

## PROLOGUE

### A Tale of Two Farms

**Two farms ■ Collapses, past and present ■ Vanished Edens? ■**

**A five-point framework \* Businesses and the environment ■**

**The comparative method \* Plan of the book ■**

A few summers ago I visited two dairy farms, Huls Farm and Gardar Farm, which despite being located thousands of miles apart were still remarkably similar in their strengths and vulnerabilities. Both were by far the largest, most prosperous, most technologically advanced farms in their respective districts. In particular, each was centered around a magnificent state-of-the-art barn for sheltering and milking cows. Those structures, both neatly divided into opposite-facing rows of cow stalls, dwarfed all other barns in the district. Both farms let their cows graze outdoors in lush pastures during the summer, produced their own hay to harvest in the late summer for feeding the cows through the winter, and increased their production of summer fodder and winter hay by irrigating their fields. The two farms were similar in area (a few square miles) and in barn size, Huls barn holding somewhat more cows than Gardar barn (200 vs. 165 cows, respectively). The owners of both farms were viewed as leaders of their respective societies. Both owners were deeply religious. Both farms were located in gorgeous natural settings that attract tourists from afar, with backdrops of high snow-capped mountains drained by streams teeming with fish, and sloping down to a famous river (below Huls Farm) or fjord (below Gardar Farm).

Those were the shared strengths of the two farms. As for their shared vulnerabilities, both lay in districts economically marginal for dairying, because their high northern latitudes meant a short summer growing season in which to produce pasture grass and hay. Because the climate was thus suboptimal even in good years, compared to dairy farms at lower latitudes, both farms were susceptible to being harmed by climate change, with drought or cold being the main concerns in the districts of Huls Farm or Gardar Farm respectively. Both districts lay far from population centers to which they could market their products, so that transportation costs and

hazards placed them at a competitive disadvantage compared to more centrally located districts. The economies of both farms were hostage to forces beyond their owners' control, such as the changing affluence and tastes of their customers and neighbors. On a larger scale, the economies of the countries in which both farms lay rose and fell with the waxing and waning of threats from distant enemy societies.

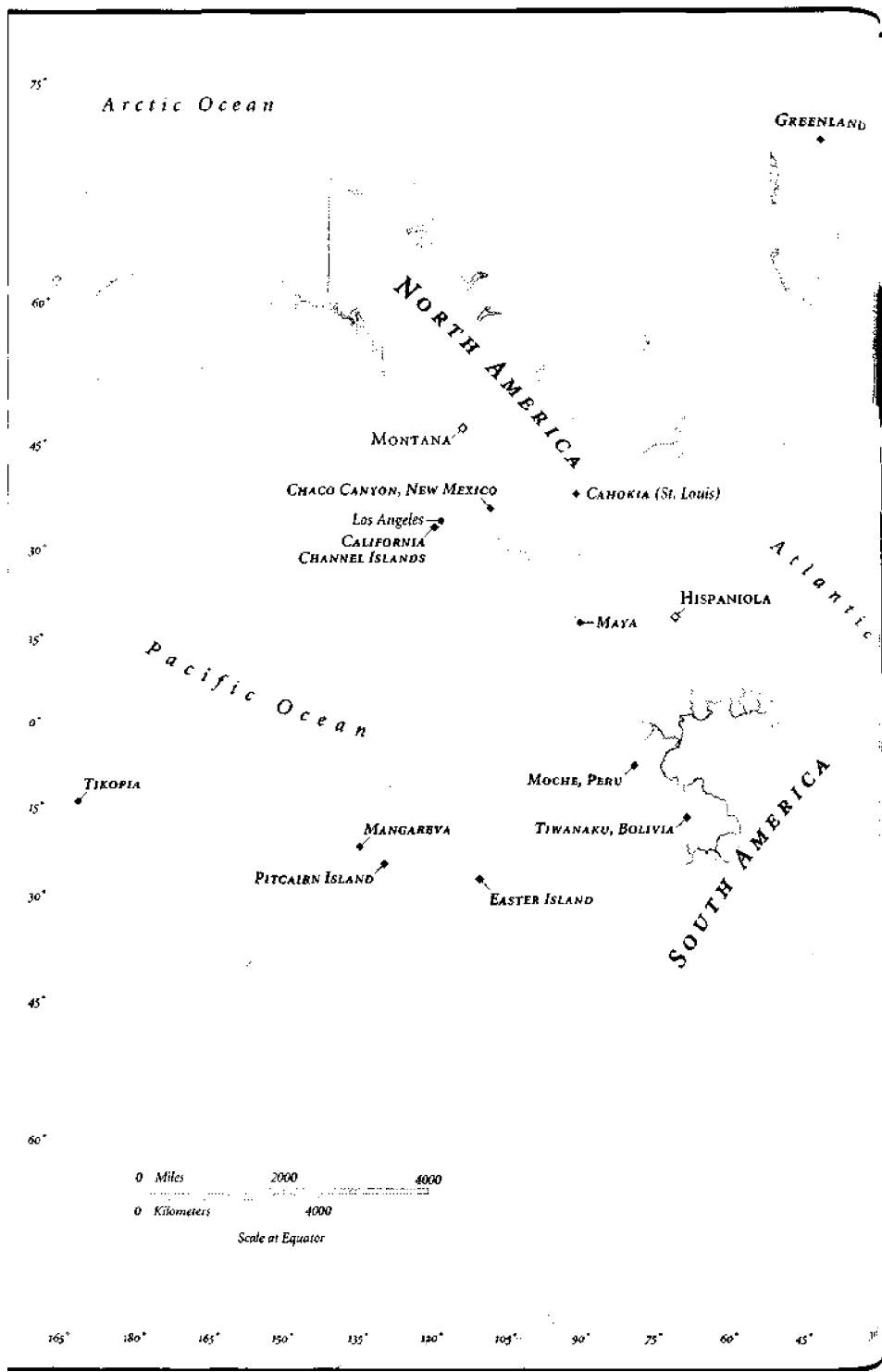
The biggest difference between Huls Farm and Gardar Farm is in their current status. Huls Farm, a family enterprise owned by five siblings and their spouses in the Bitterroot Valley of the western U.S. state of Montana, is currently prospering, while Ravalli County in which Huls Farm lies boasts one of the highest population growth rates of any American county. Tim, Trudy, and Dan Huls, who are among Huls Farm's owners, personally took me on a tour of their high-tech new barn, and patiently explained to me the attractions and vicissitudes of dairy farming in Montana. It is inconceivable that the United States in general, and Huls Farm in particular, will collapse in the foreseeable future. But Gardar Farm, the former manor farm of the Norse bishop of southwestern Greenland, was abandoned over 500 years ago. Greenland Norse society collapsed completely: its thousands of inhabitants starved to death, were killed in civil unrest or in war against an enemy, or emigrated, until nobody remained alive. While the strongly built stone walls of Gardar barn and nearby Gardar Cathedral are still standing, so that I was able to count the individual cow stalls, there is no owner to tell me today of Gardar's former attractions and vicissitudes. Yet when Gardar Farm and Norse Greenland were at their peak, their decline seemed as inconceivable as does the decline of Huls Farm and the U.S. today.

Let me make clear: in drawing these parallels between Huls and Gardar Farms, I am not claiming that Huls Farm and American society are doomed to decline. At present, the truth is quite the opposite: Huls Farm is in the process of expanding, its advanced new technology is being studied for adoption by neighboring farms, and the United States is now the most powerful country in the world. Nor am I claiming that farms or societies in general are prone to collapse: while some have indeed collapsed like Gardar, others have survived uninterruptedly for thousands of years. Instead, my trips to Huls and Gardar Farms, thousands of miles apart but visited during the same summer, vividly brought home to me the conclusion that even the richest, technologically most advanced societies today face growing environmental and economic problems that should not be underestimated. Many of our problems are broadly similar to those that undermined Gardar Farm and Norse Greenland, and that many other past societies also strug-

gled to solve. Some of those past societies failed (like the Greenland Norse), and others succeeded (like the Japanese and Tikopians). The past offers us a rich database from which we can learn, in order that we may keep on succeeding.

Norse Greenland is just one of many past societies that collapsed or vanished, leaving behind monumental ruins such as those that Shelley imagined in his poem "Ozymandias." By collapse, I mean a drastic decrease in human population size and/or political/economic/social complexity, over a considerable area, for an extended time. The phenomenon of collapses is thus an extreme form of several milder types of decline, and it becomes arbitrary to decide how drastic the decline of a society must be before it qualifies to be labeled as a collapse. Some of those milder types of decline include the normal minor rises and falls of fortune, and minor political/economic/social restructurings, of any individual society; one society's conquest by a close neighbor, or its decline linked to the neighbor's rise, without change in the total population size or complexity of the whole region; and the replacement or overthrow of one governing elite by another. By those standards, most people would consider the following past societies to have been famous victims of full-fledged collapses rather than of just minor declines: the Anasazi and Cahokia within the boundaries of the modern U.S., the Maya cities in Central America, Moche and Tiwanaku societies in South America, Mycenaean Greece and Minoan Crete in Europe, Great Zimbabwe in Africa, Angkor Wat and the Harappan Indus Valley cities in Asia, and Easter Island in the Pacific Ocean (map, pp. 4-5).

The monumental ruins left behind by those past societies hold a romantic fascination for all of us. We marvel at them when as children we first learn of them through pictures. When we grow up, many of us plan vacations in order to experience them at firsthand as tourists. We feel drawn to their often spectacular and haunting beauty, and also to the mysteries that they pose. The scales of the ruins testify to the former wealth and power of their builders—they boast "Look on my works, ye mighty, and despair!" in Shelley's words. Yet the builders vanished, abandoning the great structures that they had created at such effort. How could a society that was once so mighty end up collapsing? What were the fates of its individual citizens?—did they move away, and (if so) why, or did they die there in some unpleasant way? Lurking behind this romantic mystery is the nagging thought: might such a fate eventually befall our own wealthy society? Will tourists



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someday stare mystified at the rusting hulks of New York's skyscrapers, much as we stare today at the jungle-overgrown ruins of Maya cities?

It has long been suspected that many of those mysterious abandonments were at least partly triggered by ecological problems: people inadvertently destroying the environmental resources on which their societies depended. This suspicion of unintended ecological suicide—ecocide—has been confirmed by discoveries made in recent decades by archaeologists, climatologists, historians, paleontologists, and palynologists (pollen scientists). The processes through which past societies have undermined themselves by damaging their environments fall into eight categories, whose relative importance differs from case to case: deforestation and habitat destruction, soil problems (erosion, salinization, and soil fertility losses), water management problems, overhunting, overfishing, effects of introduced species on native species, human population growth, and increased per-capita impact of people.

Those past collapses tended to follow somewhat similar courses constituting variations on a theme. Population growth forced people to adopt intensified means of agricultural production (such as irrigation, double-cropping, or terracing), and to expand farming from the prime lands first chosen onto more marginal land, in order to feed the growing number of hungry mouths. Unsustainable practices led to environmental damage of one or more of the eight types just listed, resulting in agriculturally marginal lands having to be abandoned again. Consequences for society included food shortages, starvation, wars among too many people fighting for too few resources, and overthrows of governing elites by disillusioned masses. Eventually, population decreased through starvation, war, or disease, and society lost some of the political, economic, and cultural complexity that it had developed at its peak. Writers find it tempting to draw analogies between those trajectories of human societies and the trajectories of individual human lives—to talk of a society's birth, growth, peak, senescence, and death—and to assume that the long period of senescence that most of us traverse between our peak years and our deaths also applies to societies. But that metaphor proves erroneous for many past societies (and for the modern Soviet Union): they declined rapidly after reaching peak numbers and power, and those rapid declines must have come as a surprise and shock to their citizens. In the worst cases of complete collapse, everybody in the society emigrated or died. Obviously, though, this grim trajectory is not one that all past societies followed unvaryingly to completion:

different societies collapsed to different degrees and in somewhat different ways, while many societies didn't collapse at all.

The risk of such collapses today is now a matter of increasing concern; indeed, collapses have already materialized for Somalia, Rwanda, and some other Third World countries. Many people fear that ecocide has now come to overshadow nuclear war and emerging diseases as a threat to global civilization. The environmental problems facing us today include the same eight that undermined past societies, plus four new ones: human-caused climate change, buildup of toxic chemicals in the environment, energy shortages, and full human utilization of the Earth's photosynthetic capacity. Most of these 12 threats, it is claimed, will become globally critical within the next few decades: either we solve the problems by then, or the problems will undermine not just Somalia but also First World societies. Much more likely than a doomsday scenario involving human extinction or an apocalyptic collapse of industrial civilization would be "just" a future of significantly lower living standards, chronically higher risks, and the undermining of what we now consider some of our key values. Such a collapse could assume various forms, such as the worldwide spread of diseases or else of wars, triggered ultimately by scarcity of environmental resources. If this reasoning is correct, then our efforts today will determine the state of the world in which the current generation of children and young adults lives out their middle and late years.

But the seriousness of these current environmental problems is vigorously debated. Are the risks greatly exaggerated, or conversely are they underestimated? Does it stand to reason that today's human population of almost seven billion, with our potent modern technology, is causing our environment to crumble globally at a much more rapid rate than a mere few million people with stone and wooden tools already made it crumble locally in the past? Will modern technology solve our problems, or is it creating new problems faster than it solves old ones? When we deplete one resource (e.g., wood, oil, or ocean fish), can we count on being able to substitute some new resource (e.g., plastics, wind and solar energy, or farmed fish)? Isn't the rate of human population growth declining, such that we're already on course for the world's population to level off at some manageable number of people?

All of these questions illustrate why those famous collapses of past civilizations have taken on more meaning than just that of a romantic mystery. Perhaps there are some practical lessons that we could learn from all those

past collapses. We know that some past societies collapsed while others didn't: what made certain societies especially vulnerable? What, exactly, were the processes by which past societies committed ecocide? Why did some past societies fail to see the messes that they were getting into, and that (one would think in retrospect) must have been obvious? Which were the solutions that succeeded in the past? If we could answer these questions, we might be able to identify which societies are now most at risk, and what measures could best help them, without waiting for more Somalia-like collapses.

But there are also differences between the modern world and its problems, and those past societies and their problems. We shouldn't be so naive as to think that study of the past will yield simple solutions, directly transferable to our societies today. We differ from past societies in some respects that put us at lower risk than them; some of those respects often mentioned include our powerful technology (i.e., its beneficial effects), globalization, modern medicine, and greater knowledge of past societies and of distant modern societies. We also differ from past societies in some respects that put us at greater risk than them: mentioned in that connection are, again, our potent technology (i.e., its unintended destructive effects), globalization (such that now a collapse even in remote Somalia affects the U.S. and Europe), the dependence of millions (and, soon, billions) of us on modern medicine for our survival, and our much larger human population. Perhaps we can still learn from the past, but only if we think carefully about its lessons.

Efforts to understand past collapses have had to confront one major controversy and four complications. The controversy involves resistance to the idea that past peoples (some of them known to be ancestral to peoples currently alive and vocal) did things that contributed to their own decline. We are much more conscious of environmental damage now than we were a mere few decades ago. Even signs in hotel rooms now invoke love of the environment to make us feel guilty if we demand fresh towels or let the water run. To damage the environment today is considered morally culpable.

Not surprisingly, Native Hawaiians and Maoris don't like paleontologists telling them that their ancestors exterminated half of the bird species that had evolved on Hawaii and New Zealand, nor do Native Americans like archaeologists telling them that the Anasazi deforested parts of the southwestern U.S. The supposed discoveries by paleontologists and archaeolo-



gists sound to some listeners like just one more racist pretext advanced by whites for dispossessing indigenous peoples. It's as if scientists were saying, "Your ancestors were bad stewards of their lands, so they deserved to be dispossessed." Some American and Australian whites, resentful of government payments and land retribution to Native Americans and Aboriginal Australians, do indeed seize on the discoveries to advance that argument today. Not only indigenous peoples, but also some anthropologists and archaeologists who study them and identify with them, view the recent supposed discoveries as racist lies.

Some of the indigenous peoples and the anthropologists identifying with them go to the opposite extreme. They insist that past indigenous peoples were (and modern ones still are) gentle and ecologically wise stewards of their environments, intimately knew and respected Nature, innocently lived in a virtual Garden of Eden, and could never have done all those bad things. As a New Guinea hunter once told me, "If one day I succeed in shooting a big pigeon in one direction from our village, I wait a week before hunting pigeons again, and then I go out in the opposite direction from the village." Only those evil modern First World inhabitants are ignorant of Nature, don't respect the environment, and destroy it.

In fact, both extreme sides in this controversy—the racists and the believers in a past Eden—are committing the error of viewing past indigenous peoples as fundamentally different from (whether inferior to or superior to) modern First World peoples. Managing environmental resources sustainably has *always* been difficult, ever since *Homo sapiens* developed modern inventiveness, efficiency, and hunting skills by around 50,000 years ago. Beginning with the first human colonization of the Australian continent around 46,000 years ago, and the subsequent prompt extinction of most of Australia's former giant marsupials and other large animals, every human colonization of a land mass formerly lacking humans—whether of Australia, North America, South America, Madagascar, the Mediterranean islands, or Hawaii and New Zealand and dozens of other Pacific islands—has been followed by a wave of extinction of large animals that had evolved without fear of humans and were easy to kill, or else succumbed to human-associated habitat changes, introduced pest species, and diseases. Any people can fall into the trap of overexploiting environmental resources, because of ubiquitous problems that we shall consider later in this book: that the resources initially seem inexhaustibly abundant; that signs of their incipient depletion become masked by normal fluctuations in resource levels between years or decades; that it's difficult to get people to agree on exercising

restraint in harvesting a shared resource (the so-called tragedy of the commons, to be discussed in later chapters); and that the complexity of ecosystems often makes the consequences of some human-caused perturbation virtually impossible to predict even for a professional ecologist. Environmental problems that are hard to manage today were surely even harder to manage in the past. Especially for past non-literate peoples who couldn't read case studies of societal collapses, ecological damage constituted a tragic, unforeseen, unintended consequence of their best efforts, rather than morally culpable blind or conscious selfishness. The societies that ended up collapsing were (like the Maya) among the most creative and (for a time) advanced and successful of their times, rather than stupid and primitive.

Past peoples were neither ignorant bad managers who deserved to be exterminated or dispossessed, nor all-knowing conscientious environmentalists who solved problems that we can't solve today. They were people like us, facing problems broadly similar to those that we now face. They were prone either to succeed or to fail, depending on circumstances similar to those making us prone to succeed or to fail today. Yes, there are differences between the situation we face today and that faced by past peoples, but there are still enough similarities for us to be able to learn from the past.

Above all, it seems to me wrongheaded and dangerous to invoke historical assumptions about environmental practices of native peoples in order to justify treating them fairly. In many or most cases, historians and archaeologists have been uncovering overwhelming evidence that this assumption (about Eden-like environmentalism) is wrong. By invoking this assumption to justify fair treatment of native peoples, we imply that it would be OK to mistreat them if that assumption could be refuted. In fact, the case against mistreating them isn't based on any historical assumption about their environmental practices: it's based on a moral principle, namely, that it is morally wrong for one people to dispossess, subjugate, or exterminate another people.

That's the controversy about past ecological collapses. As for the complications, of course it's not true that all societies are doomed to collapse because of environmental damage: in the past some societies did while others didn't; the real question is why only some societies proved fragile, and what distinguished those that collapsed from those that didn't. Some societies that I shall discuss, such as the Icelanders and Tikopians, succeeded in solving extremely difficult environmental problems, have thereby been able to persist

for a long time, and are still going strong today. For example, when Norwegian colonists of Iceland first encountered an environment superficially similar to that of Norway but in reality very different, they inadvertently destroyed much of Iceland's topsoil and most of its forests. Iceland for a long time was Europe's poorest and most ecologically ravaged country. However, Icelanders eventually learned from experience, adopted rigorous measures of environmental protection, and now enjoy one of the highest per-capita national average incomes in the world. Tikopia Islanders inhabit a tiny island so far from any neighbors that they were forced to become self-sufficient in almost everything, but they micromanaged their resources and regulated their population size so carefully that their island is still productive after 3,000 years of human occupation. Thus, this book is not an uninterrupted series of depressing stories of failure, but also includes success stories inspiring imitation and optimism.

In addition, I don't know of any case in which a society's collapse can be attributed solely to environmental damage: there are always other contributing factors. When I began to plan this book, I didn't appreciate those complications, and I naively thought that the book would just be about environmental damage. Eventually, I arrived at a five-point framework of possible contributing factors that I now consider in trying to understand any putative environmental collapse. Four of those sets of factors—environmental damage, climate change, hostile neighbors, and friendly trade partners—may or may not prove significant for a particular society. The fifth set of factors—the society's responses to its environmental problems—always proves significant. Let's consider these five sets of factors one by one, in a sequence not implying any primacy of cause but just convenience of presentation.

A first set of factors involves damage that people inadvertently inflict on their environment, as already discussed. The extent and reversibility of that damage depend partly on properties of people (e.g., how many trees they cut down per acre per year), and partly on properties of the environment (e.g., properties determining how many seedlings germinate per acre, and how rapidly saplings grow, per year). Those environmental properties are referred to either as fragility (susceptibility to damage) or as resilience (potential for recovery from damage), and one can talk separately of the fragility or resilience of an area's forests, its soils, its fish populations, and so on. Hence the reasons why only certain societies suffered environmental collapses might in principle involve either exceptional imprudence of their people, exceptional fragility of some aspects of their environment, or both.

A next consideration in my five-point framework is climate change, a term that today we tend to associate with global warming caused by humans. In fact, climate may become hotter or colder, wetter or drier, or more or less variable between months or between years, because of changes in natural forces that drive climate and that have nothing to do with humans. Examples of such forces include changes in the heat put out by the sun, volcanic eruptions that inject dust into the atmosphere, changes in the orientation of the Earth's axis with respect to its orbit, and changes in the distribution of land and ocean over the face of the Earth. Frequently discussed cases of natural climate change include the advance and retreat of continental ice sheets during the Ice Ages beginning over two million years ago, the so-called Little Ice Age from about A.D. 1400 to 1800, and the global cooling following the enormous volcanic eruption of Indonesia's Mt. Tambora on April 5, 1815. That eruption injected so much dust into the upper atmosphere that the amount of sunlight reaching the ground decreased until the dust settled out, causing widespread famines even in North America and Europe due to cold temperatures and reduced crop yields in the summer of 1816 ("the year without a summer").

Climate change was even more of a problem for past societies with short human lifespans and without writing than it is today, because climate in many parts of the world tends to vary not just from year to year but also on a multi-decade time scale; e.g., several wet decades followed by a dry half-century. In many prehistoric societies the mean human generation time—average number of years between births of parents and of their children—was only a few decades. Hence towards the end of a string of wet decades, most people alive could have had no firsthand memory of the previous period of dry climate. Even today, there is a human tendency to increase production and population during good decades, forgetting (or, in the past, never realizing) that such decades were unlikely to last. When the good decades then do end, the society finds itself with more population than can be supported, or with ingrained habits unsuitable to the new climate conditions. (Just think today of the dry U.S. West and its urban or rural policies of profligate water use, often drawn up in wet decades on the tacit assumption that they were typical.) Compounding these problems of climate change, many past societies didn't have "disaster relief" mechanisms to import food surpluses from other areas with a different climate into areas developing food shortages. All of those considerations exposed past societies to increased risk from climate change.

Natural climate changes may make conditions either better or worse for

any particular human society, and may benefit one society while hurting another society. (For example, we shall see that the Little Ice Age was bad for the Greenland Norse but good for the Greenland Inuit.) In many historical cases, a society that was depleting its environmental resources could absorb the losses as long as the climate was benign, but was then driven over the brink of collapse when the climate became drier, colder, hotter, wetter, or more variable. Should one then say that the collapse was caused by human environmental impact, or by climate change? Neither of those simple alternatives is correct. Instead, if the society hadn't already partly depleted its environmental resources, it might have survived the resource depletion caused by climate change. Conversely, it was able to survive its self-inflicted resource depletion until climate change produced further resource depletion. It was neither factor taken alone, but the combination of environmental impact and climate change, that proved fatal.

A third consideration is hostile neighbors. All but a few historical societies have been geographically close enough to some other societies to have had at least some contact with them. Relations with neighboring societies may be intermittently or chronically hostile. A society may be able to hold off its enemies as long as it is strong, only to succumb when it becomes weakened for any reason, including environmental damage. The proximate cause of the collapse will then be military conquest, but the ultimate cause—the factor whose change led to the collapse—will have been the factor that caused the weakening. Hence collapses for ecological or other reasons often masquerade as military defeats.

The most familiar debate about such possible masquerading involves the fall of the Western Roman Empire. Rome became increasingly beset by barbarian invasions, with the conventional date for the Empire's fall being taken somewhat arbitrarily as A.D. 476, the year in which the last emperor of the West was deposed. However, even before the rise of the Roman Empire, there had been "barbarian" tribes who lived in northern Europe and Central Asia beyond the borders of "civilized" Mediterranean Europe, and who periodically attacked civilized Europe (as well as civilized China and India). For over a thousand years, Rome successfully held off the barbarians, for instance slaughtering a large invading force of Cimbri and Teutones bent on conquering northern Italy at the Battle of Campi Raudii in 101 B.C.

Eventually, it was the barbarians rather than Romans who won the battles: what was the fundamental reason for that shift in fortune? Was it because of changes in the barbarians themselves, such that they became more numerous or better organized, acquired better weapons or more horses, or

profited from climate change in the Central Asian steppes? In that case, we would say that barbarians really could be identified as the fundamental cause of Rome's fall. Or was it instead that the same old unchanged barbarians were always waiting on the Roman Empire's frontiers, and that they couldn't prevail until Rome became weakened by some combination of economic, political, environmental, and other problems? In that case we would blame Rome's fall on its own problems, with the barbarians just providing the coup de grace. This question continues to be debated. Essentially the same question has been debated for the fall of the Khmer Empire centered on Angkor Wat in relation to invasions by Thai neighbors, for the decline in Harappan Indus Valley civilization in relation to Aryan invasions, and for the fall of Mycenaean Greece and other Bronze Age Mediterranean societies in relation to invasions by Sea Peoples.

The fourth set of factors is the converse of the third set: decreased support by friendly neighbors, as opposed to increased attacks by hostile neighbors. All but a few historical societies have had friendly trade partners as well as neighboring enemies. Often, the partner and the enemy are one and the same neighbor, whose behavior shifts back and forth between friendly and hostile. Most societies depend to some extent on friendly neighbors, either for imports of essential trade goods (like U.S. imports of oil, and Japanese imports of oil, wood, and seafood, today), or else for cultural ties that lend cohesion to the society (such as Australia's cultural identity imported from Britain until recently). Hence the risk arises that, if your trade partner becomes weakened for any reason (including environmental damage) and can no longer supply the essential import or the cultural tie, your own society may become weakened as a result. This is a familiar problem today because of the First World's dependence on oil from ecologically fragile and politically troubled Third World countries that imposed an oil embargo in 1973. Similar problems arose in the past for the Greenland Norse, Pitcairn Islanders, and other societies.

The last set of factors in my five-point framework involves the ubiquitous question of the society's responses to its problems, whether those problems are environmental or not. Different societies respond differently to similar problems. For instance, problems of deforestation arose for many past societies, among which Highland New Guinea, Japan, Tikopia, and Tonga developed successful forest management and continued to prosper, while Easter Island, Mangareva, and Norse Greenland failed to develop successful forest management and collapsed as a result. How can we understand such differing outcomes? A society's responses depend on its political,

economic, and social institutions and on its cultural values. Those institutions and values affect whether the society solves (or even tries to solve) its problems. In this book we shall consider this five-point framework for each past society whose collapse or persistence is discussed.

I should add, of course, that just as climate change, hostile neighbors, and trade partners may or may not contribute to a particular society's collapse, environmental damage as well may or may not contribute. It would be absurd to claim that environmental damage must be a major factor in all collapses: the collapse of the Soviet Union is a modern counter-example, and the destruction of Carthage by Rome in 146 B.C. is an ancient one. It's obviously true that military or economic factors alone may suffice. Hence a full title for this book would be "Societal collapses involving an environmental component, and in some cases also contributions of climate change, hostile neighbors, and trade partners, plus questions of societal responses." That restriction still leaves us ample modern and ancient material to consider.

Issues of human environmental impacts today tend to be controversial, and opinions about them tend to fall on a spectrum between two opposite camps. One camp, usually referred to as "environmentalist" or "pro-environment," holds that our current environmental problems are serious and in urgent need of addressing, and that current rates of economic and population growth cannot be sustained. The other camp holds that environmentalists' concerns are exaggerated and unwarranted, and that continued economic and population growth is both possible and desirable. The latter camp isn't associated with an accepted short label, and so I shall refer to it simply as "non-environmentalist." Its adherents come especially from the world of big business and economics, but the equation "non-environmentalist" = "pro-business" is imperfect; many businesspeople consider themselves environmentalists, and many people skeptical of environmentalists' claims are not in the world of big business. In writing this book, where do I stand myself with the respect to these two camps?

On the one hand, I have been a bird-watcher since I was seven years old. I trained professionally as a biologist, and I have been doing research on New Guinea rainforest birds for the past 40 years. I love birds, enjoy watching them, and enjoy being in rainforest. I also like other plants, animals, and habitats and value them for their own sakes. I've been active in many efforts to preserve species and natural environments in New Guinea and elsewhere.

For the past dozen years I've been a director of the U.S. affiliate of World Wildlife Fund, one of the largest international environmentalist organizations and the one with the most cosmopolitan interests. All of those things have earned me criticism from non-environmentalists, who use phrases such as "fearmonger," "Diamond preaches gloom and doom," "exaggerates risks," and "favors endangered purple louseworts over the needs of people." But while I do love New Guinea birds, I love much more my sons, my wife, my friends, New Guineans, and other people. I'm more interested in environmental issues because of what I see as their consequences for people than because of their consequences for birds.

On the other hand, I have much experience, interest, and ongoing involvement with big businesses and other forces in our society that exploit environmental resources and are often viewed as anti-environmentalist. As a teenager, I worked on large cattle ranches in Montana, to which, as an adult and father, I now regularly take my wife and my sons for summer vacations. I had a job on a crew of Montana copper miners for one summer. I love Montana and my rancher friends, I understand and admire and sympathize with their agribusinesses and their lifestyles, and I've dedicated this book to them. In recent years I've also had much opportunity to observe and become familiar with other large extractive companies in the mining, logging, fishing, oil, and natural gas industries. For the last seven years I've been monitoring environmental impacts in Papua New Guinea's largest producing oil and natural gas field, where oil companies have engaged World Wildlife Fund to provide independent assessments of the environment. I have often been a guest of extractive businesses on their properties, I've talked a lot with their directors and employees, and I've come to understand their own perspectives and problems.

While these relationships with big businesses have given me close-up views of the devastating environmental damage that they often cause, I've also had close-up views of situations where big businesses found it in their interests to adopt environmental safeguards more draconian and effective than I've encountered even in national parks. I'm interested in what motivates these differing environmental policies of different businesses. My involvement with large oil companies in particular has brought me condemnation from some environmentalists, who use phrases such as "Diamond has sold out to big business," "He's in bed with big businesses," or "He prostitutes himself to the oil companies."

In fact, I am not hired by big businesses, and I describe frankly what I see happening on their properties even though I am visiting as their guest.



On some properties I have seen oil companies and logging companies being destructive, and I have said so; on other properties I have seen them being careful, and that was what I said. My view is that, if environmentalists aren't willing to engage with big businesses, which are among the most powerful forces in the modern world, it won't be possible to solve the world's environmental problems. Thus, I am writing this book from a middle-of-the-road perspective, with experience of both environmental problems and of business realities.

How can one study the collapses of societies "scientifically"? Science is often misrepresented as "the body of knowledge acquired by performing replicated controlled experiments in the laboratory." Actually, science is something much broader: the acquisition of reliable knowledge about the world. In some fields, such as chemistry and molecular biology, replicated controlled experiments in the laboratory are feasible and provide by far the most reliable means to acquire knowledge. My formal training was in two such fields of laboratory biology, biochemistry for my undergraduate degree and physiology for my Ph.D. From 1955 to 2002 I conducted experimental laboratory research in physiology, at Harvard University and then at the University of California in Los Angeles.

When I began studying birds in New Guinea rainforest in 1964, I was immediately confronted with the problem of acquiring reliable knowledge without being able to resort to replicated controlled experiments, whether in the laboratory or outdoors. It's usually neither feasible, legal, nor ethical to gain knowledge about birds by experimentally exterminating or manipulating their populations at one site while maintaining their populations at another site as unmanipulated controls. I had to use different methods. Similar methodological problems arise in many other areas of population biology, as well as in astronomy, epidemiology, geology, and paleontology.

A frequent solution is to apply what is termed the "comparative method" or the "natural experiment"—i.e., to compare natural situations differing with respect to the variable of interest. For instance, when I as an ornithologist am interested in effects of New Guinea's Cinnamon-browed Melidectes Honeyeater on populations of other honeyeater species, I compare bird communities on mountains that are fairly similar except that some do and others don't happen to support populations of Cinnamon-browed Melidectes Honeyeaters. Similarly, my books *The Third Chimpanzee: The Evolution and Future of the Human Animal* and *Why Is Sex Fun?*

*The Evolution of Human Sexuality* compared different animal species, especially different species of primates, in an effort to figure out why women (unlike females of most other animal species) undergo menopause and lack obvious signs of ovulation, why men have a relatively large penis (by animal standards), and why humans usually have sex in private (rather than in the open, as almost all other animal species do). There is a large scientific literature on the obvious pitfalls of that comparative method, and on how best to overcome those pitfalls. Especially in historical sciences (like evolutionary biology and historical geology), where it's impossible to manipulate the past experimentally, one has no choice except to renounce laboratory experiments in favor of natural ones.

This book employs the comparative method to understand societal collapses to which environmental problems contribute. My previous book (*Guns, Germs, and Steel: The Fates of Human Societies*) had applied the comparative method to the opposite problem: the differing rates of buildup of human societies on different continents over the last 13,000 years. In the present book focusing instead on collapses rather than on buildups, I compare many past and present societies that differed with respect to environmental fragility, relations with neighbors, political institutions, and other "input" variables postulated to influence a society's stability. The "output" variables that I examine are collapse or survival, and form of the collapse if a collapse does occur. By relating output variables to input variables, I aim to tease out the influence of possible input variables on collapses.

A rigorous, comprehensive, and quantitative application of this method was possible for the problem of deforestation-induced collapses on Pacific islands. Prehistoric Pacific peoples deforested their islands to varying degrees, ranging from only slight to complete deforestation, and with societal outcomes ranging from long-term persistence to complete collapses that left everybody dead. For 81 Pacific islands my colleague Barry Rolett and I graded the extent of deforestation on a numerical scale, and we also graded values of nine input variables (such as rainfall, isolation, and restoration of soil fertility) postulated to influence deforestation. By a statistical analysis we were able to calculate the relative strengths with which each input variable predisposed the outcome to deforestation. Another comparative experiment was possible in the North Atlantic, where medieval Vikings from Norway colonized six islands or land masses differing in suitability for agriculture, ease of trade contact with Norway, and other input variables, and also differing in outcome (from quick abandonment, to everybody dead af-

ter 500 years, to still thriving after 1,200 years). Still other comparisons are possible between societies from different parts of the world.

All of these comparisons rest on detailed information about individual societies, patiently accumulated by archaeologists, historians, and other scholars. At the end of this book I provide references to the many excellent books and papers on the ancient Maya and Anasazi, the modern Rwandans and Chinese, and the other past and present societies that I compare. Those individual studies constitute the indispensable database for my book. But there are additional conclusions that can be drawn from comparisons among those many societies, and that could not have been drawn from detailed study of just a single society. For example, to understand the famous Maya collapse requires not only accurate knowledge of Maya history and the Maya environment; we can place the Maya in a broader context and gain further insights by comparing them with other societies that did or didn't collapse, and that resembled the Maya in some respects and differed from them in other respects. Those further insights require the comparative method.

I have belabored this necessity for both good individual studies and good comparisons, because scholars practicing one approach too often belittle the contributions of the other approach. Specialists in the history of one society tend to dismiss comparisons as superficial, while those who compare tend to dismiss studies of single societies as hopelessly myopic and of limited value for understanding other societies. But we need both types of studies if we are to acquire reliable knowledge. In particular, it would be dangerous to generalize from one society, or even just to be confident about interpreting a single collapse. Only from the weight of evidence provided by a comparative study of many societies with different outcomes can one hope to reach convincing conclusions.

So that readers will have some advance idea where they are heading, here is how this book is organized. Its plan resembles a boa constrictor that has swallowed two very large sheep. That is, my discussions of the modern world and also of the past both consist of a disproportionately long account of one society, plus briefer accounts of four other societies.

We shall begin with the first large sheep. Part One comprises a single lengthy chapter (Chapter 1), on the environmental problems of southwestern Montana, where Huls Farm and the ranches of my friends the Hirschys I to whom this book is dedicated) are located. Montana has the advantage of

being a modern First World society whose environmental and population problems are real but still relatively mild compared to those of most of the rest of the First World. Above all, I know many Montanans well, so that I can connect the policies of Montana society to the often-conflicting motivations of individual people. From that familiar perspective of Montana, we can more easily imagine what was happening in the remote past societies that initially strike us as exotic, and where we can only guess what motivated individual people.

Part Two begins with four briefer chapters on past societies that did collapse, arranged in a sequence of increasing complexity according to my five-point framework. Most of the past societies that I shall discuss in detail were small and peripherally located, and some were geographically bounded, or socially isolated, or in fragile environments. Lest the reader thereby be misled into concluding that they are poor models for familiar big modern societies, I should explain that I selected them for close consideration precisely because processes unfolded faster and reached more extreme outcomes in such small societies, making them especially clear illustrations. It is not the case that large central societies trading with neighbors and located in robust environments didn't collapse in the past and can't collapse today. One of the past societies that I do discuss in detail, the Maya, had a population of many millions or tens of millions, was located within one of the two most advanced cultural areas of the New World before European arrival (Mesoamerica), and traded with and was decisively influenced by other advanced societies in that area. I briefly summarize in the Further Readings section for Chapter 9 some of the many other famous past societies—Fertile Crescent societies, Angkor Wat, Harappan Indus Valley society, and others—that resembled the Maya in those respects, and to whose declines environmental factors contributed heavily.

Our first case study from the past, the history of Easter Island (Chapter 2), is as close as we can get to a "pure" ecological collapse, in this case due to total deforestation that led to war, overthrow of the elite and of the famous stone statues, and a massive population die-off. As far as we know, Easter's Polynesian society remained isolated after its initial founding, so that Easter's trajectory was uninfluenced by either enemies or friends. Nor do we have evidence of a role of climate change on Easter, though that could still emerge from future studies. Barry Rolett's and my comparative analysis helps us understand why Easter, of all Pacific islands, suffered such a severe collapse.

Pitcairn Island and Henderson Island (Chapter 3), also settled by Polynesians, offer examples of the effect of item four of my five-point framework: loss of support from neighboring friendly societies. Both Pitcairn and Henderson islands suffered local environmental damage, but the fatal blow came from the environmentally triggered collapse of their major trade partner. There were no known complicating effects of hostile neighbors or of climate change.

Thanks to an exceptionally detailed climate record reconstructed from tree rings, the Native American society of the Anasazi in the U.S. Southwest (Chapter 4) clearly illustrates the intersection of environmental damage and population growth with climate change (in this case, drought). Neither friendly or hostile neighbors, nor (except towards the end) warfare, appear to have been major factors in the Anasazi collapse.

No book on societal collapses would be complete without an account (Chapter 5) of the Maya, the most advanced Native American society and the quintessential romantic mystery of cities covered by jungle. As in the case of the Anasazi, the Maya illustrate the combined effects of environmental damage, population growth, and climate change without an essential role of friendly neighbors. Unlike the case with the Anasazi collapse, hostile neighbors were a major preoccupation of Maya cities already from an early stage. Among the societies discussed in Chapters 2 through 5, only the Maya offer us the advantage of a deciphered written record.

Norse Greenland (Chapters 6-8) offers us our most complex case of a prehistoric collapse, the one for which we have the most information (because it was a well-understood literate European society), and the one warranting the most extended discussion: the second sheep inside the boa constrictor. All five items in my five-point framework are well documented: environmental damage, climate change, loss of friendly contacts with Norway, rise of hostile contacts with the Inuit, and the political, economic, social, and cultural setting of the Greenland Norse. Greenland provides us with our closest approximation to a controlled experiment in collapses: two societies (Norse and Inuit) sharing the same island, but with very different cultures, such that one of those societies survived while the other was dying. Thus, Greenland history conveys the message that, even in a harsh environment, collapse isn't inevitable but depends on a society's choices. Comparisons are also possible between Norse Greenland and five other North Atlantic societies founded by Norse colonists, to help us understand why the Orkney Norse thrived while their Greenland cousins were succumbing.

One of those five other Norse societies, Iceland, ranks as an outstanding success story of triumph over a fragile environment to achieve a high level of modern prosperity.

Part Two concludes (Chapter 9) with three more societies that (like Iceland) succeeded, as contrast cases for understanding societies that failed. While those three faced less severe environmental problems than Iceland or than most of those that failed, we shall see that there are two different paths to success: a bottom-up approach exemplified by Tikopia and the New Guinea highlands, and a top-down approach exemplified by Japan of the Tokugawa Era.

Part Three then returns to the modern world. Having already considered modern Montana in Chapter 2, we now take up four markedly different modern countries, the first two small and the latter two large or huge: a Third World disaster (Rwanda), a Third World survivor-so-far (the Dominican Republic), a Third World giant racing to catch up with the First World (China), and a First World society (Australia). Rwanda (Chapter 10) represents a Malthusian catastrophe happening under our eyes, an overpopulated land that collapsed in horrible bloodshed, as the Maya did in the past. Rwanda and neighboring Burundi are notorious for their Hutu/Tutsi ethnic violence, but we shall see that population growth, environmental damage, and climate change provided the dynamite for which ethnic violence was the fuse.

The Dominican Republic and Haiti (Chapter 11), sharing the island of Hispaniola, offer us a grim contrast, as did Norse and Inuit societies in Greenland. From decades of equally vile dictatorships, Haiti emerged as the modern New World's saddest basket case, while there are signs of hope in the Dominican Republic. Lest one suppose that this book preaches environmental determinism, the latter country illustrates what a big difference one person can make, especially if he or she is the country's leader.

China (Chapter 12) suffers from heavy doses of all 12 modern types of environmental problems. Because China is so huge in its economy, population, and area, China's environmental and economic impact is important not only for China's own people but also for the whole world.

Australia (Chapter 13) is at the opposite extreme from Montana, as the First World society occupying the most fragile environment and experiencing the most severe environmental problems. As a result, it is also among the countries now considering the most radical restructuring of its society, in order to solve those problems.

This book's concluding section (Part Four) extracts practical lessons for

us today. Chapter 14 asks the perplexing question arising for every past society that ended up destroying itself, and that will perplex future earthlings if we too end up destroying ourselves: how could a society fail to have seen the dangers that seem so clear to us in retrospect? Can we say that their end was the inhabitants' own fault, or that they were instead tragic victims of insoluble problems? How much past environmental damage was unintentional and imperceptible, and how much was perversely wrought by people acting in full awareness of the consequences? For instance, what were Easter Islanders saying as they cut down the last tree on their island? It turns out that group decision-making can be undone by a whole series of factors, beginning with failure to anticipate or perceive a problem, and proceeding through conflicts of interest that leave some members of the group to pursue goals good for themselves but bad for the rest of the group.

Chapter 15 considers the role of modern businesses, some of which are among the most environmentally destructive forces today, while others provide some of the most effective environmental protection. We shall examine why some (but only some) businesses find it in their interests to be protective, and what changes would be necessary before other businesses would find it in their interests to emulate them.

Finally, Chapter 16 summarizes the types of environmental dangers facing the modern world, the commonest objections raised against claims of their seriousness, and differences between environmental dangers today and those faced by past societies. A major difference has to do with globalization, which lies at the heart of the strongest reasons both for pessimism and for optimism about our ability to solve our current environmental problems. Globalization makes it impossible for modern societies to collapse in isolation, as did Easter Island and the Greenland Norse in the past. Any society in turmoil today, no matter how remote—think of Somalia and Afghanistan as examples—can cause trouble for prosperous societies on other continents, and is also subject to their influence (whether helpful or destabilizing). For the first time in history, we face the risk of a global decline. But we also are the first to enjoy the opportunity of learning quickly from developments in societies anywhere else in the world today, and from what has unfolded in societies at any time in the past. That's why I wrote this book.