CHAPTER 16

The World as a Polder: What Does It All Mean to Us Today?

Introduction ▪ The most serious problems ▪ If we don't solve them . . . ▪ Life in Los Angeles ▪ One-liner objections ▪ The past and the present ▪ Reasons for hope ▪

The chapters of this book have discussed why past or present societies succeed or fail at solving their environmental problems. Now, this final chapter considers the book's practical relevance: what does it all mean to us today?

I shall begin by explaining the major sets of environmental problems facing modern societies, and the time scale on which they pose threats. As a specific example of how these problems play out, I examine the area where I have spent most of the last 39 years of my life, Southern California. I then consider the objections most often raised to dismiss the significance of environmental problems today. Since half of this book was devoted to ancient societies because of the lessons that they might hold for modern societies, I look at differences between the ancient and the modern worlds that affect what lessons we can draw from the past. Finally, for anyone who asks, "What can I do as an individual?" I offer suggestions in the Further Readings section.

The most serious problems

It seems to me that the most serious environmental problems facing past and present societies fall into a dozen groups. Eight of the 12 were significant already in the past, while four (numbers 5, 7, 8, and 10: energy, the photosynthetic ceiling, toxic chemicals, and atmospheric changes) became serious only recently. The first four of the 12 consist of destruction or losses of natural resources; the next three involve ceilings on natural resources; the three after that consist of harmful things that we produce or move around; and the last two are population issues. Let's begin with the natural resources

that we are destroying or losing: natural habitats, wild food sources, biological diversity, and soil.

1. At an accelerating rate, we are destroying natural habitats or else converting them to human-made habitats, such as cities and villages, farmlands and pastures, roads, and golf courses. The natural habitats whose losses have provoked the most discussion are forests, wetlands, coral reefs, and the ocean bottom. As I mentioned in the preceding chapter, more than half of the world's original area of forest has already been converted to other uses, and at present conversion rates one-quarter of the forests that remain will become converted within the next half-century. Those losses of forests represent losses for us humans, especially because forests provide us with timber and other raw materials, and because they provide us with so-called ecosystem services such as protecting our watersheds, protecting soil against erosion, constituting essential steps in the water cycle that generates much of our rainfall, and providing habitat for most terrestrial plant and animal species. Deforestation was a or *the* major factor in all the collapses of past societies described in this book. In addition, as discussed in Chapter 1 in connection with Montana, issues of concern to us are not only forest destruction and conversion, but also changes in the structure of wooded habitats that do remain. Among other things, that changed structure results in changed fire regimes that put forests, chaparral woodlands, and savannahs at greater risk of infrequent but catastrophic fires.

Other valuable natural habitats besides forests are also being destroyed. An even larger fraction of the world's original wetlands than of its forests has already been destroyed, damaged, or converted. Consequences for us arise from wetlands' importance in maintaining the quality of our water supplies and the existence of commercially important freshwater fisheries, while even ocean fisheries depend on mangrove wetlands to provide habitat for the juvenile phase of many fish species. About one-third of the world's coral reefs—the oceanic equivalent of tropical rainforests, because they are home to a disproportionate fraction of the ocean's species—have already been severely damaged. If current trends continue, about half of the remaining reefs would be lost by the year 2030. That damage and destruction result from the growing use of dynamite as a fishing method, reef overgrowth by algae ("seaweeds") when the large herbivorous fish that normally graze on the algae become fished out, effects of sediment runoff and pollutants from adjacent lands cleared or converted to agriculture, and coral

bleaching due to rising ocean water temperatures. It has recently become appreciated that fishing by trawling is destroying much or most of the shallow ocean bottom and the species dependent on it.

2. Wild foods, especially fish and to a lesser extent shellfish, contribute a large fraction of the protein consumed by humans. In effect, this is protein that we obtain for free (other than the cost of catching and transporting the fish), and that reduces our needs for animal protein that we have to grow ourselves in the form of domestic livestock. About two billion people, most of them poor, depend on the oceans for protein. If wild fish stocks were managed appropriately, the stock levels could be maintained, and they could be harvested perpetually. Unfortunately, the problem known as the tragedy of the commons (Chapter 14) has regularly undone efforts to manage fisheries sustainably, and the great majority of valuable fisheries already either have collapsed or are in steep decline (Chapter 15). Past societies that overfished included Easter Island, Mangareva, and Henderson.

Increasingly, fish and shrimp are being grown by aquaculture, which in principle has a promising future as the cheapest way to produce animal protein. In several respects, though, aquaculture as commonly practiced today is making the problem of declining wild fisheries worse rather than better. Fish grown by aquaculture are mostly fed wild-caught fish and thereby usually consume more wild fish meat (up to 20 times more) than they yield in meat of their own They contain higher toxin levels than do wild-caught fish. Cultured fish regularly escape, interbreed with wild fish, and thereby harm wild fish stocks genetically, because cultured fish strains have been selected for rapid growth at the expense of poor survival in the wild (50 times worse survival for cultured salmon than for wild salmon). Aquaculture runoff causes pollution and eutrophication. The lower costs of aquaculture than of fishing, by driving down fish prices, initially drive fishermen to exploit wild fish stocks even more heavily in order to maintain their incomes constant when they are receiving less money per pound of fish.

3. A significant fraction of wild species, populations, and genetic diversity has already been lost, and at present rates a large fraction of what remains will be lost within the next half-century. Some species, such as big edible animals, or plants with edible fruits or good timber, are of obvious value to us. Among the many past societies that harmed themselves by exterminating such species were the Easter and Henderson Islanders whom we have discussed.

But biodiversity losses of small inedible species often provoke the response, "Who cares? Do you really care less for humans than for some lousy

useless little fish or weed, like the snail darter or Furbish lousewort?" This response misses the point that the entire natural world is made up of wild species providing us for free with services that can be very expensive, and in many cases impossible, for us to supply ourselves. Elimination of lots of lousy little species regularly causes big harmful consequences for humans, just as does randomly knocking out many of the lousy little rivets holding together an airplane. The literally innumerable examples include: the role of earthworms in regenerating soil and maintaining its texture (one of the reasons that oxygen levels dropped inside the Biosphere 2 enclosure, harming its human inhabitants and crippling a colleague of mine, was a lack of appropriate earthworms, contributing to altered soil/atmosphere gas exchange); soil bacteria that fix the essential crop nutrient nitrogen, which otherwise we have to spend money to supply in fertilizers; bees and other insect pollinators (they pollinate our crops for free, whereas it's expensive for us to pollinate every crop flower by hand); birds and mammals that disperse wild fruits (foresters still haven't figured out how to grow from seed the most important commercial tree species of the Solomon Islands, whose seeds are naturally dispersed by fruit bats, which are becoming hunted out); elimination of whales, sharks, bears, wolves, and other top predators in the seas and on the land, changing the whole food chain beneath them; and wild plants and animals that decompose wastes and recycle nutrients, ultimately providing us with clean water and air.

4. Soils of farmlands used for growing crops are being carried away by water and wind erosion at rates between 10 and 40 times the rates of soil formation, and between 500 and 10,000 times soil erosion rates on forested land. Because those soil erosion rates are so much higher than soil formation rates, that means a net loss of soil. For instance, about half of the topsoil of Iowa, the state whose agriculture productivity is among the highest in the U.S., has been eroded in the last 150 years. On my most recent visit to Iowa, my hosts showed me a churchyard offering a dramatically visible example of those soil losses. A church was built there in the middle of farmland during the 19th century and has been maintained continuously as a church ever since, while the land around it was being farmed. As a result of soil being eroded much more rapidly from fields than from the churchyard, the yard now stands like a little island raised 10 feet above the surrounding sea of farmland.

Other types of soil damage caused by human agricultural practices include salinization, as discussed for Montana, China, and Australia in Chapters 1, 12, and 13; losses of soil fertility, because farming removes nutrients

much more rapidly than they are restored by weathering of the underlying rock; and soil acidification in some areas, or its converse, alkalinization, in other areas. All of these types of harmful impacts have resulted in a fraction of the world's farmland variously estimated at between 20% and 80% having become severely damaged, during an era in which increasing human population has caused us to need more farmland rather than less farmland. Like deforestation, soil problems contributed to the collapses of all past societies discussed in this book.

The next three problems involve ceilings—on energy, freshwater, and photosynthetic capacity. In each case the ceiling is not hard and fixed but soft: we can obtain more of the needed resource, but at increasing costs.

5. The world's major energy sources, especially for industrial societies, are fossil fuels: oil, natural gas, and coal. While there has been much discussion about how many big oil and gas fields remain to be discovered, and while coal reserves are believed to be large, the prevalent view is that known and likely reserves of readily accessible oil and natural gas will last for a few more decades. This view should not be misinterpreted to mean that all of the oil and natural gas within the Earth will have been used up by then. Instead, further reserves will be deeper underground, dirtier, increasingly expensive to extract or process, or will involve higher environmental costs. Of course, fossil fuels are not our sole energy sources, and I shall consider problems raised by the alternatives below.

6. Most of the world's freshwater in rivers and lakes is already being utilized for irrigation, domestic and industrial water, and in situ uses such as boat transportation corridors, fisheries, and recreation. Rivers and lakes that are not already utilized are mostly far from major population centers and likely users, such as in Northwestern Australia, Siberia, and Iceland. Throughout the world, freshwater underground aquifers are being depleted at rates faster than they are being naturally replenished, so that they will eventually dwindle. Of course, freshwater can be made by desalinization of seawater, but that costs money and energy, as does pumping the resulting desalinized water inland for use. Hence desalinization, while it is useful locally, is too expensive to solve most of the world's water shortages. The Anasazi and Maya were among the past societies to be undone by water problems, while today over a billion people lack access to reliable safe drinking water.

7. It might at first seem that the supply of sunlight is infinite, so one might reason that the Earth's capacity to grow crops and wild plants is also infinite. Within the last 20 years, it has been appreciated that that is not the case, and that's not only because plants grow poorly in the world's Arctic regions and deserts unless one goes to the expense of supplying heat or water. More generally, the amount of solar energy fixed per acre by plant photosynthesis, hence plant growth per acre, depends on temperature and rainfall. At any given temperature and rainfall the plant growth that can be supported by the sunlight falling on an acre is limited by the geometry and biochemistry of plants, even if they take up the sunlight so efficiently that not a single photon of light passes through the plants unabsorbed to reach the ground. The first calculation of this photosynthetic ceiling, carried out in 1986, estimated that humans then already used (e.g., for crops, tree plantations, and golf courses) or diverted or wasted (e.g., light falling on concrete roads and buildings) about half of the Earth's photosynthetic capacity. Given the rate of increase of human population, and especially of population impact (see point 12 below), since 1986, we are projected to be utilizing most of the world's terrestrial photosynthetic capacity by the middle of this century. That is, most energy fixed from sunlight will be used for human purposes, and little will be left over to support the growth of natural plant communities, such as natural forests.

The next three problems involve harmful things that we generate or move around: toxic chemicals, alien species, and atmospheric gases.

8. The chemical industry and many other industries manufacture or release into the air, soil, oceans, lakes, and rivers many toxic chemicals, some of them "unnatural" and synthesized only by humans, others present naturally in tiny concentrations (e.g., mercury) or else synthesized by living things but synthesized and released by humans in quantities much larger than natural ones (e.g., hormones). The first of these toxic chemicals to achieve wide notice were insecticides, pesticides, and herbicides, whose effects on birds, fish, and other animals were publicized by Rachel Carson's 1962 book *Silent Spring*. Since then, it has been appreciated that the toxic effects of even greater significance for us humans are those on ourselves. The culprits include not only insecticides, pesticides, and herbicides, but also mercury and other metals, fire-retardant chemicals, refrigerator coolants, detergents, and components of plastics. We swallow them in our food and water, breathe them in our air, and absorb them through our skin. Often in very low concentrations, they variously cause birth defects, mental

retardation, and temporary or permanent damage to our immune and reproductive systems. Some of them act as endocrine disruptors, i.e., they interfere with our reproductive systems by mimicking or blocking effects of our own sex hormones. They probably make the major contribution to the steep decline in sperm count in many human populations over the last several decades, and to the apparently increasing frequency with which couples are unable to conceive, even when one takes into account the increasing average age of marriage in many societies. In addition, deaths in the U.S. from air pollution alone (without considering soil and water pollution) are conservatively estimated at over 130,000 per year.

Many of these toxic chemicals are broken down in the environment only slowly (e.g., DDT and PCBs) or not at all (mercury), and they persist in the environment for long times before being washed out. Thus, cleanup costs of many polluted sites in the U.S. are measured in the billions of dollars (e.g., Love Canal, the Hudson River, Chesapeake Bay, the *Exxon Valdez* oil spill, and Montana copper mines). But pollution at those worst sites in the U.S. is mild compared to that in the former Soviet Union, China, and many Third World mines, whose cleanup costs no one even dares to think about.

9. The term "alien species" refers to species that we transfer, intentionally or inadvertently, from a place where they are native to another place where they are not native. Some alien species are obviously valuable to us as crops, domestic animals, and landscaping. But others devastate populations of native species with which they come in contact, either by preying on, parasitizing, infecting, or outcompeting them. The aliens cause these big effects because the native species with which they come in contact had no previous evolutionary experience of them and are unable to resist them (like human populations newly exposed to smallpox or AIDS). There are by now literally hundreds of cases in which alien species have caused one-time or annually recurring damages of hundreds of millions of dollars or even billions of dollars. Modern examples include Australia's rabbits and foxes, agricultural weeds like Spotted Knapweed and Leafy Spurge (Chapter 1), pests and pathogens of trees and crops and livestock (like the blights that wiped out American chestnut trees and devasted American elms), the water hyacinth that chokes waterways, the zebra mussels that choke power plants, and the lampreys that devastated the former commercial fisheries of the North American Great Lakes (Plates 30, 31). Ancient examples include the introduced rats that contributed to the extinction of Easter Island's palm tree by gnawing its nuts, and that ate the eggs and chicks of nesting birds on Easter, Henderson, and all other Pacific islands previously without rats.

10. Human activities produce gases that escape into the atmosphere, where they either damage the protective ozone layer (as do formerly widespread refrigerator coolants) or else act as greenhouse gases that absorb sunlight and thereby lead to global warming. The gases contributing to global warming include carbon dioxide from combustion and respiration, and methane from fermentation in the intestines of ruminant animals. Of course, there have always been natural fires and animal respiration producing carbon dioxide, and wild ruminant animals producing methane, but our burning of firewood and of fossil fuels has greatly increased the former, and our herds of cattle and of sheep have greatly increased the latter.

For many years, scientists debated the reality, cause, and extent of global warming: are world temperatures really historically high now, and, if so, by how much, and are humans the leading cause? Most knowledgeable scientists now agree that, despite year-to-year ups and downs of temperature that necessitate complicated analyses to extract warming trends, the atmosphere really has been undergoing an unusually rapid rise in temperature recently, and that human activities are the or a major cause. The remaining uncertainties mainly concern the future expected magnitude of the effect: e.g., whether average global temperatures will increase by "just" 1.5 degrees Centigrade or by 5 degrees Centigrade over the next century. Those numbers may not sound like a big deal, until one reflects that average global temperatures were "only" 5 degrees cooler at the height of the last Ice Age.

While one might at first think that we should welcome global warming on the grounds that warmer temperatures mean faster plant growth, it turns out that global warming will produce both winners and losers. Crop yields in cool areas with temperatures marginal for agriculture may indeed increase, while crop yields in already warm or dry areas may decrease. In Montana, California, and many other dry climates, the disappearance of mountain snowpacks will decrease the water available for domestic uses, and for irrigation that actually limits crop yields in those areas. The rise in global sea levels as a result of snow and ice melting poses dangers of flooding and coastal erosion for densely populated low-lying coastal plains and river deltas already barely above or even below sea level. The areas thereby threatened include much of the Netherlands, Bangladesh, and the seaboard of the eastern U.S., many low-lying Pacific islands, the deltas of the Nile and Mekong Rivers, and coastal and riverbank cities of the United Kingdom (e.g., London), India, Japan, and the Philippines. Global warming will also produce big secondary effects that are difficult to predict exactly in advance and that are likely to cause huge problems, such as further climate changes

resulting from changes in ocean circulation resulting in turn from melting of the Arctic ice cap.

The remaining two problems involve the increase in human population:

11. The world's human population is growing. More people require more food, space, water, energy, and other resources. Rates and even the direction of human population change vary greatly around the world, with the highest rates of population growth (4% per year or higher) in some Third World countries, low rates of growth (1% per year or less) in some First World countries such as Italy and Japan, and negative rates of growth (i.e., decreasing populations) in countries facing major public health crises, such as Russia and AIDS-affected African countries. Everybody agrees that the world population is increasing, but that its annual percentage rate of increase is not as high as it was a decade or two ago. However, there is still disagreement about whether the world's population will stabilize at some value above its present level (double the present population?), and (if so) how many years (30 years? 50 years?) it will take for population to reach that level, or whether population will continue to grow.

There is long built-in momentum to human population growth because of what is termed the "demographic bulge" or "population momentum," i.e., a disproportionate number of children and young reproductive-age people in today's population, as a result of recent population growth. That is, suppose that every couple in the world decided tonight to limit themselves to two children, approximately the correct number of children to yield an unchanging population in the long run by exactly replacing their two parents who will eventually die (actually, around 2.1 children when one considers mortality, childless couples, and children who won't marry). The world's population would nevertheless continue to increase for about 70 years, because more people today are of reproductive age or entering reproductive age than are old and post-reproductive. The problem of human population growth has received much attention in recent decades and has given rise to movements such as Zero Population Growth, which aim to slow or halt the increase in the world's population.

12. What really counts is not the number of people alone, but their impact on the environment. If most of the world's 6 billion people today were in cryogenic storage and neither eating, breathing, nor metabolizing, that large population would cause no environmental problems. Instead, our numbers pose problems insofar as we consume resources and generate

wastes. That per-capita impact—the resources consumed, and the wastes put out, by each person—varies greatly around the world, being highest in the First World and lowest in the Third World. On the average, each citizen of the U.S., western Europe, and Japan consumes 32 times more resources such as fossil fuels, and puts out 32 times more wastes, than do inhabitants of the Third World (Plate 35).

But low-impact people are becoming high-impact people for two reasons: rises in living standards in Third World countries whose inhabitants see and covet First World lifestyles; and immigration, both legal and illegal, of individual Third World inhabitants into the First World, driven by political, economic, and social problems at home. Immigration from low-impact countries is now the main contributor to the increasing populations of the U.S. and Europe. By the same token, the overwhelmingly most important human population problem for the world as a whole is not the high rate of population increase in Kenya, Rwanda, and some other poor Third World countries, although that certainly does pose a problem for Kenya and Rwanda themselves, and although that is the population problem most discussed. Instead, the biggest problem is the increase in total human impact, as the result of rising Third World living standards, and of Third World individuals moving to the First World and adopting First World living standards.

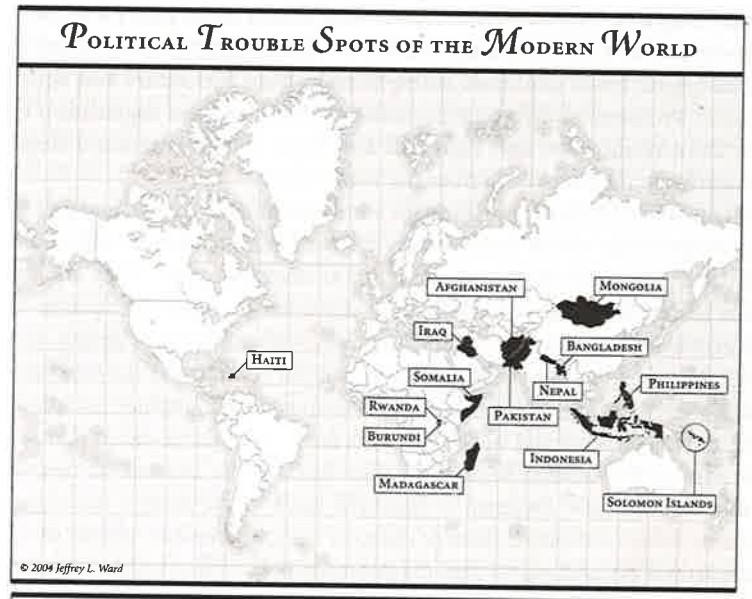
There are many "optimists" who argue that the world could support double its human population, and who consider only the increase in human numbers and not the average increase in per-capita impact. But I have not met anyone who seriously argues that the world could support 12 times its current impact, although an increase of that factor would result from all Third World inhabitants adopting First World living standards. (That factor of 12 is less than the factor of 32 that I mentioned in the preceding paragraph, because there are already First World inhabitants with high-impact lifestyles, although they are greatly outnumbered by Third World inhabitants.) Even if the people of China alone achieved a First World living standard while everyone else's living standard remained constant, that would double our human impact on the world (Chapter 12).

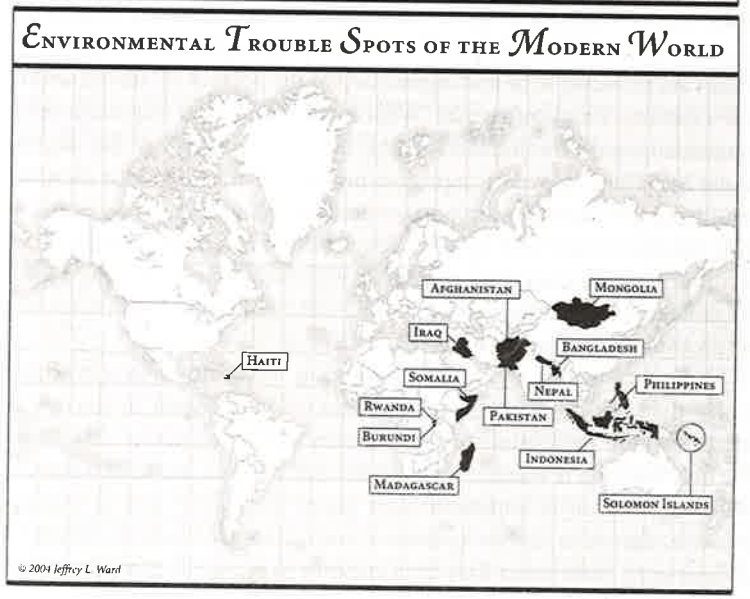
People in the Third World aspire to First World living standards. They develop that aspiration through watching television, seeing advertisements for First World consumer products sold in their countries, and observing First World visitors to their countries. Even in the most remote villages and refugee camps today, people know about the outside world. Third World citizens are encouraged in that aspiration by First World and United

Nations development agencies, which hold out to them the prospect of achieving their dream if they will only adopt the right policies, like balancing their national budgets, investing in education and infrastructure, and so on.

But no one in First World governments is willing to acknowledge the dream's impossibility: the unsustainability of a world in which the Third World's large population were to reach and maintain current First World living standards. It is impossible for the First World to resolve that dilemma by blocking the Third World's efforts to catch up: South Korea, Malaysia, Singapore, Hong Kong, Taiwan, and Mauritius have already succeeded or are close to success; China and India are progressing rapidly by their own efforts; and the 15 rich Western European countries making up the European Union have just extended Union membership to 10 poorer countries of Eastern Europe, in effect thereby pledging to help those 10 countries catch up. Even if the human populations of the Third World did not exist, it would be impossible for the First World alone to maintain its present course, because it is not in a steady state but is depleting its own resources as well as those imported from the Third World. At present, it is untenable politically for First World leaders to propose to their own citizens that they lower their living standards, as measured by lower resource consumption and waste production rates. What will happen when it finally dawns on all those people in the Third World that current First World standards are unreachable for them, and that the First World refuses to abandon those standards for itself? Life is full of agonizing choices based on trade-offs, but that's the cruelest trade-off that we shall have to resolve: encouraging and helping all people to achieve a higher standard of living, without thereby undermining that standard through overstressing global resources.

I have described these 12 sets of problems as separate from each other. In fact, they are linked: one problem exacerbates another or makes its solution more difficult. For example, human population growth affects all 11 other problems: more people means more deforestation, more toxic chemicals, more demand for wild fish, etc. The energy problem is linked to other problems because use of fossil fuels for energy contributes heavily to greenhouse gases, the combating of soil fertility losses by using synthetic fertilizers requires energy to make the fertilizers, fossil fuel scarcity increases our interest in nuclear energy which poses potentially the biggest "toxic" problem of all in case of an accident, and fossil fuel scarcity also makes it more expensive to solve our freshwater problems by using energy to desalinize ocean





water. Depletion of fisheries and other wild food sources puts more pressure on livestock, crops, and aquaculture to replace them, thereby leading to more topsoil losses and more eutrophication from agriculture and aquaculture. Problems of deforestation, water shortage, and soil degradation in the Third World foster wars there and drive legal asylum seekers and illegal emigrants to the First World from the Third World.

Our world society is presently on a non-sustainable course, and any of our 12 problems of non-sustainability that we have just summarized would suffice to limit our lifestyle within the next several decades. They are like time bombs with fuses of less than 50 years. For example, destruction of accessible lowland tropical rainforest outside national parks is already virtually complete in Peninsular Malaysia, will be complete at current rates within less than a decade in the Solomon Islands, the Philippines, on Sumatra, and on Sulawesi, and will be complete around the world except perhaps for parts of the Amazon Basin and Congo Basin within 25 years. At current rates, we shall have depleted or destroyed most of the world's remaining marine fisheries, depleted clean or cheap or readily accessible reserves of oil and natural gas, and approached the photosynthetic ceiling within a few decades. Global warming is projected to have reached a degree Centigrade or more, and a substantial fraction of the world's wild animal and plant species are projected to be endangered or past the point of no return, within half a century. People often ask, "What is the single most important environmental/population problem facing the world today?" A flip answer would be, "The single most important problem is our misguided focus on identifying the single most important problem!" That flip answer is essentially correct, because any of the dozen problems if unsolved would do us grave harm, and because they all interact with each other. If we solved 11 of the problems, but not the 12th, we would still be in trouble, whichever was the problem that remained unsolved. We have to solve them all.

Thus, because we are rapidly advancing along this non-sustainable course, the world's environmental problems *will* get resolved, in one way or another, within the lifetimes of the children and young adults alive today. The only question is whether they will become resolved in pleasant ways of our own choice, or in unpleasant ways not of our choice, such as warfare, genocide, starvation, disease epidemics, and collapses of societies. While all of those grim phenomena have been endemic to humanity throughout our history, their frequency increases with environmental degradation, population pressure, and the resulting poverty and political instability.

Examples of those unpleasant solutions to environmental and population problems abound in both the modern world and the ancient world. The examples include the recent genocides in Rwanda, Burundi, and the former Yugoslavia; war, civil war, or guerrilla war in the modern Sudan, Philippines, and Nepal, and in the ancient Maya homeland; cannibalism on prehistoric Easter Island and Mangareva and among the ancient Anasazi; starvation in many modern African countries and on prehistoric Easter Island; the AIDS epidemic already in Africa, and incipiently elsewhere; and the collapse of state government in modern Somalia, the Solomon Islands, and Haiti, and among the ancient Maya. An outcome less drastic than a worldwide collapse might "merely" be the spread of Rwanda-like or Haiti-like conditions to many more developing countries, while we First World inhabitants retain many of our First World amenities but face a future with which we are unhappy, beset by more chronic terrorism, wars, and disease outbreaks. But it is doubtful that the First World could retain its separate lifestyle in the face of desperate waves of immigrants fleeing from collapsing Third World countries, in numbers much larger than the current unstoppable influx. I'm reminded again of how I picture the end of Gardar Cathedral Farm and its splendid cattle barn on Greenland, overwhelmed by the influx of Norse from poorer farms where all the livestock had died or been eaten.

But before we let ourselves give way to this one-sidedly pessimistic scenario, let's examine further the problems facing us, and their complexities. This will bring us, I feel, to a position of cautious optimism.

Life in Los Angeles

To make the preceding discussion less abstract, I shall now illustrate how those dozen environmental problems affect lifestyles in the part of the world with which I am most familiar: the city of Los Angeles in Southern California, where I live. After growing up on the East Coast of the United States and living for several years in Europe, I first visited California in 1964. It immediately appealed to me, and I moved here in 1966.

Thus, I have seen how Southern California has changed over the last 39 years, mostly in ways that make it less appealing. By world standards, Southern California's environmental problems are relatively mild. Jokes of East Coast Americans to the contrary, this is not an area at imminent risk of a societal collapse. By world standards and even by U.S. standards, its human population is exceptionally rich and environmentally educated. Los Angeles is well known for some problems, especially its smog, but most of its environmental and population problems are modest or typical compared to

those of other leading First World cities. How do those problems affect the lives of my fellow Angelenos and me?

The complaints voiced by virtually everybody in Los Angeles are those directly related to our growing and already high population: our incurable traffic jams; the very high price of housing (Plate 36), as a result of millions of people working in a few centers of employment, and only limited residential space near those centers; and, as a consequence, the long distances, of up to two hours and 60 miles one way, over which people commute daily in their cars between home and work. Los Angeles became the U.S. city with the worst traffic in 1987 and has remained so every year since then. Everyone recognizes that these problems have gotten worse within the last decade. They are now the biggest single factor hurting the ability of Los Angeles employers to attract and retain employees, and they affect our willingness to drive to events and to visit friends. For the 12-mile trip from my home to downtown Los Angeles or its airport, I now allow an hour and 15 minutes. The average Angeleno spends 368 hours per year, or the equivalent of fifteen 24-hour days, commuting to and from work, without considering time spent driving for other purposes (Plate 37).

No cure is even under serious discussion for these problems, which will only get worse. Such highway construction as is now proposed or under way aims only at smoothing a few of the tightest points of congestion and will be overwhelmed by the increasing number of cars. There is no end in sight to how much worse Los Angeles's problems of congestion will become, because millions of people put up with far worse traffic in other cities. For example, my friends in Bangkok, the capital of Thailand, now carry a portable small chemical toilet in their car because travel can be so prolonged and slow; they once set off to go out of town on a holiday weekend but gave up and returned home after 17 hours, when they had advanced only three miles through the traffic jam. While there are optimists who explain in the abstract why increased population will be good and how the world can accommodate it, I have never met an Angeleno (and very few people anywhere in the world) who personally expressed a desire for increased population in the area where he or she personally lived.

The contribution of Southern California to the ongoing increase in the world's average per-capita human impact, as a result of transfers of people from the Third World to the First World, has for years been the most explosive issue in California politics. California's population growth is accelerating, due almost entirely to immigration and to the large average family sizes of the immigrants after their arrival. The border between California and

Mexico is long and impossible to patrol effectively against people from Central America seeking to immigrate here illegally in search of jobs and personal safety. Every month, one reads of would-be immigrants dying in the desert or being robbed or shot, but that does not deter them. Other illegal immigrants come from as far away as China and Central Asia, in ships that unload them just off the coast. California residents are of two minds about all those Third World immigrants seeking to come here to attain the First World lifestyle. On the one hand, our economy is utterly dependent on them to fill jobs in the service and construction industries and on farms. On the other hand, California residents complain that the immigrants compete with unemployed residents for many jobs, depress wages, and burden our already overcrowded hospitals and public education system. A measure (Proposition 187) on the 1994 state election ballot, overwhelmingly approved by voters but then gutted by the courts on constitutional grounds, would have deprived illegal immigrants of most state-funded benefits. No California resident or elected official has suggested a practical solution to the long-standing contradiction, reminiscent of Dominicans' attitude towards Haitians, between needing immigrants as workers and otherwise resenting their presence and their own needs.

Southern California is a leading contributor to the energy crisis. Our city's former network of electric streetcars collapsed in bankruptcies in the 1920s and 1930s, and the rights of way were bought up by automobile manufacturers and subdivided so as to make it impossible to rebuild the network (which competed with automobiles). Angelenos' preference for living in houses rather than in high-rise apartments, and the long distances and diverse routes over which employees working in any given district commute, have made it impossible to design systems of public transportation that would satisfy the needs of most residents. Hence Los Angelenos are dependent on motorcars.

Our high gas consumption, the mountains ringing much of the Los Angeles basin, and prevailing wind directions generate the smog problem that is our city's most notorious drawback (Plate 38). Despite progress in combating smog in recent decades, and despite seasonal variation (smog worst in the late summer and early autumn) and local variation (smog generally worse as one precedes inland), Los Angeles on the average continues to rank near the bottom of American cities for air quality. After years of improvement, our air quality has again been deteriorating in recent years. Another toxic problem that affects lifestyle and health is the spread of the disease-causing organism giardia in California's rivers and lakes over the last several

decades. When I first moved here in the 1960s and went hiking in the mountains, it was safe to drink water from streams; today the guaranteed result would be giardia infection.

The problem of habitat management of which we are most conscious is the fire risk in Southern California's two predominant habitats, chaparral (a scrub woodland similar to the *macchia* of the Mediterranean) and oak woodland. Under natural conditions both habitats experienced occasional fires from lightning strikes, like the situation in Montana forests that I discussed in Chapter 1. Now that people are living in and next to those highly flammable habitats, Angelenos demand that fires be suppressed immediately. Each year, the late summer and early fall, which are the hottest and driest and windiest time of year in Southern California, are the fire season, when somewhere or other hundreds of homes will go up in flames. The canyon in which I live has not had a fire get out of control since 1961, when there was a big fire that burned 600 houses. A theoretical solution to this problem, as in Montana forests, might be frequent controlled small-scale fires to reduce the fuel load, but such fires would be absurdly dangerous in this densely populated urban area, and the public would not stand for it.

Introduced alien species are a big threat and economic burden to California agriculture, the current leading threat being the Mediterranean fruit fly. Non-agricultural threats are introduced pathogens threatening to kill our oak trees and pine trees. Because one of my two sons became interested as a child in amphibians (frogs and salamanders), I have learned that most species of native amphibians have been exterminated from two-thirds of the streams in Los Angeles County, as the result of the spread of three alien predators on amphibians (a crayfish, bullfrog, and mosquitofish) against which Southern California amphibians are helpless because they never evolved to avoid those threats.

The major soil problem affecting California agriculture is salinization as a result of irrigation agriculture, ruining expanses of agricultural land in California's Central Valley, the richest farmland in the United States.

Because rainfall is low in Southern California, Los Angeles depends for its water on long aqueducts, principally from the Sierra Nevada mountain range and adjacent valleys of Northern California, and from the Colorado River on the eastern border of our state. With the growth of California's population, there has been increasing competition for those water supplies among farmers and cities. With global warming, the Sierra snowpack that provides most of our water will decrease, just as in Montana, increasing the likelihood of water shortages in Los Angeles.

As for collapses of fisheries, the sardine fishery of Northern California collapsed early in the 20th century, the abalone industry of Southern California collapsed a few decades ago soon after my arrival, and the rockfish fishery of Southern California is now collapsing and has become subject to severe restrictions or closure within the last year. Fish prices in Los Angeles supermarkets have increased by a factor of 4 since I moved here.

Finally, losses of biodiversity have affected Southern California's most distinctive species. The symbol of the state of California, and of my university (the University of California), is the California Golden Bear, but it is now extinct. (What dreadful symbolism for one's state and university!) Southern California's population of sea otters was exterminated in the last century, and the outcome of recent attempts at reintroduction is uncertain. Within the time that I've lived in Los Angeles, populations of two of our most characteristic bird species, the Roadrunner and the California Quail, have crashed. Southern California amphibians whose numbers have plummeted are the California Newt and the California Tree Frog.

Thus, environmental and population problems have been undermining the economy and the quality of life in Southern California. They are in large measure ultimately responsible for our water shortages, power shortages, garbage accumulation, school crowding, housing shortages and price rises, and traffic congestion. In most of these respects except for our especially bad traffic jams and air quality, we are no worse off than many other areas of the United States.

Most environmental problems involve detailed uncertainties that are legitimate subjects for debate. In addition, however, there are many reasons that are commonly advanced to dismiss the importance of environmental problems, and that are in my opinion not well informed. These objections are often posed in the form of simplistic "one-liners." Here are a dozen of the commonest ones:

"*The environment has to be balanced against the economy.*" This quote portrays environmental concerns as a luxury, views measures to solve environmental problems as incurring a net cost, and considers leaving environmental problems unsolved to be a money-saving device. This one-liner puts the truth exactly backwards. Environmental messes cost us huge sums of money both in the short run and in the long run; cleaning up or preventing those messes saves us huge sums in the long run, and often in the short run as well. In caring for the health of our surroundings, just as of our bodies, it

is cheaper and preferable to avoid getting sick than to try to cure illnesses after they have developed. Just think of the damage caused by agricultural weeds and pests, non-agricultural pests like water hyacinths and zebra mussels, the recurrent annual costs of combating those pests, the value of lost time when we are stuck in traffic, the financial costs resulting from people getting sick or dying from environmental toxins, cleanup costs for toxic chemicals, the steep increase in fish prices due to depletion of fish stocks, and the value of farmland damaged or ruined by erosion and salinization. It adds up to a few hundred million dollars per year here, tens of billions of dollars there, another billion dollars over here, and so on for hundreds of different problems. For instance, the value of "one statistical life" in the U.S.—i.e., the cost to the U.S. economy resulting from the death of an average American whom society has gone to the expense of rearing and educating but who dies before a lifetime of contributing to the national economy—is usually estimated at around $5 million. Even if one takes the conservative estimate of annual U.S. deaths due to air pollution as 130,000, then deaths due to air pollution cost us about $650 billion per year. That illustrates why the U.S. Clean Air Act of 1970, although its cleanup measures do cost money, has yielded estimated net health savings (benefits in excess of costs) of about $1 trillion per year, due to saved lives and reduced health costs.

"*Technology will solve our problems.*" This is an expression of faith about the future, and therefore based on a supposed track record of technology having solved more problems than it created in the recent past. Underlying this expression of faith is the implicit assumption that, from tomorrow onwards, technology will function primarily to solve existing problems and will cease to create new problems. Those with such faith also assume that the new technologies now under discussion will succeed, and that they will do so quickly enough to make a big difference soon. In extended conversations that I had with two of America's most successful and best-known businessmen and financiers, both of them eloquently described to me emerging technologies and financial instruments that differ fundamentally from those of the past and that, they confidently predicted, would solve our environmental problems.

But actual experience is the opposite of this assumed track record. Some dreamed-of new technologies succeed, while others don't. Those that do succeed typically take a few decades to develop and phase in widely: think of gas heating, electric lighting, cars and airplanes, television, computers, and

so on. New technologies, whether or not they succeed in solving the problem that they were designed to solve, regularly create unanticipated new problems. Technological solutions to environmental problems are routinely far more expensive than preventive measures to avoid creating the problem in the first place: for example, the billions of dollars of damages and cleanup costs associated with major oil spills, compared to the modest cost of safety measures effective at minimizing the risks of a major oil spill.

Most of all, advances in technology just increase our ability to do things, which may be either for the better or for the worse. All of our current problems are unintended negative consequences of our existing technology. The rapid advances in technology during the 20th century have been creating difficult new problems faster than they have been solving old problems: that's why we're in the situation in which we now find ourselves. What makes you think that, as of January 1, 2006, for the first time in human history, technology will miraculously stop causing new unanticipated problems while it just solves the problems that it previously produced?

From thousands of examples of unforeseen harmful side effects of new technological solutions, two must suffice: CFCs (chlorofluorocarbons) and motor vehicles. The coolant gases formerly used in refrigerators and air conditioners were toxic ones (like ammonia) that could prove fatal if those appliances leaked while the homeowner was asleep at night. Hence it was hailed as a great advance when CFCs (alias freons) were developed as synthetic refrigerant gases. They are odorless, non-toxic, and highly stable under ordinary conditions at the Earth's surface, so that initially no bad side effects were observed or expected. Within a short time they became viewed as miracle substances and adopted throughout the world as refrigerator and air-conditioner coolants, foam-blowing agents, solvents, and propellants in aerosol cans. But in 1974 it was discovered that in the stratosphere they are broken down by intense ultraviolet radiation to yield highly reactive chlorine atoms that destroy a significant fraction of the ozone layer protecting us and all other living things against lethal ultraviolet effects. That discovery provoked vigorous denial by some corporate interests, fueled not only by the $200 billion value of CFC-based industrial efforts but also by genuine doubts because of scientific complications involved. Hence the phasing-out of CFCs has taken a long time: not until 1988 did the DuPont Company (the largest manufacturer of CFCs) decide to stop manufacturing them, in 1992 industrialized countries agreed to cease CFC production by 1995, and China and some other developing countries are still producing them.

Unfortunately, the amounts of CFCs already in the atmosphere are sufficiently large, and their breakdown sufficiently slow, that they will continue to be present for many decades after the eventual end of all CFC production.

The other example involves the introduction of the motor vehicle. When I was a child in the 1940s, some of my teachers were old enough to remember the first decades of the 20th century, when motor vehicles were in the process of replacing horse-drawn carriages and trams on city streets of the United States. The two biggest immediate consequences experienced by urban Americans, my teachers recall, were that American cities became wonderfully cleaner and quieter. No longer were streets constantly polluted with horse manure and urine, and no longer was there the constant din of horse hoofs clicking on the pavement. Today, after a century's experience of cars and buses, it strikes us as ludicrous or inconceivable that anyone could praise them for being non-polluting and quiet. While no one is advocating a return to the horse as a solution to smog from engine emissions, the example does serve to illustrate the unanticipated negative side effects even of technologies that (unlike CFCs) we choose to retain.

"If we exhaust one resource, we can always switch to some other resource meeting the same need." Optimists who make such claims ignore the unforeseen difficulties and long transition times regularly involved. For instance, one area in which switching based on not-yet-perfected new technologies has repeatedly been touted as promising to solve a major environmental problem is automobiles. The current hope for breakthrough involves hydrogen cars and fuel cells, which are technologically in their infancy as applied to motor transport. Thus, there is not a track record justifying faith in the hydrogen-car solution to our fossil fuel problem. However, we do have a track record of a long series of other proposed new car technologies touted as breakthroughs, such as rotary engines and (most recently) electric cars, that aroused much discussion and even sales of production models, only to decline or disappear because of unforeseen problems.

Equally instructive is the automobile industry's recent development of fuel-efficient hybrid gas/electric cars, which have been enjoying increasing sales. However, it would be unfair for a believer in switching to mention hybrid cars without also mentioning the automobile industry's simultaneous development of SUVs, which have been outselling hybrids by a big margin and more than offsetting their fuel savings. The net result of these two technological breakthroughs has been that the fuel consumption and exhaust production of our national car fleet has been going up rather than down.

Nobody has figured out a method to ensure that technology will yield only increasingly environment-friendly effects and products (e.g., hybrid cars), without also yielding environment-unfriendly effects and products (e.g., SUVs).

Another example of faith in switching and substitution is the hope that renewable energy sources, such as wind and solar energy, may solve the energy crisis. These technologies do indeed exist; many Californians now use solar energy to heat their swimming pools, and wind generators are already supplying about one-sixth of Denmark's energy needs. However, wind and solar energy have limited applicability because they can be used only at locations with reliable winds or sunlight. In addition, the recent history of technology shows that conversion times for adoption of major switches—e.g., from candles to oil lamps to gas lamps to electric lights for lighting, or from wood to coal to petroleum for energy—require several decades, because so many institutions and secondary technologies associated with the former technology have to be changed. It is indeed likely that energy sources other than fossil fuels will make increasing contributions to our motor transport and energy generation, but this is a long-term prospect. We'll also need to solve our fuel and energy problems for the next several decades, before new technologies become widespread. All too often, a focus by politicians or industries on the promise of hydrogen cars and wind energy for the distant future distracts attention from all the obvious measures needed right now to decrease driving and fuel consumption by existing cars, and to decrease consumption by fossil fuel generating plants.

"There really isn't a world food problem; there is already enough food; we only need to solve the transportation problem of distributing that food to places that need it." (The same thing could be said for energy.) Or else: *"The world's food problem is already being solved by the Green Revolution, with its new high-yield varieties of rice and other crops, or else it will be solved by genetically modified crops."* This argument notes two things: that First World citizens enjoy on the average greater per-capita food consumption than do Third World citizens; and that some First World countries, such as the United States, do or can produce more food than their citizens consume. If food consumption could be equalized over the world, or if surplus First World food could be exported to the Third World, might that alleviate Third World starvation?

The obvious flaw in the first half of this argument is that First World citizens show no interest in eating less, in order that Third World citizens could eat more. The flaw in the second half of the argument is that, while

First World countries are willing occasionally to export food to mitigate starvation occasioned by some crisis (such as a drought or war) in certain Third World countries, First World citizens have shown no interest in paying on a regular basis (via their tax dollars that support foreign aid and subsidies to farmers) to feed billions of Third World citizens on a chronic basis. If that did happen but without effective overseas family planning programs, which the U.S. government currently opposes on principle, the result would just be Malthus's dilemma, i.e., an increase in population proportional to an increase in available food. Population increase and Malthus's dilemma also contribute to explaining why, after decades of hope and money invested in the Green Revolution and high-yield varieties, starvation is still widespread in the world. All of these considerations mean that genetically modified (GM) food varieties by themselves are equally unlikely to solve the world's food problems (while world population supposedly remains stationary?). In addition, virtually all GM crop production at present is of just four crops (soybeans, corn, canola, and cotton) not eaten directly by humans but used for animal fodder, oil, or clothing, and grown in six temperate-zone countries or regions. Reasons are the strong consumer resistance to eating GM foods; and the cruel fact that companies developing GM crops can make money by selling their products to rich farmers in mostly affluent temperate-zone countries, but not by selling to poor farmers in developing tropical countries. Hence the companies have no interest in investing heavily to develop GM cassava, millet, or sorghum for Third World farmers.

"As measured by commonsense indicators such as human lifespan, health, and wealth (in economists' terms, per-capita gross national product or GNP), conditions have actually been getting better for many decades." Or: *"Just look around you: the grass is still green, there is plenty of food in the supermarkets, clean water still flows from the taps, and there is absolutely no sign of imminent collapse."* For affluent First World citizens, conditions have indeed been getting better, and public health measures have on the average lengthened lifespans in the Third World as well. But lifespan alone is not a sufficient indicator: billions of Third World citizens, constituting about 80% of the world's population, still live in poverty, near or below the starvation level. Even in the United States, an increasing fraction of the population is at the poverty level and lacks affordable medical care, and all proposals to change this situation (e.g., "Just provide everyone with health insurance paid by the government") have been politically unacceptable.

In addition, all of us know as individuals that we don't measure our economic well-being just by the present *size* of our bank accounts: we also look

at our *direction* of cash flow. When you look at your bank statement and you see a positive $5,000 balance, you don't smile if you then realize that you have been experiencing a net cash drain of $200 per month for the last several years, and at that rate you have just two years and one month left before you have to file for bankruptcy. The same principle holds for our national economy, and for environmental and population trends. The prosperity that the First World enjoys at present is based on spending down its environmental capital in the bank (its capital non-renewable energy sources, fish stocks, topsoil, forests, etc.). Spending capital should not be misrepresented as making money. It makes no sense to be content with our present comfort when it is clear that we are currently on a non-sustainable course.

In fact, one of the main lessons to be learned from the collapses of the Maya, Anasazi, Easter Islanders, and those other past societies (as well as from the recent collapse of the Soviet Union) is that a society's steep decline may begin only a decade or two after the society reaches its peak numbers, wealth, and power. In that respect, the trajectories of the societies that we have discussed are unlike the usual courses of individual human lives, which decline in a prolonged senescence. The reason is simple: maximum population, wealth, resource consumption, and waste production mean maximum environmental impact, approaching the limit where impact outstrips resources. On reflection, it's no surprise that declines of societies tend to follow swiftly on their peaks.

"Look at how many times in the past the gloom-and-doom predictions of fearmongering environmentalists have proved wrong. Why should we believe them this time?" Yes, some predictions by environmentalists have proved incorrect, favorite examples of critics being a prediction made in 1980 by Paul Ehrlich, John Harte, and John Holdren about rises in prices of five metals, and predictions made in the Club of Rome forecast of 1972. But it is misleading to look selectively for environmentalist predictions that proved wrong, and not also to look for environmentalist predictions that proved right, or anti-environmentalist predictions that proved wrong. There is an abundance of errors of the latter sort: e.g., overly optimistic predictions that the Green Revolution would already have solved the world's hunger problems; the prediction of the economist Julian Simon that we could feed the world's population as it continues to grow for the next 7 billion years; and Simon's prediction "Copper can be made from other elements" and thus there is no risk of a copper shortage. As regards the first of Simon's two predictions, continuation of our current population growth rate would yield

10 people per square yard of land in 774 years, a mass of people equal to the Earth's mass in slightly under 2,000 years, and a mass of people equal to the universe's mass in 6,000 years, long before Simon's forecast of 7 billion years without such problems. As regards his second prediction, we learn in our first course of chemistry that copper is an element, which means that by definition it cannot be made from other elements. My impression is that pessimistic predictions that have proved incorrect, such as Ehrlich's, Harte's, and Holdren's about metal prices or the Club of Rome's about future food supplies, have on the average been much more realistic possibilities at the time that they were made than were Simon's two predictions.

Basically, the one-liner about some environmentalist predictions proving wrong boils down to a complaint about false alarms. In other spheres of our lives, such as fires, we adopt a commonsense attitude towards false alarms. Our local governments maintain expensive firefighting forces, even though in some small towns they are rarely called on to put out fires. Of the fire alarms phoned in to fire departments, many prove to be false alarms, and many others involve small fires that the property owner himself then succeeds in putting out before the fire engines arrive. We comfortably accept a certain frequency of such false alarms and extinguished fires, because we understand that fire risks are uncertain and hard to judge when a fire has just started, and that a fire that does rage out of control may exact high costs in property and human lives. No sensible person would dream of abolishing the town fire department, whether manned by full-time professionals or volunteers, just because a few years went by without a big fire. Nor would anyone blame a homeowner for calling the fire department on detecting a small fire, only to succeed in quenching the fire before the fire truck's arrival. Only if false alarms become an inordinately high proportion of all fire alarms do we feel that something is wrong. In effect, the proportion of false alarms that we tolerate is based on subconsciously comparing the frequency and destructive costs of big fires with the frequency and wasted-services costs of false alarms. A very low frequency of false alarms proves that too many homeowners are being too cautious, waiting too long to call the fire department, and consequently losing their homes.

By the same reasoning, we must expect some environmentalist warnings to turn out to be false alarms, otherwise we would know that our environmental warning systems were much too conservative. The multibillion-dollar costs of many environmental problems justify a moderate frequency of false alarms. In addition, the reason that alarms proved false is often that they convinced us to adopt successful countermeasures. For example, it's

true that our air quality here in Los Angeles today is not as bad as some gloom-and-doom predictions of 50 years ago. However, that's entirely because Los Angeles and the state of California were thereby aroused to adopt many countermeasures (such as vehicle emission standards, smog certificates, and lead-free gas), not because initial predictions of the problem were exaggerated.

"*The population crisis is already solving itself, because the rate of increase of the world's population is decreasing, such that world population will level off at less than double its present level.*" While the prediction that world population will level off at less than double its present level may or may not prove true, it is at present a realistic possibility. However, we can take no comfort in this possibility, for two reasons: by many criteria, even the world's present population is living at a non-sustainable level; and, as explained earlier in this chapter, the larger danger that we face is not just of a two-fold increase in population, but of a much larger increase in human impact if the Third World's population succeeds in attaining a First World living standard. It is surprising to hear some First World citizens nonchalantly mentioning the world's adding "only" 2½ billion more people (the lowest estimate that anyone would forecast) as if that were acceptable, when the world already holds that many people who are malnourished and living on less than $3 per day.

"*The world can accommodate human population growth indefinitely. The more people, the better, because more people mean more inventions and ultimately more wealth.*" Both of these ideas are associated especially with Julian Simon but have been espoused by many others, especially by economists. The statement about our ability to absorb current rates of population growth indefinitely is not to be taken seriously, because we have already seen that that would mean 10 people per square yard in the year 2779. Data on national wealth demonstrate that the claim that more people mean more wealth is the opposite of correct. The 10 countries with the most people (over 100 million each) are, in descending order of population, China, India, the U.S., Indonesia, Brazil, Pakistan, Russia, Japan, Bangladesh, and Nigeria. The 10 countries with the highest affluence (per-capita real GDP) are, in descending order, Luxembourg, Norway, the U.S., Switzerland, Denmark, Iceland, Austria, Canada, Ireland, and the Netherlands. The only country on both lists is the U.S.

Actually, the countries with large populations are disproportionately poor: eight of the 10 have per-capita GDP under $8,000, and five of them under $3,000. The affluent countries have disproportionately few people: seven of the 10 have populations below 9,000,000, and two of them under

500,000. Instead, what does distinguish the two lists is population growth rates: all 10 of the affluent countries have very low relative population growth rates (1% per year or less), while eight of the 10 most populous countries have higher relative population growth rates than any of the most affluent countries, except for two large countries that achieved low population growth in unpleasant ways: China, by government order and enforced abortion, and Russia, whose population is actually decreasing because of catastrophic health problems. Thus, as an empirical fact, more people and a higher population growth rate mean more poverty, not more wealth.

"Environmental concerns are a luxury affordable just by affluent First World yuppies, who have no business telling desperate Third World citizens what they should be doing." This view is one that I have heard mainly from affluent First World yuppies lacking experience of the Third World. In all my experience of Indonesia, Papua New Guinea, East Africa, Peru, and other Third World countries with growing environmental problems and populations, I have been impressed that their people know very well how they are being harmed by population growth, deforestation, overfishing, and other problems. They know it because they immediately pay the penalty, in forms such as loss of free timber for their houses, massive soil erosion, and (the tragic complaint that I hear incessantly) their inability to afford clothes, books, and school fees for their children. The reason why the forest behind their village is nevertheless being logged is usually either that a corrupt government has ordered it logged over their often-violent protest, or else that they signed a logging lease with great reluctance because they saw no other way to get the money needed next year for their children. My best friends in the Third World, with families of 4 to 8 children, lament that they have heard of the benign forms of contraception widespread in the First World, and they want those measures desperately for themselves, but they can't afford or obtain them, due in part to the refusal of the U.S. government to fund family planning in its foreign aid programs.

Another view that is widespread among affluent First World people, but which they will rarely express openly, is that they themselves are managing just fine at carrying on with their lifestyles despite all those environmental problems, which really don't concern them because the problems fall mainly on Third World people (though it is not politically correct to be so blunt). Actually, the rich are not immune to environmental problems. CEOs of big First World companies eat food, drink water, breathe air, and have (or try to conceive) children, like the rest of us. While they can usually avoid problems of water quality by drinking bottled water, they find it much more difficult to avoid being exposed to the same problems of food and air quality as the rest of us. Living disproportionately high on the food chain, at levels at which toxic substances become concentrated, they are at more rather than less risk of reproductive impairment due to ingestion of or exposure to toxic materials, possibly contributing to their higher infertility rates and the increasing frequency with which they require medical assistance in conceiving. In addition, one of the conclusions that we saw emerging from our discussion of Maya kings, Greenland Norse chieftains, and Easter Island chiefs is that, in the long run, rich people do not secure their own interests and those of their children if they rule over a collapsing society and merely buy themselves the privilege of being the last to starve or die. As for First World society as a whole, its resource consumption accounts for most of the world's total consumption that has given rise to the impacts described at the beginning of this chapter. Our totally unsustainable consumption means that the First World could not continue for long on its present course, even if the Third World didn't exist and weren't trying to catch up to us.

"If those environmental problems become desperate, it will be at some time far off in the future, after I die, and I can't take them seriously." In fact, at current rates most or all of the dozen major sets of environmental problems discussed at the beginning of this chapter will become acute within the lifetime of young adults now alive. Most of us who have children consider the securing of our children's future as the highest priority to which to devote our time and our money. We pay for their education and food and clothes, make wills for them, and buy life insurance for them, all with the goal of helping them to enjoy good lives 50 years from now. It makes no sense for us to do these things for our individual children, while simultaneously doing things undermining the world in which our children will be living 50 years from now.

This paradoxical behavior is one of which I personally was guilty, because I was born in the year 1937, hence before the birth of my children I too could not take seriously any event (like global warming or the end of the tropical rainforests) projected for the year 2037. I shall surely be dead before that year, and even the date 2037 struck me as unreal. However, when my twin sons were born in 1987, and when my wife and I then started going through the usual parental obsessions about schools, life insurance, and wills, I realized with a jolt: 2037 is the year in which my kids will be my own age of 50 (then)! It's not an imaginary year! What's the point of willing our property to our kids if the world will be in a mess then anyway?

Having lived for five years in Europe shortly after World War II, and then having married into a Polish family with a Japanese branch, I saw at first hand what can happen when parents take good care of their individual children but not of their children's future world. The parents of my Polish, German, Japanese, Russian, British, and Yugoslav friends also bought life insurance, made wills, and obsessed about the schooling of their children, as my wife and I have been doing more recently. Some of them were rich and would have had valuable property to will to their children. But they did not take good care of their children's world, and they blundered into the disaster of World War II. As a result, most of my European and Japanese friends born in the same year as I had their lives blighted in various ways, such as being orphaned, separated from one or both parents during their childhood, bombed out of their houses, deprived of schooling opportunities, deprived of their family estates, or raised by parents burdened with memories of war and concentration camps. The worst-case scenarios that today's children face if we too blunder about their world are different, but equally unpleasant.

This leaves us with two other common one-liners that we have not considered: *"There are big differences between modern societies and those past societies of Easter Islanders, Maya, and Anasazi who collapsed, so that we can't straightforwardly apply lessons from the past."* And: *"What can I, as an individual, do, when the world is really being shaped by unstoppable powerful juggernauts of governments and big businesses?"* In contrast to the previous one-liners, which upon examination can be quickly dismissed, these two concerns are valid and cannot be dismissed. I shall devote the remainder of this chapter to the former question, and a section of the Further Readings (pp. 555–59) to the latter question.

Are the parallels between the past and present sufficiently close that the collapses of the Easter Islanders, Henderson Islanders, Anasazi, Maya, and Greenland Norse could offer any lessons for the modern world?

At first, a critic, noting the obvious differences, might be tempted to object, "It's ridiculous to suppose that the collapses of all those ancient peoples could have broad relevance today, especially to the modern U.S. Those ancients didn't enjoy the wonders of modern technology, which benefits us and which lets us solve problems by inventing new environment-friendly technologies. Those ancients had the misfortune to suffer from effects of climate change. They behaved stupidly and ruined their own environment by doing obviously dumb things, like cutting down their forests, overharvesting wild animal sources of their protein, watching their topsoil erode away, and building cities in dry areas likely to run short of water. They had foolish leaders who didn't have books and so couldn't learn from history, and who embroiled them in expensive and destabilizing wars, cared only about staying in power, and didn't pay attention to problems at home. They got overwhelmed by desperate starving immigrants, as one society after another collapsed, sending floods of economic refugees to tax the resources of the societies that weren't collapsing. In all those respects, we moderns are fundamentally different from those primitive ancients, and there is nothing that we could learn from them. Especially we in the U.S., the richest and most powerful country in the world today, with the most productive environment and wise leaders and strong loyal allies and only weak insignificant enemies—none of those bad things could possibly apply to us."

Yes, it's true that there are big differences between the situations of those past societies and our modern situation today. The most obvious difference is that there are far more people alive today, packing far more potent technology that impacts the environment, than in the past. Today we have over 6 billion people equipped with heavy metal machinery such as bulldozers and nuclear power, whereas the Easter Islanders had at most a few tens of thousands of people with stone chisels and human muscle power. Yet the Easter Islanders still managed to devastate their environment and bring their society to the point of collapse. That difference greatly increases, rather than decreases, the risks for us today.

A second big difference stems from globalization. Leaving out of this discussion for the moment the question of environmental problems within the First World itself, let's just ask whether the lessons from past collapses might apply anywhere in the Third World today. First ask some ivory-tower academic ecologist, who knows a lot about the environment but never reads a newspaper and has no interest in politics, to name the overseas countries facing some of the worst problems of environmental stress, overpopulation, or both. The ecologist would answer: "That's a no-brainer, it's obvious. Your list of environmentally stressed or overpopulated countries should surely include Afghanistan, Bangladesh, Burundi, Haiti, Indonesia, Iraq, Madagascar, Mongolia, Nepal, Pakistan, the Philippines, Rwanda, the Solomon Islands, and Somalia, plus others" (map, p. 497).

Then go ask a First World politician, who knows nothing and cares less about the environment and population problems, to name the world's worst trouble spots: countries where state government has already been