes increased 2.5-, 10-, and 108-fold. The number of motor vehicles (mostly trucks and buses) increased 15-fold between 1980 and 2001, cars 130-fold. In 1994, after the number of motor vehicles had increased 9 times, China decided to make car production one of its four so-called pillar industries, with the goal of increasing production (now especially of cars) by another factor of 4 by the year 2010. That would make China the world's third largest vehicle manufacturing country, after the U.S. and Japan. Considering how bad the air quality already is in Beijing and other cities, due mostly to motor vehicles, it will be interesting to see what urban air quality is like in 2010. The planned increase in motor vehicles will also impact the environment by requiring more land conversion into roads and parking lots.

Behind those impressive statistics on the scale and growth of China's economy lurks the fact that much of it is based on outdated, inefficient, or polluting technology. China's energy efficiency in industrial production is only half that of the First World; its paper production consumes more than twice as much water as in the First World; and its irrigation relies on inefficient surface methods responsible for water wastage, soil nutrient losses, eutrophication, and river sediment loads. Three-quarters of China's energy consumption depends on coal, the main cause of its air pollution and acid rain and a significant cause of inefficiency. For instance, China's coal-based production of ammonia, required for fertilizer and textile manufacture, consumes 42 times more water than natural-gas-based ammonia production in the First World.

Another distinctive inefficient feature of China's economy is its rapidly

expanding small-scale rural economy: its so-called township and village enterprises, or TVEs, with an average of only six employees per enterprise, and especially involved in construction and in producing paper, pesticides, and fertilizer. They account for one-third of China's production and half of its exports but contribute disproportionately to pollution in the form of sulfur dioxide, waste water, and solid wastes. Hence in 1995 the government declared an emergency and banned or closed 15 of the worst-polluting types of small-scale TVEs.

China's history of environmental impacts has gone through phases. Even already by several thousand years ago, there was large-scale deforestation. After the end of World War II and the Chinese Civil War, the return of peace in 1949 brought more deforestation, overgrazing, and soil erosion. The years of the Great Leap Forward, from 1958 to 1965, saw a chaotic increase in the number of factories (a four-fold increase in the two-year period 1957–1959 alone!), accompanied by still more deforestation (to obtain the fuel needed for inefficient backyard steel production) and pollution. During the Cultural Revolution of 1966–1976, pollution spread still further, as many factories were relocated to deep valleys and high mountains from coastal areas considered vulnerable in case of war. Since economic reform began in 1978, environmental degradation has continued to increase or accelerate. China's environmental problems can be summarized under six main headings: air, water, soil, habitat destruction, biodiversity losses, and megaprojects.

To begin with China's most notorious pollution problem, its air quality is dreadful, symbolized by now-familiar photographs of people having to wear face masks on the streets of many Chinese cities (Plate 25). Air pollution in some cities is the worst in the world, with pollutant levels several times higher than levels considered safe for people's health. Pollutants such as nitrogen oxides and carbon dioxide are rising due to the increasing numbers of motor vehicles and the coal-dominated energy generation. Acid rain, confined in the 1980s to just a few areas in the southwest and south, has spread over much of the country and is now experienced in one-quarter of Chinese cities for more than half of the rainy days each year.

Similarly, water quality in most Chinese rivers and groundwater sources is poor and declining, due to industrial and municipal waste water discharges, and agricultural and aquacultural runoffs of fertilizers, pesticides, and manure causing widespread eutrophication. (That term refers to

growth of excessive algal concentrations as a result of all that nutrient runoff.) About 75% of Chinese lakes, and almost all coastal seas, are polluted. Red tides in China's seas—blooms of plankton whose toxins are poisonous to fish and other ocean animals—have increased to nearly 100 per year, from only one in every five years in the 1960s. The famous Guanting Reservoir in Beijing was declared unsuitable for drinking in 1997. Only 20% of domestic waste water is treated, as compared to 80% in the First World.

Those water problems are exacerbated by shortages and waste. By world standards, China is poor in fresh water, with a quantity per person only one-quarter of the world average value. Making matters worse, even that little water is unevenly distributed, with North China having only one-fifth the per-capita water supply of South China. That underlying water shortage, plus wasteful use, causes over 100 cities to suffer from severe water shortages and occasionally even halts industrial production. Of the water required for cities and for irrigation, two-thirds depends on groundwater pumped from wells tapping aquifers. However, those aquifers are becoming depleted, permitting seawater to enter them in most coastal areas, and causing land to sink under some cities as the aquifers are becoming empty. China also already has the world's worst problem of cessation of river flows, and that problem is becoming much worse because water continues to be drawn from rivers for use. For instance, between 1972 and 1997 there were flow stoppages on the lower Yellow River (China's second longest river) in 20 out of the 25 years, and the number of days without any flow increased from 10 days in 1988 to the astonishing total of 230 days in 1997. Even on the Yangtze and Pearl Rivers in wetter South China, flow cessation happens during the dry season and impedes ship navigation.

China's soil problems start with its being one of the world's countries most severely damaged by erosion (Plate 26), now affecting 19% of its land area and resulting in soil loss at 5 billion tons per year. Erosion is especially devastating on the Loess Plateau (the middle stretch of the Yellow River, about 70% of the plateau eroded), and increasingly on the Yangtze River, whose sediment discharge from erosion exceeds the confined discharges of the Nile and Amazon, the world's two longest rivers. By filling up China's rivers (as well as its reservoirs and lakes), sediment has shortened China's navigable river channels by 50% and restricted the size of ships that can use them. Soil quality and fertility as well as soil quantity have declined, partly because of long-term fertilizer use plus pesticide-related drastic declines in soil-renewing earthworms, thereby causing a 50% decrease in the area of crop-

land considered to be of high quality. Salinization, whose causes will be discussed in detail in the next chapter (Chapter 13) on Australia, has affected 9% of China's lands, mainly due to poor design and management of irrigation systems in dry areas. (This is one environmental problem that government programs have made good progress in combating and starting to reverse.) Desertification, due to overgrazing and land reclamation for agriculture, has affected more than one-quarter of China, destroying about 15% of North China's area remaining for agriculture and pastoralism within the last decade.

All of these soil problems—erosion, fertility losses, salinization, and desertification—have joined urbanization and land appropriation for mining, forestry, and aquaculture in reducing China's area of cropland. That poses a big problem for China's food security, because at the same time as its cropland has been declining, its population and per-capita food consumption have been increasing, and its area of potentially cultivatable land is limited. Cropland per person is now only one hectare, barely half of the world average, and nearly as low as the value for Northwest Rwanda discussed in Chapter 10. In addition, because China recycles very little trash, huge quantities of industrial and domestic trash are dumped into open fields, polluting soil and taking over or damaging cropland. More than two-thirds of China's cities are now surrounded by trash whose composition has changed dramatically from vegetable leftovers, dust, and coal residues to plastics, glass, metal, and wrapping paper. As my Dominican friends envisioned for their country's future (Chapter 11), a world buried in garbage will figure prominently in China's future as well.

Discussions of habitat destruction in China begin with deforestation. China is one of the world's most forest-poor countries, with only 0.3 acres of forest per person compared to a world average of 1.6, and with forests covering only 16% of China's land area (compared to 74% of Japan's). While government efforts have increased the area of single-species tree plantations and thereby slightly increased the total area considered forested, natural forests, especially old-growth forests, have been shrinking. That deforestation is a major contributor to China's soil erosion and floods. After the great floods of 1996 had caused $25 billion in damages, the even bigger 1998 floods that affected 240 million people (one-fifth of China's population) shocked the government into action, including the banning of any further logging of

natural forests. Along with climate change, deforestation has probably contributed to China's increasing frequency of droughts, which now affect 30% of its cropland each year.

The other two most serious forms of habitat destruction in China besides deforestation are destruction or degradation of grasslands and wetlands. China is second only to Australia in the extent of its natural grasslands, which cover 40% of its area, mainly in the drier north. However, because of China's large population, that translates into a per-capita grassland area less than half of the world average. China's grasslands have been subject to severe damage by overgrazing, climate change, and mining and other types of development, so that 90% of China's grasslands are now considered degraded. Grass production per hectare has decreased by about 40% since the 1950s, and weeds and poisonous grass species have spread at the expense of high-quality grass species. All that degradation of grassland has implications extending beyond the mere usefulness to China of grassland for food production, because China's grasslands of the Tibetan Plateau (the world's largest high-altitude plateau) are the headwaters for major rivers of India, Pakistan, Bangladesh, Thailand, Laos, Cambodia, and Vietnam as well as of China. For example, grassland degradation has increased the frequency and severity of floods on China's Yellow and Yangtze Rivers, and has also increased the frequency and severity of dust storms in eastern China (notably in Beijing, as seen by television viewers around the world).

Wetlands have been decreasing in area, their water level has been fluctuating greatly, their capacity to mitigate floods and to store water has decreased, and wetland species have become endangered or extinct. For example, 60% of the swamps in the Sanjian Plain in the northeast, the area with China's largest freshwater swamps, have already been converted to farmland, and at the present ongoing rate of drainage the 8,000 square miles remaining of those swamps will disappear within 20 years.

Other biodiversity losses with big economic consequences include the severe degradation of both freshwater and coastal marine fisheries by overfishing and pollution, because fish consumption is rising with growing affluence. Per-capita consumption increased nearly five-fold in the past 25 years, and to that domestic consumption must be added China's growing exports of fish, molluscs, and other aquatic species. As a result, the white sturgeon has been pushed to the brink of extinction, the formerly robust Bohai prawn harvest declined 90%, formerly abundant fish species like the yellow croaker and hairtail must now be imported, the annual take of wild

fish in the Yangtze River has declined 75%, and that river had to be closed to fishing for the first time ever in 2003. More generally, China's biodiversity is very high, with over 10% of the world's plant and terrestrial vertebrate species. However, about one-fifth of China's native species (including its best-known one, the Giant Panda) are now endangered, and many other distinctive rare ones (such as Chinese Alligators and ginkgos) are already at risk of extinction.

The flip side of these declines in native species has been a rise in invasive species. China has had a long history of intentionally introducing species considered beneficial. Now, with the recent 60-fold increase in international trade, those intentional introductions are being joined by accidental introductions of many species that no one would consider beneficial. For example, in Shanghai Harbor alone between 1986 and 1990, examination of imported materials carried by 349 ships from 30 countries revealed as contaminants almost 200 species of foreign weeds. Some of those invasive plants, insects, and fish have gone on to establish themselves as pests and weeds causing huge economic damage to Chinese agriculture, aquaculture, forestry, and livestock production.

If all that were not enough, under way in China are the world's largest development projects, all expected to cause severe environmental problems. The Three Gorges Dam of the Yangtze River—the world's largest dam, started in 1993 and projected for completion in 2009—aims to provide electricity, flood control, and improved navigation at a financial cost of $30 billion, social costs of uprooting millions of people, and environmental costs associated with soil erosion and the disruption of a major ecosystem (that of the world's third longest river). Still more expensive is the South-to-North Water Diversion Project, which began in 2002, is not scheduled for completion until around 2050, and is projected to cost $59 billion, to spread pollution, and to cause water imbalance in China's longest river. Even that project will be exceeded by the projected development of currently underdeveloped western China, making up over half of the country's land area and viewed by China's leaders as the key to national development.

Let's now pause to distinguish, as elsewhere in this book, between consequences for animals and plants by themselves, and consequences for people. Recent developments in China are clearly bad news for Chinese earthworms and yellow croakers, but how much difference does it all make for Chinese

people? The consequences for them can be partitioned into economic costs, health costs, and exposure to natural disasters. Here are some estimates or examples for each of those three categories.

As examples of economic costs, let's start with small ones and proceed to larger ones. A small cost is the mere $72 million per year being spent to curb the spread of a single weed, the alligator weed that was introduced from Brazil as pig forage and escaped to infest gardens, sweet potato fields, and citrus groves. Also a bargain is the annual loss of just $250 million arising from factory closures due to water shortages in a single city, Xian. Sandstorms inflict damage of about $540 million per year, and losses of crops and forests due to acid rain amount to about $730 million per year. More serious are the $6 billion costs of the "green wall" of trees being built to shield Beijing against sand and dust, and the $7 billion per year of losses created by pest species other than alligator weed. We enter the zone of impressive numbers when we consider the onetime cost of the 1996 floods ($27 billion, but still cheaper than the 1998 floods), the annual direct losses due to desertification ($42 billion), and the annual losses due to water and air pollution ($54 billion). The combination of the latter two items alone costs China the equivalent of 14% of its gross domestic product each year.

Three items may be selected to give an indication of health consequences. Average blood lead levels in Chinese city-dwellers are nearly double the levels considered elsewhere in the world to be dangerously high and to put at risk the mental development of children. About 300,000 deaths per year, and $54 billion of health costs (8% of the gross national product), are attributed to air pollution. Smoking deaths amount to about 730,000 per year and are rising, because China is the world's largest consumer and producer of tobacco and is home to the most smokers (320 million of them, one-quarter of the world's total, smoking an average of 1,800 cigarettes per year per person).

China is noted for the frequency, number, extent, and damage of its natural disasters. Some of these—especially dust storms, landslides, droughts, and floods—are closely related to human environmental impacts and have become more frequent as those impacts have increased. For instance, dust storms have increased in frequency and severity as more land has been laid bare by deforestation, overgrazing, erosion, and partly human-caused droughts. From A.D. 300 to 1950 dust storms used to afflict northwestern China on the average once every 31 years; from 1950 to 1990, once every 20 months; and since 1990, almost every year. The huge dust storm of May 5, 1993, killed about a hundred people. Droughts have increased

because of deforestation interrupting the rain-producing natural hydrological cycle, and perhaps also because of the draining and overuse of lakes and wetlands and hence the decrease in water surfaces for evaporation. The area of cropland damaged each year by droughts is now about 60,000 square miles, double the annual area damaged in the 1950s. Flooding has greatly increased because of deforestation; the 1996 and 1998 floods were the worst in recent memory. The alternating occurrence of droughts and floods has also become more frequent and is more damaging than either disaster alone, because droughts first destroy vegetation cover, then floods on bare ground cause worse erosion than would have been the case otherwise.

Even if China's people had no connection through trade and travel with people elsewhere, China's large territory and population would guarantee effects on other peoples merely because China is releasing its wastes and gases into the same ocean and atmosphere. But China's connections to the rest of the world through trade, investment, and foreign aid have been accelerating almost exponentially in the last two decades, although trade (now $621 billion per year) was negligible before 1980 and foreign investment in China still negligible as recently as 1991. Among other consequences, the development of export trade has been a driving force behind increased pollution in China, because the highly polluting and inefficient little rural industries (the TVEs) that produce half of China's exports in effect ship their finished products abroad but leave behind their pollutants in China. In 1991 China became the country annually receiving the second highest amount of foreign investment behind the U.S., and in 2002 China moved into first place by receiving record investments of $53 billion. Foreign aid between 1981 and 2000 included $100 million from international NGOs, a large sum as measured by NGO budgets but a paltry amount compared to China's other sources: half a billion dollars from the United Nations Development program, $10 billion from Japan's International Development Agency, $11 billion from the Asian Development Bank, and $24 billion from the World Bank.

All of those transfers of money contribute to fueling China's rapid economic growth and environmental degradation. Let's now consider other ways in which the rest of the world influences China, then how China influences the rest of the world. These reciprocal influences are aspects of the modern buzzword "globalization," which is important for the purposes of

this book. The interconnectedness of societies in today's world causes some of the most important differences (to be explored in Chapter 16) between how environmental problems played out in the past on Easter Island or among the Maya and Anasazi, and how they play out today.

Among the bad things that China receives from the rest of the world, I already mentioned economically damaging invasive species. Another large-scale import that will surprise readers is garbage (Plate 27). Some First World countries reduce their mountains of garbage by paying China to accept untreated garbage, including wastes containing toxic chemicals. In addition, China's expanding manufacturing economy and industries accept garbage/scrap that could serve as cheap sources of recoverable raw materials. Just to take one item as an example, in September 2002 a Chinese customs office in Zhejiang Province recorded a 400-ton shipment of "electronic garbage" originating from the U.S., and consisting of scrap electronic equipment and parts such as broken or obsolete color TV sets, computer monitors, photocopiers, and keyboards. While statistics on the amount of such garbage imported are inevitably incomplete, available numbers show an increase from one million to 11 million tons from 1990 to 1997, and an increase in First World garbage transshipped to China via Hong Kong from 2.3 to over 3 million tons per year from 1998 to 2002. This represents direct transfer of pollution from the First World to China.

Even worse than garbage, while many foreign companies have helped China's environment by transferring advanced technology to China, others have hurt it by transferring pollution-intensive industries (PIIs), including technologies now illegal in the country of origin. Some of these technologies are then in turn transferred from China to still less developed countries. As one example, in 1992 the technology for producing Fuyaman, a pesticide against aphids banned in Japan 17 years earlier, was sold to a Sino-Japanese joint company in Fujian Province, where it proceeded to poison and kill many people and to cause serious environmental pollution. In Guangdong Province alone the amount of ozone-destroying chlorofluorocarbons imported by foreign investors reached 1,800 tons in 1996, thereby making it more difficult for China to eliminate its contribution to world ozone destruction. As of 1995, China was home to an estimated 16,998 PII firms with a combined industrial product of about $50 billion.

Turning now from China's imports to its exports in a broad sense, China's high native biodiversity means that China gives back to other countries many invasive species that were already well adapted to competing in China's species-rich environment. For instance, the three best-known pests

that have wiped out numerous North American tree populations—the chestnut blight, the misnamed "Dutch" elm disease, and the Asian long-horned beetle—all originated in China or else somewhere nearby in East Asia. Chestnut blight already wiped out native chestnut trees in the U.S.; Dutch elm disease has been eliminating the elm trees that used to be a hallmark of New England towns while I was growing up there over 60 years ago; and the Asian long-horned beetle, first discovered in the U.S. in 1996 attacking maple and ash trees, has the potential for causing U.S. tree losses of up to $41 billion, more than those due to the other two of those pests combined. Another recent arrival, China's grass carp, is now established in rivers and lakes of 45 U.S. states, where it competes with native fish species and causes large changes in aquatic plant, plankton, and invertebrate communities. Still another species of which China has an abundant population, which has large ecological and economic impacts, and which China is exporting in increasing numbers is *Homo sapiens.* For instance, China has now moved into third place as a source of legal immigration into Australia (Chapter 13), and significant numbers of illegal as well as legal immigrants crossing the Pacific Ocean reach even the U.S.

While inadvertently or intentionally exported Chinese insects, freshwater fish, and people reach overseas countries by ship and plane, other inadvertent exports arrive in the atmosphere. China became the world's largest producer and consumer of gaseous ozone-depleting substances, such as chlorofluorocarbons, after First World countries phased them out in 1995. China also now contributes to the atmosphere 12% of the world's carbon dioxide emissions that play a major role in global warming. If current trends continue—emissions rising in China, steady in the U.S., declining elsewhere—China will become the world's leader in carbon dioxide emissions, accounting for 40% of the world's total, by the year 2050. China already leads the world in production of sulfur oxides, with an output double that of the U.S. Propelled eastwards by winds, the pollutant-laden dust, sand, and soil originating from China's deserts, degraded pastures, and fallow farmland get blown to Korea, Japan, Pacific islands, and across the Pacific within a week to the U.S. and Canada. Those aerial particles are the result of China's coal-burning economy, deforestation, overgrazing, erosion, and destructive agricultural methods.

The next exchange between China and other countries involves an import doubling as an export: imported timber, hence exported deforestation. China ranks third in the world in timber consumption, because wood provides 40% of the nation's rural energy in the form of firewood, and provides

almost all the raw material for the paper and pulp industry and also the panels and lumber for the construction industry. But a growing gap has been developing between China's increasing demand for wood products and its declining domestic supply, especially since the national logging ban went into effect after the floods of 1998. Hence China's wood imports have increased six-fold since the ban. As an importer of tropical lumber from countries on all three continents that span the tropics (especially from Malaysia, Gabon, Papua New Guinea, and Brazil), China now stands second only to Japan, which it is rapidly overtaking. It also imports timber from the temperate zone, especially from Russia, New Zealand, the U.S., Germany, and Australia. With China's entrance into the World Trade Organization, those timber imports are expected to increase even more, because tariffs on wood products are about to be reduced from a rate of 15–20% to 2–3%. In effect, this means that China, like Japan, will be conserving its own forests, but only by exporting deforestation to other countries, several of which (including Malaysia, Papua New Guinea, and Australia) have already reached or are on the road to catastrophic deforestation.

Potentially more important than all of these other impacts is a rarely discussed consequence of the aspirations of China's people, like other people in developing countries, to a First World lifestyle. That abstract phrase means many specific things to an individual Third World citizen: acquiring a house, appliances, utensils, clothes, and consumer products manufactured commercially by energy-consuming processes, not made at home or locally by hand; having access to manufactured modern medicines, and to doctors and dentists educated and equipped at much expense; eating abundant food grown at high production rates with synthetic fertilizers, not with animal manure or plant mulches; eating some industrially processed food; traveling by motor vehicle (preferably one's own car), not by walking or bicycle; and having access to other products manufactured elsewhere and arriving by motor vehicle transport, not just to local products carried to consumers. All Third World peoples of whom I am aware—even those trying to retain or re-create some of their traditional lifestyle—also value at least some elements of this First World lifestyle.

The global consequences of everybody aspiring to the lifestyle currently enjoyed by First World citizens are well illustrated by China, because it combines the world's largest population with the fastest-growing economy. Total productions or consumptions are products of population sizes times per-capita production or consumption rates. For China, those total productions are already high because of its huge population, and despite its per-

capita rates still being very low: for instance, only 9% of per-capita consumption rates of the leading industrial countries in the case of four major industrial metals (steel, aluminum, copper, and lead). But China is progressing rapidly towards its goal of achieving a First World economy. If China's per-capita consumption rates do rise to First World levels, and even if nothing else about the world changed—e.g., even if population and production/consumption rates everywhere else remained unchanged—then that production/consumption rate increase alone would translate (as multiplied by China's population) into an increase in total *world* production or consumption of 94% in that same case of industrial metals. In other words, China's achievement of First World standards will approximately double the entire world's human resource use and environmental impact. But it is doubtful whether even the world's current human resource use and impact can be sustained. Something has to give way. That is the strongest reason why China's problems automatically become the world's problems.

China's leaders used to believe that humans can and should conquer Nature, that environmental damage was a problem affecting only capitalist societies, and that socialist societies were immune to it. Now, facing overwhelming signs of China's own severe environmental problems, they know better. The shift in thinking began as early as 1972, when China sent a delegation to the First United Nations Conference on the Human Environment. The year 1973 saw the establishment of the government's so-called Leading Group for Environmental Protection, which morphed in 1998 (the year of the great floods) into the State Environmental Protection Administration. In 1983 environmental protection was declared a basic national principle—in theory. In reality, although much effort has been made to control environmental degradation, economic development still takes priority and remains the chief criterion for evaluating government officials' performance. Many environmental protection laws and policies that have been adopted on paper are not effectively implemented or enforced.

What does the future hold for China? Of course, the same question arises everywhere in the world: the development of environmental problems is accelerating, the development of attempted solutions is also accelerating, which horse will win the race? In China this question has special urgency, not only because of China's already-discussed scale and impact on the world, but also because of a feature of Chinese history that may be termed "lurching." (I use this term in its neutral strict sense of "swaying

suddenly from side to side," not in its pejorative sense of the gait of a drunk person.) By this metaphor, I am thinking of what seems to me the most distinctive feature of Chinese history, which I discussed in my earlier book *Guns, Germs, and Steel.* Because of geographic factors—such as China's relatively smooth coastline, its lack of major peninsulas as large as Italy and Spain/Portugal, its lack of major islands as large as Britain and Ireland, and its parallel-flowing major rivers—China's geographic core was unified already in 221 B.C. and has remained unified for most of the time since then, whereas geographically fragmented Europe has never been unified politically. That unity enabled China's rulers to command changes over a larger area than any European ruler could ever command—both changes for the better, and changes for the worse, often in rapid alternation (hence "lurching"). China's unity and decisions by emperors may contribute to explaining why China at the time of Renaissance Europe developed the world's best and largest ships, sent fleets to India and Africa, and then dismantled those fleets and left overseas colonization to much smaller European states; and why China began, and then did not pursue, its own incipient industrial revolution.

The strengths and risks of China's unity have persisted into recent times, as China continues to lurch on major policies affecting its environment and its population. On the one hand, China's leaders have been able to solve problems on a scale scarcely possible for European and American leaders: for instance, by mandating a one-child policy to reduce population growth, and by ending logging nationally in 1998. On the other hand, China's leaders have also succeeded in creating messes on a scale scarcely possible for European and American leaders: for instance, by the chaotic transition of the Great Leap Forward, by dismantling the national educational system in the Cultural Revolution, and (some would say) by the emerging environmental impacts of the three megaprojects.

As for the outcome of China's current environmental problems, all one can say for sure is that things will get worse before they get better, because of time lags and the momentum of damage already under way. One big factor acting both for the worse and for the better is the anticipated increase in China's international trade as a result of its joining the World Trade Organization (WTO), thereby lowering or abolishing tariffs and increasing exports and imports of cars, textiles, agricultural products, and many other commodities. Already, China's export industries tend to send manufactured finished products overseas and to leave in China the pollutants involved in their manufacture; there will presumably now be more of that. Some of

China's imports, such as garbage and cars, have already been bad for the environment; there may be more of that too. On the other hand, some countries belonging to the WTO adhere to environmental standards much stricter than China's, and that will force China to adopt those international standards as a condition of its exports being admitted by those countries. More agricultural imports may permit China to decrease its use of fertilizers, pesticides, and low-productivity cropland, while importation of oil and natural gas will let China decrease pollution from its burning of coals. A two-edged consequence of WTO membership may be that, by increasing imports and thereby decreasing Chinese domestic production, it will merely enable China to transfer environmental damage from China itself to overseas, as has already happened in the shift from domestic logging to imported timber (thereby in effect paying countries other than China to suffer the harmful consequences of deforestation).

A pessimist will note many dangers and bad harbingers already operating in China. Among generalized dangers, economic growth rather than environmental protection or sustainability is still China's priority. Public environmental awareness is low, in part because of China's low investment in education, less than half that of First World countries as a proportion of gross national production. With 20% of the world's population, China accounts for only 1% of the world's outlay on education. A college or university education for children is beyond the means of most Chinese parents, because one year's tuition would consume the average salary of one city worker or three rural workers. China's existing environmental laws were largely written piecemeal, lack effective implementation and evaluation of long-term consequences, and are in need of a systems approach: for instance, there is no overall framework for protection of China's rapidly vanishing wetlands, despite individual laws affecting them. Local officials of China's State Environmental Protection Administration (SEPA) are appointed by local governments rather than by upper-level officials of the SEPA itself, so that local governments often block enforcement of national environmental laws and regulations. Prices for important environmental resources are set so low as to encourage waste: e.g., a ton of Yellow River water for use in irrigation costs only between $^1/_{10}$ and $^1/_{100}$ of a small bottle of spring water, thereby removing any financial incentive for irrigation farmers to conserve water. Land is owned by the government and is leased by farmers, but may be leased to a series of different farmers within a short time span, so that farmers lack incentive to make long-term investments in their land or to take good care of it.

The Chinese environment also faces more specific dangers. Already under way are a big increase in the number of cars, the three megaprojects, and the rapid disappearance of wetlands, whose harmful consequences will continue to accumulate in the future. The projected decrease in Chinese household size to 2.7 people by the year 2015 will add 126 million new households (more than the total number of U.S. households), even if China's population size itself remains constant. With growing affluence and hence growing meat and fish consumption, environmental problems from meat production and aquaculture, such as pollution from all the animal and fish droppings and eutrophication from uneaten feed for fish, will increase. Already, China is the world's largest producer of aquaculture-grown food, and is the sole country in which more fish and aquatic foods are obtained from aquaculture than from wild fisheries. The world consequences of China's catching up to First World levels of meat consumption exemplify the broader issue, which I already illustrated by metal consumption, of the current gap between per-capita First World and Third World consumption and production rates. China will of course not tolerate being told not to aspire to First World levels. But the world cannot sustain China and other Third World countries and current First World countries all operating at First World levels.

Offsetting all of those dangers and discouraging signs, there are also important promising signs. Both WTO membership and the impending 2008 Olympic Games in China have spurred the Chinese government to pay more attention to environmental problems. For instance, a $6 billion "green wall" or tree belt is now under development around Beijing to protect the city against dust and sandstorms. To reduce air pollution in Beijing, its city government ordered that motor vehicles be converted to permit the use of natural gas and liquefied petroleum gas. China phased out lead in gasoline in little more than a year, something that Europe and the U.S. took many years to achieve. It recently decided to establish fuel efficiency minima for automobiles, including even SUVs. New cars are required to meet exacting emission standards prevailing in Europe.

China is already making a big effort to protect its outstanding biodiversity with 1,757 nature reserves covering 13% of its land area, not to mention all of its zoos, botanical gardens, wildlife breeding centers, museums, and gene and cell banks. China uses some distinctive, environmentally friendly, traditional technologies on a large scale, such as the common South Chinese practice of raising fish in irrigated rice fields. That recycles the fish droppings as natural fertilizer, increases rice production, uses fish to control

insect pests and weeds, decreases herbicide and pesticide and synthetic fertilizer use, and yields more dietary protein and carbohydrate without increasing environmental damage. Encouraging signs in reafforestation are the initiation of major tree plantations in 1978, and in 1998 the national ban on logging and the start of the Natural Forest Conservation Program to reduce the risk of further destructive flooding. Since 1990, China has combatted desertification on 15,000 square miles of land by reafforestation and fixation of sand dunes. The Grain-to-Green program, begun in 2000, gives grain subsidies to farmers who convert cropland to forest or grassland, and is thereby reducing the use of environmentally sensitive steep hillsides for agriculture.

How will it all end up? Like the rest of the world, China is lurching between accelerating environmental damage and accelerating environmental protection. China's large population and large growing economy, and its current and historic centralization, mean that China's lurches involve more momentum than those of any other country. The outcome will affect not just China, but the whole world as well. While I was writing this chapter, I found my own feelings lurching between despair at the mind-numbing litany of depressing details, and hope inspired by the drastic and rapidly implemented measures of environmental protection that China has already adopted. Because of China's size and its unique form of government, top-down decision-making has operated on a far larger scale there than anywhere else, utterly dwarfing the impacts of the Dominican Republic's President Balaguer. My best-case scenario for the future is that China's government will recognize that its environmental problems pose an even graver threat that did its problem of population growth. It may then conclude that China's interests require environmental policies as bold, and as effectively carried out, as its family planning policies.