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GUNS, GERMS, AND STEEL

THE FATES OF HUMAN SOCIETIES

Jared Diamond

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To Esa, Kariniga, Omwai, Paran, Sauakari, Wiwor, and all my other New Guinea friends and teachers—masters of a difficult environment

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CHAPTER 1

UP TO THE STARTING LINE

A SUITABLE STARTING POINT FROM WHICH TO COMPARE historical developments on the different continents is around 11,000 B.C.* This date corresponds approximately to the beginnings of village life in a few parts of the world, the first undisputed peopling of the Americas, the end of the Pleistocene Era and last Ice Age, and the start of what geologists term the Recent Era. Plant and animal domestication began in at least one part of the world within a few thousand years of that date. As of then, did the people of some continents already have a head start or a clear advantage over peoples of other continents?

If so, perhaps that head start, amplified over the last 13,000 years, provides the answer to Yali's question. Hence this chapter will offer a whirlwind tour of human history on all the continents, for millions of years, from our

*Throughout this book, dates for about the last 15,000 years will be quoted as so-called calibrated radiocarbon dates, rather than as conventional, uncalibrated radiocarbon dates. The difference between the two types of dates will be explained in Chapter 5. Calibrated dates are the ones believed to correspond more closely to actual calendar dates. Readers accustomed to uncalibrated dates will need to bear this distinction in mind whenever they find me quoting apparently erroneous dates that are older than the ones with which they are familiar. For example, the date of the Clovis archaeological horizon in North America is usually quoted as around 9000 B.C. (11,000 years ago), but I quote it instead as around 11,000 B.C. (13,000 years ago), because the date usually quoted is uncalibrated.

origins as a species until 13,000 years ago. All that will now be summarized in less than 20 pages. Naturally, I shall gloss over details and mention only what seem to me the trends most relevant to this book.

Our closest living relatives are three surviving species of great ape: the gorilla, the common chimpanzee, and the pygmy chimpanzee (also known as bonobo). Their confinement to Africa, along with abundant fossil evidence, indicates that the earliest stages of human evolution were also played out in Africa. Human history, as something separate from the history of animals, began there about 7 million years ago (estimates range from 5 to 9 million years ago). Around that time, a population of African apes broke up into several populations, of which one proceeded to evolve into modern gorillas, a second into the two modern chimps, and the third into humans. The gorilla line apparently split off slightly before the split between the chimp and the human lines.

Fossils indicate that the evolutionary line leading to us had achieved a substantially upright posture by around 4 million years ago, then began to increase in body size and in relative brain size around 2.5 million years ago. Those protohumans are generally known as *Australopithecus africanus*, *Homo habilis*, and *Homo erectus*, which apparently evolved into each other in that sequence. Although *Homo erectus*, the stage reached around 1.7 million years ago, was close to us modern humans in body size, its brain size was still barely half of ours. Stone tools became common around 2.5 million years ago, but they were merely the crudest of flaked or battered stones. In zoological significance and distinctiveness, *Homo erectus* was more than an ape, but still much less than a modern human.

All of that human history, for the first 5 or 6 million years after our origins about 7 million years ago, remained confined to Africa. The first human ancestor to spread beyond Africa was *Homo erectus*, as is attested by fossils discovered on the Southeast Asian island of Java and conventionally known as Java man (see Figure 1.1). The oldest Java "man" fossils—of course, they may actually have belonged to a Java woman—have usually been assumed to date from about a million years ago. However, it has recently been argued that they actually date from 1.8 million years ago. (Strictly speaking, the name *Homo erectus* belongs to these Javan fossils, and the African fossils classified as *Homo erectus* may warrant a different name.) At present, the earliest unquestioned evidence for humans in Europe stems from around half a million years ago, but there are claims of an earlier presence. One would certainly assume that the colonization of Asia also permitted the simultaneous colonization of Europe, since Eurasia is a single landmass not bisected by major barriers.

That illustrates an issue that will recur throughout this book. Whenever

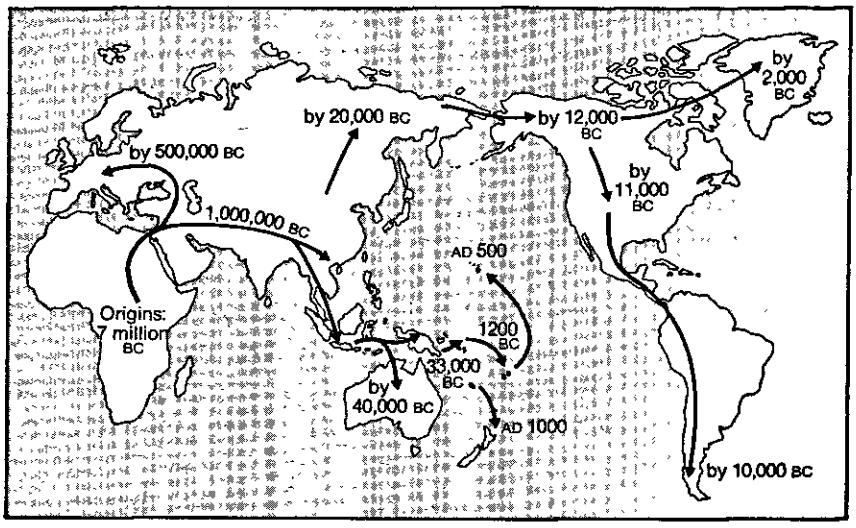

Figure 1.1. The spread of humans around the world.

some scientist claims to have discovered "the earliest X"—whether X is the earliest human fossil in Europe, the earliest evidence of domesticated corn in Mexico, or the earliest anything anywhere—that announcement challenges other scientists to beat the claim by finding something still earlier. In reality, there must be some truly "earliest X," with all claims of earlier X's being false. However, as we shall see, for virtually any X, every year brings forth new discoveries and claims of a purported still earlier X, along with refutations of some or all of previous years' claims of earlier X. It often takes decades of searching before archaeologists reach a consensus on such questions.

By about half a million years ago, human fossils had diverged from older *Homo erectus* skeletons in their enlarged, rounder, and less angular skulls. African and European skulls of half a million years ago were sufficiently similar to skulls of us moderns that they are classified in our species, *Homo sapiens*, instead of in *Homo erectus*. This distinction is arbitrary, since *Homo erectus* evolved into *Homo sapiens*. However, these early *Homo sapiens* still differed from us in skeletal details, had brains significantly smaller than ours, and were grossly different from us in their artifacts and behavior. Modern stone-tool-making peoples, such as Yali's great-grandparents, would have scorned the stone tools of half a million years ago as very crude. The only other significant addition to our ancestors' cultural repertoire that can be documented with confidence around that time was the use of fire.

No art, bone tool, or anything else has come down to us from early *Homo sapiens* except for their skeletal remains, plus those crude stone tools. There were still no humans in Australia, for the obvious reason that it would have taken boats to get there from Southeast Asia. There were also no humans anywhere in the Americas, because that would have required the occupation of the nearest part of the Eurasian continent (Siberia), and possibly boat-building skills as well. (The present, shallow Bering Strait, separating Siberia from Alaska, alternated between a strait and a broad intercontinental bridge of dry land, as sea level repeatedly rose and fell during the Ice Ages.) However, boat building and survival in cold Siberia were both still far beyond the capabilities of early *Homo sapiens*.

After half a million years ago, the human populations of Africa and western Eurasia proceeded to diverge from each other and from East Asian populations in skeletal details. The population of Europe and western Asia between 130,000 and 40,000 years ago is represented by especially many skeletons, known as Neanderthals and sometimes classified as a separate species, *Homo neanderthalensis*. Despite being depicted in innumerable cartoons as apelike brutes living in caves, Neanderthals had brains slightly larger than our own. They were also the first humans to leave behind strong evidence of burying their dead and caring for their sick. Yet their stone tools were still crude by comparison with modern New Guineans' polished stone axes and were usually not yet made in standardized diverse shapes, each with a clearly recognizable function.

The few preserved African skeletal fragments contemporary with the Neanderthals are more similar to our modern skeletons than to Neanderthal skeletons. Even fewer preserved East Asian skeletal fragments are known, but they appear different again from both Africans and Neanderthals. As for the lifestyle at that time, the best-preserved evidence comes from stone artifacts and prey bones accumulated at southern African sites. Although those Africans of 100,000 years ago had more modern skeletons than did their Neanderthal contemporaries, they made essentially the same crude stone tools as Neanderthals, still lacking standardized shapes. They had no preserved art. To judge from the bone evidence of the animal species on which they preyed, their hunting skills were unimpressive and mainly directed at easy-to-kill, not-at-all-dangerous animals. They were not yet in the business of slaughtering buffalo, pigs, and other dangerous prey. They couldn't even catch fish: their sites immediately on the seacoast lack fish bones and fishhooks. They and their Neanderthal contemporaries still rank as less than fully human.

Human history at last took off around 50,000 years ago, at the time of

what I have termed our Great Leap Forward. The earliest definite signs of that leap come from East African sites with standardized stone tools and the first preserved jewelry (ostrich-shell beads). Similar developments soon appear in the Near East and in southeastern Europe, then (some 40,000 years ago) in southwestern Europe, where abundant artifacts are associated with fully modern skeletons of people termed Cro-Magnons. Thereafter, the garbage preserved at archaeological sites rapidly becomes more and more interesting and leaves no doubt that we are dealing with biologically and behaviorally modern humans.

Cro-Magnon garbage heaps yield not only stone tools but also tools of bone, whose suitability for shaping (for instance, into fishhooks) had apparently gone unrecognized by previous humans. Tools were produced in diverse and distinctive shapes so modern that their functions as needles, awls, engraving tools, and so on are obvious to us. Instead of only single-piece tools such as hand-held scrapers, multipiece tools made their appearance. Recognizable multipiece weapons at Cro-Magnon sites include harpoons, spear-throwers, and eventually bows and arrows, the precursors of rifles and other multipiece modern weapons. Those efficient means of killing at a safe distance permitted the hunting of such dangerous prey as rhinos and elephants, while the invention of rope for nets, lines, and snares allowed the addition of fish and birds to our diet. Remains of houses and sewn clothing testify to a greatly improved ability to survive in cold climates, and remains of jewelry and carefully buried skeletons indicate revolutionary aesthetic and spiritual developments.

Of the Cro-Magnons' products that have been preserved, the best known are their artworks: their magnificent cave paintings, statues, and musical instruments, which we still appreciate as art today. Anyone who has experienced firsthand the overwhelming power of the life-sized painted bulls and horses in the Lascaux Cave of southwestern France will understand at once that their creators must have been as modern in their minds as they were in their skeletons.

Obviously, some momentous change took place in our ancestors' capabilities between about 100,000 and 50,000 years ago. That Great Leap Forward poses two major unresolved questions, regarding its triggering cause and its geographic location. As for its cause, I argued in my book *The Third Chimpanzee* for the perfection of the voice box and hence for the anatomical basis of modern language, on which the exercise of human creativity is so dependent. Others have suggested instead that a change in brain organization around that time, without a change in brain size, made modern language possible.

As for the site of the Great Leap Forward, did it take place primarily in

one geographic area, in one group of humans, who were thereby enabled to expand and replace the former human populations of other parts of the world? Or did it occur in parallel in different regions, in each of which the human populations living there today would be descendants of the populations living there before the leap? The rather modern-looking human skulls from Africa around 100,000 years ago have been taken to support the former view, with the leap occurring specifically in Africa. Molecular studies (of so-called mitochondrial DNA) were initially also interpreted in terms of an African origin of modern humans, though the meaning of those molecular findings is currently in doubt. On the other hand, skulls of humans living in China and Indonesia hundreds of thousands of years ago are considered by some physical anthropologists to exhibit features still found in modern Chinese and in Aboriginal Australians, respectively. If true, that finding would suggest parallel evolution and multiregional origins of modern humans, rather than origins in a single Garden of Eden. The issue remains unresolved.

The evidence for a localized origin of modern humans, followed by their spread and then their replacement of other types of humans elsewhere, seems strongest for Europe. Some 40,000 years ago, into Europe came the Cro-Magnons, with their modern skeletons, superior weapons, and other advanced cultural traits. Within a few thousand years there were no more Neanderthals, who had been evolving as the sole occupants of Europe for hundreds of thousands of years. That sequence strongly suggests that the modern Cro-Magnons somehow used their far superior technology, and their language skills or brains, to infect, kill, or displace the Neanderthals, leaving behind little or no evidence of hybridization between Neanderthals and Cro-Magnons.

THE GREAT LEAP FORWARD coincides with the first proven major extension of human geographic range since our ancestors' colonization of Eurasia. That extension consisted of the occupation of Australia and New Guinea, joined at that time into a single continent. Many radiocarbon-dated sites attest to human presence in Australia/New Guinea between 40,000 and 30,000 years ago (plus the inevitable somewhat older claims of contested validity). Within a short time of that initial peopling, humans had expanded over the whole continent and adapted to its diverse habitats, from the tropical rain forests and high mountains of New Guinea to the dry interior and wet southeastern corner of Australia.

During the Ice Ages, so much of the oceans' water was locked up in gla-

ciers that worldwide sea levels dropped hundreds of feet below their present stand. As a result, what are now the shallow seas between Asia and the Indonesian islands of Sumatra, Borneo, Java, and Bali became dry land. (So did other shallow straits, such as the Bering Strait and the English Channel.) The edge of the Southeast Asian mainland then lay 700 miles east of its present location. Nevertheless, central Indonesian islands between Bali and Australia remained surrounded and separated by deepwater channels. To reach Australia / New Guinea from the Asian mainland at that time still required crossing a minimum of eight channels, the broadest of which was at least 50 miles wide. Most of those channels divided islands visible from each other, but Australia itself was always invisible from even the nearest Indonesian islands, Timor and Tanimbar. Thus, the occupation of Australia / New Guinea is momentous in that it demanded watercraft and provides by far the earliest evidence of their use in history. Not until about 30,000 years later (13,000 years ago) is there strong evidence of watercraft anywhere else in the world, from the Mediterranean.

Initially, archaeologists considered the possibility that the colonization of Australia / New Guinea was achieved accidentally by just a few people swept to sea while fishing on a raft near an Indonesian island. In an extreme scenario the first settlers are pictured as having consisted of a single pregnant young woman carrying a male fetus. But believers in the fluke-colonization theory have been surprised by recent discoveries that still other islands, lying to the east of New Guinea, were colonized soon after New Guinea itself, by around 35,000 years ago. Those islands were New Britain and New Ireland, in the Bismarck Archipelago, and Buka, in the Solomon Archipelago. Buka lies out of sight of the closest island to the west and could have been reached only by crossing a water gap of about 100 miles. Thus, early Australians and New Guineans were probably capable of intentionally traveling over water to visible islands, and were using watercraft sufficiently often that the colonization of even invisible distant islands was repeatedly achieved unintentionally.

The settlement of Australia / New Guinea was perhaps associated with still another big first, besides humans' first use of watercraft and first range extension since reaching Eurasia: the first mass extermination of large animal species by humans. Today, we regard Africa as *the* continent of big mammals. Modern Eurasia also has many species of big mammals (though not in the manifest abundance of Africa's Serengeti Plains), such as Asia's rhinos and elephants and tigers, and Europe's moose and bears and (until classical times) lions. Australia / New Guinea today has no equally large mammals,

in fact no mammal larger than 100-pound kangaroos. But Australia / New Guinea formerly had its own suite of diverse big mammals, including giant kangaroos, rhinolike marsupials called diprotodonts and reaching the size of a cow, and a marsupial "leopard." It also formerly had a 400-pound ostrich-like flightless bird, plus some impressively big reptiles, including a one-ton lizard, a giant python, and land-dwelling crocodiles.

All of those Australian / New Guinean giants (the so-called megafauna) disappeared after the arrival of humans. While there has been controversy about the exact timing of their demise, several Australian archaeological sites, with dates extending over tens of thousands of years, and with prodigiously abundant deposits of animal bones, have been carefully excavated and found to contain not a trace of the now extinct giants over the last 35,000 years. Hence the megafauna probably became extinct soon after humans reached Australia.

The near-simultaneous disappearance of so many large species raises an obvious question: what caused it? An obvious possible answer is that they were killed off or else eliminated indirectly by the first arriving humans. Recall that Australian / New Guinean animals had evolved for millions of years in the absence of human hunters. We know that Galápagos and Antarctic birds and mammals, which similarly evolved in the absence of humans and did not see humans until modern times, are still incurably tame today. They would have been exterminated if conservationists had not imposed protective measures quickly. On other recently discovered islands where protective measures did not go into effect quickly, exterminations did indeed result: one such victim, the dodo of Mauritius, has become virtually a symbol for extinction. We also know now that, on every one of the well-studied oceanic islands colonized in the prehistoric era, human colonization led to an extinction spasm whose victims included the moas of New Zealand, the giant lemurs of Madagascar, and the big flightless geese of Hawaii. Just as modern humans walked up to unafraid dodos and island seals and killed them, prehistoric humans presumably walked up to unafraid moas and giant lemurs and killed them too.

Hence one hypothesis for the demise of Australia's and New Guinea's giants is that they met the same fate around 40,000 years ago. In contrast, most big mammals of Africa and Eurasia survived into modern times, because they had coevolved with protohumans for hundreds of thousands or millions of years. They thereby enjoyed ample time to evolve a fear of humans, as our ancestors' initially poor hunting skills slowly improved. The

dodo, moas, and perhaps the giants of Australia / New Guinea had the misfortune suddenly to be confronted, without any evolutionary preparation, by invading modern humans possessing fully developed hunting skills.

However, the overkill hypothesis, as it is termed, has not gone unchallenged for Australia / New Guinea. Critics emphasize that, as yet, no one has documented the bones of an extinct Australian / New Guinean giant with compelling evidence of its having been killed by humans, or even of its having lived in association with humans. Defenders of the overkill hypothesis reply: you would hardly expect to find kill sites if the extermination was completed very quickly and long ago, such as within a few millennia some 40,000 years ago. The critics respond with a countertheory: perhaps the giants succumbed instead to a change in climate, such as a severe drought on the already chronically dry Australian continent. The debate goes on.

Personally, I can't fathom why Australia's giants should have survived innumerable droughts in their tens of millions of years of Australian history, and then have chosen to drop dead almost simultaneously (at least on a time scale of millions of years) precisely and just coincidentally when the first humans arrived. The giants became extinct not only in dry central Australia but also in drenching wet New Guinea and southeastern Australia. They became extinct in every habitat without exception, from deserts to cold rain forest and tropical rain forest. Hence it seems to me most likely that the giants were indeed exterminated by humans, both directly (by being killed for food) and indirectly (as the result of fires and habitat modification caused by humans). But regardless of whether the overkill hypothesis or the climate hypothesis proves correct, the disappearance of all of the big animals of Australia / New Guinea had, as we shall see, heavy consequences for subsequent human history. Those extinctions eliminated all the large wild animals that might otherwise have been candidates for domestication, and left native Australians and New Guineans with not a single native domestic animal.

THUS, THE COLONIZATION of Australia / New Guinea was not achieved until around the time of the Great Leap Forward. Another extension of human range that soon followed was the one into the coldest parts of Eurasia. While Neanderthals lived in glacial times and were adapted to the cold, they penetrated no farther north than northern Germany and Kiev. That's not surprising, since Neanderthals apparently lacked needles, sewn clothing, warm houses, and other technology essential to survival in the

coldest climates. Anatomically modern peoples who did possess such technology had expanded into Siberia by around 20,000 years ago (there are the usual much older disputed claims). That expansion may have been responsible for the extinction of Eurasia's woolly mammoth and woolly rhinoceros.

With the settlement of Australia/New Guinea, humans now occupied three of the five habitable continents. (Throughout this book, I count Eurasia as a single continent, and I omit Antarctica because it was not reached by humans until the 19th century and has never had any self-supporting human population.) That left only two continents, North America and South America. They were surely the last ones settled, for the obvious reason that reaching the Americas from the Old World required either boats (for which there is no evidence even in Indonesia until 40,000 years ago and none in Europe until much later) in order to cross by sea, or else it required the occupation of Siberia (unoccupied until about 20,000 years ago) in order to cross the Bering land bridge.

However, it is uncertain when, between about 14,000 and 35,000 years ago, the Americas were first colonized. The oldest unquestioned human remains in the Americas are at sites in Alaska dated around 12,000 B.C., followed by a profusion of sites in the United States south of the Canadian border and in Mexico in the centuries just before 11,000 B.C. The latter sites are called Clovis sites, named after the type site near the town of Clovis, New Mexico, where their characteristic large stone spearpoints were first recognized. Hundreds of Clovis sites are now known, blanketing all 48 of the lower U.S. states south into Mexico. Unquestioned evidence of human presence appears soon thereafter in Amazonia and in Patagonia. These facts suggest the interpretation that Clovis sites document the Americas' first colonization by people, who quickly multiplied, expanded, and filled the two continents.

One might at first be surprised that Clovis descendants could reach Patagonia, lying 8,000 miles south of the U.S.-Canada border, in less than a thousand years. However, that translates into an average expansion of only 8 miles per year, a trivial feat for a hunter-gatherer likely to cover that distance even within a single day's normal foraging.

One might also at first be surprised that the Americas evidently filled up with humans so quickly that people were motivated to keep spreading south toward Patagonia. That population growth also proves unsurprising when one stops to consider the actual numbers. If the Americas eventually came to hold hunter-gatherers at an average population density of somewhat under one person per square mile (a high value for modern hunter-gatherers), then the whole

area of the Americas would eventually have held about 10 million hunter-gatherers. But even if the initial colonists had consisted of only 100 people and their numbers had increased at a rate of only 1.1 percent per year, the colonists' descendants would have reached that population ceiling of 10 million people within a thousand years. A population growth rate of 1.1 percent per year is again trivial: rates as high as 3.4 percent per year have been observed in modern times when people colonized virgin lands, such as when the HMS *Bounty* mutineers and their Tahitian wives colonized Pitcairn Island.

The profusion of Clovis hunters' sites within the first few centuries after their arrival resembles the site profusion documented archaeologically for the more recent discovery of New Zealand by ancestral Maori. A profusion of early sites is also documented for the much older colonization of Europe by anatomically modern humans, and for the occupation of Australia/New Guinea. That is, everything about the Clovis phenomenon and its spread through the Americas corresponds to findings for other, unquestioned virgin-land colonizations in history.

What might be the significance of Clovis sites' bursting forth in the centuries just before 11,000 B.C., rather than in those before 16,000 or 21,000 B.C.? Recall that Siberia has always been cold, and that a continuous ice sheet stretched as an impassable barrier across the whole width of Canada during much of the Pleistocene Ice Ages. We have already seen that the technology required for coping with extreme cold did not emerge until after anatomically modern humans invaded Europe around 40,000 years ago, and that people did not colonize Siberia until 20,000 years later. Eventually, those early Siberians crossed to Alaska, either by sea across the Bering Strait (only 50 miles wide even today) or else on foot at glacial times when Bering Strait was dry land. The Bering land bridge, during its millennia of intermittent existence, would have been up to a thousand miles wide, covered by open tundra, and easily traversable by people adapted to cold conditions. The land bridge was flooded and became a strait again most recently when sea level rose after around 14,000 B.C. Whether those early Siberians walked or paddled to Alaska, the earliest secure evidence of human presence in Alaska dates from around 12,000 B.C.

Soon thereafter, a north–south ice-free corridor opened in the Canadian ice sheet, permitting the first Alaskans to pass through and come out into the Great Plains around the site of the modern Canadian city of Edmonton. That removed the last serious barrier between Alaska and Patagonia for modern humans. The Edmonton pioneers would have found the Great Plains

teeming with game. They would have thrived, increased in numbers, and gradually spread south to occupy the whole hemisphere.

One other feature of the Clovis phenomenon fits our expectations for the first human presence south of the Canadian ice sheet. Like Australia / New Guinea, the Americas had originally been full of big mammals. About 15,000 years ago, the American West looked much as Africa's Serengeti Plains do today, with herds of elephants and horses pursued by lions and cheetahs, and joined by members of such exotic species as camels and giant ground sloths. Just as in Australia / New Guinea, in the Americas most of those large mammals became extinct. Whereas the extinctions took place probably before 30,000 years ago in Australia, they occurred around 17,000 to 12,000 years ago in the Americas. For those extinct American mammals whose bones are available in greatest abundance and have been dated especially accurately, one can pinpoint the extinctions as having occurred around 11,000 B.C. Perhaps the two most accurately dated extinctions are those of the Shasta ground sloth and Harrington's mountain goat in the Grand Canyon area; both of those populations disappeared within a century or two of 11,100 B.C. Whether coincidentally or not, that date is identical, within experimental error, to the date of Clovis hunters' arrival in the Grand Canyon area.

The discovery of numerous skeletons of mammoths with Clovis spearpoints between their ribs suggests that this agreement of dates is not a coincidence. Hunters expanding southward through the Americas, encountering big animals that had never seen humans before, may have found those American animals easy to kill and may have exterminated them. A countertheory is that America's big mammals instead became extinct because of climate changes at the end of the last Ice Age, which (to confuse the interpretation for modern paleontologists) also happened around 11,000 B.C.

Personally, I have the same problem with a climatic theory of megafaunal extinction in the Americas as with such a theory in Australia / New Guinea. The Americas' big animals had already survived the ends of 22 previous Ice Ages. Why did most of them pick the 23rd to expire in concert, in the presence of all those supposedly harmless humans? Why did they disappear in all habitats, not only in habitats that contracted but also in ones that greatly expanded at the end of the last Ice Age? Hence I suspect that Clovis hunters did it, but the debate remains unresolved. Whichever theory proves correct, most large wild mammal species that might otherwise have later been domesticated by Native Americans were thereby removed.

Also unresolved is the question whether Clovis hunters really were the

first Americans. As always happens whenever anyone claims the first anything, claims of discoveries of pre-Clovis human sites in the Americas are constantly being advanced. Every year, a few of those new claims really do appear convincing and exciting when initially announced. Then the inevitable problems of interpretation arise. Were the reported tools at the site really tools made by humans, or just natural rock shapes? Are the reported radiocarbon dates really correct, and not invalidated by any of the numerous difficulties that can plague radiocarbon dating? If the dates are correct, are they really associated with human products, rather than just being a 15,000-year-old lump of charcoal lying next to a stone tool actually made 9,000 years ago?

To illustrate these problems, consider the following typical example of an often quoted pre-Clovis claim. At a Brazilian rock shelter named Pedra Furada, archaeologists found cave paintings undoubtedly made by humans. They also discovered, among the piles of stones at the base of a cliff, some stones whose shapes suggested the possibility of their being crude tools. In addition, they came upon supposed hearths, whose burnt charcoal yielded radiocarbon dates of around 35,000 years ago. Articles on Pedra Furada were accepted for publication in the prestigious and highly selective international scientific journal *Nature*.

But none of those rocks at the base of the cliff is an obviously human-made tool, as are Clovis points and Cro-Magnon tools. If hundreds of thousands of rocks fall from a high cliff over the course of tens of thousands of years, many of them will become chipped and broken when they hit the rocks below, and some will come to resemble crude tools chipped and broken by humans. In western Europe and elsewhere in Amazonia, archaeologists have radiocarbon-dated the actual pigments used in cave paintings, but that was not done at Pedra Furada. Forest fires occur frequently in the vicinity and produce charcoal that is regularly swept into caves by wind and streams. No evidence links the 35,000-year-old charcoal to the undoubted cave paintings at Pedra Furada. Although the original excavators remain convinced, a team of archaeologists who were not involved in the excavation but receptive to pre-Clovis claims recently visited the site and came away unconvinced.

The North American site that currently enjoys the strongest credentials as a possible pre-Clovis site is Meadowcroft rock shelter, in Pennsylvania, yielding reported human-associated radiocarbon dates of about 16,000 years ago. At Meadowcroft no archaeologist denies that many human artifacts do occur in many carefully excavated layers. But the oldest radiocarbon dates don't make sense, because the plant and animal species associated with them are species liv-

ing in Pennsylvania in recent times of mild climates, rather than species expected for the glacial times of 16,000 years ago. Hence one has to suspect that the charcoal samples dated from the oldest human occupation levels consist of post-Clovis charcoal infiltrated with older carbon. The strongest pre-Clovis candidate in South America is the Monte Verde site, in southern Chile, dated to at least 15,000 years ago. It too now seems convincing to many archaeologists, but caution is warranted in view of all the previous disillusionments.

If there really were pre-Clovis people in the Americas, why is it still so hard to prove that they existed? Archaeologists have excavated hundreds of American sites unequivocally dating to between 2000 and 11,000 B.C., including dozens of Clovis sites in the North American West, rock shelters in the Appalachians, and sites in coastal California. Below all the archaeological layers with undoubted human presence, at many of those same sites, deeper older layers have been excavated and still yield undoubted remains of animals—but with no further evidence of humans. The weaknesses in pre-Clovis evidence in the Americas contrast with the strength of the evidence in Europe, where hundreds of sites attest to the presence of modern humans long before Clovis hunters appeared in the Americas around 11,000 B.C. Even more striking is the evidence from Australia / New Guinea, where there are barely one-tenth as many archaeologists as in the United States alone, but where those few archaeologists have nevertheless discovered over a hundred unequivocal pre-Clovis sites scattered over the whole continent.

Early humans certainly didn't fly by helicopter from Alaska to Meadowcroft and Monte Verde, skipping all the landscape in between. Advocates of pre-Clovis settlement suggest that, for thousands or even tens of thousands of years, pre-Clovis humans remained at low population densities or poorly visible archaeologically, for unknown reasons unprecedented elsewhere in the world. I find that suggestion infinitely more implausible than the suggestion that Monte Verde and Meadowcroft will eventually be reinterpreted, as have other claimed pre-Clovis sites. My feeling is that, if there really had been pre-Clovis settlement in the Americas, it would have become obvious at many locations by now, and we would not still be arguing. However, archaeologists remain divided on these questions.

The consequences for our understanding of later American prehistory remain the same, whichever interpretation proves correct. Either: the Americas were first settled around 11,000 B.C. and quickly filled up with people. Or else: the first settlement occurred somewhat earlier (most advocates of pre-Clovis settlement would suggest by 15,000 or 20,000 years ago, possi-

bly 30,000 years ago, and few would seriously claim earlier); but those pre-Clovis settlers remained few in numbers, or inconspicuous, or had little impact, until around 11,000 B.C. In either case, of the five habitable continents, North America and South America are the ones with the shortest human prehistories.

WITH THE OCCUPATION of the Americas, most habitable areas of the continents and continental islands, plus oceanic islands from Indonesia to east of New Guinea, supported humans. The settlement of the world's remaining islands was not completed until modern times: Mediterranean islands such as Crete, Cyprus, Corsica, and Sardinia between about 8500 and 4000 B.C.; Caribbean islands beginning around 4000 B.C.; Polynesian and Micronesian islands between 1200 B.C. and A.D. 1000; Madagascar sometime between A.D. 300 and 800; and Iceland in the ninth century A.D. Native Americans, possibly ancestral to the modern Inuit, spread throughout the High Arctic around 2000 B.C. That left, as the sole uninhabited areas awaiting European explorers over the last 700 years, only the most remote islands of the Atlantic and Indian Oceans (such as the Azores and Seychelles), plus Antarctica.

What significance, if any, do the continents' differing dates of settlement have for subsequent history? Suppose that a time machine could have transported an archaeologist back in time, for a world tour at around 11,000 B.C. Given the state of the world then, could the archaeologist have predicted the sequence in which human societies on the various continents would develop guns, germs, and steel, and thus predicted the state of the world today?

Our archaeologist might have considered the possible advantages of a head start. If that counted for anything, then Africa enjoyed an enormous advantage: at least 5 million more years of separate protohuman existence than on any other continent. In addition, if it is true that modern humans arose in Africa around 100,000 years ago and spread to other continents, that would have wiped out any advantages accumulated elsewhere in the meantime and given Africans a new head start. Furthermore, human genetic diversity is highest in Africa; perhaps more-diverse humans would collectively produce more-diverse inventions.

But our archaeologist might then reflect: what, really, does a "head start" mean for the purposes of this book? We cannot take the metaphor of a

footrace literally. If by head start you mean the time required to populate a continent after the arrival of the first few pioneering colonists, that time is relatively brief: for example, less than 1,000 years to fill up even the whole New World. If by head start you instead mean the time required to adapt to local conditions, I grant that some extreme environments did take time: for instance, 9,000 years to occupy the High Arctic after the occupation of the rest of North America. But people would have explored and adapted to most other areas quickly, once modern human inventiveness had developed. For example, after the ancestors of the Maori reached New Zealand, it apparently took them barely a century to discover all worthwhile stone sources; only a few more centuries to kill every last moa in some of the world's most rugged terrain; and only a few centuries to differentiate into a range of diverse societies, from that of coastal hunter-gatherers to that of farmers practicing new types of food storage.

Our archaeologist might therefore look at the Americas and conclude that Africans, despite their apparently enormous head start, would have been overtaken by the earliest Americans within at most a millennium. Thereafter, the Americas' greater area (50 percent greater than Africa's) and much greater environmental diversity would have given the advantage to Native Americans over Africans.

The archaeologist might then turn to Eurasia and reason as follows. Eurasia is the world's largest continent. It has been occupied for longer than any other continent except Africa. Africa's long occupation before the colonization of Eurasia a million years ago might have counted for nothing anyway, because protohumans were at such a primitive stage then. Our archaeologist might look at the Upper Paleolithic flowering of southwestern Europe between 20,000 and 12,000 years ago, with all those famous artworks and complex tools, and wonder whether Eurasia was already getting a head start then, at least locally.

Finally, the archaeologist would turn to Australia / New Guinea, noting first its small area (it's the smallest continent), the large fraction of it covered by desert capable of supporting few humans, the continent's isolation, and its later occupation than that of Africa and Eurasia. All that might lead the archaeologist to predict slow development in Australia / New Guinea.

But remember that Australians and New Guineans had by far the earliest watercraft in the world. They were creating cave paintings apparently at least as early as the Cro-Magnons in Europe. Jonathan Kingdon and Tim Flannery have noted that the colonization of Australia / New Guinea from

the islands of the Asian continental shelf required humans to learn to deal with the new environments they encountered on the islands of central Indonesia—a maze of coastlines offering the richest marine resources, coral reefs, and mangroves in the world. As the colonists crossed the straits separating each Indonesian island from the next one to the east, they adapted anew, filled up that next island, and went on to colonize the next island again. It was a hitherto unprecedented golden age of successive human population explosions. Perhaps those cycles of colonization, adaptation, and population explosion were what selected for the Great Leap Forward, which then diffused back westward to Eurasia and Africa. If this scenario is correct, then Australia / New Guinea gained a massive head start that might have continued to propel human development there long after the Great Leap Forward.

Thus, an observer transported back in time to 11,000 B.C. could not have predicted on which continent human societies would develop most quickly, but could have made a strong case for any of the continents. With hindsight, of course, we know that Eurasia was the one. But it turns out that the actual reasons behind the more rapid development of Eurasian societies were not at all the straightforward ones that our imaginary archaeologist of 11,000 B.C. guessed. The remainder of this book consists of a quest to discover those real reasons.

A NATURAL EXPERIMENT OF HISTORY

ON THE CHATHAM ISLANDS, 500 MILES EAST OF NEW Zealand, centuries of independence came to a brutal end for the Moriori people in December 1835. On November 19 of that year, a ship carrying 500 Maori armed with guns, clubs, and axes arrived, followed on December 5 by a shipload of 400 more Maori. Groups of Maori began to walk through Moriori settlements, announcing that the Moriori were now their slaves, and killing those who objected. An organized resistance by the Moriori could still then have defeated the Maori, who were outnumbered two to one. However, the Moriori had a tradition of resolving disputes peacefully. They decided in a council meeting not to fight back but to offer peace, friendship, and a division of resources.

Before the Moriori could deliver that offer, the Maori attacked en masse. Over the course of the next few days, they killed hundreds of Moriori, cooked and ate many of the bodies, and enslaved all the others, killing most of them too over the next few years as it suited their whim. A Moriori survivor recalled, "[The Maori] commenced to kill us like sheep. . . . [We] were terrified, fled to the bush, concealed ourselves in holes underground, and in any place to escape our enemies. It was of no avail; we were discovered and killed—men, women, and children indiscriminately." A Maori conqueror explained, "We took possession . . . in accordance with our customs and we caught all the people. Not

one escaped. Some ran away from us, these we killed, and others we killed—but what of that? It was in accordance with our custom."

The brutal outcome of this collision between the Moriori and the Maori could have been easily predicted. The Moriori were a small, isolated population of hunter-gatherers, equipped with only the simplest technology and weapons, entirely inexperienced at war, and lacking strong leadership or organization. The Maori invaders (from New Zealand's North Island) came from a dense population of farmers chronically engaged in ferocious wars, equipped with more-advanced technology and weapons, and operating under strong leadership. Of course, when the two groups finally came into contact, it was the Maori who slaughtered the Moriori, not vice versa.

The tragedy of the Moriori resembles many other such tragedies in both the modern and the ancient world, pitting numerous well-equipped people against few ill-equipped opponents. What makes the Maori-Moriori collision grimly illuminating is that both groups had diverged from a common origin less than a millennium earlier. Both were Polynesian peoples. The modern Maori are descendants of Polynesian farmers who colonized New Zealand around A.D. 1000. Soon thereafter, a group of those Maori in turn colonized the Chatham Islands and became the Moriori. In the centuries after the two groups separated, they evolved in opposite directions, the North Island Maori developing more-complex and the Moriori less-complex technology and political organization. The Moriori reverted to being hunter-gatherers, while the North Island Maori turned to more intensive farming.

Those opposite evolutionary courses sealed the outcome of their eventual collision. If we could understand the reasons for the disparate development of those two island societies, we might have a model for understanding the broader question of differing developments on the continents.

MORIORI AND MAORI history constitutes a brief, small-scale natural experiment that tests how environments affect human societies. Before you read a whole book examining environmental effects on a very large scale—effects on human societies around the world for the last 13,000 years—you might reasonably want assurance, from smaller tests, that such effects really are significant. If you were a laboratory scientist studying rats, you might perform such a test by taking one rat colony, distributing groups of those ancestral rats among many cages with differing environments, and coming back many rat generations later to see what had happened. Of course, such purposeful experiments cannot be

carried out on human societies. Instead, scientists must look for "natural experiments," in which something similar befell humans in the past.

Such an experiment unfolded during the settlement of Polynesia. Scattered over the Pacific Ocean beyond New Guinea and Melanesia are thousands of islands differing greatly in area, isolation, elevation, climate, productivity, and geological and biological resources (Figure 2.1). For most of human history those islands lay far beyond the reach of watercraft. Around 1200 B.C. a group of farming, fishing, seafaring people from the Bismarck Archipelago north of New Guinea finally succeeded in reaching some of those islands. Over the following centuries their descendants colonized virtually every habitable scrap of land in the Pacific. The process was mostly complete by A.D. 500, with the last few islands settled around or soon after A.D. 1000.

Thus, within a modest time span, enormously diverse island environments were settled by colonists all of whom stemmed from the same founding population. The ultimate ancestors of all modern Polynesian populations shared essentially the same culture, language, technology, and set of domesticated plants and animals. Hence Polynesian history constitutes a natural experiment allowing us to study human adaptation, devoid of the usual complications of multiple waves of disparate colonists that often frustrate our attempts to understand adaptation elsewhere in the world.

Within that medium-sized test, the fate of the Moriori forms a smaller test. It is easy to trace how the differing environments of the Chatham Islands and of New Zealand molded the Moriori and the Maori differently. While those ancestral Maori who first colonized the Chathams may have been farmers, Maori tropical crops could not grow in the Chathams' cold climate, and the colonists had no alternative except to revert to being hunter-gatherers. Since as hunter-gatherers they did not produce crop surpluses available for redistribution or storage, they could not support and feed nonhunting craft specialists, armies, bureaucrats, and chiefs. Their prey were seals, shellfish, nesting seabirds, and fish that could be captured by hand or with clubs and required no more elaborate technology. In addition, the Chathams are relatively small and remote islands, capable of supporting a total population of only about 2,000 hunter-gatherers. With no other accessible islands to colonize, the Moriori had to remain in the Chathams, and to learn how to get along with each other. They did so by renouncing war, and they reduced potential conflicts from overpopulation by castrating some male infants. The result was a small, unwarlike population with simple technology and weapons, and without strong leadership or organization.

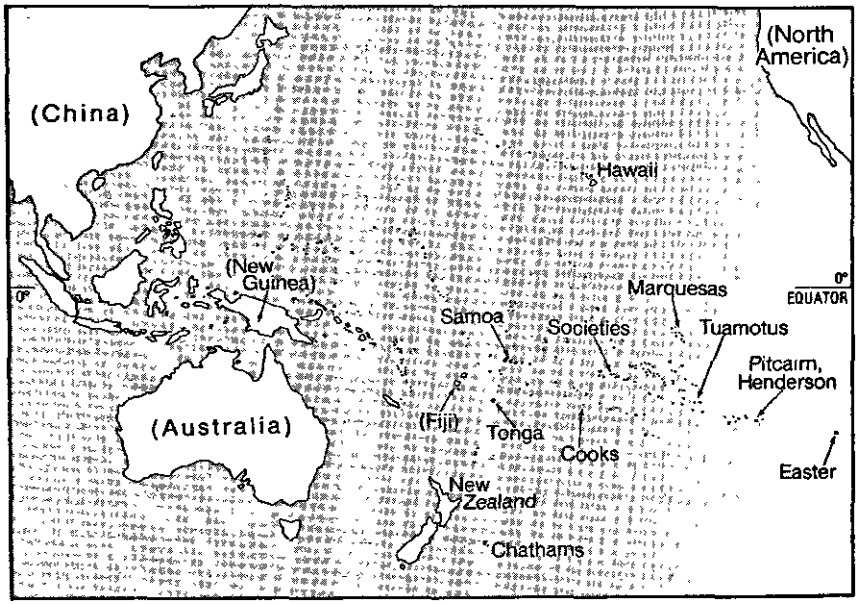

Figure 2.1. Polynesian islands. (Parentheses denote some non-Polynesian lands.)

In contrast, the northern (warmer) part of New Zealand, by far the largest island group in Polynesia, was suitable for Polynesian agriculture. Those Maori who remained in New Zealand increased in numbers until there were more than 100,000 of them. They developed locally dense populations chronically engaged in ferocious wars with neighboring populations. With the crop surpluses that they could grow and store, they fed craft specialists, chiefs, and part-time soldiers. They needed and developed varied tools for growing their crops, fighting, and making art. They erected elaborate ceremonial buildings and prodigious numbers of forts.

Thus, Moriori and Maori societies developed from the same ancestral society, but along very different lines. The resulting two societies lost awareness even of each other's existence and did not come into contact again for many centuries, perhaps for as long as 500 years. Finally, an Australian seal-hunting ship visiting the Chathams en route to New Zealand brought the news to New Zealand of islands where "there is an abundance of sea and shellfish; the lakes swarm with eels; and it is a land of the karaka berry. . . . The inhabitants are very numerous, but they do not understand how to fight, and have no weap-

ons." That news was enough to induce 900 Maori to sail to the Chathams. The outcome clearly illustrates how environments can affect economy, technology, political organization, and fighting skills within a short time.

As I ALREADY mentioned, the Maori-Moriori collision represents a small test within a medium-sized test. What can we learn from all of Polynesia about environmental influences on human societies? What differences among societies on different Polynesian islands need to be explained?

Polynesia as a whole presented a much wider range of environmental conditions than did just New Zealand and the Chathams, although the latter define one extreme (the simple end) of Polynesian organization. In their subsistence modes, Polynesians ranged from the hunter-gatherers of the Chathams, through slash-and-burn farmers, to practitioners of intensive food production living at some of the highest population densities of any human societies. Polynesian food producers variously intensified production of pigs, dogs, and chickens. They organized work forces to construct large irrigation systems for agriculture and to enclose large ponds for fish production. The economic basis of Polynesian societies consisted of more or less self-sufficient households, but some islands also supported guilds of hereditary part-time craft specialists. In social organization, Polynesian societies ran the gamut from fairly egalitarian village societies to some of the most stratified societies in the world, with many hierarchically ranked lineages and with chief and commoner classes whose members married within their own class. In political organization, Polynesian islands ranged from landscapes divided into independent tribal or village units, up to multi-island proto-empires that devoted standing military establishments to invasions of other islands and wars of conquest. Finally, Polynesian material culture varied from the production of no more than personal utensils to the construction of monumental stone architecture. How can all that variation be explained?

Contributing to these differences among Polynesian societies were at least six sets of environmental variables among Polynesian islands: island climate, geological type, marine resources, area, terrain fragmentation, and isolation. Let's examine the ranges of these factors, before considering their specific consequences for Polynesian societies.

The climate in Polynesia varies from warm tropical or subtropical on most islands, which lie near the equator, to temperate on most of New Zealand, and cold subantarctic on the Chathams and the southern part of New Zea-

land's South Island. Hawaii's Big Island, though lying well within the Tropic of Cancer, has mountains high enough to support alpine habitats and receive occasional snowfalls. Rainfall varies from the highest recorded on Earth (in New Zealand's Fjordland and Hawaii's Alakai Swamp on Kauai) to only one-tenth as much on islands so dry that they are marginal for agriculture.

Island geological types include coral atolls, raised limestone, volcanic islands, pieces of continents, and mixtures of those types. At one extreme, innumerable islets, such as those of the Tuamotu Archipelago, are flat, low atolls barely rising above sea level. Other former atolls, such as Henderson and Rennell, have been lifted far above sea level to constitute raised limestone islands. Both of those atoll types present problems to human settlers, because they consist entirely of limestone without other stones, have only very thin soil, and lack permanent fresh water. At the opposite extreme, the largest Polynesian island, New Zealand, is an old, geologically diverse, continental fragment of Gondwanaland, offering a range of mineral resources, including commercially exploitable iron, coal, gold, and jade. Most other large Polynesian islands are volcanoes that rose from the sea, have never formed parts of a continent, and may or may not include areas of raised limestone. While lacking New Zealand's geological richness, the oceanic volcanic islands at least are an improvement over atolls (from the Polynesians' perspective) in that they offer diverse types of volcanic stones, some of which are highly suitable for making stone tools.

The volcanic islands differ among themselves. The elevations of the higher ones generate rain in the mountains, so the islands are heavily weathered and have deep soils and permanent streams. That is true, for instance, of the Societies, Samoa, the Marquesas, and especially Hawaii, the Polynesian archipelago with the highest mountains. Among the lower islands, Tonga and (to a lesser extent) Easter also have rich soil because of volcanic ashfalls, but they lack Hawaii's large streams.

As for marine resources, most Polynesian islands are surrounded by shallow water and reefs, and many also encompass lagoons. Those environments teem with fish and shellfish. However, the rocky coasts of Easter, Pitcairn, and the Marquesas, and the steeply dropping ocean bottom and absence of coral reefs around those islands, are much less productive of seafood.

Area is another obvious variable, ranging from the 100 acres of Anuta, the smallest permanently inhabited isolated Polynesian island, up to the 103,000 square miles of the minicontinent of New Zealand. The habitable terrain of some islands, notably the Marquesas, is fragmented into steep-walled valleys

by ridges, while other islands, such as Tonga and Easter, consist of gently rolling terrain presenting no obstacles to travel and communication.

The last environmental variable to consider is isolation. Easter Island and the Chathams are small and so remote from other islands that, once they were initially colonized, the societies thus founded developed in total isolation from the rest of the world. New Zealand, Hawaii, and the Marquesas are also very remote, but at least the latter two apparently did have some further contact with other archipelagoes after the first colonization, and all three consist of many islands close enough to each other for regular contact between islands of the same archipelago. Most other Polynesian islands were in more or less regular contact with other islands. In particular, the Tongan Archipelago lies close enough to the Fijian, Samoan, and Wallis Archipelagoes to have permitted regular voyaging between archipelagoes, and eventually to permit Tongans to undertake the conquest of Fiji.

AFTER THAT BRIEF look at Polynesia's varying environments, let's now see how that variation influenced Polynesian societies. Subsistence is a convenient facet of society with which to start, since it in turn affected other facets.

Polynesian subsistence depended on varying mixes of fishing, gathering wild plants and marine shellfish and Crustacea, hunting terrestrial birds and breeding seabirds, and food production. Most Polynesian islands originally supported big flightless birds that had evolved in the absence of predators, New Zealand's moas and Hawaii's flightless geese being the best-known examples. While those birds were important food sources for the initial colonists, especially on New Zealand's South Island, most of them were soon exterminated on all islands, because they were easy to hunt down. Breeding seabirds were also quickly reduced in number but continued to be important food sources on some islands. Marine resources were significant on most islands but least so on Easter, Pitcairn, and the Marquesas, where people as a result were especially dependent on food that they themselves produced.

Ancestral Polynesians brought with them three domesticated animals (the pig, chicken, and dog) and domesticated no other animals within Polynesia. Many islands retained all three of those species, but the more isolated Polynesian islands lacked one or more of them, either because livestock brought in canoes failed to survive the colonists' long overwater journey or because livestock that died out could not be readily obtained again from the outside. For instance, isolated New Zealand ended up with only dogs; Easter and Tikopia,

with only chickens. Without access to coral reefs or productive shallow waters, and with their terrestrial birds quickly exterminated, Easter Islanders turned to constructing chicken houses for intensive poultry farming.

At best, however, these three domesticated animal species provided only occasional meals. Polynesian food production depended mainly on agriculture, which was impossible at subantarctic latitudes because all Polynesian crops were tropical ones initially domesticated outside Polynesia and brought in by colonists. The settlers of the Chathams and the cold southern part of New Zealand's South Island were thus forced to abandon the farming legacy developed by their ancestors over the previous thousands of years, and to become hunter-gatherers again.

People on the remaining Polynesian islands did practice agriculture based on dryland crops (especially taro, yams, and sweet potatoes), irrigated crops (mainly taro), and tree crops (such as breadfruit, bananas, and coconuts). The productivity and relative importance of those crop types varied considerably on different islands, depending on their environments. Human population densities were lowest on Henderson, Rennell, and the atolls because of their poor soil and limited fresh water. Densities were also low on temperate New Zealand, which was too cool for some Polynesian crops. Polynesians on these and some other islands practiced a nonintensive type of shifting, slash-and-burn agriculture.

Other islands had rich soils but were not high enough to have large permanent streams and hence irrigation. Inhabitants of those islands developed intensive dryland agriculture requiring a heavy input of labor to build terraces, carry out mulching, rotate crops, reduce or eliminate fallow periods, and maintain tree plantations. Dryland agriculture became especially productive on Easter, tiny Anuta, and flat and low Tonga, where Polynesians devoted most of the land area to the growing of food.

The most productive Polynesian agriculture was taro cultivation in irrigated fields. Among the more populous tropical islands, that option was ruled out for Tonga by its low elevation and hence its lack of rivers. Irrigation agriculture reached its peak on the westernmost Hawaiian islands of Kauai, Oahu, and Molokai, which were big and wet enough to support not only large permanent streams but also large human populations available for construction projects. Hawaiian labor corvées built elaborate irrigation systems for taro fields yielding up to 24 tons per acre, the highest crop yields in all of Polynesia. Those yields in turn supported intensive pig production. Hawaii was also unique within Polynesia in using mass labor for aquaculture, by constructing large fishponds in which milkfish and mullet were grown.

As a result of all this environmentally related variation in subsistence, human population densities (measured in people per square mile of arable land) varied greatly over Polynesia. At the lower end were the hunter-gatherers of the Chathams (only 5 people per square mile) and of New Zealand's South Island, and the farmers of the rest of New Zealand (28 people per square mile). In contrast, many islands with intensive agriculture attained population densities exceeding 120 per square mile. Tonga, Samoa, and the Societies achieved 210–250 people per square mile and Hawaii 300. The upper extreme of 1,100 people per square mile was reached on the high island of Anuta, whose population converted essentially all the land to intensive food production, thereby crammed 160 people into the island's 100 acres, and joined the ranks of the densest self-sufficient populations in the world. Anuta's population density exceeded that of modern Holland and even rivaled that of Bangladesh.

Population size is the product of population density (people per square mile) and area (square miles). The relevant area is not the area of an island but that of a political unit, which could be either larger or smaller than a single island. On the one hand, islands near one another might become combined into a single political unit. On the other hand, single large rugged islands were divided into many independent political units. Hence the area of the political unit varied not only with an island's area but also with its fragmentation and isolation.

For small isolated islands without strong barriers to internal communication, the entire island constituted the political unit—as in the case of Anuta, with its 160 people. Many larger islands never did become unified politically, whether because the population consisted of dispersed bands of only a few dozen hunter-gatherers each (the Chathams and New Zealand's southern South Island), or of farmers scattered over large distances (the rest of New Zealand), or of farmers living in dense populations but in rugged terrain precluding political unification. For example, people in neighboring steep-sided valleys of the Marquesas communicated with each other mainly by sea; each valley formed an independent political entity of a few thousand inhabitants, and most individual large Marquesan islands remained divided into many such entities.

The terrains of the Tongan, Samoan, Society, and Hawaiian islands did permit political unification within islands, yielding political units of 10,000 people or more (over 30,000 on the large Hawaiian islands). The distances between islands of the Tongan archipelago, as well as the distances between Tonga and

neighboring archipelagoes, were sufficiently modest that a multi-island empire encompassing 40,000 people was eventually established. Thus, Polynesian political units ranged in size from a few dozen to 40,000 people.

A political unit's population size interacted with its population density to influence Polynesian technology and economic, social, and political organization. In general, the larger the size and the higher the density, the more complex and specialized were the technology and organization, for reasons that we shall examine in detail in later chapters. Briefly, at high population densities only a portion of the people came to be farmers, but they were mobilized to devote themselves to intensive food production, thereby yielding surpluses to feed nonproducers. The nonproducers mobilizing them included chiefs, priests, bureaucrats, and warriors. The biggest political units could assemble large labor forces to construct irrigation systems and fishponds that intensified food production even further. These developments were especially apparent on Tonga, Samoa, and the Societies, all of which were fertile, densely populated, and moderately large by Polynesian standards. The trends reached their zenith on the Hawaiian Archipelago, consisting of the largest tropical Polynesian islands, where high population densities and large land areas meant that very large labor forces were potentially available to individual chiefs.

The variations among Polynesian societies associated with different population densities and sizes were as follows. Economies remained simplest on islands with low population densities (such as the hunter-gatherers of the Chathams), low population numbers (small atolls), or both low densities and low numbers. In those societies each household made what it needed; there was little or no economic specialization. Specialization increased on larger, more densely populated islands, reaching a peak on Samoa, the Societies, and especially Tonga and Hawaii. The latter two islands supported hereditary part-time craft specialists, including canoe builders, navigators, stone masons, bird catchers, and tattooers.

Social complexity was similarly varied. Again, the Chathams and the atolls had the simplest, most egalitarian societies. While those islands retained the original Polynesian tradition of having chiefs, their chiefs wore little or no visible signs of distinction, lived in ordinary huts like those of commoners, and grew or caught their food like everyone else. Social distinctions and chiefly powers increased on high-density islands with large political units, being especially marked on Tonga and the Societies.

Social complexity again reached its peak in the Hawaiian Archipelago, where people of chiefly descent were divided into eight hierarchically ranked

lineages. Members of those chiefly lineages did not intermarry with commoners but only with each other, sometimes even with siblings or half-siblings. Commoners had to prostrate themselves before high-ranking chiefs. All the members of chiefly lineages, bureaucrats, and some craft specialists were freed from the work of food production.

Political organization followed the same trends. On the Chathams and atolls, the chiefs had few resources to command, decisions were reached by general discussion, and landownership rested with the community as a whole rather than with the chiefs. Larger, more densely populated political units concentrated more authority with the chiefs. Political complexity was greatest on Tonga and Hawaii, where the powers of hereditary chiefs approximated those of kings elsewhere in the world, and where land was controlled by the chiefs, not by the commoners. Using appointed bureaucrats as agents, chiefs requisitioned food from the commoners and also conscripted them to work on large construction projects, whose form varied from island to island: irrigation projects and fishponds on Hawaii, dance and feast centers on the Marquesas, chiefs' tombs on Tonga, and temples on Hawaii, the Societies, and Easter.

At the time of Europeans' arrival in the 18th century, the Tongan chiefdom or state had already become an inter-archipelagal empire. Because the Tongan Archipelago itself was geographically close-knit and included several large islands with unfragmented terrain, each island became unified under a single chief; then the hereditary chiefs of the largest Tongan island (Tongatapu) united the whole archipelago, and eventually they conquered islands outside the archipelago up to 500 miles distant. They engaged in regular long-distance trade with Fiji and Samoa, established Tongan settlements in Fiji, and began to raid and conquer parts of Fiji. The conquest and administration of this maritime proto-empire were achieved by navies of large canoes, each holding up to 150 men.

Like Tonga, Hawaii became a political entity encompassing several populous islands, but one confined to a single archipelago because of its extreme isolation. At the time of Hawaii's "discovery" by Europeans in 1778, political unification had already taken place within each Hawaiian island, and some political fusion between islands had begun. The four largest islands—Big Island (Hawaii in the narrow sense), Maui, Oahu, and Kauai—remained independent, controlling (or jockeying with each other for control of) the smaller islands (Lanai, Molokai, Kahoolawe, and Niihau). After the arrival of Europeans, the Big Island's King Kamehameha I rapidly proceeded with the consolidation of the largest islands by purchasing European guns and ships to invade and conquer first Maui and

then Oahu. Kamehameha thereupon prepared invasions of the last independent Hawaiian island, Kauai, whose chief finally reached a negotiated settlement with him, completing the archipelago's unification.

The remaining type of variation among Polynesian societies to be considered involves tools and other aspects of material culture. The differing availability of raw materials imposed an obvious constraint on material culture. At the one extreme was Henderson Island, an old coral reef raised above sea level and devoid of stone other than limestone. Its inhabitants were reduced to fabricating adzes out of giant clamshells. At the opposite extreme, the Maori on the minicontinent of New Zealand had access to a wide range of raw materials and became especially noted for their use of jade. Between those two extremes fell Polynesia's oceanic volcanic islands, which lacked granite, flint, and other continental rocks but did at least have volcanic rocks, which Polynesians worked into ground or polished stone adzes used to clear land for farming.

As for the types of artifacts made, the Chatham Islanders required little more than hand-held clubs and sticks to kill seals, birds, and lobsters. Most other islanders produced a diverse array of fishhooks, adzes, jewelry, and other objects. On the atolls, as on the Chathams, those artifacts were small, relatively simple, and individually produced and owned, while architecture consisted of nothing more than simple huts. Large and densely populated islands supported craft specialists who produced a wide range of prestige goods for chiefs—such as the feather capes reserved for Hawaiian chiefs and made of tens of thousands of bird feathers.

The largest products of Polynesia were the immense stone structures of a few islands—the famous giant statues of Easter Island, the tombs of Tongan chiefs, the ceremonial platforms of the Marquesas, and the temples of Hawaii and the Societies. This monumental Polynesian architecture was obviously evolving in the same direction as the pyramids of Egypt, Mesopotamia, Mexico, and Peru. Naturally, Polynesia's structures are not on the scale of those pyramids, but that merely reflects the fact that Egyptian pharaohs could draw conscript labor from a much larger human population than could the chief of any Polynesian island. Even so, the Easter Islanders managed to erect 30-ton stone statues—no mean feat for an island with only 7,000 people, who had no power source other than their own muscles.

THUS POLYNESIAN ISLAND societies differed greatly in their economic specialization, social complexity, political organization, and material

products, related to differences in population size and density, related in turn to differences in island area, fragmentation, and isolation and in opportunities for subsistence and for intensifying food production. All those differences among Polynesian societies developed, within a relatively short time and modest fraction of the Earth's surface, as environmentally related variations on a single ancestral society. Those categories of cultural differences within Polynesia are essentially the same categories that emerged everywhere else in the world.

Of course, the range of variation over the rest of the globe is much greater than that within Polynesia. While modern continental peoples included ones dependent on stone tools, as were Polynesians, South America also spawned societies expert in using precious metals, and Eurasians and Africans went on to utilize iron. Those developments were precluded in Polynesia, because no Polynesian island except New Zealand had significant metal deposits. Eurasia had full-fledged empires before Polynesia was even settled, and South America and Mesoamerica developed empires later, whereas Polynesia produced just two proto-empires, one of which (Hawaii) coalesced only after the arrival of Europeans. Eurasia and Mesoamerica developed indigenous writing, which failed to emerge in Polynesia, except perhaps on Easter Island, whose mysterious script may however have postdated the islanders' contact with Europeans.

That is, Polynesia offers us a small slice, not the full spectrum, of the world's human social diversity. That shouldn't surprise us, since Polynesia provides only a small slice of the world's geographic diversity. In addition, since Polynesia was colonized so late in human history, even the oldest Polynesian societies had only 3,200 years in which to develop, as opposed to at least 13,000 years for societies on even the last-colonized continents (the Americas). Given a few more millennia, perhaps Tonga and Hawaii would have reached the level of full-fledged empires battling each other for control of the Pacific, with indigenously developed writing to administer those empires, while New Zealand's Maori might have added copper and iron tools to their repertoire of jade and other materials.

In short, Polynesia furnishes us with a convincing example of environmentally related diversification of human societies in operation. But we thereby learn only that it can happen, because it happened in Polynesia. Did it also happen on the continents? If so, what were the environmental differences responsible for diversification on the continents, and what were their consequences?

COLLISION AT CAJAMARCA

THE BIGGEST POPULATION SHIFT OF MODERN TIMES HAS been the colonization of the New World by Europeans, and the resulting conquest, numerical reduction, or complete disappearance of most groups of Native Americans (American Indians). As I explained in Chapter 1, the New World was initially colonized around or before 11,000 B.C. by way of Alaska, the Bering Strait, and Siberia. Complex agricultural societies gradually arose in the Americas far to the south of that entry route, developing in complete isolation from the emerging complex societies of the Old World. After that initial colonization from Asia, the sole well-attested further contacts between the New World and Asia involved only hunter-gatherers living on opposite sides of the Bering Strait, plus an inferred transpacific voyage that introduced the sweet potato from South America to Polynesia.

As for contacts of New World peoples with Europe, the sole early ones involved the Norse who occupied Greenland in very small numbers between A.D. 986 and about 1500. But those Norse visits had no discernible impact on Native American societies. Instead, for practical purposes the collision of advanced Old World and New World societies began abruptly in A.D. 1492, with Christopher Columbus's "discovery" of Caribbean islands densely populated by Native Americans.

The most dramatic moment in subsequent European–Native American

relations was the first encounter between the Inca emperor Atahuallpa and the Spanish conquistador Francisco Pizarro at the Peruvian highland town of Cajamarca on November 16, 1532. Atahuallpa was absolute monarch of the largest and most advanced state in the New World, while Pizarro represented the Holy Roman Emperor Charles V (also known as King Charles I of Spain), monarch of the most powerful state in Europe. Pizarro, leading a ragtag group of 168 Spanish soldiers, was in unfamiliar terrain, ignorant of the local inhabitants, completely out of touch with the nearest Spaniards (1,000 miles to the north in Panama) and far beyond the reach of timely reinforcements. Atahuallpa was in the middle of his own empire of millions of subjects and immediately surrounded by his army of 80,000 soldiers, recently victorious in a war with other Indians. Nevertheless, Pizarro captured Atahuallpa within a few minutes after the two leaders first set eyes on each other. Pizarro proceeded to hold his prisoner for eight months, while extracting history's largest ransom in return for a promise to free him. After the ransom—enough gold to fill a room 22 feet long by 17 feet wide to a height of over 8 feet—was delivered, Pizarro reneged on his promise and executed Atahuallpa.

Atahuallpa's capture was decisive for the European conquest of the Inca Empire. Although the Spaniards' superior weapons would have assured an ultimate Spanish victory in any case, the capture made the conquest quicker and infinitely easier. Atahuallpa was revered by the Incas as a sun-god and exercised absolute authority over his subjects, who obeyed even the orders he issued from captivity. The months until his death gave Pizarro time to dispatch exploring parties unmolested to other parts of the Inca Empire, and to send for reinforcements from Panama. When fighting between Spaniards and Incas finally did commence after Atahuallpa's execution, the Spanish forces were more formidable.

Thus, Atahuallpa's capture interests us specifically as marking the decisive moment in the greatest collision of modern history. But it is also of more general interest, because the factors that resulted in Pizarro's seizing Atahuallpa were essentially the same ones that determined the outcome of many similar collisions between colonizers and native peoples elsewhere in the modern world. Hence Atahuallpa's capture offers us a broad window onto world history.

WHAT UNFOLDED THAT day at Cajamarca is well known, because it was recorded in writing by many of the Spanish participants. To get a flavor of those events, let us relive them by weaving together excerpts from

eyewitness accounts by six of Pizarro's companions, including his brothers Hernando and Pedro:

"The prudence, fortitude, military discipline, labors, perilous navigations, and battles of the Spaniards—vassals of the most invincible Emperor of the Roman Catholic Empire, our natural King and Lord—will cause joy to the faithful and terror to the infidels. For this reason, and for the glory of God our Lord and for the service of the Catholic Imperial Majesty, it has seemed good to me to write this narrative, and to send it to Your Majesty, that all may have a knowledge of what is here related. It will be to the glory of God, because they have conquered and brought to our holy Catholic Faith so vast a number of heathens, aided by His holy guidance. It will be to the honor of our Emperor because, by reason of his great power and good fortune, such events happened in his time. It will give joy to the faithful that such battles have been won, such provinces discovered and conquered, such riches brought home for the King and for themselves; and that such terror has been spread among the infidels, such admiration excited in all mankind.

"For when, either in ancient or modern times, have such great exploits been achieved by so few against so many, over so many climes, across so many seas, over such distances by land, to subdue the unseen and unknown? Whose deeds can be compared with those of Spain? Our Spaniards, being few in number, never having more than 200 or 300 men together, and sometimes only 100 and even fewer, have, in our times, conquered more territory than has ever been known before, or than all the faithful and infidel princes possess. I will only write, at present, of what befell in the conquest, and I will not write much, in order to avoid prolixity.

"Governor Pizarro wished to obtain intelligence from some Indians who had come from Cajamarca, so he had them tortured. They confessed that they had heard that Atahuallpa was waiting for the Governor at Cajamarca. The Governor then ordered us to advance. On reaching the entrance to Cajamarca, we saw the camp of Atahuallpa at a distance of a league, in the skirts of the mountains. The Indians' camp looked like a very beautiful city. They had so many tents that we were all filled with great apprehension. Until then, we had never seen anything like this in the Indies. It filled all our Spaniards with fear and confusion. But we could not show any fear or turn back, for if the Indians had sensed any weakness in us, even the Indians that we were bringing with us as guides would have killed us. So we made a show of good spirits, and after carefully observing the town and the tents, we descended into the valley and entered Cajamarca.

"We talked a lot among ourselves about what to do. All of us were full of fear, because we were so few in number and we had penetrated so far into a land where we could not hope to receive reinforcements. We all met with the Governor to debate what we should undertake the next day. Few of us slept that night, and we kept watch in the square of Cajamarca, looking at the campfires of the Indian army. It was a frightening sight. Most of the campfires were on a hillside and so close to each other that it looked like the sky brightly studded with stars. There was no distinction that night between the mighty and the lowly, or between foot soldiers and horsemen. Everyone carried out sentry duty fully armed. So too did the good old Governor, who went about encouraging his men. The Governor's brother Hernando Pizarro estimated the number of Indian soldiers there at 40,000, but he was telling a lie just to encourage us, for there were actually more than 80,000 Indians.

"On the next morning a messenger from Atahuallpa arrived, and the Governor said to him, 'Tell your lord to come when and how he pleases, and that, in what way soever he may come I will receive him as a friend and brother. I pray that he may come quickly, for I desire to see him. No harm or insult will befall him.'

"The Governor concealed his troops around the square at Cajamarca, dividing the cavalry into two portions of which he gave the command of one to his brother Hernando Pizarro and the command of the other to Hernando de Soto. In like manner he divided the infantry, he himself taking one part and giving the other to his brother Juan Pizarro. At the same time, he ordered Pedro de Candia with two or three infantrymen to go with trumpets to a small fort in the plaza and to station themselves there with a small piece of artillery. When all the Indians, and Atahuallpa with them, had entered the Plaza, the Governor would give a signal to Candia and his men, after which they should start firing the gun, and the trumpets should sound, and at the sound of the trumpets the cavalry should dash out of the large court where they were waiting hidden in readiness.

"At noon Atahuallpa began to draw up his men and to approach. Soon we saw the entire plain full of Indians, halting periodically to wait for more Indians who kept filing out of the camp behind them. They kept filling out in separate detachments into the afternoon. The front detachments were now close to our camp, and still more troops kept issuing from the camp of the Indians. In front of Atahuallpa went 2,000 Indians who swept the road ahead of him, and these were followed by the warriors, half of whom were marching in the fields on one side of him and half on the other side.

"First came a squadron of Indians dressed in clothes of different colors, like a

chessboard. They advanced, removing the straws from the ground and sweeping the road. Next came three squadrons in different dresses, dancing and singing. Then came a number of men with armor, large metal plates, and crowns of gold and silver. So great was the amount of furniture of gold and silver which they bore, that it was a marvel to observe how the sun glinted upon it. Among them came the figure of Atahuallpa in a very fine litter with the ends of its timbers covered in silver. Eighty lords carried him on their shoulders, all wearing a very rich blue livery. Atahuallpa himself was very richly dressed, with his crown on his head and a collar of large emeralds around his neck. He sat on a small stool with a rich saddle cushion resting on his litter. The litter was lined with parrot feathers of many colors and decorated with plates of gold and silver.

"Behind Atahuallpa came two other litters and two hammocks, in which were some high chiefs, then several squadrons of Indians with crowns of gold and silver. These Indian squadrons began to enter the plaza to the accompaniment of great songs, and thus entering they occupied every part of the plaza. In the meantime all of us Spaniards were waiting ready, hidden in a courtyard, full of fear. Many of us urinated without noticing it, out of sheer terror. On reaching the center of the plaza, Atahuallpa remained in his litter on high, while his troops continued to file in behind him.

"Governor Pizarro now sent Friar Vicente de Valverde to go speak to Atahuallpa, and to require Atahuallpa in the name of God and of the King of Spain that Atahuallpa subject himself to the law of our Lord Jesus Christ and to the service of His Majesty the King of Spain. Advancing with a cross in one hand and the Bible in the other hand, and going among the Indian troops up to the place where Atahuallpa was, the Friar thus addressed him: 'I am a Priest of God, and I teach Christians the things of God, and in like manner I come to teach you. What I teach is that which God says to us in this Book. Therefore, on the part of God and of the Christians, I beseech you to be their friend, for such is God's will, and it will be for your good.'

"Atahuallpa asked for the Book, that he might look at it, and the Friar gave it to him closed. Atahuallpa did not know how to open the Book, and the Friar was extending his arm to do so, when Atahuallpa, in great anger, gave him a blow on the arm, not wishing that it should be opened. Then he opened it himself, and, without any astonishment at the letters and paper he threw it away from him five or six paces, his face a deep crimson.

"The Friar returned to Pizarro, shouting, 'Come out! Come out, Christians! Come at these enemy dogs who reject the things of God. That tyrant has thrown my book of holy law to the ground! Did you not see what hap-

pened? Why remain polite and servile toward this over-proud dog when the plains are full of Indians? March out against him, for I absolve you!'

"The governor then gave the signal to Candia, who began to fire off the guns. At the same time the trumpets were sounded, and the armored Spanish troops, both cavalry and infantry, sallied forth out of their hiding places straight into the mass of unarmed Indians crowding the square, giving the Spanish battle cry, 'Santiago!' We had placed rattles on the horses to terrify the Indians. The booming of the guns, the blowing of the trumpets, and the rattles on the horses threw the Indians into panicked confusion. The Spaniards fell upon them and began to cut them to pieces. The Indians were so filled with fear that they climbed on top of one another, formed mounds, and suffocated each other. Since they were unarmed, they were attacked without danger to any Christian. The cavalry rode them down, killing and wounding, and following in pursuit. The infantry made so good an assault on those that remained that in a short time most of them were put to the sword.

"The Governor himself took his sword and dagger, entered the thick of the Indians with the Spaniards who were with him, and with great bravery reached Atahuallpa's litter. He fearlessly grabbed Atahuallpa's left arm and shouted 'Santiago!,' but he could not pull Atahuallpa out of his litter because it was held up high. Although we killed the Indians who held the litter, others at once took their places and held it aloft, and in this manner we spent a long time in overcoming and killing Indians. Finally seven or eight Spaniards on horseback spurred on their horses, rushed upon the litter from one side, and with great effort they heaved it over on its side. In that way Atahuallpa was captured, and the Governor took Atahuallpa to his lodging. The Indians carrying the litter, and those escorting Atahuallpa, never abandoned him: all died around him.

"The panic-stricken Indians remaining in the square, terrified at the firing of the guns and at the horses—something they had never seen—tried to flee from the square by knocking down a stretch of wall and running out onto the plain outside. Our cavalry jumped the broken wall and charged into the plain, shouting, 'Chase those with the fancy clothes! Don't let any escape! Spear them!' All of the other Indian soldiers whom Atahuallpa had brought were a mile from Cajamarca ready for battle, but not one made a move, and during all this not one Indian raised a weapon against a Spaniard. When the squadrons of Indians who had remained in the plain outside the town saw the other Indians fleeing and shouting, most of them too panicked and fled. It was an astonishing sight, for the whole valley for 15 or 20 miles was completely filled with Indians. Night had already fallen, and our cavalry were

continuing to spear Indians in the fields, when we heard a trumpet calling for us to reassemble at camp.

"If night had not come on, few out of the more than 40,000 Indian troops would have been left alive. Six or seven thousand Indians lay dead, and many more had their arms cut off and other wounds. Atahuallpa himself admitted that we had killed 7,000 of his men in that battle. The man killed in one of the litters was his minister, the lord of Chincha, of whom he was very fond. All those Indians who bore Atahuallpa's litter appeared to be high chiefs and councillors. They were all killed, as well as those Indians who were carried in the other litters and hammocks. The lord of Cajamarca was also killed, and others, but their numbers were so great that they could not be counted, for all who came in attendance on Atahuallpa were great lords. It was extraordinary to see so powerful a ruler captured in so short a time, when he had come with such a mighty army. Truly, it was not accomplished by our own forces, for there were so few of us. It was by the grace of God, which is great.

"Atahuallpa's robes had been torn off when the Spaniards pulled him out of his litter. The Governor ordered clothes to be brought to him, and when Atahuallpa was dressed, the Governor ordered Atahuallpa to sit near him and soothed his rage and agitation at finding himself so quickly fallen from his high estate. The Governor said to Atahuallpa, 'Do not take it as an insult that you have been defeated and taken prisoner, for with the Christians who come with me, though so few in number, I have conquered greater kingdoms than yours, and have defeated other more powerful lords than you, imposing upon them the dominion of the Emperor, whose vassal I am, and who is King of Spain and of the universal world. We come to conquer this land by his command, that all may come to a knowledge of God and of His Holy Catholic Faith; and by reason of our good mission, God, the Creator of heaven and earth and of all things in them, permits this, in order that you may know Him and come out from the bestial and diabolical life that you lead. It is for this reason that we, being so few in number, subjugate that vast host. When you have seen the errors in which you live, you will understand the good that we have done you by coming to your land by order of his Majesty the King of Spain. Our Lord permitted that your pride should be brought low and that no Indian should be able to offend a Christian.' "

LET US NOW trace the chain of causation in this extraordinary confrontation, beginning with the immediate events. When Pizarro and Atahuallpa

met at Cajamarca, why did Pizarro capture Atahuallpa and kill so many of his followers, instead of Atahuallpa's vastly more numerous forces capturing and killing Pizarro? After all, Pizarro had only 62 soldiers mounted on horses, along with 106 foot soldiers, while Atahuallpa commanded an army of about 80,000. As for the antecedents of those events, how did Atahuallpa come to be at Cajamarca at all? How did Pizarro come to be there to capture him, instead of Atahuallpa's coming to Spain to capture King Charles I? Why did Atahuallpa walk into what seems to us, with the gift of hindsight, to have been such a transparent trap? Did the factors acting in the encounter of Atahuallpa and Pizarro also play a broader role in encounters between Old World and New World peoples and between other peoples?

Why did Pizarro capture Atahuallpa? Pizarro's military advantages lay in the Spaniards' steel swords and other weapons, steel armor, guns, and horses. To those weapons, Atahuallpa's troops, without animals on which to ride into battle, could oppose only stone, bronze, or wooden clubs, maces, and hand axes, plus slingshots and quilted armor. Such imbalances of equipment were decisive in innumerable other confrontations of Europeans with Native Americans and other peoples.

The sole Native Americans able to resist European conquest for many centuries were those tribes that reduced the military disparity by acquiring and mastering both horses and guns. To the average white American, the word "Indian" conjures up an image of a mounted Plains Indian brandishing a rifle, like the Sioux warriors who annihilated General George Custer's U.S. Army battalion at the famous battle of the Little Big Horn in 1876. We easily forget that horses and rifles were originally unknown to Native Americans. They were brought by Europeans and proceeded to transform the societies of Indian tribes that acquired them. Thanks to their mastery of horses and rifles, the Plains Indians of North America, the Araucanian Indians of southern Chile, and the Pampas Indians of Argentina fought off invading whites longer than did any other Native Americans, succumbing only to massive army operations by white governments in the 1870s and 1880s.

Today, it is hard for us to grasp the enormous numerical odds against which the Spaniards' military equipment prevailed. At the battle of Cajamarca recounted above, 168 Spaniards crushed a Native American army 500 times more numerous, killing thousands of natives while not losing a single Spaniard. Time and again, accounts of Pizarro's subsequent battles with the Incas, Cortés's conquest of the Aztecs, and other early European campaigns against Native Americans describe encounters in which a few dozen Euro-

pean horsemen routed thousands of Indians with great slaughter. During Pizarro's march from Cajamarca to the Inca capital of Cuzco after Atahuallpa's death, there were four such battles: at Jauja, Vilcashuaman, Vilcaconga, and Cuzco. Those four battles involved a mere 80, 30, 110, and 40 Spanish horsemen, respectively, in each case ranged against thousands or tens of thousands of Indians.

These Spanish victories cannot be written off as due merely to the help of Native American allies, to the psychological novelty of Spanish weapons and horses, or (as is often claimed) to the Incas' mistaking Spaniards for their returning god Viracocha. The initial successes of both Pizarro and Cortés did attract native allies. However, many of them would not have become allies if they had not already been persuaded, by earlier devastating successes of unassisted Spaniards, that resistance was futile and that they should side with the likely winners. The novelty of horses, steel weapons, and guns undoubtedly paralyzed the Incas at Cajamarca, but the battles after Cajamarca were fought against determined resistance by Inca armies that had already seen Spanish weapons and horses. Within half a dozen years of the initial conquest, Incas mounted two desperate, large-scale, well-prepared rebellions against the Spaniards. All those efforts failed because of the Spaniards' far superior armament.

By the 1700s, guns had replaced swords as the main weapon favoring European invaders over Native Americans and other native peoples. For example, in 1808 a British sailor named Charlie Savage equipped with muskets and excellent aim arrived in the Fiji Islands. The aptly named Savage proceeded single-handedly to upset Fiji's balance of power. Among his many exploits, he paddled his canoe up a river to the Fijian village of Kasavu, halted less than a pistol shot's length from the village fence, and fired away at the undefended inhabitants. His victims were so numerous that surviving villagers piled up the bodies to take shelter behind them, and the stream beside the village was red with blood. Such examples of the power of guns against native peoples lacking guns could be multiplied indefinitely.

In the Spanish conquest of the Incas, guns played only a minor role. The guns of those times (so-called harquebuses) were difficult to load and fire, and Pizarro had only a dozen of them. They did produce a big psychological effect on those occasions when they managed to fire. Far more important were the Spaniards' steel swords, lances, and daggers, strong sharp weapons that slaughtered thinly armored Indians. In contrast, Indian blunt clubs, while capable of battering and wounding Spaniards and their horses, rarely

succeeded in killing them. The Spaniards' steel or chain mail armor and, above all, their steel helmets usually provided an effective defense against club blows, while the Indians' quilted armor offered no protection against steel weapons.

The tremendous advantage that the Spaniards gained from their horses leaps out of the eyewitness accounts. Horsemen could easily outride Indian sentries before the sentries had time to warn Indian troops behind them, and could ride down and kill Indians on foot. The shock of a horse's charge, its maneuverability, the speed of attack that it permitted, and the raised and protected fighting platform that it provided left foot soldiers nearly helpless in the open. Nor was the effect of horses due only to the terror that they inspired in soldiers fighting against them for the first time. By the time of the great Inca rebellion of 1536, the Incas had learned how best to defend themselves against cavalry, by ambushing and annihilating Spanish horsemen in narrow passes. But the Incas, like all other foot soldiers, were never able to defeat cavalry in the open. When Quizo Yupanqui, the best general of the Inca emperor Manco, who succeeded Atahuallpa, besieged the Spaniards in Lima in 1536 and tried to storm the city, two squadrons of Spanish cavalry charged a much larger Indian force on flat ground, killed Quizo and all of his commanders in the first charge, and routed his army. A similar cavalry charge of 26 horsemen routed the best troops of Emperor Manco himself, as he was besieging the Spaniards in Cuzco.

The transformation of warfare by horses began with their domestication around 4000 B.C., in the steppes north of the Black Sea. Horses permitted people possessing them to cover far greater distances than was possible on foot, to attack by surprise, and to flee before a superior defending force could be gathered. Their role at Cajamarca thus exemplifies a military weapon that remained potent for 6,000 years, until the early 20th century, and that was eventually applied on all the continents. Not until the First World War did the military dominance of cavalry finally end. When we consider the advantages that Spaniards derived from horses, steel weapons, and armor against foot soldiers without metal, it should no longer surprise us that Spaniards consistently won battles against enormous odds.

How did Atahuallpa come to be at Cajamarca? Atahuallpa and his army came to be at Cajamarca because they had just won decisive battles in a civil war that left the Incas divided and vulnerable. Pizarro quickly appreciated those divisions and exploited them. The reason for the civil war was that an epidemic of smallpox, spreading overland among South American Indians

after its arrival with Spanish settlers in Panama and Colombia, had killed the Inca emperor Huayna Capac and most of his court around 1526, and then immediately killed his designated heir, Ninan Cuyuchi. Those deaths precipitated a contest for the throne between Atahuallpa and his half brother Huascar. If it had not been for the epidemic, the Spaniards would have faced a united empire.

Atahuallpa's presence at Cajamarca thus highlights one of the key factors in world history: diseases transmitted to peoples lacking immunity by invading peoples with considerable immunity. Smallpox, measles, influenza, typhus, bubonic plague, and other infectious diseases endemic in Europe played a decisive role in European conquests, by decimating many peoples on other continents. For example, a smallpox epidemic devastated the Aztecs after the failure of the first Spanish attack in 1520 and killed Cuitláhuac, the Aztec emperor who briefly succeeded Montezuma. Throughout the Americas, diseases introduced with Europeans spread from tribe to tribe far in advance of the Europeans themselves, killing an estimated 95 percent of the pre-Columbian Native American population. The most populous and highly organized native societies of North America, the Mississippian chiefdoms, disappeared in that way between 1492 and the late 1600s, even before Europeans themselves made their first settlement on the Mississippi River. A smallpox epidemic in 1713 was the biggest single step in the destruction of South Africa's native San people by European settlers. Soon after the British settlement of Sydney in 1788, the first of the epidemics that decimated Aboriginal Australians began. A well-documented example from Pacific islands is the epidemic that swept over Fiji in 1806, brought by a few European sailors who struggled ashore from the wreck of the ship *Argo*. Similar epidemics marked the histories of Tonga, Hawaii, and other Pacific islands.

I do not mean to imply, however, that the role of disease in history was confined to paving the way for European expansion. Malaria, yellow fever, and other diseases of tropical Africa, India, Southeast Asia, and New Guinea furnished the most important obstacle to European colonization of those tropical areas.

How did Pizarro come to be at Cajamarca? Why didn't Atahuallpa instead try to conquer Spain? Pizarro came to Cajamarca by means of European maritime technology, which built the ships that took him across the Atlantic from Spain to Panama, and then in the Pacific from Panama to Peru. Lacking such technology, Atahuallpa did not expand overseas out of South America.

In addition to the ships themselves, Pizarro's presence depended on the centralized political organization that enabled Spain to finance, build, staff, and equip the ships. The Inca Empire also had a centralized political organization, but that actually worked to its disadvantage, because Pizarro seized the Inca chain of command intact by capturing Atahuallpa. Since the Inca bureaucracy was so strongly identified with its godlike absolute monarch, it disintegrated after Atahuallpa's death. Maritime technology coupled with political organization was similarly essential for European expansions to other continents, as well as for expansions of many other peoples.

A related factor bringing Spaniards to Peru was the existence of writing. Spain possessed it, while the Inca Empire did not. Information could be spread far more widely, more accurately, and in more detail by writing than it could be transmitted by mouth. That information, coming back to Spain from Columbus's voyages and from Cortés's conquest of Mexico, sent Spaniards pouring into the New World. Letters and pamphlets supplied both the motivation and the necessary detailed sailing directions. The first published report of Pizarro's exploits, by his companion Captain Cristóbal de Mena, was printed in Seville in April 1534, a mere nine months after Atahuallpa's execution. It became a best-seller, was rapidly translated into other European languages, and sent a further stream of Spanish colonists to tighten Pizarro's grip on Peru.

Why did Atahuallpa walk into the trap? In hindsight, we find it astonishing that Atahuallpa marched into Pizarro's obvious trap at Cajamarca. The Spaniards who captured him were equally surprised at their success. The consequences of literacy are prominent in the ultimate explanation.

The immediate explanation is that Atahuallpa had very little information about the Spaniards, their military power, and their intent. He derived that scant information by word of mouth, mainly from an envoy who had visited Pizarro's force for two days while it was en route inland from the coast. That envoy saw the Spaniards at their most disorganized, told Atahuallpa that they were not fighting men, and that he could tié them all up if given 200 Indians. Understandably, it never occurred to Atahuallpa that the Spaniards were formidable and would attack him without provocation.

In the New World the ability to write was confined to small elites among some peoples of modern Mexico and neighboring areas far to the north of the Inca Empire. Although the Spanish conquest of Panama, a mere 600 miles from the Incas' northern boundary, began already in 1510, no knowledge even of the Spaniards' existence appears to have reached the Incas until

Pizarro's first landing on the Peruvian coast in 1527. Atahuallpa remained entirely ignorant about Spain's conquests of Central America's most powerful and populous Indian societies.

As surprising to us today as Atahuallpa's behavior leading to his capture is his behavior thereafter. He offered his famous ransom in the naive belief that, once paid off, the Spaniards would release him and depart. He had no way of understanding that Pizarro's men formed the spearhead of a force bent on permanent conquest, rather than an isolated raid.

Atahuallpa was not alone in these fatal miscalculations. Even after Atahuallpa had been captured, Francisco Pizarro's brother Hernando Pizarro deceived Atahuallpa's leading general, Chalcuchima, commanding a large army, into delivering himself to the Spaniards. Chalcuchima's miscalculation marked a turning point in the collapse of Inca resistance, a moment almost as significant as the capture of Atahuallpa himself. The Aztec emperor Montezuma miscalculated even more grossly when he took Cortés for a returning god and admitted him and his tiny army into the Aztec capital of Tenochtitlán. The result was that Cortés captured Montezuma, then went on to conquer Tenochtitlán and the Aztec Empire.

On a mundane level, the miscalculations by Atahuallpa, Chalcuchima, Montezuma, and countless other Native American leaders deceived by Europeans were due to the fact that no living inhabitants of the New World had been to the Old World, so of course they could have had no specific information about the Spaniards. Even so, we find it hard to avoid the conclusion that Atahuallpa "should" have been more suspicious, if only his society had experienced a broader range of human behavior. Pizarro too arrived at Cajamarca with no information about the Incas other than what he had learned by interrogating the Inca subjects he encountered in 1527 and 1531. However, while Pizarro himself happened to be illiterate, he belonged to a literate tradition. From books, the Spaniards knew of many contemporary civilizations remote from Europe, and about several thousand years of European history. Pizarro explicitly modeled his ambush of Atahuallpa on the successful strategy of Cortés.

In short, literacy made the Spaniards heirs to a huge body of knowledge about human behavior and history. By contrast, not only did Atahuallpa have no conception of the Spaniards themselves, and no personal experience of any other invaders from overseas, but he also had not even heard (or read) of similar threats to anyone else, anywhere else, anytime previously in history. That gulf of experience encouraged Pizarro to set his trap and Atahuallpa to walk into it.

THUS PIZARRO'S CAPTURE of Atahuallpa illustrates the set of proximate factors that resulted in Europeans' colonizing the New World instead of Native Americans' colonizing Europe. Immediate reasons for Pizarro's success included military technology based on guns, steel weapons, and horses; infectious diseases endemic in Eurasia; European maritime technology; the centralized political organization of European states; and writing. The title of this book will serve as shorthand for those proximate factors, which also enabled modern Europeans to conquer peoples of other continents. Long before anyone began *manufacturing* guns and steel, others of those same factors had led to the expansions of some non-European peoples, as we shall see in later chapters.

But we are still left with the fundamental question why all those immediate advantages came to lie more with Europe than with the New World. Why weren't the Incas the ones to invent guns and steel swords, to be mounted on animals as fearsome as horses, to bear diseases to which Europeans lacked resistance, to develop oceangoing ships and advanced political organization, and to be able to draw on the experience of thousands of years of written history? Those are no longer the questions of proximate causation that this chapter has been discussing, but questions of ultimate causation that will take up the next two parts of this book.