CHAPTER 4
The Ancient Ones: The Anasazi and Their Neighbors

Desert farmers • Tree rings • Agricultural strategies • Chaco's problems and packrats • Regional integration • Chaco's decline and end • Chaco's message •

Of the sites of societal collapses considered in this book, the most remote are Pitcairn and Henderson Islands discussed in the last chapter. At the opposite extreme, the ones closest to home for Americans are the Anasazi sites of Chaco Culture National Historical Park (Plates 9, 10) and Mesa Verde National Park, lying in the U.S. Southwest and New Mexico state highway 57 and near U.S. highway 666, respectively, less than 600 miles from my home in Los Angeles. Like the Maya cities that will be the subject of the next chapter, they and other ancient Native American ruins are popular tourist attractions that thousands of modern First World citizens visit each year. One of those former southwestern cultures, Mimbres, is also a favorite of art collectors because of its beautiful pottery decorated with geometrical patterns and realistic figures: a unique tradition created by a society numbering barely 4,000 people, and sustained at its peak for just a few generations before abruptly disappearing.

I concede that U.S. southwestern societies operated on a much smaller scale than did Maya cities, with populations of thousands rather than millions. As a result, Maya cities are far more extensive in area, have more lavish monuments and art, were products of more deeply stratified societies headed by kings, and possessed writing. But the Anasazi did manage to construct in stone the largest and tallest buildings erected in North America until the Chicago steel girders skyscrapers of the 1880s. Even though the Anasazi lacked a writing system such as the one that allows us to date Maya inscriptions to the exact day, we shall see that many U.S. southwestern structures can still be dated to within a year, thereby enabling archaeologists to understand the societies' history with much finer time resolution than is possible for Easter Island, Pitcairn, and Henderson Islands.

In the U.S. Southwest we are dealing with not just a single culture in decline, but with a whole series of them (map, p. 142). Southwestern cultures that underwent regional collapses, drastic reorganizations, or abandonments at different locations and different times include Mimbres shortly before A.D. 1130; Chaco Canyon, North Black Mesa, and the Virgin Anasazi in the middle or late 12th century; around 1300, Mesa Verde and the Hovenweep Anasazi; Mogollon around 1400; and possibly as late as the 15th century, Hohokam, well known for its elaborate system of irrigation agriculture. While all of these transitions occurred before Columbus's arrival in the New World in 1492, the Anasazi did not vanish as people: other southwestern Native American societies incorporating some of their descendants persist to this day, such as the Hopi and Zuni pueblos. What accounts for all those declines or abrupt changes in so many neighboring societies?

Despite single-factor explanations invoke environmental damage, drought, or warfare and cannibalism. Actually, the field of U.S. southwestern prehistory is a graveyard for single-factor explanations. Multiple factors interrelated, but they all go back to the fundamental problem that the U.S. Southwest is a fragile and marginal environment for agriculture—as is much of the world today. It has low and unpredictable rainfall, quickly eroded soils, and very low rates of forest regrowth. Environmental problems, especially major droughts and episodes of streambed erosion, tend to recur in intervals much longer than a human lifetime or oral memory span. Given those severe difficulties, it's impressive that Native Americans in the Southwest developed such complex farming societies as they did. Testimony to their success is that most of this area today supports a much sparser population growing their own food than it did in Anasazi times. It was a sobering and unforgettable experience for me, while I was driving through much of desert dotted with the remains of former Anasazi stone houses, dams, and irrigation systems, to see a now virtually empty landscape with only occasional occupied house. The Anasazi collapse and other southwestern collapses offer us not only a gripping story but also an instructive look at the purposes of this book, illustrating well our themes of human environmental impact and climate change intersecting, environmental and population problems spilling over into warfare, the strengths but also the dangers of complex non-self-sufficient societies dependent on imports and systems and societies collapsing swiftly after attaining peak population numbers and power.
Our understanding of southwestern prehistory is detailed because of two advantages that archaeologists in this area enjoy. One is the packrat middens method that I'll discuss below, which provides us with a virtual time capsule of the plants growing within a few dozen yards of a midden within a few decades of a calculated date. That advantage has allowed paleobotanists to reconstruct changes in local vegetation. The other advantage allows archaeologists to date building sites to the nearest year by the tree rings of the site's wood construction beams, instead of having to rely on the radiocarbon method used by archaeologists elsewhere, with its inevitable errors of 50 to 100 years.

The tree ring method depends on the fact that rainfall and temperature vary seasonally in the Southwest, so that tree growth rates also vary seasonally, as true at other sites in the temperate zones as well. Hence, temperate zone trees lay down new wood in annual growth rings, unlike tropical rainforest trees whose growth is more nearly continuous. But the Southwest is better for tree ring studies than most other temperate zone sites, because the dry climate results in excellent preservation of wooden beams from trees felled over a thousand years ago.

Here's how tree ring dating, known to scientists as dendrochronology (from the Greek roots dendron = tree, and chronos = time), works. If you cut down a tree today, it's straightforward to count the rings inwards, starting from the tree's outside (corresponding to this year's growth ring), and thereby to state that the 177th ring from the outermost one towards the center was laid down in the year 2005 minus 177, or 1828. But it's less straightforward to attach a date to a particular ring in an ancient Anasazi wooden beam, because at first you don't know in what year the beam was cut. However, the widths of tree growth rings vary from year to year, depending on rain or drought conditions in each year. Hence the sequence of rings in a tree cross-section is like a message in the Morse code formerly used for sending telegraph messages; dot-dot-dash-dot-dash in the Morse code, wide-wide-narrow-wide-narrow in a tree ring sequence. Actually, the ring sequence is even more diagnostic and richer in information than the Morse code, because trees actually contain rings spanning many different widths, rather than the Morse code's choice between only a dot or a dash.

Tree ring specialists (known as dendrochronologists) proceed by noting the sequence of wider and narrower rings in a tree cut down in a known recent year, and also noting the sequence in beams from trees cut down at various unknown times in the past. They then match up and align ring sequences with the same diagnostic wide/narrow patterns from different trees. For instance, suppose that this year (2005) you cut down a tree that proves to be 400 years old (400 rings), and that has an especially distinctive sequence of five wide rings, two narrow rings, and six wide rings for the 13 years from 1643 back to 1631. If you find that same distinctive sequence dating seven years from the outermost ring in an old beam of unknown dating date with 332 rings, then you can conclude that the old beam came from a tree cut down in 1650 (seven years after 1643), and that the tree began to grow in the year 1318 (332 years before 1650). You then go on to infer that beam, from the tree living between 1318 and 1650, with even other beams, and you similarly try to match up tree ring patterns and find a beam whose pattern shows that it comes from a tree that was cut down after 1828 but began growing before 1318, thereby extending your tree ring record farther back into the past. In that way, dendrochronologists have constructed tree ring records extending back for thousands of years in some parts of the world. Each such record is valid for a geographic area whose extent depends on local weather patterns, because weather and hence tree growth patterns vary with location. For instance, the basic tree ring chronology of the American Southwest applies (with some variation) to the area from northern Mexico to Wyoming.

A bonus of dendrochronology is that the width and substructure of each ring reflect the amount of rain and the season at which the rain fell during the particular year. Thus, tree ring studies also allow one to reconstruct climate; e.g., a series of wide rings means a wet period, and a series of narrow rings means a drought. Tree rings thereby provide southwestern archaeologists with uniquely exact dating and uniquely detailed year-to-year environmental information.

The first humans to reach the Americas, living as hunter-gatherers, arrived in the U.S. Southwest by 11,000 B.C. but possibly earlier, as part of the colonization of the New World from Asia by peoples ancestral to modern Native Americans. Agriculture did not develop indigenously in the U.S. Southwest, because of a paucity of domesticable wild plant and animal species. Instead, agriculture arrived from Mexico, where corn, squash, beans, and many other crops were domesticated—corn arriving by 2000 B.C., squash around 800 B.C., beans somewhat later, and cotton not until A.D. 400. People also kept domestic turkeys, about which there is some debate whether they were first domesticated in Mexico and spread to the Southwest, or vice versa, or whether they were domesticated independently in both areas. Originally,
southwestern Native Americans just incorporated some agriculture as part of their hunter-gatherer lifestyle, as did the modern Apache in the 18th and 19th centuries: the Apache settled down to plant and harvest crops during the growing season, then moved around as hunter-gatherers during the rest of the year. By A.D. 1, some southwestern Native Americans had already taken up residence in villages and become primarily dependent on agriculture with ditch irrigation. Thereafter, their populations exploded in numbers and spread over the landscape until the retrenchments beginning around A.D. 1117.

At least three alternative types of agriculture emerged, all involving different solutions to the Southwest's fundamental problem: how to obtain enough water to grow crops in an environment most of which has rainfall so low and unpredictable that little or no farming is practiced there today. One of the three solutions consisted of so-called dryland agriculture, which meant relying on rainfall at the higher elevations where there really was enough rain to promote growth of crops in the fields in which the rain fell. A second solution did not depend on rain falling directly on the field, but instead was adopted in areas where the water table in the ground reached close enough to the surface that plant roots could extend down into the water table. That method was employed in canyon bottoms with intermittent or permanent streams and a shallow alluvial groundwater table, such as at Chaco Canyon. The third solution, practiced especially by the Hohokam and also at Chaco Canyon, consisted of collecting water runoff in ditches or canals to irrigate fields.

While the methods used in the Southwest to obtain enough water to grow crops were variants on those three types, people experimented in different locations with alternative strategies for applying those methods. The experiments lasted for almost a thousand years, and many of them succeeded for centuries, but eventually all except one succumbed to environmental problems caused by human impact or climate change. Each alternative involved different risks.

One strategy was to live at higher elevations where rainfall was higher, as did the Mogollon, the people at Mesa Verde, and the people of the early agricultural phase known as the Pueblo I phase. But that carried the risk that it is cooler at high than at low elevations, and in an especially cool year it might be too cold to grow crops at all. An opposite extreme was to farm the warmer low elevations, but there the rainfall is insufficient for dryland agriculture. The Hohokam got around that problem by constructing the most extensive irrigation system in the Americas outside Peru, with hundreds of miles of secondary canals branching off a main canal 12 miles long, 16 feet deep, and 80 feet wide. But irrigation entailed the risk that heavy flooding and cutting of ditches and canals could lead to sudden heavy water runoff from rainstorms digging further down into the ditches and canals and into deep channels called arroyos, in which the water level would drop below the field level, making irrigation impossible for people without pumps.

Irrigation poses the danger that especially heavy rains or floods could wash away the dams and channels, as may indeed eventually have happened at Hohokam.

Another, more conservative, strategy was to plant crops only in areas near reliable springs and groundwater tables. That was the solution initially adopted by the Mimbres, and by people in the farming phase known as Pueblo II at Chaco Canyon. However, it then became dangerously tempting to extend and agriculture, in wet decades with favorable growing conditions, into marginal areas with less reliable springs or groundwater. The population, multiplying in those marginal areas might then find itself unable to plant crops and starving when the unpredictable climate turned dry again. That actually befell the Mimbres, who started by safely farming the floodplain and then began to farm adjacent land above the floodplain as the population came to saturate the floodplain's capacity to support it. They got away with their gamble during a wet climate phase, when they were able to obtain half of their food requirements outside the floodplain. However, when drought conditions returned, that gamble left them with a population double what the floodplain could support, and Mimbres society collapsed suddenly under the stress.

A third solution was to occupy an area for only a few decades, until the area's soil and game became exhausted, then to move on to another place that method worked when people were living at low population densities so that there were lots of unoccupied areas to which to move, and so that each occupied area could be left unoccupied again for sufficiently long occupation that its vegetation and soil nutrients had time to recover. southwestern archaeological sites were indeed inhabited for only a few decades, even though our attention today is drawn to a few big sites that were inhabited continuously for several centuries, such as Pueblo Bonito in Chaco Canyon. However, the method of shifting sites after a short occupation became impossible at high population densities, when people filled up the whole landscape and there was nowhere left empty to move to.

A more strategy was to plant crops at many sites even though rainfall was unpredictable, and then to harvest crops at whichever sites did get...
enough rain to produce a good harvest, and to redistribute some of that harvest to the people still living at all the sites that didn't happen to receive enough rain that year. That was one of the solutions eventually adopted at Chaco Canyon. But it involved the risk that redistribution required a complex political and social system to integrate activities between different sites, and that lots of people then ended up starving when that complex system collapsed.

The remaining strategy was to plant crops and live near permanent or dependable sources of water, but on landscape benches above the main drainages, so as to avoid the risk of a heavy flood washing out fields and villages, and to practice a diverse economy, exploiting ecologically diverse habitats, so that each settlement would be self-sufficient. That solution, adopted by people whose descendants live today in the Southwest’s Hopi and Zuni Pueblos, has succeeded for more than a thousand years. Some modern Hopis and Zunis, looking at the extravagance of American society around them, shake their heads and say, “We were here long before you were, and we expect still to be here long after you too are gone.”

If all of these alternative solutions face a similar overarching risk: that a series of good years, with adequate rainfall or with sufficiently shallow groundwater tables, may result in population growth, resulting in turn in society becoming increasingly complex and interdependent and no longer self-sufficient. Such a society then cannot cope with, and rebuild itself after, a series of bad years that a less populous, less interdependent, and self-sufficient society had previously been able to cope with. As we shall see, precisely that dilemma ended Anasazi settlement of Long House Valley and perhaps other areas as well.

The most intensively studied abandonment was of the most spectacular and largest set of sites, the Anasazi sites in Chaco Canyon of northwestern New Mexico. Chaco Anasazi society flourished from about A.D. 600 for more than five centuries, until it disappeared some time between 1150 and 1200. It was a complexly organized, geographically extensive, regionally integrated society that erected the largest buildings in pre-Columbian North America. Even more than the barren treeless landscape of Easter Island, the harsh treeless landscape of Chaco Canyon today, with its deep-cut arroyos and sparse low vegetation of salt-tolerant bushes, astonishes us, because the area is now completely uninhabited except for a few National Park Service rangers' houses. Why would anyone have built an advanced city in that
wasteland, and why, having gone to all that work of building it, did they then abandon it?

When Native American farmers moved into the Chaco Canyon area around A.D. 600, they initially lived in underground pit houses, as did other contemporary Native Americans in the Southwest. Around A.D. 700 the Chaco Anasazi, out of contact with Native American societies building structures of stone a thousand miles to the south in Mexico, independent inventions of stone construction and eventually adopted rubble cores with veneers of cut stone facing (Plate 11). Initially, those structures were only one story high, but around A.D. 950 what eventually became the largest Chacoan site of Pueblo Bonito went up to two stories, then over the next centuries rose to five or six stories with 600 rooms whose roof supports were logs up to 16 feet long and weighing up to 700 pounds.

Why, out of all the Anasazi sites, was it at Chaco Canyon that construction techniques and political and societal complexity reached their apogee? Likely reasons are some environmental advantages of Chaco Canyon, which initially represented a favorable environmental oasis within northwestern New Mexico. The narrow canyon caught rain runoff from many side channels and a large upland area, which resulted in high alluvial groundwater levels permitting farming independent of local rainfall in some areas and also high rates of soil fertility from the runoff. The large habitable area in the canyon and within 50 miles of it could support a relatively high population for such a dry environment. The Chaco region has a high diversity of useful wild plant and animal species, and a relatively low elevation that provides a long growing season for crops. At first, nearby pinyon and juniper woodlands provided the construction logs and firewood. The earliest roof beams identified by their tree rings, and still preserved in the Southwest’s dry climate, are of locally available pinyon pines, and firewood remains in early hearths are of locally available pinyon and juniper. Anasazi diets depended heavily on growing corn, plus some squash and beans, but early archaeological levels also show much consumption of wild plants such as pinyon nuts (75% protein), and much hunting of deer.

All those natural advantages of Chaco Canyon were balanced by two major disadvantages resulting from the Southwest’s environmental fragility. One involved problems of water management. Initially, rain runoff would have been a broad sheet over the flat canyon bottom, permitting floodplain agriculture watered both by the runoff and by the high alluvial groundwater table. When the Anasazi began diverting water into channels for irrigation, the concentration of water runoff in the channels and the necessity of vegetation for agriculture, combined with natural processes, resulted around A.D. 900 in the cutting of deep arroyos in which the water table was below field levels, thereby making irrigation agriculture and also agriculture based on groundwater impossible until the arroyos filled up. Such arroyo-cutting can develop surprisingly suddenly. For example, the Arizona city of Tucson in the late 1880s, American settlers excavated a required ditch to intercept the shallow groundwater table and divert water downstream onto the floodplain. Unfortunately, floods from heavy rains in the summer of 1890 cut into the head of that ditch, starting an arroyo that within a mere three days extended itself for a distance of two miles upstream, an incised and agriculturally useless floodplain near Tucson. Early Southwest Native American societies probably attempted similar intercept ditches, with similar results. The Chaco Anasazi did with that problem of arroyos in the canyon in several ways: by building dams inside side-canyons above the elevation of the main canyon to store rainwater; by laying out field systems that that rainwater could irrigate by storing rainwater coming down over the tops of the cliffs rimming the canyon’s north wall between each pair of side-canyons; and by building a dam across the main canyon.

The other major environmental problem besides water management involved deforestation, as revealed by the method of packrat middens analysis. Those of you who (like me until some years ago) have never seen packrats don’t know what their middens are, and can’t possibly imagine their relevance to Anasazi prehistory, here is a quick crash course in midden analysis. In 1849, hungry gold miners crossing the Nevada desert noticed ground, listening balls of a candy-like substance on a cliff, licked or ate the balls, and discovered them to be sweet-tasting, but then they developed nausea. Eventually it was realized that the balls were hardened deposits made by small rodents, called packrats, that protect themselves by building nests of sticks, plant fragments, and mammal dung gathered in the vicinity, the rodent remains, discarded bones, and their own feces. Not being toilet-trained, the rats urinate in their nests, and sugar and other substances crystallize from their urine as it dries out, cementing the midden to a brick-like consistency. In effect, the hungry gold miners were eating dried rat urine laced with rat feces and rat garbage.

Conventionally, to save themselves work and to minimize their risk of being eaten by a predator while out of the nest, packrats gather vegetation within just a few dozen yards of the nest. After a few decades the rats’ nest is abandoned and moved on to build a new nest, while the
crystallized urine prevents the material in the old midden from decaying. By identifying the remains of the dozens of urine-encrusted plant species in a midden, paleobotanists can reconstruct a snapshot of the vegetation growing near the midden at the time that the rats were accumulating it, while zoologists can reconstruct something of the fauna from the insect and vertebrate remains. In effect, a packrat midden is a paleontologist’s dreamtime capsule preserving a sample of the local vegetation, gathered within a few dozen yards of the spot within a period of a few decades, at a date fixed by radiocarbon-dating the midden.

In 1975 paleoecologist Julio Betancourt happened to visit Chaco Can-
yon while driving through New Mexico as a tourist. Looking down on the treeless landscape around Pueblo Bonito, he thought to himself, “This place looks like beat-up Mongolian steppe; where did those people get their timber and firewood?” Archaeologists studying the ruins had been asking themselves the same question. In a moment of inspiration three years later, when a friend asked him for completely unrelated reasons to write a grant proposal to study packrat middens, Julio recalled his first impression of Pueblo Bonito. A quick phone call to midden expert Tom Van Devender established that Tom had already collected a few middens at the National Park Service campground near Pueblo Bonito. Almost all of them had proved to contain needles of pinyon pines, which don’t grow anywhere within miles today but which had nevertheless somehow furnished the roof beams in the early phases of Pueblo Bonito’s construction, as well as furnishing much of the charcoal found in hearths and trash middens. Julio and Tom realized that those must be old middens from a time when pines did grow nearby, but they had no idea how old they thought perhaps just a century or so. Hence they submitted samples of those middens for radiocarbon dating. When the dates came back from the radiocarbon laboratory, Julio and Tom were astonished to learn that many of the middens were over a thousand years old.

That serendipitous observation triggered an explosion of packrat midden studies. Today we know that middens decay extremely slowly in the Southwest’s dry climate. If protected from the elements under an overhang or inside a cave, middens can last 40,000 years, far longer than anyone would have dared to guess. As Julio showed me my first packrat midden near the Chaco Anasazi site of Kin Kletso, I stood in awe at the thought that that apparently fresh-looking nest might have been built at a time when mammoths, giant ground sloths, American Lions, and other extinct Ice Age mammals were still living in the territory of the modern U.S.

In the Chaco Canyon area Julio went on to collect and radiocarbon-date middens, whose dates turned out to encompass the entire period of the rise and fall of Anasazi civilization, from A.D. 600 to 1200. In this way Julio was able to reconstruct vegetational changes in Chaco Canyon throughout the history of Anasazi occupation. Those midden studies identified defor-
mation as the other one (besides water management) of the two major envi-
ronmental problems caused by the growing population that had developed in Chaco Canyon by around A.D. 1000. Middens before that date still incorporated pinyon pine and juniper needles, like the first midden that Julio had analyzed, and like the midden that he showed me. Hence Chaco Anasazi sett-
lements were initially constructed in a pinyon/juniper woodland unlike the current treeless landscape but convenient for obtaining firewood and construction timber nearby. However, middens dated after A.D. 1000 lacked pinyon and juniper, showing that the woodland had then become completely destroyed and the site had achieved its present treeless appearance. The reason why Chaco Canyon became deforested so quickly is the same reason that I discussed in Chapter 2 to explain why Easter Island and many dry Pacific islands settled by people were more likely to end up defor-
moted than were wet islands: in a dry climate, the rate of tree regrowth on cleared land may be too slow to keep up with the rate of logging.
used isotopes of strontium, an element chemically very similar to calcium and hence incorporated along with calcium into plants and animals. Strontium exists as alternative forms (isotopes) differing slightly in atomic weight, of which strontium-87 and strontium-86 are commonest in nature. But the strontium-87/strontium-86 ratio varies with rock age and rock rubidium content, because strontium is produced by radioactive decay of a rubidium isotope. It turned out that living conifers from the three mountain ranges proved to be clearly separated by their strontium-87/strontium-86 ratios, with no overlap at all. From six Chaco ruins, Nathan sampled 52 conifer logs selected on the basis of their tree rings to have been felled at dates ranging from A.D. 974 to 1104. The result he obtained was that two-thirds of the logs could be traced by their strontium ratios to the Chuska Mountains, one-third to the San Mateo Mountains, and none to the San Pedro Mountains. In some cases a given Chaco building incorporated logs from both mountain ranges in the same year, or used logs from one mountain in one year and from the other mountain in another year, while the same mountain furnished logs to several different buildings in the same year. Thus, we have unequivocal evidence of a well-organized, long-distance supply network for the Anasazi capital of Chaco Canyon.

Despite the development of these two environmental problems that reduced crop production and virtually eliminated timber supplies within the Chaco Canyon itself, or because of the solutions that the Anasazi found to these problems, the canyon's population continued to increase, particularly during a big spurt of construction that began in A.D. 1029. Such spurts were especially during wet decades, when more rain meant more food, more people, and more need for buildings. A dense population is attested not only by the famous Great Houses (such as Pueblo Bonito) spaced about a mile apart on the north side of Chaco Canyon, but also by holes drilled into the northern cliff face to support roof beams, indicating a continuous line of residences at the base of the cliffs between the Great Houses, and by the remains of hundreds of small settlements on the south side of the canyon. The size of the canyon's total population is unknown and much debated. Many archaeologists think that it was less than 5,000, and that those numerous buildings had few permanent occupants except priests and were just visited seasonally by peasants at the time of rituals. Other archaeologists note that Pueblo Bonito, which is just one of the large houses at Chaco Canyon, by itself was a building of 600 rooms, and that all those post holes suggest dwellings for much of the length of the canyon, thus implying a population much greater than 5,000. Such debates about estimated population arise frequently in archaeology, as discussed for Easter Island and Easter Island in other chapters of this book.

Whatever the number, this dense population could no longer support itself. It was subsidized by outlying satellite settlements constructed in similar architectural styles and joined to Chaco Canyon by a radiating regional network of hundreds of miles of roads that are still visible today. Those outlying dams to catch summer rain, which fell unpredictably and very patchily: a thunderstorm might produce abundant rain in one desert wash and no rain on another wash just a mile away. The dams meant that when a particular area was fortunate enough to receive a rainstorm, much of the rainywater was stored behind the dam, and people living there could quickly plant and irrigate, and grow a huge surplus of food at that wash in that year. Surpluses could then feed people living at all the other outliers that didn't happen to receive rain then.

Chaco Canyon became a black hole into which goods were imported but from which nothing tangible was exported. Into Chaco Canyon came: thousands of big trees for construction; pottery (all late-period pottery); Chaco Canyon was imported, probably because exhaustion of local building supplies precluded firing pots within the canyon itself; stone of good quality for making stone tools; turquoise for making ornaments, from the areas of New Mexico; and macaws, shell jewelry, and copper bells from the Hohokam and from Mexico, as luxury goods. Even food had to be imported, as shown by a recent study tracing the origins of corn cobs excavated from Pueblo Bonito by means of the same strontium isotope method used by Nathan English to trace the origins of Pueblo Bonito's wooden work. It turns out that, already in the 9th century, corn was being imported from the Chuska Mountains 50 miles to the west (also one of the sources of roof beams), while a corn cob from the last years of Pueblo Bonito in the 12th century came from the San Juan River system 60 miles to the north.

Chaco society turned into a mini-empire, divided between a well-fed ruling class enjoying in luxury and a less well-fed peasantry doing the work and raising the food. The road system and the regional extent of standardized architecture testify to the large size of the area over which the economy and culture of Chaco and its outliers were regionally integrated. Styles of buildings indicate a three-step pecking order: the largest buildings, so-called Great Houses, in Chaco Canyon itself (residences of the governing chiefs?); other Great Houses beyond the canyon ("provincial capitals" of junior chiefs?); and small homesteads of just a few rooms (peasants' houses?).
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Compared to smaller buildings, the Great Houses were distinguished by finer construction with veneer masonry, large structures called Great Kivas, used for religious rituals (similar to ones still used today in modern Pueblos), and a higher ratio of storage space to total space. Great Houses far exceeded homesteads in their contents of imported luxury goods, such as turquoise, macaws, shell jewelry, and copper bells mentioned above, plus imported Mimbres and Hohokam pottery. The highest concentration of luxury items located to date comes from Pueblo Bonito’s room number 3, which held burials of 14 individuals accompanied by 56,000 pieces of turquoise and thousands of shell decorations, including one necklace of 2,000 turquoise beads and a basket covered with a turquoise mosaic and filled with turquoise and shell beads. As for evidence that the chiefs ate better than did the peasants, garbage excavated near Great Houses contained a higher proportion of deer and antelope bones than did garbage from homesteads, with the result that human burials indicate taller, better-nourished, less anemic people and lower infant mortality at Great Houses.

Why did outlying settlements have supported the Chaco center, dutifully delivering timber, pottery, stone, turquoise, and food without receiving anything in return? The answer is probably the same as the reasons why outlying areas of Italy and Britain today support our cities such as Rome and London, which also produce no timber or food but serve as political and religious centers. Like the modern Italians and British, Chacoan outlying settlements were now irreversibly committed to living in a complex, interdependent society. They could no longer revert to their original condition of self-sufficiency, supporting mobile little groups, because the trees in the canyon were gone, the arroyos were cut below field levels, and the growing population had filled up the region and left no unoccupied suitable areas to which to move. When the pinyon and juniper trees were cut down, the nutrients in the litter underneath the trees were flushed out. Today, more than 800 years later, there is still no pinyon/juniper woodland anywhere near the past rat midden containing twigs of the woodland that had grown there before A.D. 1000. Food remains in rubbish at archaeological sites attest to the growing problems of the canyon’s inhabitants in nourishing themselves. Deer declined in their diets, to be replaced by smaller game, especially rabbits and mice. Remains of complete headless mice in human coprolite (preserved dry feces) suggest that people were catching mice in the fields, beheading them, and popping them in whole.

Chaco’s Decline and End

The last identified construction at Pueblo Bonito, dating from the decade before A.D. 1100, was from a wall of rooms enclosing the south side of the plaza, which had formerly been open to the outside. That suggests strife: people evidently moving about the plaza at the last moment, not just to participate in religious ceremonies and to receive orders, but also to make trouble. The last doubtless dated roof beam at Pueblo Bonito and at the nearby Great House of the Great Kiva was cut in A.D. 1117, and the last beam anywhere in Chaco Canyon in A.D. 1170. Other Anasazi sites show more abundant evidence of strife, including signs of cannibalism, plus Kayenta Anasazi settlements at the bases of steep cliffs far from fields and water and understandable only as defended locations. At those southwestern sites that outlasted Chaco Canyon until after A.D. 1250, warfare evidently became intense, as reflected in a proliferation of defensive walls and moats and towers, clustering of scattered small hamlets into larger hilltop fortresses, apparently deliberate burned villages containing unburied bodies, skulls with cut marks, and by scalping, and skeletons with arrowheads inside the body cavity. The explosion of environmental and population problems in the form of deforestation and warfare is a frequent theme in this book, both for past societies (the Easter Islanders, Mangarevans, Maya, and Tikopians) and for modern societies (Rwanda, Haiti, and others).

Signs of warfare-related cannibalism among the Anasazi are an interesting story in themselves. While everyone acknowledges that cannibalism may be practiced in emergencies by desperate people, such as the Donner Party trapped by snow at Donner Pass en route to California in the winter of 1846–47, or by starving Russians during the siege of Leningrad during World War II, the existence of non-emergency cannibalism is controversial. In fact, it was reported in hundreds of non-European societies at the times when they were first contacted by Europeans within recent centuries. The practice took two forms: eating either the bodies of enemies killed in war, or else eating one’s own relatives who had died of natural causes.多位 New Guineans with whom I have worked over the past 40 years have accurately described their cannibalistic practices, have expressed disgust at our own Western burial customs of burying relatives without doing them the honor of eating them, and one of my best New Guinean workers flirted with me in 1965 in order to partake in the consumption of recently deceased prospective son-in-law. There have also been many anthropological finds of ancient human bones in contexts suggestive of cannibalism.
Nevertheless, many or most European and American anthropologists brought up to regard cannibalism with horror in their own societies, are also horrified at the thought of it being practiced by peoples that they admire and study, and so they deny its occurrence and consider claims of its racist slander. They dismiss all the descriptions of cannibalism by non-European peoples themselves or by early European explorers as unreliable hearsay, and they would evidently be convinced only by a videotape taken by a government official or, most convincing of all, by an anthropologist. However, no such tape exists, for the obvious reason that the first Europeans to encounter people reported to be cannibals routinely expressed their disgust at the practice and threatened its practitioners with arrest.

Such objections have created controversy around the many reports of human remains, with evidence consistent with cannibalism, found at Anasazi sites. The strongest evidence comes from an Anasazi site at which a house and its contents had been smashed, and the scattered bones of several people were left inside the house, consistent with their having been killed in a war raid rather than properly buried. Some of the bones had been cracked in the same way that bones of animals consumed for food were cracked to extract the marrow. Other bones showed smooth ends, a hallmark of animal bones boiled in pots, but not of ones not boiled in pots. Broken potsherds themselves from that Anasazi site had residues of the human muscle protein myoglobin on the pots’ inside, consistent with human flesh having been cooked in the pots. But skeptics might still object that boiling human meat in pots, and cracking open human bones, does not prove that other humans actually consumed the meat of the former owners of those bones (though why else would they go to all that trouble of boiling and cracking bones to be left scattered on the floor?). The most direct sign of cannibalism at that site is that dried human feces, found in the house’s hearth and still well preserved after nearly a thousand years in that dry climate, proved to contain human muscle protein, which is absent from normal human feces, even from the feces of people with injured and bleeding intestines. This makes it probable that whoever attacked that site, killed the inhabitants, cracked open their bones, boiled their flesh in pots, scattered the bones, and believed himself or herself by depositing feces in that hearth had actually consumed the flesh of his or her victims.

The final blow for Chacoans was a drought that tree rings show to have begun around A.D. 1130. There had been similar droughts previously around A.D. 1090 and 1040, but the difference this time was that Chaco Canyon now held more people, more dependent on outlying settlements with no land left unoccupied. A drought would have caused the groundwater table to drop below the level where it could be tapped by plant roots and could support agriculture; a drought would also make rainfall-supported dryland agriculture and irrigation agriculture impossible. A drought that lasted more than three years would have been fatal, because modern Pueblos can store corn for only two or three years, after which it is rotted or infested to eat. Probably the outlying settlements that had supplied the Chaco political and religious centers with food lost in the Chacoan priests whose prayers for rain remained unanswered, and they refused to make more food deliveries. A model for the end of Anasazi settlement at Chaco Canyon, which Europeans did not observe, is what happened in the Pueblo Indian revolt of 1680 against the Spaniards, a revolt that Europeans did observe. As in Chaco Anasazi centers, the Spaniards had extracted food from local farmers by taxing them, and those taxes were tolerated until a drought left the farmers themselves short of food, provoking them to revolt.

Some time between A.D. 1150 and 1200, Chaco Canyon was virtually abandoned and remained largely empty until Navajo shepherders reoccupied it 600 years later. Because the Navajo did not know who had built the ruins that they found there, they referred to those vanished former inhabitants as the Anasazi, meaning “the Ancient Ones.” What actually happened to the thousands of Chacoan inhabitants? By analogy with historically witnessed abandonments of other pueblos during a drought in the 170s, probably many people starved to death, some people killed each other, and the survivors fled to other settled areas in the Southwest. It must have been a planned evacuation, because most rooms at Anasazi sites lack pottery and other useful objects that people would be expected to take with them in a planned evacuation, in contrast to the pottery still in the rooms of the above-mentioned site whose unfortunate occupants were left to die and eaten. The settlements to which Chaco survivors managed to flee include some pueblos in the area of the modern Zuni pueblos, where redware built in a style similar to Chaco Canyon houses and containing similar styles of pottery have been found at dates around the time of Chaco’s abandonment.

Lee Dean and his colleagues Rob Axtell, Josh Epstein, George Gumerman, Steve McCarroll, Miles Parker, and Alan Swardlund have carried out an extremely detailed reconstruction of what happened to a group of about a thousand Kayenta Anasazi in Long House Valley in northeastern Arizona. They calculated the valley’s actual population at various times from
A.D. 800 to 1350, based on numbers of house sites containing pottery that changed in style with time, thereby permitting dating of the house sites. They also calculated the valley’s annual corn harvests as a function of times from annual tree rings that provide a measure of rainfall, and from studies that provide information about the rise and fall of groundwater levels. It turned out that the rises and falls of the actual population at A.D. 800 closely mirrored the rises and falls of calculated annual corn harvests, except that the Anasazi completely abandoned the valley by A.D. 1300 at a time when some reduced corn harvests sufficient to support one-third of the valley’s peak population (400 out of the peak of 1,070 people) could still have been extracted.

Why did those last 400 Kayenta Anasazi of Long House Valley not remain when most of their relatives were leaving? Perhaps the valley A.D. 1300 had deteriorated for human occupation in other ways besides reduced agricultural potential calculated in the authors’ model. For instance, perhaps soil fertility had been exhausted, or else the former forest may have been felled, leaving no nearby timber for buildings and firewood as we know to have been the case in Chaco Canyon. Alternatively, perhaps the explanation was that complex human societies require a certain minimum population size to maintain institutions that its citizens consider essential. How many New Yorkers would choose to remain in New York City if two-thirds of their family and friends had just starved to death there, if they fled, if the subway trains and taxis were no longer running, and if offices and stores had closed?

Along with those Chaco Canyon Anasazi and Long House Valley Anasazi, whose fates we have followed, I mentioned at the start of this chapter the many other southwestern societies—the Mimbres, Mesa Verdeans, Hopis, Mogollon, and others—also underwent collapses, reorganizations, or abandonments at various times within the period A.D. 1100–1500. It turns out that quite a few different environmental problems and cultural responses contributed to these collapses and transitions, and that different factors operated in different areas. For example, deforestation was a problem for the Anasazi, who required trees to support the roof beams of their houses, but it wasn’t as much of a problem for the Hopis, who did not use beams in their houses. Salinization resulting from irrigation agriculture hurt the Hopis, who had to irrigate their fields, but not the Mesa Verdeans, who did not have to irrigate. Cold affected the Mogollon and...
collapse is external enemies. While the Anasazi did indeed attack each other as their population grew and as the climate deteriorated, the civilizations of the U.S. Southwest were too distant from other populous societies to have been seriously threatened by any external enemies.

From that perspective, we can propose a simple answer to the long-standing either/or debate: was Chaco Canyon abandoned because of human impact on the environment, or because of drought? The answer is: it was abandoned for both reasons. Over the course of six centuries the human population of Chaco Canyon grew, its demands on the environment grew, its environmental resources declined, and people came to be living increasingly close to the margin of what the environment could support. That was the ultimate cause of abandonment. The proximate cause, the proverbial last straw that broke the camel’s back, was the drought that finally pushed Chacoans over the edge, a drought that a society living at a lower population density could have survived. When Chaco society did collapse, its inhabitants could no longer reconstruct their society in the way that the first farmers of the Chaco area had built up their society. The reason is that the initial conditions of abundant nearby trees, high groundwater levels, and a smooth floodplain without arroyos had disappeared.

That type of conclusion is likely to apply to many other collapses of past societies (including the Maya to be considered in the next chapter), and to our own destiny today. All of us moderns—house-owners, investors, politicians, university administrators, and others—can get away with a lot of waste when the economy is good. We forget that conditions fluctuate, and we may not be able to anticipate when conditions will change. By that time, we may already have become attached to an expensive lifestyle, leaving an enforced diminished lifestyle or bankruptcy as the sole outs.

CHAPTER 5

The Maya Collapses

Mysteries of lost cities ■ The Maya environment ■ Maya agriculture ■ Maya history ■ Copán ■ Complexities of collapses ■ Wars and droughts ■ Collapse in the southern lowlands ■ The Maya message ■

By now, millions of modern tourists have visited ruins of the ancient Maya civilization that collapsed over a thousand years ago in Mexico’s Yucatán Peninsula and adjacent parts of Central America. All of us are a romantic mystery, and the Maya offer us one at our doorstep, almost as close for Americans as the Anasazi ruins. To visit a former Maya city, we can merely board a direct flight from the U.S. to the modern Mexican state capital city of Mérida, jump into a rental car or minibus, and drive an hour on a paved highway (map, p. 161).

Today, many Maya ruins, with their great temples and monuments, still stand surrounded by jungle, far from current human settlement (Plate 12). Yet they were once the sites of the New World’s most advanced Native American civilization before European arrival, and the only one with extensive detailed written texts. How could ancient peoples have supported urban societies in areas where few farmers eke out a living today? The Maya cities were not only with that mystery and with their beauty, but also because they are “pure” archaeological sites. That is, their locations became cultivated, so they were not covered up by later buildings as were so many other ancient cities, like the Aztec capital of Tenochtitlán (now buried under modern Mexico City and Rome).

Maya cities remained deserted, hidden by trees, and virtually unknown outside world until rediscovered in 1839 by a rich American lawyer named John Stephens, together with the English draftsman Frederick Catherwood. Having heard rumors of ruins in the jungle, Stephens got President Martin Van Buren to appoint him ambassador to the Confederation of Central American Republics, an amorphous political entity then straddling from modern Guatemala to Nicaragua, as a front for his archaeological explorations. Stephens and Catherwood ended up exploring 44 sites in a year. From the extraordinary quality of the buildings and the art, they
realized that these were not the work of savages (in their words) but of vanished high civilization. They recognized that some of the carvings on the stone monuments constituted writing, and that they correctly guessed that they related historical events and the names of people. On his return, Stephens wrote two travel books, illustrated by Catherwood and describing the ruins that became best sellers.

A few quotes from Stephens's writings will give a sense of the romantic appeal of the Maya: "The city was desolate. No remnant of this race hangs around the ruins, with traditions handed down from father to son and from generation to generation. It lay before us like a shattered bark in the midst of the ocean, her mast gone, her name effaced, her crew perished, and none to tell whence she came, to whom she belonged, how long on her journey or what caused her destruction... Architecture, sculpture, and painting, the arts which embellish life, had flourished in this overgrown forest; orators, warriors, and statesmen, beauty, ambition, and glory had lived and passed away, and none knew that such things had been, or could tell of their past existence... Here were the remains of a cultivated, polished, and peculiar people, who had passed through all the stages incident to the rise and fall of nations; reached their golden age, and perished... We went up to their desolate temples and fallen altars; and wherever we moved we saw the evidence of their taste, their skill in arts... We called back into life the strange people who gazed in sadness from the wall; pictured them, in fanciful costumes and adorned with plumes of feather, ascending the terraces of the palace and the steps leading to the temples... In the romance of the world's history nothing ever impressed me more forcibly than the spectacle of this once great and lovely city, overturned, desolate, and lost... overgrown with trees for miles around, and without even a name to distinguish it." Those sensations are what tourists drawn to Maya ruins still feel today, and why we find the Maya collapse so fascinating.

The Maya story has several advantages for all of us interested in prehistoric collapses. First, the Maya written records that have survived, although frustratingly incomplete, are still useful for reconstructing Maya history in much greater detail than we can reconstruct Easter Island, or even Anasazi history with its tree rings and packrat middens. The great art and architecture of Maya cities have resulted in far more archaeologists studying the Maya than would have been the case if they had just been illiterate hunter-gatherers living in archaeologically invisible hovels. Climatologists and paleoecologists have recently been able to recognize several signals of ancient climate and environmental changes that contributed to the Maya collapse.

Similarly, today there are still Maya people living in their ancient homeland and speaking Maya languages. Because much ancient Maya culture survived the collapse, early European visitors to the homeland recorded information about contemporary Maya society that played a vital role in our understanding of ancient Maya society. The first Maya contact with Europeans came only in 1502, just 10 years after Christopher Columbus's "discovery" of the New World, when Columbus on the last of his four voyages captured a Mayan canoe that may have been from Maya. In 1527 the Spanish began in earnest to conquer the Maya, but it was not until 1697 that they subdued the last principalities. Thus, the Spanish had opportunities to observe independent Maya societies for a period of nearly two centuries. Especially important, both for bad and for good, was the bishop Diego de Landa, who lived in the Yucatán Peninsula for most of the years from 1549 to 1578.

On the one hand, in one of history's worst acts of cultural vandalism, he burned all Maya manuscripts that he could locate in his effort to eliminate "idolatry," so that only four survive today. On the other hand, he wrote a detailed account of Maya society, and he obtained from an informant a garbled explanation of Maya writing that eventually, nearly four centuries later, turned out to offer clues to its decipherment.

A further reason for our devoting a chapter to the Maya is to provide an introduction to our other chapters on past societies, which consist disproportionately of small societies in somewhat fragile and geographically isolated environments, and behind the cutting edge of contemporary technology and culture. The Maya were none of those things. Instead, they were culturally the most advanced society (or among the most advanced ones) in the pre-Columbian New World, the only one with extensive preserved writing, located within one of the two heartlands of New World civilization (Mesoamerica). While their environment did present some problems associated with its karst terrain and unpredictably fluctuating rainfall, it does not rank as notably fragile by world standards, and it was certainly less fragile than the environments of ancient Easter Island, the Anasazi area, Greenland, or modern Australia. Lest one be misled into thinking that crashes are limited only for small peripheral societies in fragile areas, the Maya warn us that crashes can also befall the most advanced and creative societies.

From the perspective of our five-point framework for understanding societal collapses, the Maya illustrate four of our points. They did damage their environment, especially by deforestation and erosion. Climate changes (though slight) did contribute to the Maya collapse, probably repeatedly. However, among the Maya themselves did play a large role. Finally, political/
cultural factors, especially the competition among kings and nobles that led to a chronic emphasis on war and erecting monuments rather than on solving underlying problems, also contributed. The remaining item on our five-point list, trade or cessation of trade with external friendly societies, does not appear to have been essential in sustaining the Maya or in causing their downfall. While obsidian (their preferred raw material for making into stone tools), jade, gold, and shells were imported into the Maya area, the latter three items were non-essential luxuries. Obsidian tools remained widely distributed in the Maya area long after the political collapse, so obsidian was evidently never in short supply.

To understand the Maya, let's begin by considering their environment, which we think of as "jungle" or "tropical rainforest." That's not true, and the reason why not proves to be important. Properly speaking, tropical rainforests grow in high-rainfall equatorial areas that remain wet or humid all year round. But the Maya homeland lies more than a thousand miles from the equator, at latitudes 17° to 22°N, in a habitat termed a "seasonal tropical forest." That is, while there does tend to be a rainy season from May to October, there is also a dry season from January through April. If one focuses on the wet months, one calls the Maya homeland a "seasonal tropical forest"; if one focuses on the dry months, one could instead describe it as a "seasonal desert."

From north to south in the Yucatán Peninsula, rainfall increases from 50 to 100 inches per year, and the soils become thicker, so that the southern peninsula was agriculturally more productive and supported denser populations. But rainfall in the Maya homeland is unpredictably variable between years; some recent years have had three or four times more rain than other years. Also, the timing of rainfall within the year is somewhat unpredictable, so it can easily happen that farmers plant their crops in anticipation of rain and then the rains do not come when expected. As a result, modern farmers attempting to grow corn in the ancient Maya homeland have faced frequent crop failures, especially in the north. The ancient Maya were presumably more experienced and did better, but nevertheless they too must have faced risks of crop failures from droughts and hurricanes.

Although southern Maya areas received more rainfall than northern areas, problems of water were paradoxically more severe in the wet south. While that made things hard for ancient Maya living in the south, it has also made things hard for modern archaeologists who have difficulty un
standing why ancient droughts would have caused bigger problems in the wet south than in the dry north. The likely explanation is that a lens of freshwater underlies the Yucatán Peninsula, but surface elevation increases from north to south, so that as one moves south the land surface lies increasingly higher above the water table. In the northern peninsula the elevation is sufficiently low that the ancient Maya were able to reach the water table at deep sinkholes called cenotes, or at deep caves; all tourists who have visited the Maya city of Chichén Itzá will remember the great cenotes there. In low-elevation north coastal areas without sinkholes, the Maya may have been able to get down to the water table by digging wells up to 75 feet deep.

Water is readily available in many parts of Belize that have rivers, along the Usamacinta River in the west, and around a few lakes in the Petén area to the south. But much of the south lies too high above the water table for cenotes or wells to reach down to it. Making matters worse, most of the Yucatán Peninsula consists of karst, a porous sponge-like limestone terrain where rain runs straight into the ground and where little or no surface water remains available.

How did those dense southern Maya populations deal with their resulting water problem? It initially surprises us that many of their cities were not built next to the few rivers but instead on promontories in rolling upland. The explanation is that the Maya excavated depressions, modified natural depressions, and then plugged up leaks in the karst by plastering the bottom of the depressions in order to create cisterns and reservoirs, which collected rain from large plastered catchment basins and stored it for use in the dry season. For example, reservoirs at the Maya city of Tikal held enough water to meet the drinking water needs of about 10,000 people for a period of 18 months. At the city of Coba the Maya built dikes around a lake in order to raise its level and make their water supply more reliable. But the inhabitants of Tikal and other cities dependent on reservoirs for drinking water would still have been in deep trouble if 18 months passed without rain in a prolonged drought. A shorter drought in which they exhausted their stored food supplies might already have gotten them in deep trouble through starvation, because growing crops required rain rather than stored reservoirs.

Of particular importance for our purposes are the details of Maya agriculture, which was based on crops domesticated in Mexico—especially corn with beans being second in importance. For the elite as well as commoners, corn constituted at least 70% of the Maya diet, as deduced from isotope analysis of ancient Maya skeletons. Their sole domestic animals were the turkey, Muscovy duck, and a stingless bee yielding honey, while their important wild meat source was deer that they hunted, plus fish at estuaries. However, the few animal bones at Maya archaeological sites suggest that the quantity of meat available to the Maya was low. Venison was a luxury food for the elite.

It was formerly believed that Maya farming was based on slash-and-burn agriculture (so-called swidden agriculture) in which forest is cleared, crops are grown in the resulting field for a year or a few years until the soil is exhausted, and then the field is abandoned for a long fallow of 15 or 20 years until regrowth of wild vegetation restores fertility of the soil. Because most of the landscape under a swidden agricultural system has a fallow at any given time, it can support only modest population densities. Thus, it was a surprise for archaeologists to discover that ancient Maya population densities, estimated from numbers of stone foundations in houses, were often far higher than what swidden agriculture could support. The actual values are the subject of much dispute and evidently among areas, but frequently cited estimates reach 250 to 750, possibly 1,500, people per square mile. (For comparison, even today the two densely populated countries in Africa, Rwanda and Burundi, have population densities of only about 750 and 540 people per square mile, respectively.) Hence the ancient Maya must have had some means of increasing agricultural production beyond what was possible through swidden farming.
must have used archaeologically invisible means to increase food production, by mulching, floodwater farming, shortening the time that a field left fallow, and tilling the soil to restore soil fertility, or in the extreme outsourcing the fallow period entirely and growing crops every year, or in especially moist areas growing two crops per year.

Socially stratified societies, including modern American and European society, consist of farmers who produce food, plus non-farmers such as bureaucrats and soldiers who do not produce food but merely consume the food grown by the farmers and are in effect parasites on farmers. Hence, any stratified society the farmers must grow enough surplus food to meet not only their own needs but also the needs of the other consumers. The number of non-producing consumers that can be supported depends on the society's agricultural productivity. In the United States today, with its highly efficient agriculture, farmers make up only 2% of our population, and each farmer can feed on average 125 others. (American non-farmers, plus people in export markets overseas). Ancient Egyptian agriculture, although much less efficient than modern mechanized agriculture, was still efficient enough for an Egyptian peasant to produce five times the food required for himself and his family. But a Maya peasant could produce only twice the needs of himself and his family. At least 70% of Maya society consisted of peasants. That's because Maya agriculture suffered from several limitations.

First, it yielded little protein. Corn, by far the dominant crop, has a lower protein content than the Old World staples of wheat and barley. The few edible domestic animals already mentioned included no large ones and yielded much less meat than did Old World cows, sheep, pigs, and goats. The Maya depended on a narrower range of crops than did the Andean farmers (who in addition to corn also had potatoes, high-protein quinoa, and many other plants, plus llamas for meat), and much narrower again than the variety of crops in China and in western Eurasia.

Another limitation was that Maya corn agriculture was less intensive and productive than the Aztec's chinampas (a very productive type of raised-field agriculture), the raised fields of the Tiwanaku civilization of the Andes, Moche irrigation on the coast of Peru, or fields tilled by animal-drawn plows over much of Eurasia.

Still a further limitation arose from the humid climate of the Maya area, which made it difficult to store corn beyond a year, whereas the Anasazi living in the dry climate of the U.S. Southwest could store it for three years.

Finally, unlike Andean Indians with their llamas, and unlike Old World farmers with their horses, oxen, donkeys, and camels, the Maya had no light-powered transport or plows. All overland transport for the Maya was on the backs of human porters. But if you send out a porter carrying a load of corn to accompany an army into the field, some of that load of corn is used to feed the porter himself on the trip out, and some more to feed him on the trip back, leaving only a fraction of the load available to feed the soldiers. The longer the trip, the less of the load is left over from the porter's requirements. Beyond a march of a few days to a week, it becomes un economical to send porters carrying corn to provision armies or markets. Thus the modest productivity of Maya agriculture, and their lack of draft animals, severely limited the duration and distance possible for their military campaigns.

We are accustomed to thinking of military success as determined by quality of weaponry, rather than by food supply. But a clear example of improvements in food supply may decisively increase military success come from the history of Maori New Zealand. The Maori are the Polynesian people who were the first to settle New Zealand. Traditionally, they engaged in frequent fierce wars against each other, but only against closely neighboring tribes. Those wars were limited by the modest productivity of their agriculture, whose staple crop was sweet potatoes. It was not possible to grow enough sweet potatoes to feed an army in the field for a long time or on distant marches. When Europeans arrived in New Zealand, they brought potatoes, which beginning around 1815 considerably increased Maori crop yields. Maori could now grow enough food to supply armies in the field for many weeks. The result was a 15-year period in Maori history, from 1818 until 1833, when Maori tribes that had acquired potatoes and guns from the English sent armies out on raids to attack tribes hundreds of miles away that had not yet acquired potatoes and guns. Thus, the potato's productivity relieved previous limitations on Maori warfare, similar to the limitations that low-productivity corn agriculture imposed on Maya society.

Food supply considerations may contribute to explaining why each society remained politically divided among small kingdoms that were constantly at war with each other, and that never became unified into large empires like the Aztec Empire of the Valley of Mexico (fed with the help of chinampa agriculture and other forms of intensification) or the Inca Empire of the Andes (fed by more diverse crops carried by llamas over well-drawn plows). Maya armies and bureaucracies remained small and unable to mount lengthy campaigns over long distances. (Even much later, in 1848,
when the Maya revolted against their Mexican overlords and a Maya army seemed to be on the verge of victory, the army had to break off fighting and go home to harvest another crop of corn.) Many Maya kingdoms had populations of only up to 25,000 to 50,000 people, none over half a million, within a radius of two or three days’ walk from the king’s palace. (The actual numbers are again highly controversial among archaeologists.) From the tops of the temples of some Maya kingdoms, it was possible to see the temples of the nearest kingdom. Maya cities remained small (mostly less than one square mile in area), without the large populations and big markets like Teotihuacán and Tenochtitlán in the Valley of Mexico, or of Chan-Chan in Peru, and without archaeological evidence of the royally managed food storage and trade that characterized ancient Greece and Mesopotamia.

Now for a quick crash-course in Maya history. The Maya area is part of the larger ancient Native American cultural region known as Mesoamerica, which extended approximately from Central Mexico to Honduras and constituted (along with the Andes of South America) one of the two New World centers of innovation before European arrival. The Maya shared much in common with other Mesoamerican societies not only in what they possessed, but also in what they lacked. For example, surprisingly modern Westerners with expectations based on Old World civilizations, Mesoamerican societies lacked metal tools, pulleys and other machinery, wheels (except locally as toys), boats with sails, and domestic animals large enough to carry loads or pull a plow. All of those great Maya temples were constructed by stone and wooden tools and by human muscle power alone.

Of the ingredients of Maya civilization, many were acquired by the Maya from elsewhere in Mesoamerica. For instance, Mesoamerican agriculture, cities, and writing first arose outside the Maya area itself, in valleys and coastal lowlands to the west and southwest, where corn and beans and squash were domesticated and became important dietary components by 3000 B.C. Pottery arose around 2500 B.C., villages by 1500 B.C., cities among the Olmecs by 1200 B.C., writing appeared among the Zapotecs in Oaxaca around or after 600 B.C., and the first states arose around 300 B.C. Two complementary calendars, a solar calendar of 365 days and a ritual calendar of 260 days, also arose outside the Maya area. Other elements of Maya civilization were either invented, perfected, or modified by the Maya themselves.

Within the Maya area, villages and pottery appeared around or after 1000 B.C., substantial buildings around 500 B.C., and writing around 250 B.C. All preserved ancient Maya writing, constituting a total of about 25,000 inscriptions, is on stone and pottery and deals only with kings, nobles, and their conquests (Plate 13). There is not a single mention of commerce. When Spaniards arrived, the Maya were still using bark paper, with plaster to write books, of which the sole four that escaped Landa’s fires turned out to be treatises on astronomy and the calendar, the ancient Maya also had had such bark-paper books, often depicted pottery, but only decayed remains of them have survived in tombs. The famous Maya Long Count calendar begins on August 13, 3114 B.C.—our own calendar begins on January 1 of the first year of the Christian era. We now the significance of us of that day-zero of our calendar: it is the supposed beginning of the year in which Christ was born. Presumably the Maya also attached some significance to their own day zero, but we do not know what it was. The first preserved Long Count date is only A.D. 197, on a monument in the Maya area and 36 B.C. outside the Maya area, indicating that the Long Count calendar’s day-zero was backdated to August 13, 3114 B.C. long after the facts; there was no writing anywhere in the New World then, nor would there be for 2,500 years after that date.

The solar calendar is divided into units of days, weeks, months, years, centuries, and millennia: for example, the date of February 19, 2003, on which I wrote the first draft of this paragraph, means the 19th day of the 7th month in the third year of the first decade of the second millennium beginning with the birth of Christ. Similarly, the Maya Long Count calendar named dates in units of days (kin), 20 days (unial), 360 days (tun), 7200 days or approximately 20 years (katun), and 144,000 days or approximately 400 years (baktun). All of Maya history falls into baktuns, 9, and 10.

The so-called Classic period of Maya civilization begins in baktun 8, A.D. 250, when evidence for the first kings and dynasties appears. Among the glyphs (written signs) on Maya monuments, students of Maya writing have recognized a few dozen, each of which was concentrated in its own geographic area, and which are now considered to have had the approximate meaning of dynasties or kingdoms. In addition to Maya kings having their own name glyphs and palaces, many nobles also had their own inscriptions and palaces. In Maya society the king also functioned as high priest, carrying the responsibility to attend to astronomical and calendrical matters and thereby to bring rain and prosperity, which the king claimed to have the supernatural power to deliver because of his asserted family relationship to the gods. That is, there was a tacitly understood quid pro quo:
the reason why the peasants supported the luxurious lifestyle of the king and his court, fed him corn and venison, and built his palaces because he had made implicit big promises to the peasants. As we shall see, kings got into trouble with their peasants if a drought came, because that was tantamount to the breaking of a royal promise.

From A.D. 250 onwards, the Maya population (as judged from the number of archaeologically attested house sites), the number of monuments and buildings, and the number of Long Count dates on monuments and pottery increased almost exponentially, to reach peak numbers in the 8th century A.D. The largest monuments were erected towards the end of the Classic period. Numbers of all three of those indicators of a complex society declined throughout the 9th century, until the last known Long Count date on any monument fell in baktun 10, in the year A.D. 909. That decline of the Maya population, architecture, and the Long Count calendar constitutes what is known as the Classic Maya collapse.

As an example of the collapse, let's consider in more detail a small densely built city whose ruins now lie in western Honduras at a site known as Copán, and described in two recent books by archaeologist David Webster. For agricultural purposes the best land in the Copán area consists of five pockets of flat land with fertile alluvial soil along a river valley, with a tiny total area of only 10 square miles; the largest of those five pockets, known as the Copán pocket, has an area of only 5 square miles. Much of the land around Copán consists of steep hills, and nearly half of the hill area is at a slope above 16% (approximately double the slope of the steepest grade that you are likely to encounter on an American highway). Soil in the hills is less fertile, more acidic, and poorer in phosphate than valley soil. Today, corn yields from valley-bottom fields are two or three times those of fields on hill slopes, which suffer rapid erosion and lose three-quarters of their productivity within a decade of farming.

As judged by numbers of house sites, population growth in the Copán Valley rose steeply from the 5th century up to a peak estimated at around 27,000 people at A.D. 750–900. Maya written history at Copán begins in the year with a Long Count date corresponding to A.D. 426, when later monuments record retrospectively that some person related to nobles at Tikal and Teotihuacán arrived. Construction of royal monuments glorifying kings was especially massive between A.D. 650 and 750. After A.D. 700, nobles other than kings also got into the act and began erecting their own palaces, of which there were about twenty by the year A.D. 800, when one of those palaces is known to have consisted of 50 buildings with room for about 250 people. All of those nobles and their courts would have increased the burden on the king and his own court imposed on the peasants. The last big buildings at Copán were put up around A.D. 800, and the last Long Count date on an incomplete altar possibly bearing a king’s name has the date of A.D. 822.

Archaeological surveys of different types of habitats in the Copán Valley show that they were occupied in a regular sequence. The first area farmed was the large Copán pocket of valley bottomland, followed by occupation of the other four bottomland pockets. During that time the human population was growing, but there was not yet occupation of the hills. Hence that surplus population must have been accommodated by intensifying production in the bottomland pockets by some combination of shorter fallow periods, double-cropping, and possibly some irrigation.

By the year A.D. 650, people started to occupy the hill slopes, but those hills were cultivated only for about a century. The percentage of Copán’s total population that was in the hills, rather than in the valleys, reached a maximum of 41%, then declined until the population again became concentrated in the valley pockets. What caused that pullback of population from the hills? Excavation of the foundations of buildings in the valley floor showed that they became covered with sediment during the 8th century, meaning that the hill slopes were getting eroded and probably also leached nutrients. Those acidic infertile hill soils were being carried down into the valley and blanketing the more fertile valley soils, where they would have reduced agricultural yields. This ancient quick abandonment of hillside coincides with modern Maya experience that fields in the hills have no fertility and that their soils become rapidly exhausted.

The reason for that erosion of the hillsides is clear: the forests that formerly covered them and protected their soils were being cut down. Dated pollen samples show that the pine forests originally covering the upper elevations of the hill slopes were eventually all cleared. Calculation suggests that most of those felled pine trees were being burned for fuel, while the rest were used for construction or for making plaster. At other Maya sites from the late Classic era, where the Maya went overboard in lavish use of thick plaster on buildings, plaster production may have been a major cause of deforestation. Besides causing sediment accumulation in the valleys and denying valley inhabitants of wood supplies, that deforestation may have been to cause a “man-made drought” in the valley bottom, because forests
play a major role in water cycling, such that massive deforestation tends to result in lowered rainfall.

Hundreds of skeletons recovered from Copán archaeological sites have been studied for signs of disease and malnutrition, such as porous bones and stress lines in the teeth. These skeletal signs show that the health of Copán’s inhabitants deteriorated from A.D. 650 to 850, both among the elite and among the commoners, although the health of commoners was worse.

Recall that Copán’s population was increasing steeply while the land was being occupied. The subsequent abandonment of all of those fields on the hills meant that the burden of feeding the extra population formerly dependent on the hills now fell increasingly on the valley floor, and that more and more people were competing for the food grown on those 10 square miles of valley bottomland. That would have led to fighting among farmers themselves for the best land, or for any land, just as in modern Rwanda (Chapter 10). Because Copán’s king was failing to deliver on the promises of rain and prosperity in return for the power and luxuries that he claimed, he would have been the scapegoat for this agricultural failure. This may explain why the last that we hear from any Copán king is A.D. 822 (the last Long Count date at Copán), and why the royal palace was burned around A.D. 850. However, the continued production of some luxury goods suggest that some nobles managed to carry on with their lifestyle after the king’s downfall, until around A.D. 975.

To judge from datable pieces of obsidian, Copán’s total population increased more gradually than did its signs of kings and nobles. The estimated population in the year A.D. 950 was still around 15,000, or 54% of the peak population of 27,000. That population continued to dwindle, until there are no more signs of anyone in the Copán Valley by around A.D. 1200. The reappearance of pollen from forest trees thereafter provides independent evidence that the valley became virtually empty of people, and that forests could at last begin to recover.

The general outline of Maya history that I have just related, and the example of Copán’s history in particular, illustrates why we talk about “the Maya collapse.” But the story grows more complicated, for at least five reasons.

First, there was not only that enormous Classic collapse, but at least five previous smaller collapses at some sites, one around the year A.D. 150 when El Mirador and some other Maya cities collapsed (the so-called pre-Classical collapse), the other (the so-called Maya hiatus) in the late 6th century and early 7th century, a period when no monuments were erected at the well-known site of Tikal. There were also some post-Classic collapses in areas where populations survived the Classic collapse or increased after it—such as the fall of Chichén Itzá around 1250 and of Mayapán around 1450.

And, the Classic collapse was obviously not complete, because there were hundreds of thousands of Maya who met and fought the Spaniards—more than during the Classic peak, but still far more people than the other ancient societies discussed in detail in this book. Those survivors were concentrated in areas with stable water supplies, especially in the north with its cenotes, the coastal lowlands with their wells, near a southern lake, and along rivers and lagoons at lower elevations. However, population otherwise disappeared almost completely in what previously had been the Maya heartland in the south.

And, the collapse of population (as gauged by numbers of house sites and obsidian tools) was in some cases much slower than the decline in numbers of Long Count dates, as I already mentioned for Copán. What collapsed quickly during the Classic collapse was the institution of kingship and the Long Count calendar.

Fourth, many apparent collapses of cities were really nothing more than a “population cycling”: i.e., particular cities becoming more powerful, then declining, getting conquered, and then rising again and conquering their neighbors, without changes in the whole population. For example, in the year 562 Tikal was defeated by its rivals Caracol and Calakmul, and its king was captured and killed. However, Tikal then gradually gained strength again and conquered its rivals in 695, long before Tikal joined many other cities in the Classic collapse (last dated Tikal monuments A.D. 869).

Finally, Copán grew in power until the year 738, when its king U’kab’al U’k’in (a name better known to Maya enthusiasts today by its “unreadable” translation of “18 Rabbit”) was captured and put to death by the rival city of Quiriguá, but then Copán thrived during the following century under more fortunate kings.

Finally, cities in different parts of the Maya area rose and fell on different schedules. For example, the Puuc region in the northwest Yucatán Peninsula, after being almost empty of people in the year 700, exploded in population after 750 while the southern cities were collapsing, peaked in population between 900 and 925, and then collapsed in turn between 950 and 1000. El Mirador, a huge site in the center of the Maya area with one of the world’s
largest pyramids, was settled in 200 B.C. and abandoned around A.D. 1250 long before the rise of Copán. Chichén Itzá in the northern peninsula after A.D. 850 and was the main northern center around 1000, only to be destroyed in a civil war around 1250.

Some archaeologists focus on these five types of collapses; we don’t want to recognize a Classic Maya collapse at all. But this overlooks obvious facts that cry out for explanation: the disappearance of between 99% of the Maya population after A.D. 800, especially in the most densely populated area of the southern lowlands, and the disappearance of kings, Long Count calendars, and other complex political and cultural institutions. That’s why we talk about a Classic Maya collapse both of population and of culture that needs explaining.

Two other phenomena that I have mentioned briefly as contributing to Maya collapses require more discussion: the roles of warfare and of drought.

Archaeologists for a long time believed the ancient Maya to be genocidal, peaceful people. We now know that Maya warfare was intense, chronic, and unresolved, because limitations of food supply and transportation made it impossible for any Maya principality to unite the whole region into an empire, in the way that Aztecs and Incas united Central Mexico and the Andes, respectively. The archaeological record shows that wars became more intense and frequent towards the time of the Classic collapse. The evidence comes from discoveries of several types over the last 55 years: archaeological excavations of massive fortifications surrounding many Maya sites; vivid depictions of warfare and captives on stone monuments, as in Plate 14, and on the famous painted murals discovered in 1946 at Bonampak; and the decipherment of Maya writing, much of which proved to consist of royal inscriptions boasting of conquests. Maya kings fought to take one another captive, one of the unfortunate losers being Copán’s King Rabbit. Captives were tortured in unpleasant ways depicted clearly on monuments and murals (such as yanking fingers out of sockets, pulling out teeth, cutting off the lower jaw, trimming off the lips and fingertips, pulling out the fingernails, and driving a pin through the lips), culminating (sometimes several years later) in the sacrifice of the captive in other equally unpleasant ways (such as tying the captive up into a ball by binding the arms and legs together, then rolling the balled-up captive down the steep stone staircase of a temple).

Maya warfare involved several well-documented types of violence: war
years, peaking around the year A.D. 800, and suspiciously associated with the Classic collapse.

Careful analysis of the frequency of droughts in the Maya area shows a tendency for them to recur at intervals of about 208 years. Those drought cycles may result from small variations in the sun's radiation, possibly made more severe in the Maya area as a result of the rainfall gradient in the Lowlands (drier in the north, wetter in the south) shifting southwards. We might expect those changes in the sun's radiation to affect not just the Maya region but, to varying degrees, the whole world. In fact, climatologists have noted that some other famous collapses of prehistoric civilizations far from the Maya realm appear to coincide with the peaks of those drought cycles: such as the collapse of the world's first empire (the Akkadian Empire of Mesopotamia) around 2170 B.C., the collapse of the Moche IV civilization on the Peruvian coast around A.D. 600, and the collapse of Tiwanaku civilization in the Andes around A.D. 1100.

In the most naive form of the hypothesis that drought contributed to the Classic collapse, one could imagine a single drought around A.D. 800 uniformly affecting the whole realm and triggering the fall of all Maya centers simultaneously. Actually, as we have seen, the Classic collapse hit different centers at slightly different times in the period A.D. 760-900, while sparing other centers. That fact makes many Maya specialists skeptical of a role of drought.

But a properly cautious climatologist would not state the drought hypothesis in that implausibly oversimplified form. Finer-resolution variations in rainfall from one year to the next can be calculated from annually banded sediments that rivers wash into ocean basins near the coast. These yield a conclusion that "The Drought" around A.D. 800 actually had four peaks, first of them less severe: two dry years around A.D. 760, then an even drier decade around A.D. 810-820, three drier years around A.D. 860, and six drier years around A.D. 910. Interestingly, Richardson Gill concluded from the latest dates on stone monuments at various large Maya centers, that collapse dates vary among sites and fall into three clusters: around A.D. 810, 860, and 910, in agreement with the dates for the three most severe droughts, would not be at all surprising if a drought in any given year varied locally in its severity, hence if a series of droughts caused different Maya centers' collapse in different years, while sparing centers with reliable water supplies such as cenotes, wells, and lakes.

The most affected by the Classic collapse was the southern lowlands, probably for two reasons already mentioned: it was the area with the densest population, and it may also have had the most severe water problems because it lay too high above the water table for water to be obtained from cenotes or wells when the rains failed. The southern lowlands lost more than 99% of their population in the course of the Classic collapse. For instance, the population of the Central Petén at the peak of the Classic Maya period is variously estimated at between 3,000,000 and 14,000,000 people, but there were only about 30,000 people there at the time that the Spanish arrived. When Cortés and his Spanish army passed through the Petén in 1524 and 1525, they nearly starved because they encountered a few villages from which to acquire corn. Cortés passed within a few miles of the ruins of the great Classic cities of Tikal and Palenque, but he never saw anything of them because they were covered by jungle and almost nobody was living in the vicinity.

How did such a huge population of millions of people disappear? We then come to some of the same questions about the disappearance of Chaco Canyon's (admittedly smaller) Anasazi population in Chapter 4. By analogy with the cases of the Anasazi and of subsequent Pueblo Indian societies during droughts in the U.S. Southwest, we infer that some people from the southern Maya lowlands survived by fleeing to areas of the northern Yucatan covered with cenotes or wells, where a rapid population increase took place around the time of the Maya collapse. But there is no sign of all those millions of southern lowland inhabitants surviving to be accommodated as immigrants in the north, just as there is no sign of thousands of Maya refugees being received as immigrants into surviving pueblos. As in the U.S. Southwest during droughts, some of that Maya population died, usually worn out by the strains of survival or illness, or killed each other in struggles over increasingly scarce resources. The other part of the Maya may reflect a slower decrease in the birthrate or child survival rate over the course of many decades. That is, depopulation probably involved a higher death rate and a lower birth rate.

Not in the Maya area as elsewhere, the past is a lesson for the present. From the time of Spanish arrival, the Central Petén's population declined further, eventually to a few hundred in A.D. 1714, as a result of deaths from diseases and other causes associated with Spanish occupation. By the 1960s, the Central Petén's population had risen back only to 25,000, still less than 1% of what it had been at the Classic Maya peak. Thereafter, however, immigrants flooded
into the Central Petén, building up its population to about 300,000 in the 1800s, and ushering in a new era of deforestation and erosion. Today, half the Petén is once again deforested and ecologically degraded. One-quarter of all the forests of Honduras were destroyed between 1964 and 1989.

To summarize the Classic Maya collapse, we can tentatively identify five strands. I acknowledge, however, that Maya archaeologists still disagree fiercely among themselves—in part, because the different strands evidently varied in importance among different parts of the Maya realm; because detailed archaeological studies are available for only some Maya sites; and because it remains puzzling why most of the Maya heartland remained empty of population and failed to recover after the collapse and after a growth of forests.

With those caveats, it appears to me that one strand consisted of population growth outstripping available resources: a dilemma similar to the one foreseen by Thomas Malthus in 1798 and being played out today in Rwanda (Chapter 10), Haiti (Chapter 11), and elsewhere. As the archaeologist David Webster succinctly puts it, “Too many farmers grew too many crops on too much of the landscape.” Compounding that mismatch between population and resources was the second strand: the effects of deforestation and hillside erosion, which caused a decrease in the amount of useful farmland and the time when more rather than less farmland was needed, and possibly exacerbated by an anthropogenic drought resulting from deforestation, by soil nutrient depletion and other soil problems, and by the struggle to prevent bracken ferns from running over the fields.

The third strand consisted of increased fighting, as more and more people fought over fewer resources. Maya warfare, already endemic, peaked just before the collapse. That is not surprising when one reflects that at least 5,000,000 people, perhaps many more, were crammed into an area smaller than the state of Colorado (104,000 square miles). That warfare would have decreased further the amount of land available for agriculture, by creating no-man’s lands between principalities where it was now unsafe to farm. Bringing matters to a head was the strand of climate change. The drought at the time of the Classic collapse was not the first drought that the Maya had lived through, but it was the most severe. At the time of previous droughts, there were still uninhabited parts of the Maya landscape, and people at a site affected by drought could save themselves by moving to another site. However, by the time of the Classic collapse the landscape was now full, the useful unoccupied land in the vicinity on which to begin anew, and the whole population could not be accommodated in the few areas that continued to have reliable water supplies.

Our fifth strand, we have to wonder why the kings and nobles failed to recognize and solve these seemingly obvious problems undermining their societies. Their attention was evidently focused on their short-term concerns of enriching themselves, waging wars, erecting monuments, competing with each other, and extracting enough food from the peasants to support all these activities. Like most leaders throughout human history, the Maya kings and nobles did not heed long-term problems, insofar as they perceived them. We shall return to this theme in Chapter 14.

Finally, while we still have some other past societies to consider in this book, before we switch our attention to the modern world, we must already have been struck by some parallels between the Maya and the past societies discussed in Chapters 2–4. As on Easter Island, Mangareva, and among the Haida, Maya environmental and population problems led to increasing conflict and civil strife. As on Easter Island and at Chaco Canyon, Maya population numbers were followed swiftly by political and social collapse, paralleling the eventual extension of agriculture from Easter Island’s coastal lowlands to its uplands, and from the Mimbres floodplain to the hills. Españ’s inhabitants also expanded from the floodplain to the more infertile slopes, leaving them with a larger population to feed when the agricultural boom in the hills went bust. Like Easter Island chiefs erecting ever larger statues, eventually crowned by pukao, and like Anasazi elite rulers themselves to necklaces of 2,000 turquoise beads, Maya kings tried to outdo each other with more and more impressive temples, covered with thicker and thicker plaster—reminiscent in turn of the extravagant and conspicuous consumption by modern American CEOs. The passivity of the chief and Maya kings in the face of the real big threats to their societies completes our list of disquieting parallels.