CONTENTS

1

The Odyssey Revealed

Five Million Years of Hominin Achievement

During the past five million years, humans and their hominin ancestors have evolved from a bipedal (two-legged) ape into the globally dominant species that we call *Homo sapiens*. We are now eight billion people rather than a few thousand; mobile phones rather than stone tools dominate the lives of many of those billions; and, by the start of the Colonial Era (1492 CE), our ancestors spoke at least 8,000 different languages, of which about 6,500 survive today. Our evolution has taken us from an African ape, through many intermediate hominin species, to *Homo sapiens* and the dizzying heights of the modern technological revolution. Indeed, the success of our global domination is currently causing many of us great concern.

How did all of this happen? The events of the past five (or more) million years have been immense in detail, and much of that detail will forever be lost to us. But there are guiding threads. Two essential processes, *evolution* and *migration*, have underpinned the histories of all species of life on earth, from viruses to whales, including *Homo sapiens* and its ancestors. Evolution creates new species out of existing ones, and migration carries the members of those new species into new environmental conditions, thus encouraging evolution to continue in new directions.

The never-ceasing production lines created by evolution, migration, and further evolution have left continuous traces of their passage, silent witnesses scattered through space and time waiting patiently for those who can find and interpret them. Those traces are the plot for a saga on a cosmic scale.

The traces are not only biological; they include two major nonbiological categories of human achievement, these being the archaeological cultures that record ancient human lifestyles and the families of related languages that record how humans communicated in the past. Our cultures and languages evolved and traveled with their human creators to far-flung corners of the world during the course of prehistory. Together with the fossils and the genes, they add to the basic conceptual scaffold around which this book is constructed.

The human Odyssey, from ape to agriculture, is thus our main field of concern. I will examine how the different hominin populations that have existed during the past five million years, including our own modern human species and its immediate ancestors, have been identified by paleoanthropologists, archaeologists, and geneticists. One ultimate goal is to show how these ancestral populations have contributed to the creation of our own place in the world, although it is not my intention to put *Homo sapiens* on a pedestal of ultimate perfection. Many might say that we deserve no such accolade.

However, we might still ask: Where does *Homo sapiens* actually fit within the Odyssey? We did not exist five million years ago as a recognizable species separate from other hominins, except perhaps in nascent form; we were an undifferentiated glimmer in the genetic cosmos of archaic humanity, waiting for the eventual chance to make an appearance and then migrate into the world to become a new species. I describe the details, such as they are known to us, of this appearance later, but the main point to be stressed in this introduction is that we are a very young species compared with the five-million-year hominin Odyssey as a whole. The oldest fossil skulls recognized as approaching a modern human status in terms of brain size and shape are only about 300,000 years old. All of us alive today descend from a common genetic ancestry of similar antiquity, at least in terms of DNA comparisons between the living human populations of the world.

Yet the genus *Homo*, within which *Homo sapiens* is the sole survivor of what were once several species, including *Homo erectus* and the Neanderthals (*Homo neanderthalensis*), has existed for at least two million years, and hominins in general for more than five million years. This recency for *Homo sapiens* as a distinct species means that we can interbreed freely, if age and health permit, with a partner from anywhere in the world. The differences we perceive in individual bodily characteristics, such as skin or hair color, are superficial.

Furthermore, the recency of our origin in Sub-Saharan Africa means that all living humans carry the same basic ability to create languages, cultures, and societies at a global level of complexity that has been recorded by linguists, historians, anthropologists, and ethnographers for well over a century. We can each learn, speak, and understand the language of anyone else in the world, if we wish to. The shared features of basic behavior and intelligence that we see across the human population today must also have characterized our ancestors since the African emergence and expansion of our species throughout the Old World, from South Africa to Australia, by at least 50,000 years ago.

Right now, therefore, humans across the whole world are a biological unity at the species level. However, it was not always so. Before the main spread of *Homo sapiens* out of Africa, many different hominin species roamed the Old World continents at any one time. There were even several distinct hominin genera (groups of related species) in Africa before one million years ago. These genera and species had been differentiating from each other for many times longer than the modern human time span, so they expressed far more diversity than we see across our own species now. All eventually became extinct, except for the still rather obscure line of genetic descent that led eventually to us, *Homo sapiens*. Some of those pre-*sapiens* species, especially the Neanderthals and Denisovans of Europe and Asia (to be discussed in chapter 4), also hybridized with our own *Homo sapiens* ancestors, in the process transferring genes that still survive among us today.

From a five-million-year perspective, one point cannot be denied. As *Homo sapiens*, we have ridden hard on the achievements of our remote ancestors to become the most successful, and now unique, heirs to those five million years of hominin biological and cultural evolution. As Charles Darwin noted over 150 years ago, "Man still bears in his bodily frame the indelible stamp of his lowly origin."[1] That five-million-year time span postdates our evolutionary separation from the ancestors of the living great apes, especially the panins (chimpanzees and bonobos, members of the genus *Pan*) of equatorial Africa.[2] After that separation, hominins forged their own unique identities as upright bipedal and increasingly large-brained primate life-forms. The panins forged their own identities in another direction to become the knuckle-walking chimpanzees and bonobos that exist in tropical Africa today.

We come from an ape heritage, as of course do our closest cousins in the natural world, the great apes themselves. Jared Diamond once referred to us as the "Third Chimpanzee,"[3] but our brains are huge by ape standards, and our cultural creations astonishing. Our ancestors spread eventually across the whole world, while those of the living great apes (panins, gorillas, orangutans) remained in tropical Africa and Southeast Asia, where they suffer threatened conditions of survival today. Our current human population numbers cause many of us concern, as does our ongoing impact on Planet Earth. In evolutionary terms we have been enormously successful, at least so far.

Brains, Cultural Creations, and Population Numbers

Let me illustrate the overall evolutionary success of humans with an impressionistic illustration of two aspects of the hominin achievement plotted against time. The first is the increase in the volume of the brain, from a chimpanzee (average 380 cubic centimeters) to a modern human (average 1,350 cubic centimeters), as recorded from fossils during the last 3.5 million years for which such brain size records exist (figure 1.1). A brain volume increase on this scale—by a factor of three or four through such a relatively brief period of evolutionary time—is unprecedented in the rest of the mammalian world.

The second aspect lies in human behavior, in the rising complexity of cultures and societies. Figure 1.2 is schematic and selective, but it

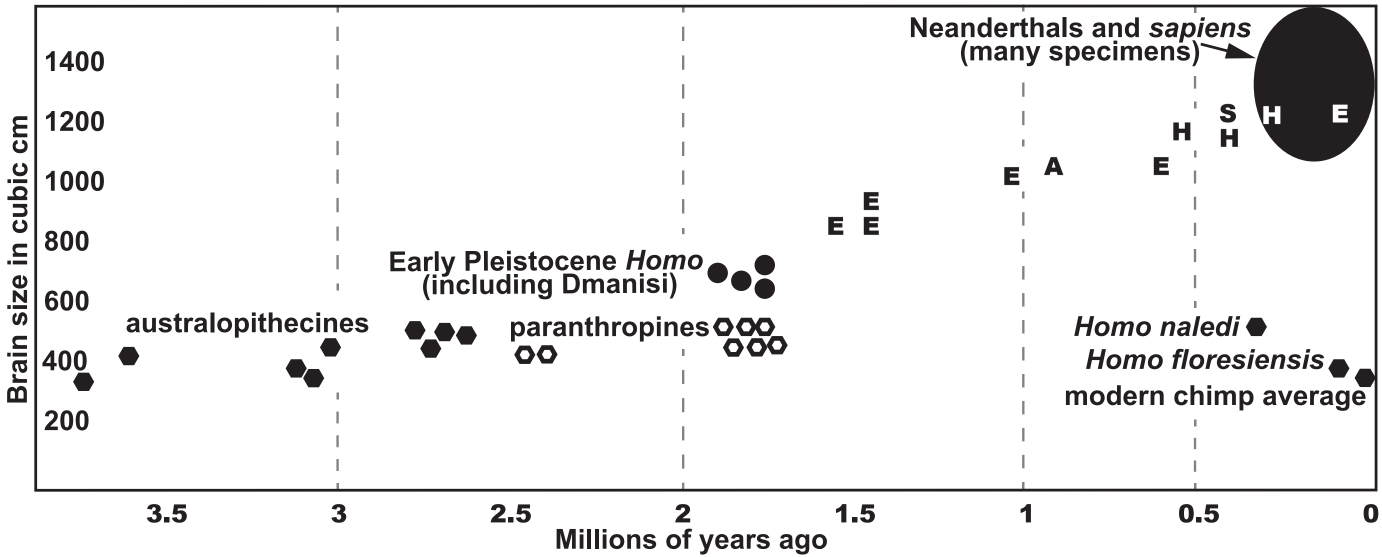

Figure 1.1. The evolution of hominin brain volume (cubic capacity) through time. A = *Homo antecessor*; E = *Homo erectus*; H = *Homo heidelbergensis*; S = Sima de los Huesos (Spain) average. Data partially from Dean Falk, "Hominin brain evolution," in S. Reynolds and A. Gallagher, eds., *African Genesis* (Cambridge University Press, 2012), 145–162.

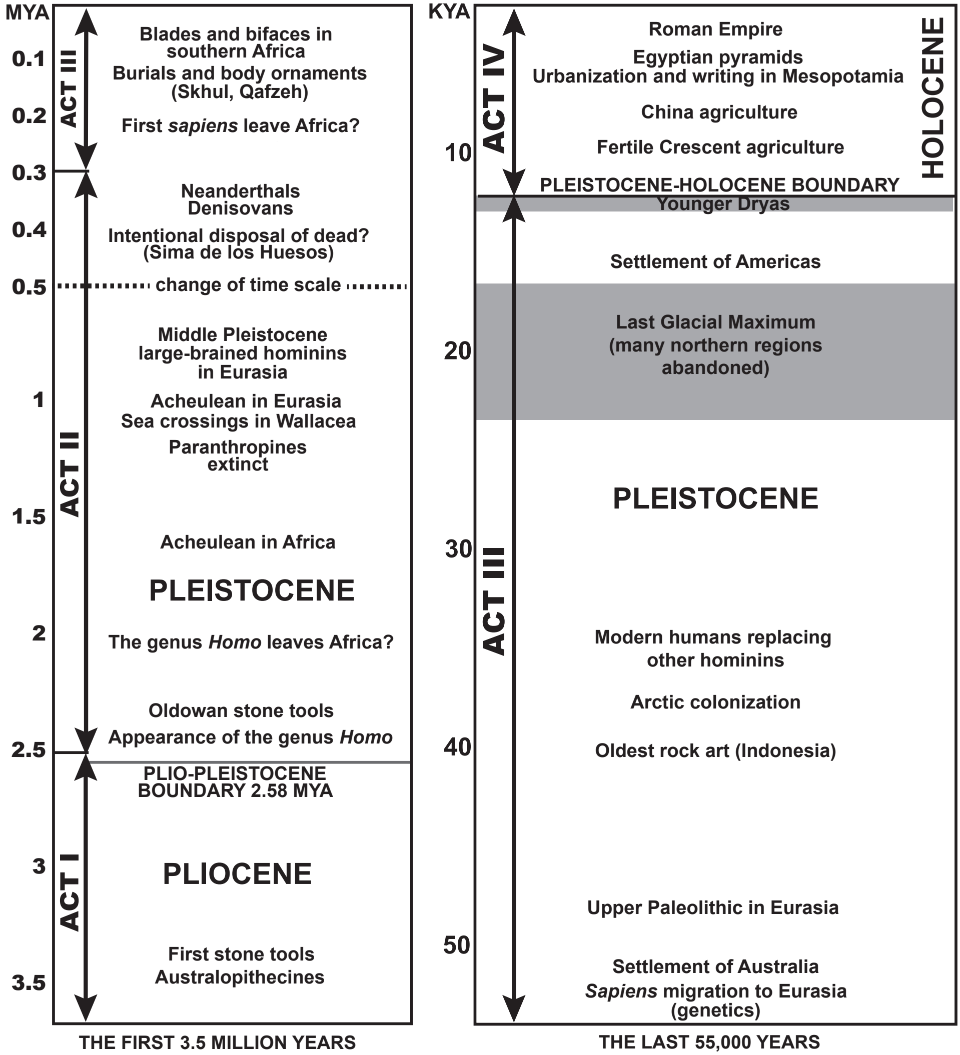

Figure 1.2. The evolution of hominin culture since 3.5 million years ago, with a time line for the four acts described in this chapter. Act I commenced six million years ago, but its early phases reveal no definite signs of cultural activity. The figure has two registers and starts at the bottom left. Note the changes in chronological scale in the vertical axes. KYA = thousands of years ago; MYA = millions of years ago.

focuses on some of the major developments in social and economic organization as recognized in the record of archaeology. These include developments in technology (e.g., stone to metal), provision of food (e.g., hunting and gathering to food production), and social organization from small nuclear family groups to the state-level empires of early history. The increasing tempo of development with the rise of food production after 10,000 years ago is evident.

There is a third aspect of the human career that is more difficult to illustrate: the increase in the estimated size of the human population. Prehistoric population sizes can be inferred from indirect sources of information, such as comparable ethnographic population densities, and areas and numbers of archaeological sites at different points in time. They can also be estimated from genetic comparisons of mutation frequency between the DNA sequences of different ancient and living populations. The larger the population, the more frequently one might expect mutation events to have occurred in its genome, and such mutation events can be dated using molecular clocks. However, I do not attempt here to create a graphical guestimate of hominin population numbers through time because there are too many uncertainties. The key point is that our numbers have grown dramatically during the course of our Odyssey.

The oldest hominin populations were small, and there were perhaps still fewer than two million humans in the world at 12,000 years ago. With the widespread establishment of food production, starting around 12,000 years ago, human populations began to increase with unprecedented speed. By 2,000 years ago we had reached an estimated 300 million people worldwide. Since 1 CE our numbers have skyrocketed, to one billion by 1800 CE and to almost eight billion now.

Of course, the trends through time in these three examples of human achievement are not identical. Our modern human brain volume was achieved by some hominin species more than 50,000 years ago, including our own *Homo sapiens* ancestors and our extinct Neanderthal cousins. There was a major development of cultural complexity (e.g., art, body ornamentation, and purposeful burial of the dead) at about the same time. But our population size only really began to explode with the beginnings of agriculture after 12,000 years ago. States, cities, and writing only became prominent in certain regions of the world after about 5,000 years ago. Before this, most of humanity lived in small egalitarian kinship-based communities.

In short, our evolution over the past five million years of our Odyssey has impacted our world on a scale equivalent to that of a major epochal change, like the coming of the Ice Ages or the appearance of mammals. As earth scientists Simon Lewis and Mark Maslin point out, for the first time in the earth's 4.5-billion-year history, a single species is increasingly dictating its future.[4]

Hominin Evolution as a Four-Act Drama

The events that have taken place in hominin prehistory can be visualized as a sequence of four Acts, which can be succinctly described as follows (figure 1.2):

- Act I: hominins before the genus *Homo* (6 to 2.5 million years ago).
- Act II: the genus *Homo* onward to the fossil appearance of *Homo sapiens* (2.5 million to 300,000 years ago).
- Act III: *Homo sapiens* onward to the appearance of food production (300,000 to 12,000 years ago).
- Act IV: the age of food production (12,000 years ago to the present).

Act I (discussed in chapter 2) was played out in Africa by the hominins who existed after the split from the panins but before the appearance of the genus *Homo* (to which we all belong today). It featured the emergence of a prototype hominin, most probably in Sub-Saharan Africa (although not everyone agrees on an ultimate African origin—see chapter 2), out of a small-brained and apelike ancestor who most likely had an upright body posture, and who later developed the ability to make and use stone tools. No definite fossils of this prototype are known just yet. The subsequent cast of Act I, as known to us today, included the extinct African hominin genera *Australopithecus* and *Paranthropus* (discussed together in chapter 2 as the "australopithecines").

Act I ended with the gradual appearance of traits that defined the emerging genus *Homo*, especially an increase in brain size. However, ancient hominins did not evolve from one genus or species into another overnight—such processes required hundreds of millennia and occurred at different rates for different traits. Bipedalism, for instance, began to develop long before any marked increase in brain size or the use of stone tools. There is no single date at which the genus *Homo* suddenly sprang forth, fully formed.

Between 2.5 million and 300,000 years ago, Act II (chapters 3 and 4) was played out on the earth's stage by a cast of species within the new genus *Homo*. The other australopithecine species that had existed in Africa during Act I gradually became extinct. As far as we know, one or more species of *Homo*, especially *Homo erectus*, left Africa early in this second Act, around two million years ago, to migrate into accessible regions of Eurasia.

Another significant migration out of Africa appears to have occurred during the later part of Act II. This gave rise eventually to new hominin species across Eurasia, one being the well-known Neanderthals, another being the recently discovered Denisovans of Siberia and eastern Asia. Back in Africa, some of the large-brained hominins who remained behind continued the separate evolution there of *Homo sapiens*, although we must wait for Act III to meet actual members of this species through their bones.

Act III (chapters 5 and 6) revolves around a new cast of ancestral modern human hunters and gatherers—*Homo sapiens*—the oldest fossil specimens of whom so far date between 300,000 and 200,000 years ago. Comparisons of skull morphology and ancient DNA suggest an earlier genetic initiation for this species in Sub-Saharan Africa, perhaps about 700,000 years ago, but no definite *sapiens* fossils yet exist from this earlier time period.

The definitive entry of *Homo sapiens* into Eurasia, in terms of founding the ancestry of living human populations outside Africa, occurred much later, between 70,000 and 50,000 years ago in terms of archaeology and genetic dating. Much mystery swirls around this topic, as I discuss in chapter 5, but we do know that ancestral *Homo sapiens* overlapped in time and sometimes interbred with the other *Homo* species that also coexisted during Act III, both inside and outside Africa. These included the Eurasian Neanderthals and Denisovans.

All of these non-*sapiens* species of *Homo* became extinct toward the end of Act III, perhaps because of cultural and demographic competition as well as interbreeding with the clever and more fecund *Homo sapiens*, "the wise human." Act III also witnessed the colonization by *Homo sapiens* of the remainder of the habitable world beyond Africa and Eurasia (except for distant oceanic islands), including Australia, New Guinea, and eventually the Americas.

Ancestral modern human populations during Act III, and especially since 50,000 years ago, also left behind a cultural record with far more detail than that left by previous hominins. Archaeologists recover aspects of these developing cultural traditions as art on cave walls and on portable objects, as red ocher used to decorate burials, and as body ornaments, including beads and pendants of stone, bone, and shell. *Homo sapiens* populations buried their dead according to rituals that sometimes involved placement of manufactured ornaments or other items for the afterlife in purposefully dug graves. These cultural traits, plus the sustained ability to travel farther at sea and farther into extreme cold than the more archaic hominins, were convincing and identifiable achievements unequaled by any pre-*sapiens* species of *Homo*.

Act IV (chapter 7 and onward), the final act that still occupies the global stage today, commenced around 12,000 years ago in the Middle East, and more recently in several other key homelands of agriculture. It emerged within the pronounced episode of global warming that followed the last Ice Age, after 18,000 years ago, and it involved only *Homo sapiens*—all other hominins were extinct as separate and independent species by this time.

The key development in Act IV was food production through the domestication of plants and animals. This created transportable food-producing economies that could underpin migration into new territories, leading in turn to dramatic population growth in latitudes where agriculture was possible. The eventual outcomes of this population growth were developing social orders that yielded cities and states in many parts of the world, and eventually a series of scientific and industrial revolutions, all leading into our current world situation. The world's largest language families underwent their expansions during this phase, many of them carried with the migrations of early farming and pastoralist populations.

Anyone who thinks further about this succession of four acts within human prehistory will quickly draw one obvious conclusion: each act was shorter in duration than its predecessor yet was increasingly dramatic in terms of human dispersal and population size. Human evolution has been like a snowball rolling downhill, gathering size and speed on steeper sections, losing momentum on flatter ones, but certainly never stopping altogether. Climate scientists even debate the possibility of an Act V which they term the Anthropocene, the Age of Humankind, although its date of commencement is not unanimously decided. The beginnings of agriculture, the Industrial Revolution, and the invention of the atomic bomb are currently all candidates.

Population Growth and Migration: Why They Mattered

Of all the hominin genera and species known to have existed, *Homo sapiens* survived the evolutionary fray as an eventual winner, alone in the world since perhaps 30,000 years ago. We are now burdened with a growing population that shares dangerously unequal access to our earth's subsistence resources.

In modern human affairs, a growing population has long been a fundamental factor in driving history, for good or ill, as stressed for recent human history by demographer Paul Morland in his book *The Human Tide*.[5] Increasing population size encouraged migration, and migration into new and productive landscapes in turn encouraged increasing population size—a powerful mutualism that must have driven a great deal of the Five-Million-Year Odyssey, especially in the case of *Homo sapiens*. Migration, after all, was one of the major factors that divorced the course of hominin evolution from that of the great apes. Our ancestors left home for good.

Prior to the start of the Colonial Era in 1492 CE, modern humans, *Homo sapiens*, experienced two unprecedented worldwide episodes of migration that led to significant population growth. The first was the successful movement beyond Africa into the rest of the world during the latter part of Act III. This unfolded as a series of consecutive migrations that commenced over 50,000 years ago, initially spreading out of Africa through Eurasia to reach Australia and New Guinea, and culminating in the settlement of the Americas from northeastern Asia by 15,000 years ago. The total human population increased greatly in overall numbers during this period, partly due to the enormous extent and resource potential of the newly colonized land masses.

The second major episode of growth resulted from the migrations of populations with transportable economies of food production during the past 12,000 years. Some of these farmer and herder migrations achieved enormous extents, even if they required centuries or millennia to unfold completely. These Act IV migrations in the Odyssey are of direct interest to billions of people in the world today because of their association with the origins and histories of many existing ethnic populations and language families. If we ever pause to wonder why English is spoken in England and Australia, Turkish in Turkey, Maori in New Zealand, and Navajo in Arizona, we will soon discover that the answers involve plentiful human migration.

Having introduced the actors, there are still two important matters that require some exposure in this introduction: the stage and the clock.

Our World as the Stage

Human evolution did not occur against an unchanging environmental background. Behind it lay the earth's surface and atmosphere, subject during the past 2.6 million years of the Pleistocene and Holocene geological epochs (defined further in chapter 3) to regular cycles of climatic change. These gyrated, in cycles of approximately 100,000 years, between glacial ice ages at one extreme and interglacial warm intervals at the other, the latter similar to the climate that our world enjoys, and fears, today. Each cycle was associated with substantial swings of temperature, rainfall distribution, and global sea level, the last varying by up to 130 meters, similar to the height of a thirty-five-story building.

Remembering that global sea level is close to a 120,000-year peak at the moment, let us imagine what the world's coastlines would have looked like whenever a 130-meter depth of seawater became locked away in the massive ice sheets that extended from the North Pole almost as far south as New York and London. Because sea level change in the open ocean is a worldwide phenomenon, all of the world's great river deltas would have been narrow incised river channels when the sea surface was so low and continental shelves would have been exposed as flat coastal plains around the edges of the continents. One would have been able to walk almost entirely on dry land, except for river crossings, from the Cape of Good Hope to Cape Horn. Asia was then joined to Alaska across a dry Bering Strait; Borneo and Bali were joined to the Malay Peninsula; and New Guinea was joined to Australia. The outlines of these land bridges can be seen in figures 3.1, 5.1, and 6.1.

One can also imagine, of course, what would have happened as rising sea levels flooded back over 130 meters in the reverse direction during warm interglacial conditions, when the ice sheets melted. Coastal impacts would have attended both directions of movement, especially when they were relatively rapid. Our ancestors lived through such glacial to interglacial cycles many times (probably more than twenty) during the 2.6 million years of the Pleistocene epoch, surviving through adaptation and movement as glaciers and sea levels waxed and waned in alternation.

Today, human activity is prolonging the current warm interglacial climate toward uncertain outcomes, causing many of us to question our future. The great climatic cycles of the Pleistocene enable us to see the results of our current actions from a long-term perspective. I do not profess to be a climate scientist or a politician, but I must state that I share the concerns of many people about the current climatic trends as they increasingly move the earth toward one of the warmest phases in its history during the past million years.

How Old Is It? Dating the Past

There is one final matter to explain before we launch into the Odyssey. To understand our past, we need a precise chronology for the many ancient populations and events that we wish to study. Obviously, it matters greatly if a given fossil from an australopithecine, a Neanderthal, or a modern human is two million, 200,000, or only 20,000 years old. The same applies to assemblages of stone tools, and indeed to all elements that survive from the human past. We need to know the real age if we are to avoid confusion in our interpretations.

So, where do "absolute" dates (i.e., dates counted in solar years ago) come from, bearing in mind that even the most precise will always have a statistical range of laboratory error? I am going to forego the temptation to explain here all of the dating methods used by investigators of the deeper levels of the human past, before written records existed, in terms of their laboratory techniques and statistical calculations. Readers who wish to know how scientists calculate dates using changes in the earth's paleomagnetism recorded in sediments, or how they measure the changing states of the various atomic particles used in radiocarbon, potassium-argon, uranium series, electron spin resonance, optically stimulated luminescence, and cosmogenic nuclide dating (to name some of the major techniques currently dominating the literature), and over what periods of time these various methods work should research the answers themselves. I can only deal in this book with the actual results.

Furthermore, archaeology is not the only source of absolute dates in prehistory. Geneticists have access to many different molecular clocks that can calculate the spans of time that have elapsed since periods of common origin between related populations and species. Linguists can calculate approximate dates for periods of common origin between related languages, based on observations about how quickly individual languages and words have changed within the historical record. As with archaeological and geophysical dating, however, many of these methods are complex and highly statistical, and this is not the place to go into them in detail.

My main interest here is to discuss how we might "trust" the dates that scientists return to prehistorians, allowing that the issue is not just one of potential laboratory or calculation error but of ancient *context*. Error ranges and variations in laboratory competence are nowadays relatively minor contributors to uncertainty. But ancient context is absolutely fundamental, and it has two aspects—the context of deposition, and whether the date is direct or indirect in terms of the material being dated.

The first aspect concerns the context of deposition, or how the object of interest reached the resting place from which it emerged into the scientific light of day. Deposition can be either primary or secondary. An undisturbed human skeleton in a grave, with all its bones in articulation, is in a primary context. If it is under 50,000 years old it can probably be dated directly by radiocarbon dating, as long as the bones still contain sufficient carbon-bearing collagen. But a piece of charcoal in the grave next to that skeleton will not necessarily be in a primary context, unless it can be shown that the burial party deliberately lit a fire during the funeral ceremony. Otherwise, the charcoal could have been dug by the gravediggers out of deeper layers laid down many thousands of years before the death of the person buried, and then thrown back with the grave fill.

As another example, a stone tool or a fossil skull found in a layer of Pleistocene riverine sediment might be in a primary context if it was incorporated directly from its user or owner into an actively accumulating flood plain. But it is also necessary to consider whether the sediment was secondarily redeposited by forces of nature long after its original deposition. Thus, tool or skull and sediment might be of the same age, or they might be thousands, even millions, of years apart in age. Only informed research of a geomorphological and stratigraphic nature will give the answer.

The second issue is that of direct versus indirect dating. For example, the bones of a human skeleton subjected to radiocarbon dating are clearly being dated directly, even if the bones come from a secondary disturbed context. If the laboratory calculation of the date is correct, then that date applies automatically to the death of the human who once carried the skeleton, wherever the bones might have been found. But a date derived from an adjacent piece of charcoal is, of course, a secondary date when applied to the skeleton, as described above—correct for the charcoal, for which it is a direct date, but not necessarily for the skeleton.

The materials that are being dated can also produce problems. Usually, dates for artifacts of stone, pottery, or metal are indirect because these nonorganic substances are difficult to date directly in terms of their actual manufacture by human artisans, as opposed to their geological ages as raw materials. However, direct dating methods can be applied to organic materials that contain carbon, such as bones or charcoal, as well to sediments that contain other radioactive minerals. Debates over the correctness of the chronologies claimed by those who have recovered ancient dating samples have peppered the literature about human prehistory for many decades.

Sometimes scientists can be led astray for long periods if wrong dates masquerade as right ones because of contextual ambiguity, especially if no further corroborating discoveries are made. More often, however, when discoveries around the studied topic are frequent, once-claimed but incorrect chronologies can be revealed as isolated outliers from the main distribution, hence unconvincing. Caution about absolute dates claimed for ancient hominins and their cultural products is always wise, as long as it is also well informed.

INDEX

Note: Page numbers in *italics* indicate figures and tables.