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# What Happened in Prehistory?

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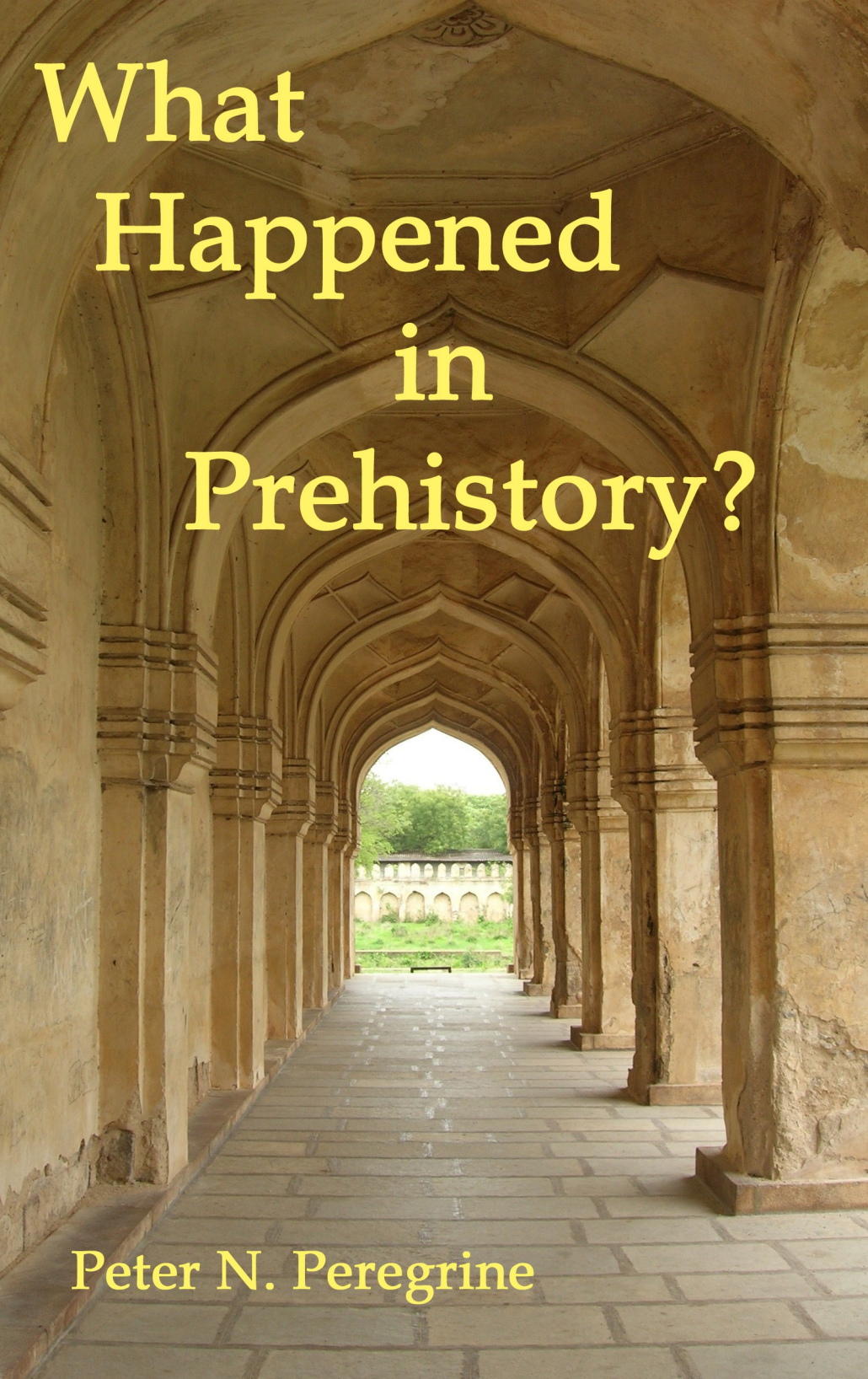
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What  
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in  
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# **What Happened in Prehistory?**

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## Preface

Archaeologists have rightly been accused of not writing enough for the general public. Most of what we write is for other archaeologists, often other archaeologists working in the same narrow area that we do. There have been exceptions, and two of the most important were Vere Gordon Childe's *Man Makes Himself* (1936) and *What Happened in History?* (1942). In these two works Childe attempted to explain the long history of humankind by describing it through marked periods of change, what he called "revolutions." These were the Neolithic Revolution, in which humans shifted from hunting and gathering to agriculture; the Urban Revolution, in which humans developed cities and states; the Writing Revolution, in which humans developed the ability to record and preserve knowledge independent of human memory; and the Industrial Revolution. Childe's books were widely read, and not only by the public—they had an immediate and powerful influence on archaeologists as well. The framework Childe established by looking at "revolutions" made sense, and became a widely-used, if also widely-suspect, way of organizing thought about the human past.

I use Childe's notions of "revolutions" here, in my attempt to provide a very brief introduction to our shared past. I have obviously alluded to *What Happened in History?* in my own title, and I see this work, to some extent, as an updating of Childe's wonderful book. I have chosen to produce this work as an e-book for two reasons. First is cost—being inexpensive will, I hope, encourage more people to read this book and have it reach a larger audience than if it were produced in print. Second, I think electronic publishing is the future, and I am happy to take part in it.

This book relies heavily on my textbook *World Prehistory: Two Million Years of Human Life* (2003) and I want to thank Prentice Hall for allowing me to recycle some of that material here. My students and colleagues, as always, have helped me to clarify and focus my ideas, and I thank them for that assistance. Finally, I must thank my family for long suffering my frequent absences for fieldwork and my long days and nights writing upon my return.

## What is Prehistory?

Prehistory refers the time period in the past that is known to us primarily through the debris left by ancient peoples--it is the time before written history allows us to know ancient peoples through their own words. We know prehistory only by finding, recovering, and interpreting objects that ancient peoples discarded or lost. Prehistory, in this sense, exists only in the present, in the interpretations we make of the ancient items we find. But these items were left by real people, and prehistory must therefore also be a direct representation of the past, if only we can find the right tools to interpret the items that were left. Prehistory, then, is something of a puzzle that we assemble from ancient material, and I think that's a large part of the fascination and the fun we have in studying prehistory.

But in being a puzzle, prehistory can also be confusing, even contentious. Indeed, there are some who suggest the word is insulting and implies that nothing happened before written history. To me this seems a serious misinterpretation of prehistory. Most of human life happened before written history, and calling the two million years during which humans spread across the globe and created the diversity of cultures we know today "prehistory" does not imply that nothing was going on. The term prehistory simply identifies the fact that we only know that long time period through objects and not through written documents. It is an important distinction to make, I think, because objects and written documents are collected, analyzed, and interpreted through very different means and by scholars trained in very different disciplines.

Scholars who study the physical items left behind by ancient peoples typically call themselves archaeologists. While many archaeologists also study the physical items left behind by cultures that have also left behind written documents (the Maya for example, or the peoples of colonial Williamsburg), the opposite is not true for many historians or ethnographers. Historians are trained to identify and interpret written documents, but few historians are trained to work with other objects from the past. Ethnographers are trained to record the life of contemporary peoples, and while many have an interest in the material culture of the peoples they study, most are not trained, as archaeologists are, to systematically examine and discern behavior from them. Prehistory, then, can also be understood as the time period studied almost exclusively by archaeologists.

What archaeologists study are the relationships between and among the objects that make up the physical record of the past—what archaeologists call artifacts, ecofacts, fossils, and features. These relationships are called context, and archaeologists use the context of artifacts, ecofacts, fossils, and features to reconstruct what happened in the past. Historians use historical records and sometimes archaeological materials, but their focus is on the analysis of textual data (that is, written documents), not contextual data (that is, the relationships between and among artifacts, ecofacts, fossils and features). And, except for the fairly recent past, textual data does not supply that much information. Similarly, ethnographers use the knowledge and memory of living peoples, and their focus is on behavior today and memory of past behaviors, not the physical record of behavior. Again, except for the fairly recent past, memory (even oral tradition or oral history) does not supply a full account of life and culture. The methods used by archaeologists are designed to allow for the study of prehistory—the time period before texts or memory allow much to be known about life and culture.

## Why Study Prehistory?

Why is prehistory worthy of study? I think the most basic answer is that prehistory is interesting. We share a fascination about the past. Who lived before us? What were they like? What happened to them? Those questions intrigue us, and it's a worthwhile activity to try to answer them, if only to satisfy our own interest. In the United States today there are over 100 archaeological societies, many with several thousand members. Some 200,000 people subscribe to *Archaeology* magazine. We regularly see television documentaries on prehistory, and there are even several television series devoted to it. The study of prehistory provides engaging entertainment and is a serious pastime for many thousands of people. But there are, I think, some more important reasons than amusement for studying prehistory.

“Man . . . hangs on the past: however far or fast he runs, that chain runs with him.”  
--Friedrich Nietzsche, *The Use and Abuse of History* (1874)

One important reason to study prehistory is to recognize the contributions and achievements of our predecessors. All of us have inherited the legacy of our ancestors --both the good and the bad--and it is important

for us to understand our ancestors' contributions. We exist because they did, and it is right to acknowledge that. For those of us whose ancestors colonized the places we now live, we must also reckon with the fact that our homes and schools are built on lands once occupied by indigenous peoples. The study of prehistory helps us understand the contributions and achievements of those indigenous peoples whom our ancestors dispatched or displaced.

Prehistory also provides precedents for the way we do things today. I think Karl Marx put this idea best when he wrote: "Men make their own history, but they do not make it just as they please; they do not make it under circumstances chosen by themselves, but under circumstances directly found, given and transmitted from the past." What we do today is in part based on what we did yesterday. There is very little that is really "new" in any society, just things transformed. It is valuable for us to understand where the things we do today started (i.e., in prehistory), if only to return to that starting place and try again if our transformations have failed or have created unanticipated problems.

Our ties to the past can also be used for political purposes, and it is important for us to understand how the past can be used in political maneuvering. When we re-elect a representative we are using the past, sending a person back to office based on what they did previously. We often use the past conservatively, to argue against change since "that's the way we've always done it." We can use the past to promote change, arguing for a transformation of past practices or for the prevention of previous mistakes. But prehistory can be used for more far-reaching political purposes. A clear example can be found in the first Gulf War. Part of Saddam Hussein's claim to Kuwait was that Iraq was the direct inheritor of the Assyrian Empire, an empire that flourished almost 3000 years ago and which had the area now known as Kuwait within its borders. Many less extreme, yet still politically powerful, claims are made on the basis of archaeological evidence. In the United States, for example, Native American groups have made extensive use archaeological evidence in pursuing Federal recognition and treaty rights. So, prehistory is also important because it is used as a political tool, and this is why the way in which the past is represented, and who gets to represent it can become a contested issue.

"Those who cannot remember the past are condemned to repeat it."

--George Santayana, *Life of Reason* (1905)

A second reason to study prehistory is because it offers vital information about experiments in technology, economics, society, and political organization; experiments that more often than not were failures and thus only survive in the archaeological record. If you think about the great civilizations of the past--Pharonic Egypt, Sumeria, the Inca Empire, to name a few--you'll notice one important commonality: they are all gone. Indeed most civilizations that have ever existed ultimately collapsed or were conquered. Why? That's a very important question because it seems likely that our civilization will ultimately collapse too if the established pattern continues. One way to hedge against our civilization's downfall is to understand how and why previous civilizations fell. That answer has to include conquest as well, because it is always a question why a conqueror succeeds in overthrowing an established civilization--the conqueror's success points to either overwhelming strength or, more likely, some pre-existing weakness in the conquered civilization.

In addition, conquerors or those remaining in a given area following a civilization's collapse often alter or neglect established patterns of life that may offer unique adaptations to that area. For example, the potato was exported to Europe following the Spanish conquest of the Andes; unfortunately, the rich diversity of potatoes, each variety adapted to specific environmental conditions, were not exported. Three centuries later Irish civilization nearly collapsed through a potato famine, a famine caused by a blight that spread rapidly because of the uniformity of potato varieties being grown in Ireland. Understanding the past adaptation, the diversity of potatoes that helped prevent such a catastrophic crop failure, has taught us how valuable it is to preserve plant varieties, just as the Inca had done five hundred years ago. And it's those kinds of lessons a knowledge of world prehistory can provide.

"The past is never dead. It's not even past."

--William Faulkner, *Requiem for a Nun* (1951)

A third, and perhaps more important reason for studying prehistory is that it helps us to better understand ourselves. We can never go back to the past (that is, at least, until someone creates a time machine), so the past only exists in the present, in our own minds. This does not mean, as some archaeologists have suggested, that a real past doesn't exist, nor does it mean that we can never accurately reconstruct the past. What it does mean is that our reconstructions of the past are always subject to question and revision. One can never go back and examine an event as it occurred. One can only view the results and try to understand them. That's the nature of prehistory.



Since our understanding of prehistory is based on our thoughts, assumptions, insights, and hypotheses in the present, prehistory is as much a product of the present as it is the past. As Immanuel Wallerstein elegantly explains: “recounting the past is a social act of the present done by men of the present and affecting the social system of the present.” This is something we cannot ignore. We can never know prehistory as it truly was, but only the way it exists today in our imagination, and given the information we have about it. As Marc Bloch explains “The past is, by definition, a datum which nothing in the future will change. But the knowledge of the past is something progressive which is constantly transforming and perfecting itself.” Our understanding of prehistory, then, is a product both of our knowledge of the past and how we interpret it.

So, why study prehistory? Because it provides important insights about our society and ourselves. It is a powerful, and sometimes misused, political tool. It offers ideas about how to, and how not to, organize our society, technology, and economy. In addition to all that, prehistory is inherently interesting. I hope that answer is good enough to get you interested in learning more about prehistory, because that’s what the rest of this book is all about.

## The Behavioral Revolution

Where should we begin this study of prehistory? We could go back to the beginnings of life on earth, some 3.5 billion years ago. Or we might start with the physical structure of our cells, which have an ancestry going back more than a billion years, to the time of the first eukaryotic cells (which have a membrane-bound nucleus). Each of our cells contain structures called mitochondria, which manufacture enzymes our cells use to produce energy, and these structures can be traced back to ancient bacteria that joined in a symbiotic relationship with early eukaryotic cells perhaps a billion years ago. We carry traces of the first mammals as well. These traces are more obvious, and more visible than mitochondria. We share hairy bodies, mammary glands, a four-chambered heart, and warm blooded metabolism with mammals living as much as 100 million years ago.

We also carry traces of our primate heritage, stretching back more than 60 million years to when mammalian insect eaters took to the trees and adapted to life in the branches of ancient forests. Over time basic primate features such as a generalized limb structure in which arms and legs are similar, grasping hands and feet with nails instead of claws, mobile digits and excellent hand-eye coordination, increased reliance on sight over smell, improved color vision and depth perception, and an enlarged brain capable of rapidly processing visual input and translating it into rapid and precise movement evolved as adaptations to arboreal life.

But humans don't ordinarily live in trees. We live on the ground, and are unique among the other primates (even those that live on the ground) in being habitually bipedal. For most archaeologists, the evolution of habitual bipedalism marks the beginning of our human family. Why? Because habitual bipedalism was the catalyst for other changes, both physical and behavioral, that fundamentally transformed our ancient ancestors from apes into humans. These changes mark the Behavioral Revolution that started humans on the path to where we are today—the most dominant animal on earth and perhaps the earth's most dominant geological force. Habitual bipedalism freed the hands for tool use, and caused changes in the pelvis that may have altered human reproductive and social behavior. All these changes can be seen in the first members of our genus, *Homo*, dating to about two million years ago.

### The First Humans

Early *Homo* people were really not that different from related species living in eastern Africa two million years ago (which included members of the genus *Australopithecus* and the genus *Paranthropus*). They lived in the same areas and had similar lifestyles. But early *Homo* people had bigger brains. The australopithecines had relatively small brains, averaging about 450 cc (a little larger than that of chimpanzees). The paranthropoids brain was not much larger, averaging about 530 cc. Early *Homo* individuals had brains averaging about 640 cc, which is about 50 percent of the brain capacity of modern humans (which average slightly more than 1,300 cc).

What caused this increase in brain size? The classic idea was that it was linked to the emergence of stone toolmaking about 2.5 million years ago. The reasoning was that stone toolmaking was important for the survival of our ancestors, and therefore bigger-brained individuals would have been favored because they had motor and conceptual skills that enabled them to be better toolmakers. But as older tools continue to be found (as early as 2.8 million years ago) this idea has lost adherents, and new theories have gained acceptance.

One is that "persistence hunting" may have led to larger brains. With their simple tools early *Homo* would not usually have been able to kill prey outright, but rather would have wounded and tracked their prey for long periods of time—perhaps days—before the wounded animal finally succumbed and could be dispatched. A bigger brain would have improved memory and concentration, and hunters with bigger brains would have been more successful. A related idea is that hunting may have been the driving force behind brain enlargement because hunting would have required cooperation and cooperation would have required sophisticated communication. In this perspective, hunting fostered communication skills, and communication skills fostered the increase in brain size.

### Culture

Culture, like habitual bipedalism, is unique to humans, and it is the key to the Behavioral Revolution among the early *Homo*. Specifically, the development of patterned tools—tools that follow a specific form across time and space—is an indicator that early *Homo* shared concepts that characterize culture. Some of the lifeways of early *Homo* peoples also suggest cultural behaviors, for example, the creation of home bases and perhaps family groups.

What, exactly, makes human culture so different from other forms of animal behavior? First, culture is *learned* and *shared*. This is the fundamental difference between culture and most other forms of animal behavior.

Culture is not a set of innate behaviors, but rather a set of learned ones. Culture is something individuals acquire during their lifetimes as they grow up and interact with others. Interaction is key, because not only are cultural behaviors learned, they are learned through interaction with others, through education, through shared experiences. Culture, then, is a social process, not an individual or innate one.

Second, culture is generally *adaptive*. What this means is that most of the learned and shared behaviors that make up a culture developed and spread through a group of people because they help that group of people survive in a given environment. Thus, cultural behaviors may be favored by natural selection just as genes are. The extent to which human culture is a product of natural selection is hotly debated, but few anthropologists would argue that culture is not a key aspect of human adaptation. What makes culture quite different from the behavioral systems of other animals is that, because culture is learned and shared rather than innate, humans can develop new behaviors quickly and adapt to diverse and changing conditions with relative ease. Adaptation, then, is perhaps the most significant process of culture.

Change is the third major process of culture, for culture is always *changing*. Culture change regularly occurs as new and beneficial means of adaptation are developed and shared. But when new behaviors are developed they tend to become integrated with existing behaviors. That is to say, new behaviors that conflict with established ones may lead to one or the other changing. A group of early *Homo* could not have, for example, both scavenged meat and at the same time had a prohibition against eating meat that they did not themselves kill. Such a situation would create a contradiction, and something would have to change. Working out contradictions between new, highly beneficial behaviors and established but less beneficial ones may be one of the reasons that cultures are so dynamic.

### ***Stone Tools and Culture***

It seems clear that the early *Homo* peoples, like other primates, were social beings. It is also clear from the archaeological record that early *Homo* individuals were making and using stone tools on a regular basis. These include core tools, made from fist-sized cores of flint, and sharp-edged flakes knocked from those cores, often used without further modification. Among the core tools, so-called choppers are common. Choppers are cores that have been partially flaked and have a side that might have been used for breaking open bones or digging out plant roots. Other core tools, with flaking along one side and a flat edge, are called scrapers, and were probably used to scrape meat off bones.

Early flake tools appear to be very versatile; they can be used for slitting the hides of animals, dismembering animals, and whittling wood into sharp-pointed sticks (wooden spears or digging sticks). Those who have made and tried to use stone tools for various purposes are so impressed by the sharpness and versatility of flakes that they wonder whether most of the core tools were really used as tools. The cores could mainly be what remained after wanted flakes were struck off. Archaeologists surmise that many early tools were also made of wood and bone, but these do not survive in the archaeological record. For example, present-day hunting and gathering people use sharp-pointed digging sticks for extracting roots and tubers from the ground; stone flakes are very effective for sharpening wood to a very fine point.

It seems clear that early *Homo* people were cutting up animal carcasses for meat. Microscopic analyses show that cut marks on animal bones were created by stone flake tools, and use-wear analyses of stone tools indicate that they were used for cutting meat. We still do not know for sure whether early *Homo* people were just scavenging meat or hunting the animals. In some cases the cut marks made by the stone tools overlie teeth marks made by carnivores. This suggests scavenging. But cut marks were sometimes made first, and this suggests that early *Homo* people were also sometimes hunters.

The artifact and animal remains from early *Homo* sites suggest a few other things about the lifeways of early *Homo* peoples. First, it seems that they moved around during the year; most of the sites in what is now Olduvai Gorge, Tanzania appear to have been used only in the dry season. Second, early Olduvai residents exploited a wide range of animals. Although most of the bones are from medium-sized antelopes and wild pigs, even large animals such as elephants and giraffes seem to have been eaten. It is clear, then, that the people inhabiting Olduvai scavenged or hunted for meat, but we cannot tell yet how important meat was in their diet.

### ***Home Bases***

While the presence of stone tools means that these early humans had probably developed culture, toolmaking itself does not imply that early *Homo* had anything like the complex cultures of humans today. Indeed, chimpanzees use tools, even simple stone tools, but they do not have that much in the way of cultural behavior. However, tools are frequently found in discrete concentrations, and often in association with animal bones and other debris from human activity. For example, at Olduvai Gorge two locations have been identified that may be the remains of

simple structures. One is a stone circle that could have formed the base of a small brush windbreak. The other is a circular area of dense debris surrounded by an area virtually lacking debris that may represent the location of a ring of thorny brush with which early *Homo* people surrounded their campsite in order to keep out predators--much like pastoralists living in the region do today.

But archaeologists today are not so sure these sites were home bases. For one thing, carnivores also frequented the sites. Places with meaty bones lying around may not have been safe to use as home bases. Second, the animal remains at the sites had not been completely dismembered and butchered. If the sites had been home bases, we would expect more complete processing of carcasses. Third, natural processes as simple as trees growing through a site can create circular areas of debris such as these, and without better evidence that early *Homo* made them, one cannot be sure that the circles of debris were indeed structures.

### ***Family Groups***

Whether they reflect home bases or not, large numbers of animal bones and tools are found in discrete locations, and these accumulations suggest that the areas were being used by groups of individuals over periods of time. In such a situation sharing of food is very likely. It seems counterintuitive to think that individuals would have purposely brought food to a common location only to keep it to themselves. And although we must move into the realm of pure speculation, it does seem reasonable to think that closely related individuals, like parents, children, and siblings, would be more likely to associate and share food with one another than more distantly related individuals. This speculation is supported by the fact that when food sharing takes place among chimpanzees it is usually among closely related individuals. Thus, the ancient locations of early *Homo* social activity may be evidence of family groups.

It is interesting that the archaeological record of early *Homo* may represent some of the essential features of modern human cultures. These include home bases, sharing, and families. If we think of culture as a process, such a combination of features seems quite likely to form a foundation to human culture. Culture is learned and shared, so a common place where learning and sharing occur--a home base--is something we should expect in early human cultures. Culture is adaptive, and adaptation has two important facets--reproduction and survival. Thus, we would expect families and the sharing of food at the base of human culture. How would such a system of social behavior--the creation of a common meeting, resting, and living place for a group of related individuals to share food--have evolved? Let's consider one model.

As I've already noted, early *Homo* had a large brain. And as I'll explain in a moment, one of the possible consequences of brain expansion was the lessening of maturity at birth. That babies were born more immature may at least partly explain the lengthening of the period of infant and child dependency in humans. Compared with other animals, we spend not only a longer proportion of our life span, but also the longest absolute period, in a dependent state. For example, a month old human infant is completely dependent upon its mother--it cannot move itself and is only beginning to have the hand-eye coordination to reach for and grasp objects. A month old chimpanzee, on the other hand, can move by itself (though not well), hold onto its mother even when she is moving swiftly, and reach for and grasp objects. Prolonged infant dependency has probably been of great significance in human cultural evolution. It used to be thought that the australopithecines had a long period of infant dependency, but more recent analyses of australopithecine teeth suggests that the early australopithecines followed an apelike pattern of tooth emergence during infancy, and thus may have matured rapidly like apes.

Prolonged infant dependency is probably a result of the size of the brain in *Homo* species. A large brain needs a large head, and a large head requires a large birth canal in order to be born. In the *Homo* genus the juvenile brain and head are so large that the mother's birth canal cannot possibly accommodate them. The solution to this problem is that *Homo* infants are born at a very juvenile state—a state in which the brain has not yet fully developed. But with undeveloped brains, *Homo* infants lack full control over their bodies and their senses—they are unable to control muscles and unable to respond to stimuli well. Thus, *Homo* infants are incapable of surviving without parental care until their brains have developed to the point where they can control their bodies and senses, and, in modern humans, this takes several years. Indeed, in the first month of life modern human infants can choke on the weight of their own heads and smother under something as light as a pillow, since they cannot control movements well enough to shift their position or purposely move even a very light item.

Bipedalism would have exacerbated this problem, for both the newborn and for the mother. Walking bipedally requires sophisticated coordination and balance, and in modern humans most infants are not capable of such coordination until they are at least a year old. For mothers, this means that infants have to be carried for at least the first year of life, and probably for several years. The changes in the pelvis that were required for bipedalism would have also caused problems for mothers, as the changes narrowed the width of the birth canal.

Thus, childbirth, even without an increase in brain size, is more difficult for a bipedal hominid than for a quadrupedal ape. Add to this the larger brain size in the *Homo* genus, and childbirth becomes a physically demanding and even dangerous process.

With the challenges of infant dependency and childbirth in mind, let's get back to our model for the evolution of culture. Although some use of tools for digging, defense, or scavenging may have influenced the development of bipedalism, full bipedalism may have made possible more efficient toolmaking and consequently more efficient foraging and scavenging. As I have noted, there is archaeological evidence that early *Homo* peoples were butchering and presumably eating big game some two million years ago.

The development of scavenging would require individuals to travel long distances frequently in search of suitable carcasses. Among groups of early *Homo*, longer infant and child dependency may have fostered the creation of home bases. The demands of childbirth and caring for a newborn might have made it difficult for early *Homo* mothers to travel for some time after the birth. Because early *Homo* males (and perhaps females without newborns) would have been able to roam freely, they probably became the scavengers or hunters. While they were away seeking carcasses or small game, women with newborn children may have gathered wild plants within a small area that could be covered without traveling far from the home base.

The creation of home bases among early *Homo* groups may have increased the likelihood of food-sharing. If mothers with newborns were limited to gathered plant foods near a home base, the only way to ensure that they could obtain a complete diet would have been to share the other foods obtained elsewhere. With whom would such sharing take place? Most likely with close relatives. Sharing with them would have made it more likely that the mother and newborn child would survive. Thus early *Homo* groups located at a home base and connected by bonds of family and sharing could have encouraged the development of the learned and shared behaviors that we call culture.

Obviously this is a "just-so" story--a tale that we never may be able to prove really happened. However, it is a tale that is consistent with the archaeological record. Patterned stone tools do not appear until early *Homo* came on the scene. And with early *Homo* we see the start of several trends in human evolution that appear to be related to the manufacture and use of stone tools--the expansion of the brain, the modification of the female pelvis to accommodate bigger-brained babies, and a general reduction in the size of teeth, face, and jaws. While these trends are present in early *Homo*, they are more apparent in *Homo erectus*.

## **Homo erectus**

*Homo erectus* may be our closest human ancestor, appearing in Africa about 1.6 to 1.8 million years ago and spreading rapidly to Asia. Compared with early *Homo*, *Homo erectus* had relatively small teeth, but their molars also had an enlarged pulp cavity, called taurodontism, which may have allowed the teeth to withstand harder use and wear than the teeth of modern humans. *Homo erectus* jaws were lighter and thinner than those of early *Homo*, and their faces were less prognathic or forward-thrusting. *Homo erectus* skulls were generally long, low, and thickly walled, with a flat frontal area and prominent brow ridges. They have a unique pentagonal shape when looked at from the back, formed in part by a rounded ridge, called a sagittal keel, running along the crest of the skull. There is also a ridge of bone running horizontally along the back of the skull, called an occipital torus, which adds to the skull's overall long shape. The brain, averaging 895–1,040 cc, was larger than that found in any early *Homo* individuals, but smaller than the average brain of a modern human.

From the neck down, *Homo erectus* was practically indistinguishable from us. In contrast to the smaller early *Homo* peoples who lived in East Africa around the same time the first *Homo erectus* did, *Homo erectus* was comparable to modern humans in size. The almost complete skeleton of a boy found at Nariokotome, Kenya suggests that he was about five and a half feet tall when he died, at about 11 years of age; researchers estimate that he would have been well over six feet had he lived to maturity. About 1.6 million years ago, the Nariokotome region was probably open grassland, with trees mostly along rivers. *Homo erectus* in East Africa was similar in size to Africans today who live in a similarly open, dry environment.

*Homo erectus* reflects a continuation of the general evolutionary trends I noted for early *Homo*. The brain continued to expand, increasing more than a third over early *Homo*. The face, teeth, and jaws continued to shrink, taking on an almost modern form. The reasons for these changes are also likely a continuation of those I discussed earlier. For example, an increasing use and variety of tools may have led to a further development of the brain. Similarly, there is good evidence that *Homo erectus* was eating and probably cooking meat, and this may have furthered a reduction in the teeth and jaws.

One additional change in *Homo erectus* is an apparent reduction in the extent of sexual dimorphism to

almost modern levels; that is, males and females do not differ much in size or bodily form. What might have caused this change? In other primates sexual dimorphism appears to be linked to social systems in which males are at the top of dominance hierarchies and dominant males control sexual access to multiple females. In contrast, lack of sexual dimorphism seems most common in both primates and other animals where pair bonding exists, that is, where one male and one female form a long-lasting breeding pair. Could pair bonding have developed in *Homo erectus*?

### ***Marriage?***

Early *Homo* seems to have established some of the basic elements of human culture, including home bases, family groups, and sharing. Another basic element of recent human culture, one that is present in all known cultures, is *marriage*. Marriage is a socially-recognized sexual and economic bond between two individuals that is intended to continue throughout the lifetimes of the individuals, and which can produce socially accepted children. It is essentially a pair bond which is formalized through human culture into a set of behaviors, expectations, and obligations that extend beyond the pair to those individuals' families. With marriage, the competition between males for access to females may have diminished, lessening the importance of sexual dimorphism. But why might marriage have developed in *Homo erectus*?

In animal species where females can feed themselves and their babies after birth, pair bonding is rare. But in species where females cannot feed both themselves and their babies, pair bonding is common. Why? Perhaps because a pair bond provides the best solution to the problem of providing food to the mother--a male can obtain food and bring it back to his female partner and children. Most primates lack pair bonding. This may be because primate infants are able to cling to their mother's fur soon after birth, so that mother's hands are free to forage (interestingly, human infants demonstrate a residual form of this innate ability to cling during their first few weeks of life, called the Moro reflex--if a human infant feels they are falling backward they will automatically stretch out their arms and clench their fists). We have no way of knowing if *Homo erectus* had fur like other primates, but the brain in *Homo erectus* may also have already expanded enough that *Homo erectus* infants, like modern human infants, could not adequately support their heads even if they could hold on to their mother's fur. In any case, when early humans began to depend on scavenging and hunting for food (and skins for clothing), it would have been difficult and hazardous for mothers with infants to engage in these activities with their infants along. Marriage would have been an effective solution to this problem

### **Out of Africa**

Another important aspect of the evolution of *Homo erectus* was the movement of populations out of eastern and southern Africa. As with the lessening of sexual dimorphism, it seems likely that cultural innovations were key to allowing *Homo erectus* peoples to move into new environments. Why? Because upon entering new environments *Homo erectus* peoples would have been faced with new (and generally colder) climatic conditions, new and different sources of raw material for stone and other tools, and new plants and animals they needed to rely on for food. All animals adapt to such changes through natural selection, but natural selection typically takes a relatively long time and requires physical changes in the adapting organisms. *Homo erectus* peoples were able to adapt to new environments very quickly and without apparent physical changes. This suggests that the primary mechanisms of adaptation for *Homo erectus* were cultural rather than biological.

What cultural adaptations might *Homo erectus* have made? Fire might have been one cultural adaptation to colder climates, as there is tantalizing evidence that *Homo erectus* used fire. But fire can only warm people when they are stationary--it doesn't help when people are out collecting food. To be mobile in colder climates, *Homo erectus* may have begun wearing animal furs for warmth. Some *Homo erectus* tools look like hide processing tools used by more recent human groups, and it seems unlikely that *Homo erectus* could have survived in some of colder locations where they have been found in eastern Europe and Asia without some form of clothing. And if *Homo erectus* was wearing furs for warmth, it seems likely they must have been hunting. *Homo erectus* could not have depended on scavenging to acquire skins--the skin is first thing predators destroy when they dismember a carcass. *Homo erectus* would have had to go out and kill fur-bearing animals themselves if they wanted intact skins for clothing

It is interesting to consider that in eastern Africa *Homo erectus* co-existed with at least one other species of hominid (*Paranthropus boisei*), and possibly with as many as three (*Paranthropus boisei*, *Australopithecus africanus*, and early *Homo*). Why did *Homo erectus* survive and flourish while these other species went extinct? Again, culture may be the answer. *Paranthropus boisei* seems to have been a specialized grasslands species. Their

large molars and powerful dental architecture allowed them to eat hard grass seeds and other coarse materials that other hominids could not chew. However, they had to compete against the many other grassland animals who also relied on these plants, but who also reproduced faster and had speed to help them escape from predators. Early *Homo* was apparently a tool user and relied at least in part on scavenging and hunting, but compared to *Homo erectus* early *Homo* technology was crude and their social organization was not as complex. *Homo erectus* appears to have been better organized to scavenge and hunt and to defend themselves against predators. These differences in culture may have provided enough of an advantage to *Homo erectus* that they drove early *Homo* to extinction.

The above scenario, just like the one I suggested for the evolution of early *Homo*, is a just-so story that may or may not be true. But it does fit the facts we know about *Homo erectus* and the area in which they evolved. And, regardless of this particular story's accuracy, there seems no doubt that the development of a more complex culture was vital to the evolution of *Homo erectus*.

### ***The Lower Paleolithic***

The culture associated with *Homo erectus* is typically called Lower Paleolithic, and dates between about 1.8 million and 200,000 years ago. In contrast to the simple tools early *Homo* made, Lower Paleolithic stone tool assemblages have more large tools created according to standardized designs or shapes. Early *Homo* tools have sharp edges made by a few blows. Lower Paleolithic toolmakers shaped the stone by knocking more flakes off most of the edges. Many of these tools were made from very large flakes that had been struck from very large cores or boulders. One of the most characteristic and prevalent tools in the Lower Paleolithic tool kit is the so-called handaxe, which is a teardrop-shaped bifacially flaked tool with a thinned sharp tip. Other large tools resemble cleavers and picks. There were also many other kinds of flake tools, such as scrapers with a wide edge

Lower Paleolithic sites vary, but were often located close to water sources, lush vegetation, and large herds of grass-eating animals. Some camps have been found in caves, but most were in open areas surrounded by rudimentary fortifications or windbreaks. Several African sites are marked by stony rubble brought there by *Homo erectus*, possibly for the dual purpose of securing the windbreaks and providing ammunition in case of a sudden attack.

The presumed base campsites display a wide variety of tools, indicating that the camp was the center of many group functions. More specialized sites away from camp have also been found. These are marked by the predominance of a particular type of tool. For example, a butchering site in Tanzania contained dismembered hippopotamus carcasses and rare heavy-duty smashing and cutting tools. Workshops are another kind of specialized site encountered with some regularity. They are characterized by tool debris and are located close to a source of natural stone suitable for toolmaking. A camp has been excavated at the Terra Amata site near Nice, on the French Riviera, which produced evidence of several huts or windbreaks, and areas where tool manufacture was apparently going on

Beyond this technological culture, what beliefs did *Homo erectus* hold about the world around them? The information we have is limited, but there are tantalizing hints that ritual may have been a part of the *Homo erectus* life. Remains of *red ochre* (oxidized clay) have been found on a number of Lower Paleolithic sites. This may be significant because in many cultures red ochre is used to represent blood or, more generally, life in rituals of various types. Ochre seems to be particularly important in burial rituals, and human remains sprinkled with red ochre have been found in many parts of the world and dating back as far as 200,000 years ago. However, there is no evidence that *Homo erectus* buried their dead, nor any evidence that ochre was being used in rituals. It may have been used for body decoration, or simply for protection against insects or sunburn.

The excavators of Zhoukoudian Cave near Beijing, China suggested that some of the *Homo erectus* remains there showed evidence of ritual cannibalism. The base of the skull in some specimens had been deliberately opened and the facial bones had been broken away from the cranium on others. The excavators have argued that the reason was to remove the brain for ritual consumption. Ritual cannibalism has been widely reported among living peoples, so its presence among ancient peoples is not impossible. But in the absence of formal burial rituals, cannibalism seems improbable. In addition, scholars point out that the parts of the skull that seem to have been purposely enlarged (to remove the brain) are those that are also the weakest points on the skull, and may have broken away because of decay or disturbance over the millennia.

If *Homo erectus* practiced some rituals, did they also have language? We know that language is a universal human capacity that is, at least in part, "hard-wired" into our brains. Dean Falk has shown that some of the structures of the brain that are important for language are present on cranial endocasts, which provide a picture of the surface of the brain, from the earliest members of our genus. Modern apes have the ability to acquire rudimentary forms of language in specific settings, and all humans acquire language in an apparently universal

manner. Does this mean that *Homo erectus* had language? Or were they only beginning to develop what would later become this distinctive human capacity?

One of the most striking things about language is its diversity-- there are some 2000 languages currently spoken and perhaps an equal number that have recently gone extinct. Language and culture are intimately linked, and we know that the diversity of languages in the world is paralleled by a similar diversity of cultures. *Homo erectus* culture lacks apparent diversity (or at least the diversity of modern culture). For example, hand axes from different parts of the world show some divergence, but the basic form and technique of manufacture are much the same. Similarly language, like culture, is constantly changing and innovating, and we might expect peoples with language to have constant change in their material culture, as we find among modern humans. But Lower Paleolithic culture remained remarkably unchanged for more than a million years.

Perhaps more significantly, language is a complex system of symbolic communication, and in modern cultures complex symbolic communication is not restricted to spoken language but is represented in the entire range of material culture. We find stylistic variation, artistic expression, and experimentation widely expressed in the material culture of modern peoples. People today use material culture to convey ideas and beliefs, along with status, wealth, and identity. There is no evidence of art, or of meaningful stylistic variation or experimentation in the Lower Paleolithic. Those materials that do exist do not appear to have been used to convey meaning to others.

Thus, the material record of *Homo erectus* suggests that complex symbolic communication was not present and it therefore seems likely that *Homo erectus* did not have language, at least not language as we know it today. Their social behavior and ability to move into new and challenging environments suggest that they must have had a complex system of communication, but it does not appear to have the productive and highly symbolic elements of human language. Most scholars today believe that language is a more recent development--perhaps as recent as the last 50,000 years, a time when human culture began to display the kinds of complex symbolic communication (such as art) that *Homo erectus* seems to lack. Indeed, it is the development of complex symboling that is the hallmark of the Cognitive Revolution that accompanies the emergence of our own species, *Homo sapiens*.

### **Consequences of the Behavioral Revolution**

We have seen that early *Homo* and *Homo erectus* developed some of the basic elements of culture, and that these developments are the foundation of what I call the Behavioral Revolution. Early humans began to make tools, and with them, began to scavenge for meat. This behavioral change, in conjunction with an increasing brain, led to other behavioral innovations, such as the creation of home bases, the development of family groups, and perhaps the emergence of marriage. The consequences for humans were enormous. Early *Homo* and, in a more dramatic fashion, *Homo erectus* were able to expand their range out of eastern Africa, with *Homo erectus* eventually colonizing most of the Old World. In doing so, these early humans also drove all other human-like species to extinction. *Homo erectus* remains the most successful human species in terms of its longevity—*Homo erectus* was the dominant human on earth for more than one and a half million years. The Behavioral Revolution, then, started us on the path to becoming what we are today, the most dominant species on earth and one of the most powerful geological forces on the planet.



## The Cognitive Revolution

Most archaeologists agree that *Homo erectus* evolved into *Homo sapiens*, but they disagree about how and where the transition occurred. Most think some populations of *Homo erectus* in eastern Africa (whether southeastern or northeastern is a matter of great debate) evolved into modern humans about 200,000 years ago. There is both fossil and DNA evidence to support this claim, but there are still some who believe the transition was far more complicated, and more dispersed, than either the archaeological or genetic evidence suggests.

## The Emergence of Modern Humans

As of now, the oldest known fossils unambiguously classified as *Homo sapiens* come from Africa. Some of these fossils, discovered in one of the Klasies River Mouth caves in South Africa, are possibly as old as 100,000 years. Other modern-looking fossils of about the same age have been found in Border Cave in South Africa, and at Omo in Ethiopia.

Two theories about the origins of modern humans continue to be debated among archaeologists. One, which can be called the single-origin or "Out of Africa" theory, suggests that modern humans emerged in just one part of the Old World (most likely Africa) and then spread to other parts, replacing other *Homo* species. The second theory, which has been called the multiregional theory, suggests that modern humans evolved in various parts of the Old World after *Homo erectus* spread out of Africa.

According to the single-origin theory, most of the pre-modern *Homo* populations did not evolve into modern humans. Rather, according to this view, all the pre-modern *Homo* species became extinct because they were replaced by modern humans by about 35,000 years ago. The main evidence for the single-origin theory comes from the mitochondrial DNA (mtDNA) of living peoples. In 1987 Rebecca Cann and her colleagues presented evidence that the mtDNA from a sample of people from the United States, New Guinea, Africa, and eastern Asia showed differences suggesting that their common ancestor lived only 200,000 years ago. They further claimed that, since the amount of variation between individuals was greatest in African populations, the common ancestor of all modern humans lived in Africa. (It is generally the case that people living in a homeland exhibit more variation than any emigrant descendent population.) Thus was born what the media called the "mitochondrial Eve" and the "Eve hypothesis" for the origins of modern humans. There were many problems with this initial study, but over the years those problems have been addressed and new and better mtDNA analyses have been performed. Most scholars now agree that the mtDNA of modern humans shows a remarkably small degree of variation (in fact less than half the variation found in most chimpanzee populations), which strongly suggests that we all share a very recent common ancestry.

According to the multiregional theory, *Homo erectus* populations in various parts of the Old World gradually evolved into anatomically modern-looking humans. The theorists espousing this view believe that pre-modern *Homo* species represent phases in the gradual development of more modern anatomical features. Indeed some of these theorists see so much continuity between *Homo erectus* and modern humans that they classify *Homo erectus* as "archaic" *Homo sapiens*.

Continuity is the main evidence used by the multiregional theorists to support their position. In several parts of the world there seem to be clear continuities in distinct skeletal features between *Homo erectus* and *Homo sapiens*. For example, *Homo erectus* fossils from China tend to have broader faces with more horizontal cheek bones than specimens from elsewhere in the world, and these traits also appear in modern Chinese populations. Southeast Asia provides more compelling evidence, according to multiregional theorists. There, a number of traits--including relatively thick cranial bones, a receding forehead, an unbroken browridge, facial prognathism, relatively large cheekbones, and relatively large molars--appear to persist from *Homo erectus* through modern populations.

Most archaeologists today cautiously favor the single origin theory over the multiregional theory, but that may not hold true forever. New fossils, new or revised dates, and new findings in genetics may sway opinion one way or the other. For now, both theories seem reasonable explanations for the origins of modern humans.

## What about the Neandertals?

Regardless of which theory (single-origin or multiregional) is correct, it seems clear that another group of humans, the Neandertals (*Homo neandertalensis*) co-existed with *Homo sapiens* in Europe and the Near East for at

least 20,000 years, and maybe as long as 60,000 years. Who were the Neandertals, and what happened to them?

Neandertals were first discovered in 1856 in the Neander Valley (tal is the German word for “valley”), near Düsseldorf, Germany. The fossils in the Neander Valley were the first that scholars could tentatively consider as an early human (*Homo erectus* was not found until 1891). A few scholars thought that Neandertals were not that different from modern humans, but the predominant reaction was that the Neandertals were too “brutish” and “primitive” to have been ancestral to modern humans. Why? In part because their sloping foreheads, large brow ridges, flattened braincases, large jaws, and nearly absent chins do make them look “brutish” compared to modern humans. But that is itself a case for their similarity to modern humans—they look like they could fit into a modern city without much notice. In addition, Neandertals had larger brains (averaging more than 1,450 cc) than modern humans (slightly more than 1,300 cc), and appear to have been capable of nearly the full range of behavior characteristic of modern humans.

The Neandertals have been the focus of cutting-edge genetic research. In 1997 mitochondrial DNA was extracted from the original Neandertal specimen found in 1856. Analyses of that mtDNA suggested that modern humans and Neandertals split some 600,000 years ago. More recently nuclear DNA has been extracted from a number of Neandertal specimens, and in 2010 a full Neandertal genome was published. It is now clear that, while modern humans and Neandertals are separate species, they did interbreed, though infrequently, and that we do share some unique genes with the Neandertals. We also may have shared some uniquely human behaviors with them.

Stone tools made by Neandertals are typically called Middle Paleolithic and are characterized by a new manufacturing technique that enabled Neandertals to produce flake tools of a predetermined size instead of simply chipping flakes away from a core to make a tool. In this Levallois method, the toolmaker first shaped the core and prepared a “striking platform” at one end. Flakes of predetermined and standard sizes could then be knocked off. Modern humans continued to use the Levallois method, and further developed it into the blade tool technology that characterizes Upper Paleolithic tool assemblages (which I discuss below).

Beyond tools, Neandertal sites contain some evidence of ritual behavior. For example, some Neandertals appear to have been deliberately buried. At Le Moustier, the skeleton of a boy 15 or 16 years old was found with a beautifully fashioned stone ax near his hand. Near Le Moustier, graves of five other children and two adults, apparently interred together in a family plot, were discovered. In some cave sites where Neandertals lived there appear to be shrines constructed of cave bear skulls. Considering that cave bears competed with Neandertals for caves to live in, and would have been dangerous adversaries (they were nine feet tall), rituals to placate or keep bears away makes good sense.

Neandertals seem very much like modern humans, so why did they disappear? Three answers have generally been considered. First, that they inter-bred with modern humans and the unique Neandertal characteristics slowly disappeared from the interbreeding population. Second, that they were killed off by modern humans. And third, that they were driven to extinction due to competition with modern humans.

The interbreeding scenario seems the most probable, yet evidence supporting it is weak. If modern humans and Neandertals inter-bred, we should be able to find “hybrid” individuals in the fossil record. In fact, such hybrid individuals have been found, but all remain controversial because none are unambiguous. Similarly, Neandertals have contributed to our genome but at a lower level than would be expected if interbreeding was widespread. On the other hand, Neandertal tools demonstrate that they adopted new techniques of tool manufacture that were thought to be uniquely associated with *Homo sapiens*. If Neandertals were learning from our direct ancestors, then the idea that they could have interbred and perhaps been absorbed within the modern human population gains credibility.

The genocide scenario, that modern humans killed off Neandertals, has appeal as a sensational story, but little evidence. Not a single “murdered” Neandertal has ever been found, and one might wonder whether, in a fight between the powerful Neandertals and the more gracile modern humans, who might get the better of whom.

Finally, the extinction scenario, that Neandertals simply could not compete with modern humans, seems to have the best archaeological support. There appear to be “refugee” populations of Neandertals in Iberia as recently as perhaps 30,000 years ago. The “retreat” of Neandertals from the Near East, Eastern Europe, and finally Western Europe following the movement of modern humans into the region seems to support the “refugee” interpretation. More importantly, physical anthropologist Erik Trinkaus has argued, based on both physical characteristics of the Neandertal skeleton and their apparent patterns of behavior, that Neandertals were less efficient hunters and gatherers than modern humans. If this is true, a modern human group would have been able to live and reproduce more easily than a Neandertal group in the same territory, and this would likely drive the Neandertals away. When there were no new territories to run to, the Neandertals would go extinct—precisely what the archaeological record seems to suggest.

But were modern humans and their cultures really that much more efficient than pre-modern *Homo* cultures? The short answer is yes.

## **The Conquest of the Earth**

Beginning about 40,000 years ago a new way of life appeared among humans, known as the Upper Paleolithic. In many respects, life-styles during the Upper Paleolithic were similar to life-styles before. People were still mainly hunters and gatherers who lived in small mobile bands. They made their camps out in the open in skin-covered huts and in caves and rock shelters. But the Upper Paleolithic is also characterized by a variety of new cultural developments that allowed humans to rapidly spread across the earth and drive earlier human species (such as *Homo neandertalensis* and remnant populations of *Homo erectus*) to extinction. One of the most striking is the emergence of art—painting on cave walls, decorative objects, and personal ornaments made out of bone, antler, shell, and stone. Perhaps for this as well as other purposes, people began to obtain materials from distant sources. Because more archaeological sites date from the Upper Paleolithic than from any previous period and some Upper Paleolithic sites seem larger than any before, many archaeologists think that the human population increased considerably during the Upper Paleolithic. And new inventions, such as the bow and arrow, the spear-thrower, and tiny replaceable blades, called microliths, appear for the first time. Such inventions may have been crucial in the expansion of Upper Paleolithic peoples across all environments of the Old World, including the Arctic, and into the New World.

### ***The Last Ice Age***

The environment of the Upper Paleolithic was very different from today's. The earth was gripped by the last ice age, with glaciers covering Europe as far south as Berlin, and North America as far south as Chicago. To the south of these glacial fronts was a tundra zone extending in Europe to the Alps and in North America to the Ozarks, Appalachians, and well out onto the Great Plains. Both Europe and North America probably resembled contemporary Siberia and northern Canada. Elsewhere in the world conditions were not as extreme, but were still different from conditions today.

The plants and animals of the Upper Paleolithic world were adapted to these extreme conditions. Among the most important, and dramatic, were the large game animals collectively known as Pleistocene megafauna. These animals, as their name suggests, were huge compared to their contemporary descendants. In North America, for example, giant ground sloths stood some eight or ten feet tall and weighed several thousand pounds. Siberian mammoths were the largest elephants ever to live--some standing more than 14 feet tall. In East Asia, species such as woolly rhinoceros and giant deer were present.

A basic feature of the Upper Paleolithic world was that the technology used for hunting and butchering these large game animals was based on the use of blades, which are single long flakes of stone with two razor-sharp edges. The Upper Paleolithic is also noted for the production of large numbers of bone, antler, and ivory tools; needles, awls, and harpoons made of bone appear for the first time. The tools made by Upper Paleolithic people suggest that they were much more effective hunters and fishers than their predecessors. For example, Upper Paleolithic hunters developed the spear-thrower or *atlatl* (the Aztec word for "spear-thrower"), which propelled a spear off a grooved board to increase the force by which it could be sent through the air, causing it to travel farther and hit harder. The bow and arrow was also used in various places during the Upper Paleolithic; and harpoons, used for fishing and perhaps for hunting reindeer, were invented at this time.

Of course, not all Upper Paleolithic peoples used exactly the same kinds of tools. Indeed, some peoples developed an entirely separate tool making tradition using small blades called microliths. These microliths were often hafted or fitted into handles, one blade at a time or several blades together, to serve as spears, adzes, knives, and sickles. The hafting required inventing a way to trim the blade's back edge so that it would be blunt rather than sharp. In this way the blades would not split the handles into which they might be inserted; the blunting would also prevent the users of an unhafted blade from cutting themselves.

With this new technology, and cognitive abilities that allowed them to be invented, Upper Paleolithic peoples were able to conquer all areas of the earth.

### ***Africa and Asia***

In Africa, the Indian subcontinent, and neighboring areas of Southwest Asia, Upper Paleolithic people slowly expanded in both population and range. Early in the period there are few sites and these appear to be located mainly in places where earlier Middle Paleolithic peoples lived. As time went on habitations were established

across the region. Most sites are small lithic workshops near outcrops of workable stone or campsites near desired resources. Houses were small, oval huts, and communities themselves were small—probably consisting of no more than 20 or 30 people. Hunters sought a wide variety of game, from elephants and rhinoceros to rodents and reptiles. Fish were important resources in many areas. Roots and fruits appear to have been the primary gathered foods. There is tantalizing evidence of a religion involving a female deity and complex burial rituals have been identified at several sites, but there is little more known about the belief system of these people.

In the Levant and Mesopotamia, peoples of the Epipaleolithic (40,000-10,500 B.P.) culture lived in the myriad environments of the region. Most people inhabited small, open-air campsites and occasionally rockshelters and caves, almost all of which are located in the Mediterranean zone. Occupations commonly contain hearths but few other features apart from the rare evidence of lightly constructed circular huts. People lived in small, egalitarian bands of 10 to 25 individuals, comprising a few nuclear families. Some large "megasites" have been found in eastern Jordan, and these may indicate larger periodic or seasonal aggregations of people, perhaps for rituals or to trade, or both.

The basic toolkit of the Epipaleolithic peoples consisted of blade and microlith stone tools. Blades were made into projectile points, scrapers, burins, and microliths were used in composite tools such as sickles. Grinding and pounding equipment of limestone and basalt increased in quantity and diversity during the course of the Epipaleolithic tradition, perhaps as cereals and nuts grew in dietary importance. Plant foods exploited by Epipaleolithic peoples included nuts, fruits, seeds, lentils, and tubers. Animal foods included gazelle, deer, onager, ibex, and fish.

Around 12,000 B.P. a period of significant warming occurred in the Levant. The climate became more moderate and wet, and forests and grasslands spread. During this time period, and perhaps as a direct result of these climatic changes, the Natufian (12,000-10,500 B.P.) culture developed. The peoples of the Natufian tradition are distinct from their Epipaleolithic predecessors and neighbors in being more sedentary and perhaps more socially complex. They appear to have developed a reliance on the intensive harvesting of stands of wild grain and on the annual production of fruits and nuts. The Natufian peoples developed small but relatively permanent villages, ranging in size from perhaps 45 to perhaps more than 200 people. Trade emerged among these communities, and shell from the Mediterranean and Red Sea, obsidian from Anatolia, and greenstone and malachite from a yet unknown source moved between these communities. People also began to bury their dead in formal cemeteries, and the goods placed with the dead and the overall arrangement of the cemeteries suggests emergent social stratification. The Natufians expanded the range of decorative art as well, and began to engrave tools and utensils such as stone bowls with geometric designs and even human and animal figures. These ventures into artistic expression, however, were minor compared to those undertaken by some of the Upper Paleolithic peoples of Europe.

### *Europe*

The earliest Upper Paleolithic peoples of Europe are those of the Aurignacian (40,000-25,000 B.P.) culture. The Aurignacian peoples, like other Upper Paleolithic groups, were hunters of large game animals who wandered seasonally through large territories in small groups. They lived during a period when glacial ice sheets retreated across Europe, and forests and grasslands moved northward. The Aurignacian peoples apparently followed the forests as they moved northward and spread across the European continent. In their spread across Europe, the Aurignacians appear to have displaced the European Neandertals, who went extinct during the time period of the Aurignacian tradition.

Technologically, the Aurignacians were much like other Upper Paleolithic peoples. They had a distinctive blade tool technology, and made extensive use of bone and wood for such items as needles, awls, and even projectile points. The Aurignacians were among the first peoples on earth to create works of expressive art. Aurignacian art includes both personal ornaments, such as shell beads, and more enigmatic items such as engraved antler "batons" and engraved bone that may have been record-keeping or mnemonic devices.

The Aurignacian peoples were followed by peoples of the Perigordian (30,000-22,000 B.P.) culture. Like the Aurignacians, the Perigordians were nomadic or semi-nomadic hunters of large game animals. Individual bands may have congregated in some highly productive locations during part of the year. The site at Dolni Vestonice in what is now the Czech Republic, dated to around 25,000 years ago, consisted of four tent-like huts, probably made from animal skins, with a large open hearth in the center. Around the outside were mammoth bones, some rammed into the ground, which suggests that the huts were surrounded by a wall. All told, there were bone heaps from about 100 mammoths. Each hut probably housed a group of related families—about 20 to 25 people. (One hut was approximately 27 by 45 feet and had five hearths distributed inside it, presumably one for each family.) With 20 to

25 people per hut, and assuming that all four huts were occupied at the same time, the population of the settlement would have been 100 to 125.

Up a hill from the settlement was a fifth and different kind of hut. It was dug into the ground and contained an oven and more than 2,300 small, fired fragments of animal figurines. There were also some hollow bones that may have been musical instruments. Another interesting feature of the settlement was a burial of a woman with a disfigured face. She may have been a particularly important personage, because her face was found engraved on an ivory plaque near the central hearth of the settlement.

The Solutrean (22,000-18,000 B.P.) culture followed the Perigordian. The Solutreans also hunted large game in small and apparently widely-separated groups. Solutrean stone tool technology is marked by the development of sophisticated flaked projectile points and knives. Solutreans apparently invented both the eyed needle and the spear thrower. The Solutrean tradition is followed by the Magdalenian (18,000-11,000 B.P.) culture, the last Upper Paleolithic tradition in Europe. The Magdalenian peoples developed an extensive bone tool industry in addition to their own unique styles of stone blade tools. Like the other Upper Paleolithic Europeans, they lived in small mobile groups and subsisted by hunting large game.

As with the other European Upper Paleolithic cultures, most of the Solutrean and Magdalenian sites that have been excavated were situated in caves and rock shelters. Laugerie-Haute in southwestern France is a good example of a Solutrean cave site. It was occupied for at least 1,000 years, and may have served as a central over-wintering site for bands living in the region. Many changes were made to the cave to make it more habitable: numerous stone-lined hearths were created, there is evidence of stone paved floors, and tents were apparently built to keep out the cold. Reindeer was the primary food source for people living in the cave, and there is a wide variety of stone manufacturing debris suggesting that the site also served as a central place for the manufacture of stone tools and other craft goods. Some open-air sites have also been excavated. Gonnertsdorf, for example, is an open-air Magdalenian site in western Germany. Numerous habitations are evident from rock-lined hearths surrounded by stone slabs which probably formed the floor of tents, and dense occupational debris.

### ***East Asia***

In East Asia there are a number of regionally-distinctive Upper Paleolithic cultures. The glacial epochs that characterize the Upper Paleolithic world had varying effects across East Asia. Open steppelands and forests appear to have dominated the eastern portions of Central Asia throughout the Pleistocene and Holocene, and Upper Paleolithic peoples there hunted large game on the vast open plains and lush alluvial valleys of the region. They left little material debris behind, and almost nothing is known about their ways of life. More is known about the Upper Paleolithic peoples of Southeast Asia, but, interestingly, their stone tools lack evidence of blade technology. Most tools are crude choppers and flakes. One reason for this may be a lack of suitable stone. Another might be the presence of bamboo which grew throughout the region even during the Pleistocene, and can be used to make sharp cutting tools. The region appears to have been much dryer than today, with parklands and grasslands common. Herds of large mammals lived in these environments, and became the predominant prey for Upper Paleolithic hunters. In coastal areas marine resources were also important, and since the islands of Indonesia, New Guinea, and Australia were populated during this time, Southeast Asian Upper Paleolithic peoples must have had boats.

Australia was colonized by Upper Paleolithic peoples from Southeast Asia sometime before 40,000 years ago. These people discovered a continental-sized landmass dominated by grasslands and savanna woodlands teeming with marsupials, birds, and reptiles. Some of the marsupials and birds were very large, similar in size to the megafauna found in Southeast Asia, and went extinct rapidly after human colonization, perhaps due to human hunting. Early Australians were hunters and gatherers, and appear to have focused on locally-available resources. Coastal groups, for example, made extensive use of the sea, while groups in the southeast intensively fished the many local lakes. At Lake Mungo, for example, fish remains are plentiful. Lake Mungo peoples also hunted wallabies and kangaroo, and likely collected a wide variety of plant food from the marshy lakeshores. Rockshelters seem to have been preferred locations for settlements, although many open air sites are also known (like Lake Mungo). No evidence for housing has been found, suggesting simple brush huts or skin tents were all that were used. Groups seem to have been small and mobile, much like Upper Paleolithic peoples elsewhere in Southeast Asia.

### ***Upper Paleolithic Art***

What accounts for the dramatic success of Upper Paleolithic peoples in spreading across the earth and displacing the pre-modern peoples living there? The most widely-accepted answer is that a Cognitive Revolution occurred among modern humans roughly 50,000 years ago, one which probably involved the emergence of modern

language capabilities, and which, in turn, allowed for the development of a rich world of creativity and imagination. Nowhere is this Cognitive Revolution of creativity and imagination more obvious than in the development of art.

The earliest discovered traces of art are beads and carvings, and then paintings, from Upper Paleolithic sites. We might expect that early artistic efforts were crude, but the cave paintings of Western Europe show a marked degree of skill. So do the naturalistic paintings on slabs of stone excavated in southern Africa. Some of those slabs appear to have been painted as much as 28,000 years ago, which suggests that painting in Africa is as old as painting in Europe. But painting may be even older than that. The early Australians may have painted on the walls of rock shelters and cliff faces about 30,000 years ago.

The subjects of the paintings are mostly animals. The paintings rest on bare walls, with no backdrops or environmental trappings. Perhaps, like many contemporary peoples, Upper Paleolithic men and women believed that the drawing of a human image could cause death or injury. If that were indeed their belief, it might explain why human figures are rarely depicted in cave art. Another explanation for the focus on animals might be that these people sought to improve their luck at hunting. This theory is suggested by evidence of chips in the painted figures, perhaps made by spears thrown at the drawings. But if hunting magic was the chief motivation for the paintings, it is difficult to explain why only a few show signs of having been speared. Perhaps the paintings were inspired by the need to increase the supply of animals. Cave art seems to have reached a peak toward the end of the Upper Paleolithic period, when the herds of game were decreasing.

Upper Paleolithic art was not confined to cave paintings. Many shafts of spears and similar objects were decorated with figures of animals. Alexander Marshack has an interesting interpretation of some of the engravings made during the Upper Paleolithic. He believes that as far back as 30,000 years ago, hunters may have used a system of notation, engraved on bone and stone, to mark the phases of the moon. If this is true, it would mean that Upper Paleolithic people were capable of complex thought and were consciously aware of their environment.

### *The Americas*

Because no remains of early humans have been found in the Americas despite over a century of active research on the peopling of the New World, it seems clear that humans first came to the New World sometime in the Upper Paleolithic. But exactly when these migrations occurred is subject to debate, particularly about when people got to areas south of Alaska. On the basis of similarities in biological traits such as tooth forms and blood types, and on possible linguistic relationships, anthropologists agree that Native Americans originally came from Asia. The traditional assumption is that they came to North America from Siberia, walking across a land bridge (Beringia) that is now under water (the Bering Strait) between Siberia and Alaska. The ice sheets or glaciers that periodically covered most of the high latitudes of the world contained so much of the world's water (the ice sheets were thousands of feet thick in some places) that Beringia was dry land in various periods, some lasting for thousands of years. Since then, the glaciers have mostly melted, and the Bering "bridge" has been completely covered by a higher sea level.

The earliest widely accepted dates place humans in the Americas by at least 12,500 years ago, and maybe as early as 18,000 years ago. These first inhabitants of the North America were members of the Paleoindian culture. The Paleoindians were nomadic hunters and gatherers who relied heavily on large game animals. An excellent example of an early Paleoindian camp site is Monte Verde in Chile. Dated to around 12,500 years ago, Monte Verde contains remarkably well-preserved archaeological deposits, including remains of a long tent-like structure associated with impressions of human footprints, hearths, clusters of animal and plants foods, and a wide variety of stone, bone, and wood tools.

The frame of the tent-like structure at Monte Verde was constructed of logs and planks anchored by stakes, and the walls were of poles covered with animal hides. Rope made of junco weed was found wrapped around wooden posts and around wooden stakes recovered among the remains of the structure. Inside the structure were what appeared to be individual living spaces divided by planks and poles. On the floors of each living space were fire pits lined with clay, stone tools, and the remains of edible seeds, nuts, and berries. Outside the structure were two large communal hearths, a store of firewood, wooden mortars with their grinding stones, and even three human footprints in the clay near a large hearth.

A second structure at Monte Verde was made of wooden uprights set into a foundation of sand and gravel hardened with animal fat. Mastodon carcasses had been butchered in this structure, hides prepared, and tools manufactured. There may even have been healing carried out with the aid of medicinal plants. These combined activities suggest this structure was a public or non-residential one unlike the long tent.

The remains of a wide variety of edible plants, along with mastodon, paleollama, small animals, and freshwater mollusks were recovered from the site, and it appears that aquatic plants from marshes, bogs, and

lagoons provided the greatest variety and, along with meat, the bulk of the diet. Most of these wetlands were located far away from the site, and suggest that the people living at Monte Verde regularly traveled to distant locations to gather, or they acquired food and other items from distant locations through trade.

Many of the artifacts excavated at Monte Verde are of wood, and bone artifacts are also present. Three different stone tool technologies have been described: chipped bifaces, ground bola stones, and pebble tools. Analysis of the stone tools, bone, plant, and other artifact collections suggests a mixed hunting and gathering economy focused on many different ecological zones.

Although big game may have been most important in many area of North America, Paleoindian people in woodland regions of what is now the eastern United States seem to have depended more heavily on plant food and smaller game. In some woodland areas, fish and shellfish may have been a vital part of the diet. On the Pacific coast, some Paleoindian people developed food-getting strategies more dependent on fish. And in other areas, the lower Illinois River valley being one example, Paleoindian people who depended on game and wild vegetable foods managed to get enough food to live in permanent villages of perhaps 100 to 150 people.

### **Consequences of the Cognitive Revolution**

If the Behavioral Revolution allowed early humans to move out of Africa and spread across most of the Old World, the Cognitive Revolution allowed modern humans to both drive those earlier humans to extinction and to conquer every corner of the earth. But beyond opening new physical worlds to live in, the Cognitive Revolution opened new worlds of creativity and imagination. Tools became more variable and complex as toolmakers tinkered with older forms and developed new innovations. New food sources—particularly fish and shellfish—started to be used, in part because new technology provided easy ways of capturing these animals, but also because humans had developed the cognitive capacity to identify new sources of food and learn how to process those foods so that they could be safely eaten. More dramatically, humans began to tinker with their environments. Settlements became more substantial and were used again and again over many generations. These settlements shaped the local environment, and as humans used the local environment, local plants and animals began to be shaped as well. This active manipulation of local plants and animals led to the Neolithic Revolution, the subject of the next chapter.

## **The Neolithic Revolution**

After about 10,000 years ago the glaciers began to disappear. With their disappearance came major environmental changes. The melting of the glacial ice caused the oceans to rise, and, as the seas moved inland, the waters inundated some of the richest fodder-producing coastal plains, creating islands, inlets, and bays. Other areas were opened up for human occupation as the glaciers retreated and the temperatures rose. The cold, treeless plains, tundras, and grasslands of Eurasia and North America eventually gave way to dense mixed forests, mostly birch, oak, and pine, and the large Pleistocene megafauna became extinct. The warming waterways began to be filled with fish and other aquatic resources.

Archaeologists believe that these environmental changes induced some populations to alter their food-getting strategies. When the tundras and grasslands disappeared, hunters could no longer obtain large quantities of meat simply by remaining close to large migratory herds of animals, as they probably did during Upper Paleolithic times. Even though deer and other game were available, the number of animals per square mile (density) had decreased, and it became difficult to stalk and kill animals sheltered in the thick woods. Thus, in many areas of the world people turned from a reliance on big-game hunting to the intensive collecting of wild plants, mollusks, fish, and small game to make up for the extinction of the large game animals they had once relied upon.

Environmental change also seems to have hastened the process of settling down that had begun in many areas of the world. As people began to know and exploit the varied resources in local areas, they moved less, and developed new, regionally-distinctive cultures. Eventually these people began to not only exploit the varied plants and animals in their changing environments, they began to change the plants and animals themselves. The active manipulation of plants and animals marks the beginning of the Neolithic Revolution.

### **Domestication**

Domestication refers to the process through which humans modify plants and animals to enhance characteristics they desire. For example, during the process of domestication wild wheat and barley developed a tough rachis—the seed-bearing part of the stem. Wild forms of wheat and barley have a brittle rachis which shatters easily, releasing the seeds. Domesticated grains have a tough rachis, which does not release seeds until they are torn from the stem by human hands. In addition, grains of wild barley and wheat have a tough shell which protects the seed from premature exposure, while domesticated grains have a brittle shell that can be easily separated, which facilitates preparing the seed for grinding into flour.

How did domesticated plants get to be different from their wild ancestors? The simple answer is that humans, either purposefully or accidentally, facilitated the growth of plants with characteristics they desired. Consider how the rachis of wheat and barley may have changed. When wild grain ripens in the field, the rachis shatters easily, scattering the seed. When humans began harvesting wild wheat with sickles, many of the seeds probably fell to the ground rather than being collected with the cut stalk. Those that were collected had a tougher rachis and did not fall off when the stalk was cut. If humans sowed these seeds, the next years' crop would likely have many tough-rachis plants. If in each successive harvest seeds from tough-rachis plants were the least likely to be lost, tough-rachis plants would come to predominate, and the plant would become domesticated. It would have the tough-rachis characteristic desired by humans and, perhaps more significantly, would have difficulty reproducing without human intervention because seeds would rarely fall off tough-rachis plants on their own.

In some species the process of domestication is even more dramatic. Maize, for example, has become entirely dependent upon humans for reproduction. Maize was domesticated from teosinte, a tall, wild grass that still grows widely in Mexico. Teosinte is quite different from maize in several important ways. Teosinte stalks do look a lot like maize, but teosinte has a "spike" to which 7 to 12 individual seeds are attached in a single row, unlike the maize cob which has many seeds in many rows. Each teosinte seed has its own brittle shell, while the entire maize cob is covered with a tough husk. This is a profound change, as maize requires a human to open the husk without damaging the seeds in order for the seeds to be exposed and disperse.

### **Where and When did the Neolithic Revolution Take Place?**

In the Old World, the earliest domesticates are wheat and barley, which appear in the Levant about 10,500 B.P. Sheep and goats were domesticated somewhat later, perhaps by 9000 B.P. The earliest clear evidence of cereal



cultivation outside of the Levant is from southwest China where people cultivated millet as early as 9000 B.P. These people also had domesticated pigs, and these also appeared about 9000 B.P. Rice was domesticated somewhat later, probably about 6000 B.P. In Africa sorghum appears to have been an early domesticate, appearing by 8000 B.P. While the cattle, sheep, and goats relied upon by many African pastoral groups were first domesticated in the Levant, recent studies of cattle genetics has demonstrated that several African groups independently domesticated cattle, perhaps as early as 9500 B.P.

Maize was domesticated in the highland valleys of Mesoamerica some 9000 years ago. Bottle gourds, runner beans, and squash were also domesticated about the same time. Outside of Mesoamerica, evidence of independent domestication of plants comes from at least two areas in the New World: South America and eastern North America. The first clear South American domesticate was the chili pepper, which appears in the Andes about 9000 B.P., making domestication in the Andes nearly as old as in Mesoamerica. Potatoes, lima beans, peanuts, amaranth, and quinoa were domesticated sometime before 7000 B.P. Many of the plants grown in the eastern North America, such as corn, beans, and squash, were apparently introduced from Mesoamerica. However, at least three seed plants were domesticated independently in eastern North America at an earlier time—sunflowers, sumpweed, and goosefoot—were cultivated perhaps as early as 7000 B.P.

Domestic animals were not as important to subsistence in the New World as they were in the Old World. In North and Middle America, dogs and turkeys were the only domestic animals before the arrival of the Spanish. In the Andes, however, domesticated alpaca and llama were a significant part of the economy, and were used for meat, transportation, and wool. They were domesticated sometime before 7000 B.P. Guinea pigs, raised for their meat, were domesticated in the Andes at about the same time. The reason for the relatively few domesticated animals in the New World probably has to do with the available species. The Old World plains and forests were the homes for the wild ancestors of the cattle, sheep, goats, pigs, and horses we know today. In the New World, the Pleistocene herds of horses, mastodons, mammoths, and other large animals were long extinct, allowing few opportunities for domestication of large animals.

From the last two paragraphs one can readily see that food production began all around the world within a relatively short period of time. Between 10,000 and 7000 years ago people everywhere were actively domesticating plants and animals. In the two million years since our genus first made its appearance, this is a remarkably brief period of time, and forces us to ask an interesting question: should we think about the shift to food production on the scale of individual cultures, or on a larger, perhaps global, scale? Was the transition to food production a human phenomenon, or a local one that just happened to occur at about the same time all over the world? How could the transition to food production be a global phenomenon?

One of the first answers was provided by archaeologists Robert Braidwood and Gordon Willey. They argued that the reason food production began at about the same time all over the world was because people did not undertake domestication until they had learned a great deal about their environment and until their culture had evolved enough for them to handle such an undertaking. In their view, no human culture was capable of making the shift to food production until after the last ice age. Before that time the environment was too cold in most of the places humans lived for food production to be successful (northern climates today generally lack food production). Perhaps more importantly, human culture did not display the sophisticated tool making and artistic expression suggesting complex abstract thought before the last ice age. In short, humans may not have had the intellectual abilities to become food producers until after the last ice age.

Alternatively, physical anthropologist Mark Cohen argued it was population pressure on a global scale that explains why food production was adopted by so many of the world's peoples within the span of a few thousand years. He suggested that hunter-gatherers all over the world gradually increased in population so that by about 10,000 years ago the world was more or less filled with food collectors. Thus people could no longer relieve population pressure by moving to uninhabited areas. To support their increasing populations, they would have had to exploit a broader range of less desirable wild foods; that is, they would have had to switch to broad-spectrum collecting, or they would have had to increase the yields of the most desirable wild plants by weeding, protecting them from animal pests, and perhaps deliberately planting the most productive among them. Cohen thinks that people might have tried a variety of these strategies but would generally have ended up depending on cultivation because that would have been the most efficient way to allow more people to live in one place.

Is there evidence to support either of these theories? As I noted earlier in the chapter about what I call the human Cognitive Revolution, art, ritual, and sophisticated tools (and potentially modern language ability) emerged just prior to the last ice age, and as soon as the ice age was over and conditions ameliorated, domestication began. These may be simple coincidences, but it is interesting that there is some tantalizing evidence suggesting that horses may have been kept (though probably not domesticated) by Upper Paleolithic peoples in Europe. The evidence

includes unique wear on horse teeth caused by gnawing on wood that today is only found among horses kept in corrals or stalls, and a carving of a horse that appears to have a nose bridled. There is also evidence for selective killing of young male reindeer at some European Upper Paleolithic sites, and in Neolithic contexts such selective killing is often associated with domesticated herds. So the process of domestication may have emerged at the same time as art and sophisticated tools, but had to wait until the climate ameliorated before it could be used to develop dependable domestic plants and animals.

It is also clear that that population and food production are strongly associated with one another. Figure 4.1 presents a table demonstrating the association between population and agriculture. I created the data upon which this table and the others I present in this and the next two chapters using the *Encyclopedia of Prehistory* (2001-2002). Here the cases are archaeological cultures, and in Figure 4.1 the variables are Agriculture and Density of Population. Each variable has three values. For Agriculture these values are 1, no food production; 2, 10% or more of food is produced, but it is still secondary to food collection; and 3, food production is the primary source of food. The values for Density of Population are 1, less than 1 person per square mile; 2, 1 to 25 persons per square mile; and 3, more than 26 persons per square mile.

			DENSITY			Total
			1	2	3	
AGRICULT	1	Count	113	6	0	119
		Expected Count	57.6	49.0	12.4	119.0
	2	Count	17	5	2	24
		Expected Count	11.6	9.9	2.5	24.0
	3	Count	10	108	28	146
		Expected Count	70.7	60.1	15.2	146.0
Total	Count	140	119	30	289	
	Expected Count	140.0	119.0	30.0	289.0	

Figure 4.1 Cross-tabulation of Agriculture and Population Density.

Figure 4.1 is called a cross-tabulation table. It shows the number of cases that have a particular value on both variables. For example, the cell at the top left shows the number of cases with a value of 1 on both variables (here there are 113 such cases), while the bottom right shows the number of cases with a value of 3 on both variables (here there are 28 cases). The other number in each cell of the table is the number of cases expected to have a given value on the two variables if there is no association between them; that is, the expected number of cases with those values by random chance. Here one could expect 58 cases with a value of 1 on both variables by chance, and 15 cases with a value of 3 on both variables by chance. By comparing the actual number of cases in each cell with the expected number, we can see if, and how, two variables are associated. If the actual and expected numbers are about the same, the two variables are not associated because their values follow a random pattern. If the actual and expected values differ, those differences tell us how the two variables are associated.

Looking at Figure 4.1 we can see that there are almost twice as many cases with a value of 1 for each variable as is expected by chance, and almost the same with cases having a value of 3 for each variable. There are also far more cases with a value of 2 for Density of Population and 3 for Agriculture than is expected by chance (there are 108 such cases and only 60 expected). On the other hand, there are far fewer cases with a value of 1 for Density of Population and 3 for Agriculture than expected by chance. What Figure 4.1 tells us is that Density of Population and Agriculture are strongly associated. As Density of Population goes up, so does Agriculture, and vice versa. This would seem to support Cohen's argument.

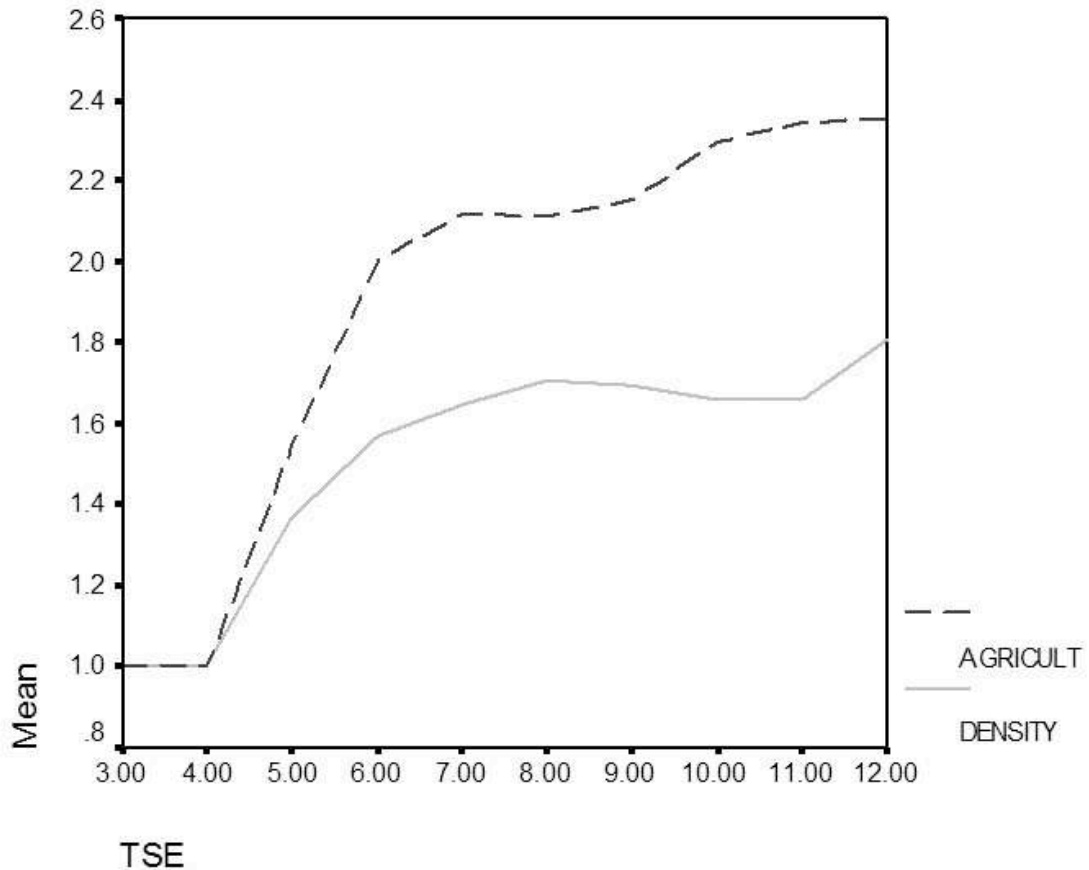


Figure 4.2 Line Graph of Average Agriculture and Population Density Values for the Last 10,000 Years

However, there is a “chicken and egg” problem here. While population and food production are strongly associated, as Cohen argues, there is no way here to tell which came first or whether one caused the other. In fact, the two seem to go hand in hand, so that neither seems causal for the other, as we can see from Figure 4.2. Figure 4.2 is a graph of Agriculture and Density of Population over time for the last 10,000 years. To make this graph I calculated the average value of Agriculture and Density of Population for all cases at 1000-year intervals and then charted them. The horizontal axis shows the time in years B.P. and the vertical axis the average value for all cases on each variable. What you can see is that Agriculture and Density of Population parallel one another throughout prehistory, and one does not seem to precede the other.

In addition to this “chicken and egg” problem there also seems to be a logical problem with Cohen’s argument, as Density of Population was not high everywhere that saw food production emerge. Indeed, even today there are areas of the earth where population density is very low, so to argue that global population rose to the point that food production was necessary seems a problematic argument. In addition, some scholars would argue that the time period within which domestication occurred around the world was at least 3000 years, and 3000 years is a long, long time no matter how you look at it. These scholars also argue that the processes through which domestication occurred were very different in different parts of the world. Before going on to consider other theories for why people made the shift from food collection to food production, then, let’s first gain a more complete understanding of how this transition occurred, by comparing the process of domestication as evidenced in the archaeological record from the Iranian Neolithic site of Ali Kosh and the Highland Mesoamerican Archaic site of Guila Naquitz.

#### ***Food Production in Southwest Asia***

For some time most archaeologists have thought that the Fertile Crescent, the arc of land stretching up from Israel and the Jordan Valley through southern Turkey and then downward to the western slopes of the Zagros Mountains in Iran, was the earliest center of plant and animal domestication. We know that several varieties of domesticated wheat were being grown there after about 10,000 B.P., as were oats, rye, barley, lentils, peas, and various fruits and nuts (apricots, pears, pomegranates, dates, figs, olives, almonds, and pistachios). It appears that

the first animals were domesticated in the Near East. One of the most important sites with evidence of early domestication is Ali Kosh.

Ali Kosh is in what is now southwestern Iran, and preserved there are the remains of a Neolithic community that started out about 9500 B.P. People at that time were living mostly on wild plants and animals. From 9500 to 8750 B.P., the people at Ali Kosh built small, multiroom structures from unbaked clay bricks. The excavated rooms are small, seldom more than 2 meters by 3 meters, and there is no evidence that the structures were definitely houses where people actually spent time or slept. Instead they may have been storage rooms. There is some evidence that the people at Ali Kosh may have moved for the summer (with their goats) to the grassier mountain valleys nearby, which were just a few days' walk away.

From 8750 to 8000 B.P., the people increased their consumption of cultivated food plants. Forty percent of the seed remains in the hearths and refuse areas were from domesticated wheat and barley. The proportion of the diet coming from wild plants was much reduced, probably because the cultivated plants have the same growing season and grow in the same kind of soil as the wild plants. Grazing by the goats and sheep that were kept may also have contributed to the reduction of wild plant foods in the area and in the diet. The village may or may not have gotten larger, but the multiroom houses definitely had. The rooms were now larger than 3 meters square; the walls were much thicker; and the clay bricks were held together by a mud mortar. Also, the walls now often had a coat of smooth mud plaster on both sides. The stamped-mud house floors were apparently covered with rush or reed mats. There were courtyards with domed brick ovens and brick-lined roasting pits. Understandably, considering the summer heat in the area, none of the ovens found were inside a house.

Even though the village probably contained no more than 100 individuals, it participated in an extensive trading network. Seashells were probably obtained from the Persian Gulf, which is some distance to the south; copper may have come from what is now central Iran; obsidian was still coming from eastern Turkey; and turquoise somehow made its way from what is now the border between Iran and Afghanistan. Some of these materials were used as ornaments worn by both sexes—or so it seems from the remains of bodies found buried under the floors of houses.

After about 7500 B.P., the area around Ali Kosh began to show signs of a much larger population, apparently made possible by a more complex agriculture employing irrigation and plows drawn by domesticated cattle. This slow, steady transition from food collection to food production is characteristic of the Neolithic Revolution in Southwest Asia, and indeed, in the Old World generally.

### ***Food Production in Mesoamerica***

A very different pattern of domestication is seen in Mesoamerica. Here a semi-nomadic hunting and gathering lifestyle persisted long after people first domesticated plants. How can this be? Don't people have to settle near their crops to take care of them? Once they have domesticated plants, don't they stop collecting wild plants? The answer is no. In Mesoamerica people sowed a variety of plants, but after doing so they went on with their seasonal rounds of hunting and gathering, and came back later to harvest what they had sown. Many of the early domesticates in Mesoamerica were not basic to subsistence, even if they were highly desirable. Domestication may have been a way for Mesoamerican peoples to make desirable plants more common in their environment. For example, one of the first domesticates was the bottle gourd. These were not eaten, but rather were used to carry water. Joyce Marcus and Kent Flannery hypothesize that the bottle gourd was domesticated by deliberately planting them in areas where they did not grow naturally, so that as groups moved through those areas they always had access to gourds for carrying water.

Bottle gourds are only one of many early domesticates from Mesoamerica. Others include tomatoes, cotton, a variety of beans and squashes and, perhaps most importantly, maize. These were probably domesticated by simple manipulation of wild varieties. Runner beans, for example, grow naturally in the soils on the slopes outside of rockshelters and caves. It is not a stretch of the imagination to envision Mesoamerican peoples harvesting these beans (for their roots to begin with--non-domestic runner bean seeds are tiny and probably were not eaten) and selectively planting those with desired qualities--like large seeds. Similarly, only the seeds of wild squashes were likely eaten by Mesoamerican peoples, as the flesh of wild squashes often has an unattractive smell and taste. But they may have selectively planted seeds from individual squashes with better tasting flesh and larger seeds than others, eventually producing the domestic varieties over time.

People who lived in Mesoamerica are often credited with the invention of planting maize, beans, and squash together in the same field. This planting strategy provides some important advantages. Maize takes nitrogen from the soil; beans, like all legumes, put nitrogen back into the soil. The maize stalk provides a natural pole for the bean plant to twine around, and the low-growing squash can grow around the base of the tall maize plant. Beans supply

people with the amino acid lysine, which is missing in maize. Thus, maize and beans together provide all the essential amino acids that humans need to obtain from their food.

The Guila Naquitz cave, excavated in the 1960s by Kent Flannery, provides a good picture of early domestication in highland Mesoamerica. Here small groups of people--probably only a single family at a time--lived intermittently (and probably seasonally) over a period of two thousand years (ca. 10,900 B.P. to 8700 B.P.), the period during which plants were domesticated. The cave itself is located in the thorn forest of the upper piedmont above the floor of the Valley of Oaxaca. The residents of Guila Naquitz hunted deer and peccary (a wild pig-like animal) with spears and spear throwers, and trapped small animals such as rabbits. They also collected plant foods from the surrounding area, particularly prickly pear fruits, cherries, acorns and pinion nuts from the forests above the cave, along with agave hearts, onions, and various other nuts and fruits from a variety of thorn forest plants.

Also found in Guila Naquitz cave are the remains of domesticated plants, including bottle gourd and several varieties of squashes. How did these come to be in the cave? Were the inhabitants planting fields of squashes? Probably not in the way one thinks of planting a field today. Squashes are common wild plants in highland Mesoamerica, and thrive in disturbed soils such as those outside of caves. It may be that the inhabitants of the Guila Naquitz cave knew squashes would grow easily near their cave, and so actively planted some with better tasting flesh or larger seeds than those that might naturally grow there. Domestication and the use of domesticated plants would be rather informal--a supplement to a diet already rich in animal and plant species. This picture seems much different from that presented by Old World sites such as Ali Kosh. Domestication in Guila Naquitz appears to have been accomplished by hunters and gatherers who supplemented their basic diet with some desired plants (squashes with tasty flesh, for example); there was no rapid change or innovation that enabled the people to rely on domesticated plants.

### **Why Did the Neolithic Revolution Occur?**

The comparison of the emergence of food production at Ali Kosh and Guila Naquitz demonstrates how diverse the patterns of domestication were across the world. With this kind of diversity, one might wonder how archaeologists can hope to develop a general answer to the question of why food production developed. Archaeologists Lewis Binford and Kent Flannery suggested that a general answer must begin with the idea that a change in external circumstances must have induced or favored food production over food collection. As Flannery pointed out, there is no evidence of a great economic incentive for hunter-gatherers to become food producers. In fact, some contemporary hunter-gatherers obtain adequate nutrition with far less work than many agriculturalists. So what might push food collectors to become food producers?

Binford and Flannery thought that the incentive to become food producers may have been a desire to reproduce what was wildly abundant in the most bountiful or optimum hunting and gathering areas. Because of population growth in the optimum areas, people might have moved to surrounding areas containing fewer wild resources. It would have been in those marginal areas that people might have first turned to food production in order to reproduce what they used to have. The Binford-Flannery model seems to fit the archaeological record in the Levant, the southwestern part of the Fertile Crescent, where population increase did precede the first signs of domestication. But as Flannery admitted, in some regions, such as southwestern Iran where Ali Kosh is located, the optimum hunting-gathering areas do not show population increase before the emergence of domestication.

Some archaeologists have recently returned to an older idea that climatic change might have been the change in external circumstances that encouraged the development of food production. It seems clear from the evidence now available that the climate of Southwest Asia about 13,000 to 12,000 years ago became more seasonal: The summers got hotter and drier than before and the winters became colder. These climatic changes may have favored the emergence of annual species of wild grain, which archaeologically we see proliferating in many areas of Southwest Asia. There people intensively exploited these seasonal grains, developing an elaborate technology for storing and processing the grains and giving up their previous nomadic existence to do so. The transition to agriculture may have occurred when sedentary foraging no longer provided sufficient resources for the population. This could have happened because sedentarization led to population increase and therefore resource scarcity, or because local wild resources became depleted after people settled down in permanent villages. In the area of Israel and Jordan, some of the people apparently turned to food production, probably to increase the supply of grain, whereas other people returned to nomadic food collection because of the decreasing availability of wild grain.

Change to a more seasonal climate might also have led to a shortage of certain nutrients for food collectors. In the dry seasons certain nutrients would have been less available. For example, grazing animals get lean when

grasses are not plentiful, so meat from hunting would have been in short supply in the dry seasons. Although it may seem surprising, some recent hunter-gatherers have starved when they had to rely on lean meat. If they could have somehow increased their carbohydrate or fat intake, they might have been more likely to get through the periods of lean game. So it is possible that some wild-food collectors in the past thought of planting crops to get them through the dry seasons when hunting, fishing, and gathering did not provide enough carbohydrates and fat for them to avoid starvation.

Mesoamerica presents a very different picture, because the early domesticates were not important to subsistence. Theories about population pressure and nutrient shortage don't seem to fit Mesoamerica well. However, there were apparently shortages of desired plants, such as bottle gourds, and domestication may well have occurred as humans actively sowed these desired plants. The difference between this model and those above is that humans in Mesoamerica were apparently not forced into domestication by climate change or population pressure, but actively turned to domestication to obtain more of the most desired or useful plant species. The most interesting case is maize, which only became a staple food some 2500 or more years after it was first domesticated. Why did it become a staple? Probably both because it was a suitable staple crop (especially when inter-cropped with beans and squash, as discussed earlier) and because people liked it, so they grew it in large quantities. Over time, and perhaps because of conflict, population pressure, and other forces similar to those that apparently led to domestication in Southwest Asia, people in Mesoamerica and later North and South America came to rely upon maize as the dietary mainstay.

Unlike Binford and Flannery, who argued a change in external circumstances must have led to food production, archaeologist Barbara Bender argued that internal changes, particularly the emergence of status differences and formal leaders, may have fostered food production. In her model the desire to have a surplus of storable foods to support feasting, craft production, and public works would have encouraged food production. She points out that among the Natufian peoples of the Levant there is not only evidence for intensive harvesting and storage of wild grains, but also some of the earliest evidence for status differences.

			STRATIFI			Total
			1	2	3	
AGRICULT	1	Count	110	6	3	119
		Expected Count	56.0	34.2	28.8	119.0
	2	Count	16	7	1	24
		Expected Count	11.3	6.9	5.8	24.0
	3	Count	10	70	66	146
		Expected Count	68.7	41.9	35.4	146.0
Total	Count	136	83	70	289	
	Expected Count	136.0	83.0	70.0	289.0	

Figure 4.3 Cross-tabulation of Agriculture and Social Stratification

Is their evidence to support Bender's model? Figure 4.3 shows a cross-tabulation of Agriculture and Social Stratification. What we see is that cases lacking agriculture also lack social stratification (stratification value 1), while cases dependent upon agriculture tend to have moderate or high levels of social stratification (values 2 and 3). The association between Agriculture and Social Stratification appears to support Bender's model, but we face the same "chicken and egg" problem that we did with Cohen's model—which came first, and did one cause the other? Looking at a graph of Agriculture and Social Stratification over the last 10,000 years presented in Figure 4.4, we can see that, like Density of Population, the two seem to increase together, with neither clearly preceding the other.

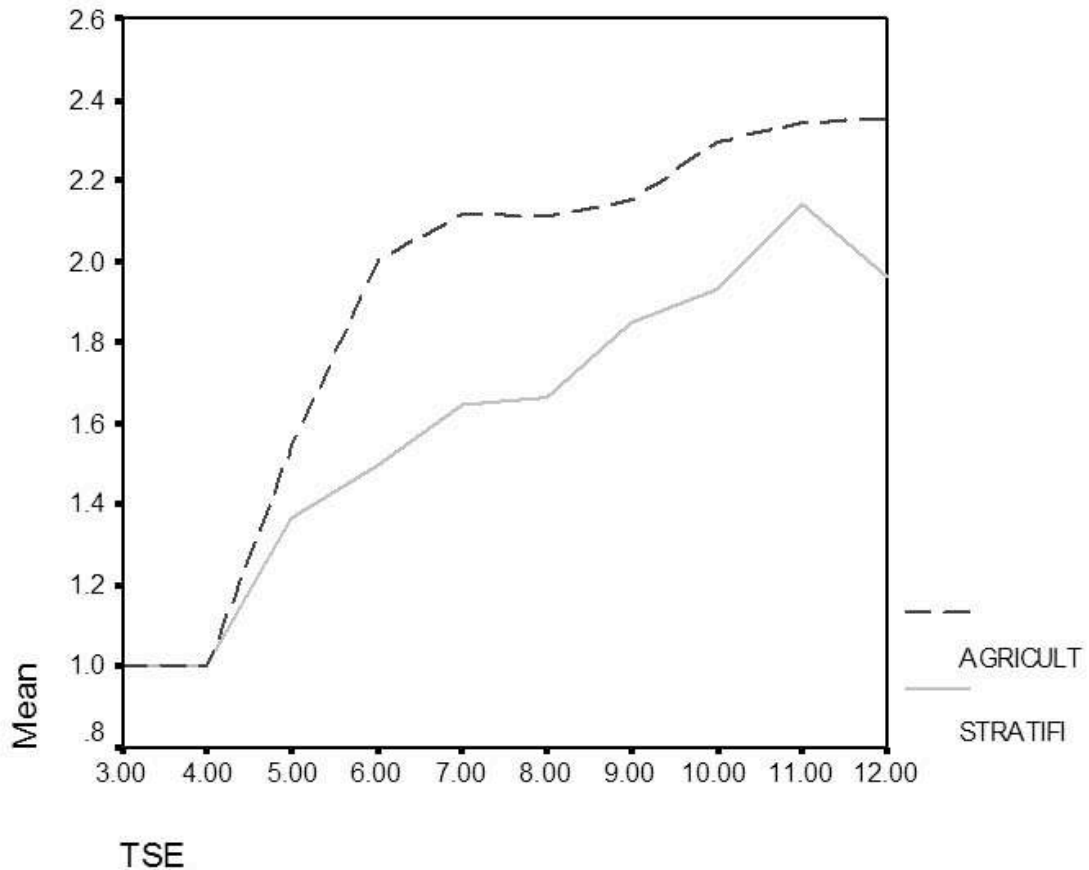


Figure 4.4 Line Graph of Average Agriculture and Social Stratification Values for the Last 10,000 Years

What, then, is the answer to our question? Why did food production develop? At present archaeologists are not sure. There are a number of reasonable theories with good supporting evidence. The best answer is probably that no single answer will suffice. In some places population growth may have been key, in others the emergence of social stratification, and in still others the desire to have a regular supply of particular plants. No single theory will likely ever apply to the development of food production in every part of the world, but our knowledge of the archaeological record for the emergence of food production is only at a very basic level. As our knowledge improves, our answers to the question of why food production evolved will surely improve as well.

### Consequences of the Neolithic Revolution

As we have seen, Density of Population and food production are strongly associated. Looking over a longer period of time, and at existing cultures, it seems clear that population growth definitely accelerated after the emergence of food production, possibly because the spacing between births was reduced further and therefore fertility (the number of births per mother) increased. Increased fertility may have been advantageous because of the greater value of children in farming and herding economies; there is evidence from recent population studies that fertility rates are higher where children contribute more to the economy. Not only may parents desire more children to help with chores; the increased workload of mothers may also (but inadvertently) decrease birth spacing. The busier a mother is, the less frequently she may nurse and the more likely her baby will be given supplementary food by other caretakers such as older siblings. Less frequent nursing and greater reliance on food other than mother's milk may result in an earlier resumption of ovulation after the birth of a baby. (Farmers and herders are likely to have animal milk to feed to babies, and also cereals that have been transformed by cooking into soft, mushy porridges.) Therefore the spacing between births may have decreased (and the number of births per mother, in turn, increased) when mothers got busier after the rise of food production.

Although the rise of food production may have led to increased fertility, this does not mean that health generally improved. In fact, it appears that health declined at least sometimes with the transition to food production.

The two trends may seem paradoxical, but rapid population growth can occur if each mother gives birth to a large number of babies, even if many of them die early because of disease or poor nutrition.

The evidence that health may have declined sometimes after the rise of food production comes from comparing the bones and teeth of some prehistoric populations from before and after the emergence of food production. Nutritional and disease problems are indicated by such features as incomplete formation of tooth enamel, non-accidental bone lesions (incompletely filled-in bone), reduction in stature, and decreased life expectancy. Many of the studied prehistoric populations that relied heavily on food production seem to show less adequate nutrition and higher infection rates than populations living in the same areas before the emergence of food production. Some of the food producing populations are shorter and had lower life expectancies.

The reasons for a decline in health in those populations are not yet clear. Greater malnutrition can result from an over-dependence on a few dietary staples that lack some necessary nutrients. Over-dependence on a few sources of food may also increase the risk of famine because the fewer the staple crops, the greater the danger to the food supply posed by a weather-caused crop failure. But some or most nutritional problems may be the result of social and political factors, particularly the rise of different status groups of people and unequal access, between and within communities, to food and other resources.

Social stratification also seems likely to develop after the rise of food production. The effects of stratification and political dominance from afar on the general level of health may be reflected in the skeletal remains of prehistoric Native Americans who died in what is now Illinois between 1050 B.P and 700 B.P., the period spanning the changeover in that region from hunting and gathering to food production. The food producing people living in the area of Dickson's Mounds—burial sites named after the doctor who first excavated them—were apparently in much worse health than their hunter-gatherer ancestors. But curiously, archaeological evidence suggests that they were still also hunting and fishing. A balanced diet was apparently available, but who was getting it? Possibly it was the elite at the Mississippian center Cahokia, about 150 kilometers away, who were getting most of the meat and fish. The individuals near Dickson's Mounds who collected the meat and fish may have gotten luxury items such as shell necklaces from the Cahokia elite, but many of the people buried at Dickson's Mounds were clearly not benefiting nutritionally from the relationship with Cahokia.

In the more permanent villages that were established after the rise of food production houses became more elaborate and comfortable, and construction methods improved. The materials used in construction depended on whether timber or stone was locally available or whether a strong sun could dry mud bricks. The interiors of houses became more complex, and where furnishings have survived, such as in European Neolithic lake dwellings, they suggest increasing number and sophistication of household possessions. For example, many longhouses at these sites had doors, beds, tables, and other furniture that closely resembled those in modern-day societies.

Woven textiles also appeared after the rise of food production. This development was not simply the result of the domestication of flax (for linen), cotton, and wool-growing sheep. These sources of fiber alone could not produce cloth. It was the development of the spindle and loom for spinning and weaving that made textiles possible. True, textiles can be woven by hand without a loom, but to do so is a slow, laborious process, impractical for producing garments.

While ceramics precede food production in many parts of the world, the ceramics of the early food producers became more diverse and complex. In Southwest Asia, for example, these included large urns for grain storage, mugs, cooking pots, and dishes. To improve the retention of liquid, potters in Southwest Asia may have been the first to glaze the earthenware's porous surface. Later ceramics became more artistic. Designers shaped the clay into graceful forms and painted colorful patterns on the vessels.

It is probable that virtually none of these architectural and technological innovations could have occurred until humans became fully sedentary. Nomadic hunting and gathering peoples would have found it difficult to carry many material goods, especially fragile items such as pottery. It was only when humans became fully sedentary that these goods would have provided advantages, enabling villagers to cook and store food more effectively and to house themselves more comfortably.

There is also evidence of increased long-distance trade following the emergence of food production. At Ali Kosh, for example, obsidian from southern Turkey was being exported to sites in the Zagros Mountains of Iran and to what are now Israel, Jordan, and Syria in the Levant. Great amounts of obsidian were exported to sites over 200 kilometers from the source of supply; more than 80 percent of the tools used by residents of those areas were made of this material. Marble was being sent from western to eastern Turkey, and seashells from the coast were traded to distant inland regions. Such trade suggests a considerable amount of contact among various food producing communities.

About 5500 B.P., cities first appeared in Southwest Asia. These cities had political assemblies, kings, scribes,



and specialized workshops. The specialized production of goods and services was supported by surrounding farming villages, which sent their produce to the urban centers. A dazzling transformation had taken place in a relatively short time, a transformation commonly known as the Urban Revolution. People had not only settled down, but they had also become “civilized,” or urbanized. (The word *civilized* literally means to make “citified.”) Urban societies seem to have developed first in Southwest Asia and somewhat later around the eastern Mediterranean, in the Indus Valley of northwestern India, in northern China, and in Mexico and Peru.

## **The Urban Revolution**

In the last chapter I discussed the transition from food collection to food production as a human event, one that occurred on every continent of the globe and impacted the all peoples of the earth. Archaeologists often refer to this as the Neolithic Revolution. The development of urban states, which I discuss in this chapter, is another human event, one commonly referred to as the Urban Revolution. Like food production, urban states arose independently across the world and, like food production, spread rapidly once they were established. Six thousand years ago not a single human was living in an urban state. Today all humans live within an urban state of some kind. Where, when, how, and why did the Urban Revolution occur? Those are the questions I hope to answer in this chapter.

Before proceeding to answer those questions, I need first to emphasize that cities and state forms of government are closely related and appear to have evolved together in the Urban Revolution. States are polities in which leaders are capable of governing by force. These leaders are typically distinguished from others in the society as a separate noble class. Force is usually exercised through police or military, and the implementation of force is often regulated through formal laws. States, then, have a variety of formal positions through which power is exercised, including through the nobility, members of the police or military, judges and legal bureaucrats, and often many others.

To support the nobility and others who work for the state government, states typically collect tribute or taxes from food producers and craftspeople. Tribute and taxes often require a formal monetary and market system so that members of the government can obtain all the goods they need. To keep track of the exchange of goods, of laws and legal precedents, and the like, states often develop formal writing systems. State governments are also typically centered in locations where markets, offices, courts, and the like are within close proximity, meaning that most states have an urban capitol. States, then, are centralized, urban polities with a complex bureaucracy and social classes.

### **Where and When Did the Urban Revolution Occur?**

The first urban societies appeared in Mesopotamia during the Uruk tradition, about 6000 B.P. These were city-states; that is, they were based in a particular city and their direct sphere of control was apparently quite limited. However, the Uruk states interacted regularly and developed a complex regional economy, often referred to as the Sumerian empire, that influenced populations throughout the Tigris and Euphrates river valleys. To the west, in the Levant, cities and states appeared by at least 5000 B.P. and these states were strongly influenced by the Sumerian states. To the east, peoples of Iran had also developed cities and states by 5000 B.P., and also at least in part through Sumerian influence.

Almost at the same time as the peoples of the Uruk tradition were developing states, the great dynastic age was beginning in the Nile Valley in Egypt. Leaders in the Nile Valley began to centralize power into what appear to be states by around 5500 B.P., and by the time of Early Dynastic Egypt, which begins at 5000 B.P., a powerful state with large urban centers had already come to control the Nile valley. Because many of the changes that led to cities and states in Egypt appear to have happened at about the same time as the Sumerian cities and states were first emerging in Mesopotamia, many scholars think that these developments were independent, and that Egypt represents a second location (after Mesopotamia) where urban societies arose without conquest or formal influence from other urban societies.

Elsewhere in Africa urban societies also arose. In what is present-day Ethiopia the Axum (or Aksum) state evolved sometime after 2000 B.P., and ultimately became a center of trade and commerce between Africa and the Arabian peninsula. The savannah and forest zones of western Africa had a succession of city-states beginning around 2000 B.P. Farther south, states apparently arose in several areas beginning around 1000 B.P. All these states appear to have emerged through interactions with existing states in Egypt and Southwest Asia.

At about the same time as cities and states were emerging in the areas around Mesopotamia, cities and states also arose in the Indus Valley. There the Harappan state developed sometime after 5000 B.P. While interaction was regular between Mesopotamia and the Harappans later, it is not clear whether early interactions could have fostered state development in the Indus valley in the same way they did in the upper Tigris and Euphrates valleys. For this reason, the Harappan state is also thought to be one of the rare examples of a state emerging outside the influence of another state.

The Longshan tradition of China represents a fourth example of a state that arose without influence from

other states. At about 4500 B.P., peoples of the Longshan culture were apparently developing cities and regional states that spread across north and central China. By the time of the Shang tradition (ca. 3900 B.P.) historical texts suggest the presence of urban states throughout much of China.

In the New World states appeared in Mesoamerica and the Andes at around the same time. In Mesoamerica, peoples developed cities and states around 2100 B.P. States arose at about the same time along the Gulf Coast, but may have been present earlier in the Olmec culture (perhaps as early as 3000 B.P.), although the evidence is equivocal. The emergence of cities and states in highland Mesoamerica and the Gulf Coast strongly influenced surrounding areas, so that by about 1800 B.P. urban societies were present throughout Highland and Lowland Mesoamerica.

In South America, a group of distinct urban societies emerged by about 2200 B.P. Cities and states were clearly present in many of the major river valleys leading from the Andes to the sea. State development may have been influenced by the widespread system of religious symbols and beliefs that emerged in the Chavín culture, around 2800 B.P. Indeed, some scholars believe that Chavín represents the first states in South America.

Interestingly, cities and states may not have emerged in North America. A few scholars have argued that some Mississippian polities, particularly Cahokia, represent cities with a state form of government, but the evidence is ambiguous.

The Urban Revolution began in the New World quite a bit later than in the Old World. The later appearance of New World cities and states is an interesting problem. Some scholars have linked the delay to the later emergence of agriculture in the New World and to the near-absence of large domesticated animals. Interestingly, New World cities and states developed much more rapidly than Old World ones, and this suggests that different processes may have been at work in the two areas of the world, much like the different processes we saw in the emergence of food production. What might some of these processes have been?

### **How and Why Did the Urban Revolution Occur?**

Once states arise they tend to expand and to conquer other polities, particularly non-state polities. Often the conquering state will impose a state form of government on areas they have conquered, and thus states tend to spread, or diffuse. The process of diffusion was one of the earliest theories put forward to explain the Urban Revolution. Nineteenth-century antiquarians, for example, put forward the idea that the ancient Greeks developed the state, and state forms of government spread from Greece across the rest of the world. It was the Greek genius that caused the Urban Revolution, and its diffusion was due to its clear superiority over other forms of political organization. This was a Eurocentric view of prehistory, and as new and better data emerged it became clear that Europe was a relative latecomer to the world of urban societies.

However, the idea that cities and states arose under rare conditions and then diffused rapidly is still widely held in archaeology. Today, four centers of “pristine” development are commonly accepted—Mesopotamia, China, Highland Mesoamerica, and Peru. Many scholars also see Egypt and the Indus Valley as “pristine” centers of urban society. The problem with the idea that there are “pristine” states and “secondary” states arising by diffusion is that interaction between and among societies seems to be a central feature of even the “pristine” states, so to argue that they arose in some kind of political or economic vacuum seems as biased as the earlier view that Europe must have been the birthplace of the Urban Revolution.

It does seem clear that the emergence of an urban society fosters the emergence of urban societies among neighboring polities. This process has been identified by archaeologists Colin Renfrew and John Cherry as “peer-polity interaction”. Renfrew and Cherry argue that neighboring polities regularly interact, and that these interactions are important because they provide a means through which information, goods from other areas, and mutual assistance can move. As changes take place in one polity involved in such interactions, they tend to spread rapidly to other polities. The others, it seems, change in order to maintain the ongoing interactions. While Renfrew and Cherry provide an excellent model for how cities and states might diffuse among a group of peer-polities, they do not offer a model for the initial rise of cities and states among those polities.

Anthropologist Elman Service developed a theory for the Urban Revolution that focused on what a state government might offer to the people living within it. He argued that a state would not arise unless it functioned in some important way to maintain the society. Service examined the rise of states all over the world (much as we have done) and came to the conclusion that in all cases states serve to control access to resources in situations where resources are highly diverse and localized. In Highland Mesoamerica, for example, good agricultural soils are limited to river valleys while important resources like obsidian are located in mountain areas. Service argued that in such cases an urban state might function to collect and redistribute important goods. The state would collect both

agricultural products and obsidian, for example, redistributing obsidian to the agriculturalists living in river valleys and agricultural products to peoples living near obsidian sources in the mountains. In this way, the state would serve an important function in ensuring all members of the polity had access to all the resources they needed.

Economic historian Karl Wittfogel suggested control of a single resource—water—was essential to the Urban Revolution. He noted that irrigation was vital in many of the areas in which early cities and states developed. Irrigation made the land habitable or productive in parts of Mesoamerica, southern Iraq, the Nile Valley, China, and South America. Wittfogel argued that the labor and management needed for the upkeep of an irrigation system led to the formation of a political elite, the overseers of the system, who eventually became the governors of the society.

However, recent work has shown that neither redistribution nor water control were important in all early states, and where they were important they seem to have developed well after an urban state had first emerged. For example, in southern Iraq, the irrigation systems serving the early cities were generally small and probably did not require extensive labor and management. Large-scale irrigation works were not constructed until after cities had been fully established. Thus, irrigation could not have been the main stimulus for the development of cities and states in Sumer. Even in China, for which the irrigation theory was first formulated, there is no evidence of large-scale irrigation as early as Shang times.

Cultural anthropologist Robert Carneiro has suggested that states may emerge because of population growth in an area that is physically or socially limited, what he calls “circumscription”. Competition and warfare in situations of circumscription may lead to the subordination of defeated groups, who are obliged to pay tribute and to submit to the control of a more powerful group. The more powerful group, then, becomes the leaders of the emergent state. Carneiro illustrated his theory by describing how states may have emerged on the northern coast of Peru.

After the people of that area first settled into an agricultural village life, population grew at a slow, steady rate. Initially, new villages were formed as population grew. But in the narrow coastal valleys—blocked by high mountains, fronted by the sea, and surrounded by desert—this splintering-off process could not continue indefinitely. The result, according to Carneiro, was increasing land shortage and warfare between villages as they competed for land. Since the high mountains, the sea, and the desert blocked any escape for losers, the defeated villagers had no choice but to submit to political domination. In this way, chiefdoms may have become kingdoms as the most powerful villages grew to control entire valleys. As chiefs’ power expanded over several valleys, states and empires may have been born.

Carneiro noted that physical or environmental circumscription may not be the only kind of barrier that gives rise to a state. Social circumscription may be just as important. People living at the center of a high-density area may find that their migration is blocked by surrounding settlements just as effectively as it could be by mountains, sea, and desert.

Cultural anthropologist Marvin Harris suggested a somewhat different form of circumscription. He argued that the first states with their coercive authority could emerge only in areas that supported intensive grain agriculture (and the possibility of high food production) and were surrounded by areas that could not support intensive grain agriculture. Only people in such areas could put up with the coercive authority of a state because they would suffer a sharp drop in living standards if they moved away.

Archaeologist William Sanders and his colleagues took yet another tack on the relationship between population growth and the rise of states. They used the ideas of agricultural economist Esther Boserup, who argued that under conditions of population pressure societies will develop innovations in order to increase subsistence production to support the growing population. Sanders and colleagues argued that one such innovation might be the rise of centralized political control to coordinate subsistence production and distribution. Their research in the Valley of Mexico showed that there was population growth before the emergence of the Teotihuacán state.

There is a clear association between population density and states. Figure 5.1 shows this association in a cross-tabulation similar to those we looked at in the last chapter. Here we see that as Political Integration increases (1 = local community; 2 = 1 or 2 levels above local community; 3 = 3 or more levels above local community, which means a state is present) so does population density. Indeed, there are no cases of low population density where a state is present (Political Integration = 3). Can we say that Density of Population causes a state to form? Not from these data, and even the line graph shown in Figure 5.2 makes us question this idea. Figure 5.2 shows the average for Density of Population and Political Integration over the last 10,000 years at 1000 year intervals. Until about 8000 years ago the two increased in basically the same way, but after about 8000 years ago Political Integration increased more rapidly than Density of Population, and Density of Population seems to have leveled off, suggesting that population growth may not have been primary in state formation.

			DENSITY			Total
			1	2	3	
INTEGRAT	1	Count	114	2	0	116
		Expected Count	56.2	47.8	12.0	116.0
	2	Count	26	80	10	116
		Expected Count	56.2	47.8	12.0	116.0
	3	Count	0	37	20	57
		Expected Count	27.6	23.5	5.9	57.0
Total	Count	140	119	30	289	
	Expected Count	140.0	119.0	30.0	289.0	

Figure 5.1 Cross-tabulation of Political Integration and Population Density

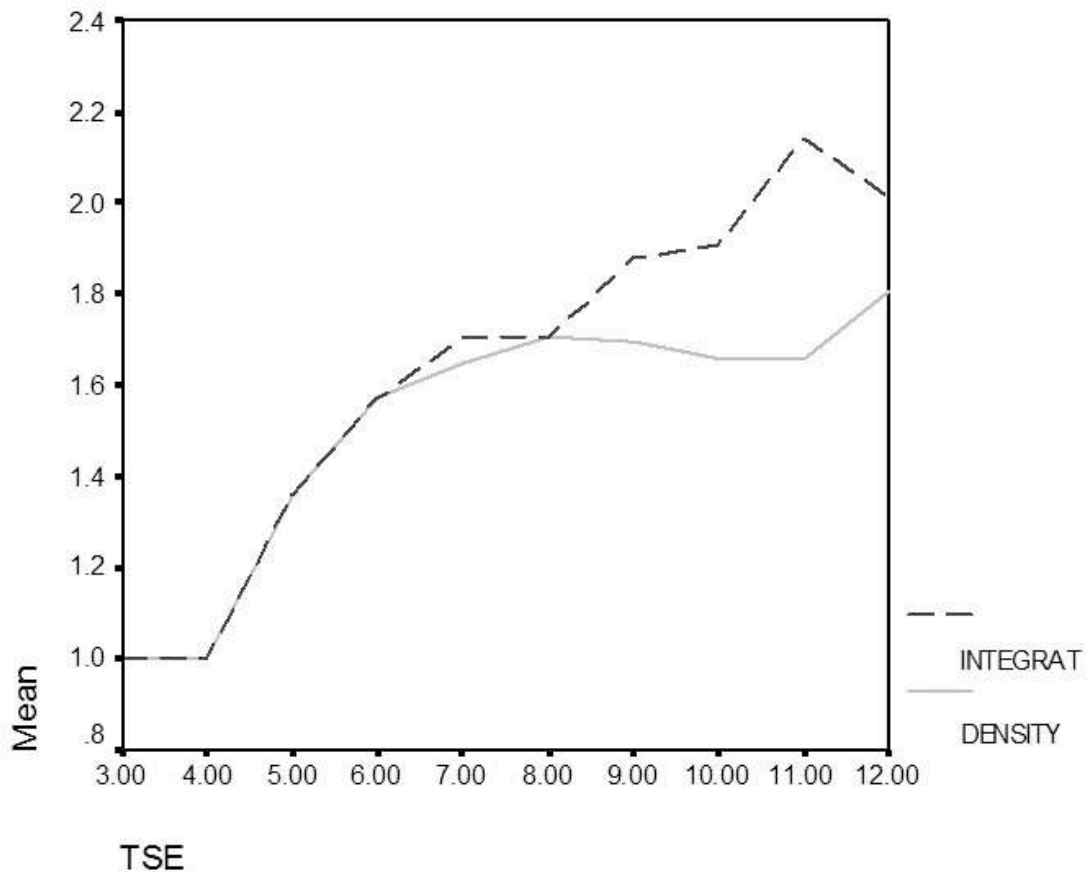


Figure 5.2 Line Graph of Average Political Integration and Population Density Values for the Last 10,000 Years

But neither population growth nor population density necessarily means that there was population pressure. For example, the populations in the Valley of Mexico apparently did increase prior to state development, but there is no evidence that they had even begun to approach the limits of their resources. More people could live there without starving. Nor is population growth definitely associated with state formation in all areas where early states arose. For example, according to Henry Wright and Gregory Johnson, there was population growth long before states emerged in southwestern Iran, but the population apparently declined just before the states emerged, and Richard Blanton and his colleagues have argued a similar population decline before the rise of the state at Monte

Albán in the Valley of Oaxaca.

In recent years a number of archaeologists have argued that interactions between societies may have played an important role in the Urban Revolution. Local polities interact with one another and, as Renfrew and Cherry noted, such interaction seems to be important to the ongoing maintenance of societies, as the interactions provide information and material exchanges over large areas. However, interactions between polities also encourage boundary maintenance, with each polity working to define and maintain its boundaries relative to the others. Richard Blanton and his colleagues have argued that in the Valley of Oaxaca such boundary maintenance may have played a vital role in the rise of an urban state. Maintaining boundaries in the face of important long-distance interactions with the Maya lowlands, the Valley of Mexico, and the Gulf Coast, may have led to the creation of what Blanton calls a core-periphery system in the Valley of Oaxaca. The core of this system was the city of Monte Albán, while peripheral towns maintained formal links to the core, even as they interacted with the peripheral towns of neighboring polities.

Trade would have been an important part of interregional interaction, and many archaeologists have suggested that trade was a factor in the emergence of the earliest states. Henry Wright and Gregory Johnson, for example, theorized that the organizational requirements of producing items for export, redistributing the items imported, and defending trading parties would foster city and state formation. Does the archaeological evidence support such a theory?

In southern Iraq and the Mayan lowlands, long-distance trade routes may indeed have stimulated bureaucratic growth. In the lowlands of southern Iraq, people needed wood and stone for building, and they traded with highland people for those items. In the Mayan lowlands, the development of civilization seems to have been preceded by long-distance trade. Farmers in the lowland regions traded with faraway places in order to obtain salt, obsidian for cutting blades, and hard stone for grinding tools. In southwestern Iran, long-distance trade did not become very important until after the city of Susa became the center of a state society, but short-distance trade may have played the same kind of role in the formation of states.

Archaeologist Kwang-chih Chang put forward a similar theory for the origin of cities and states in China. He suggested that Neolithic societies in the Yellow River valley developed a long-distance trade network, which he called an “interaction sphere,” by about 6000 B.P. Trade spread cultural elements among the societies in the interaction sphere, so that they came to share some common elements. Over time, these societies came to depend on each other both as trade partners and as cultural partners, and around 4000 B.P. they unified into a single political unit under the Shang tradition. Thus Chang sees political unification in China as an outgrowth of a pre-existing system of trade and cultural interaction.

How and why did the Urban Revolution occur? As of now, no one theory seems to fit all the known situations. The reason may be that different conditions in different places may have favored the emergence of cities and states. After all, cities and states imply an ability to organize large populations for a collective purpose. In some areas, this purpose may have been the need to organize trade with local or far-off regions. In other cases, the purpose may have been to control defeated populations in circumscribed areas. In still other instances, a combination of factors may have fostered the development of cities and states.

### **The Consequences of the Urban Revolution**

One of the ways cities and states change the lifestyles of people is by allowing for larger and denser populations. As we have already seen, agriculture itself gives populations the potential to grow, and the development of an urban state only furthers that potential. Why? Because a state is able to build infrastructure, such as irrigation systems, roadways, and markets, that allow both the production and distribution of agricultural products to become more efficient. States are able to coordinate information as well, and can use that to manage agricultural production cycles, and to anticipate or manage droughts, blights, or other natural disasters. States are also able to control access to land (through laws and a military) to maintain farmers on the land and prevent others (from either within or outside of the state) to remove them or interfere with their abilities to produce food.

With increased efficiency of agricultural production and distribution, states also allow many (if not most) people in the society to be removed from food production. These people are freed to become craftspeople, merchants, artists, as well as bureaucrats, soldiers, and political leaders. People may also live apart from agricultural fields, and thus cities with dense populations can arise. Cities can also arise in locations that are not suited to agriculture, but that perhaps are suited to trade (such as the cities on rivers in southern Mesopotamia) or defense (such as on top of a mountain--as in the case of Monte Albán). Art, music, literature, often flourish in such contexts, and these too are often consequences of the rise of states. Organized religion, too, often develops after

states appear. Thus all the hallmarks we associate with civilization can be seen as resulting from the Urban Revolution.

The development of cities and states can have many negative impacts as well. When states develop people become governed by force, and are no longer able to say "no" to their leaders. Police and military forces can become instruments of oppression and terror. On a less obvious level, the class stratification of states creates differences in access to resources and an underclass of poor, uneducated, and frequently unhealthy people. Health issues are exacerbated by the concentration of people in cities, an environment in which epidemic diseases can flourish. Without direct access to food supplies, people in cities also face the threat of malnutrition or outright starvation if food production and distribution systems fail.

All states appear to be expansionistic, and the emergence of state warfare and conquest seems one of the most striking negative impacts the evolution of states has had. In fact, more human suffering can probably be linked to state expansion than to any other single factor. Why do states expand? One basic reason may be that they are able to. States have standing armies ready to fight or be sent to conquer enemies. Another reason for state expansion might be related to the threat of famine and disease, which is more likely with intensive agriculture. A third answer might be that belligerence is simply part of the nature of states. States often arise through military means, and it may be vital to the continuation of some states that military power be continually demonstrated. Regardless of the causes, war and conquest are the consequence of state formation. Often too defeat in war is the fate of states.

### *The Decline and Collapse of States*

When you look over the list of ancient urban states I have discussed in this chapter, Monte Albán, Sumer, Pharaonic Egypt, etc., you will notice one element common to all of them: all collapsed eventually. None of them maintained their power and influence into historic times. Why? It is an important question because, if collapse is the ultimate fate of many if not all states, then we can anticipate that our own state is likely to collapse eventually. Perhaps knowing something about how and why other states have collapsed can prevent (or at least hold off) the collapse of ours.

One suggested explanation for the decline and collapse of states is environmental degradation. If states originally arose where the environment was conducive to intensive agriculture and harvests big enough to support social stratification, political officials, and a state type of political system, then perhaps environmental degradation—declining soil productivity, persistent drought, and the like—contributed to the collapse of ancient states. Archaeologist Harvey Weiss has suggested that persistent drought helped to bring about the fall of the Akkadian empire. By 4300 B.P., the Akkadians had established an empire stretching 1,300 kilometers from the Persian Gulf in what is now Iraq to the headwaters of the Euphrates River in what is now Turkey. But a century later the empire collapsed. Weiss thinks that a long-term drought brought the empire down, as well as other civilizations around at that time too. Many archaeologists doubted there was such a widespread drought, but new evidence indicates that the worst dry spell of the past 10,000 years began just as the Akkadians' northern stronghold was being abandoned. The evidence of the drought, windblown dust in sediment retrieved from the bottom of the Persian Gulf, indicates that the dry spell lasted 300 years. Other geophysical evidence suggests that the drought was worldwide.

Environmental degradation may occur for reasons other than natural events. The behavior of humans may sometimes be responsible. Consider the collapse of Cahokia, a Mississippian city of at least 15,000 people that thrived for a few centuries in the area where the Missouri and Mississippi rivers converge. By around 1000 B.P., Cahokia had large public plazas, a city wall constructed from some 20,000 logs, and massive mounds. But within 300 years only the mounds were left. Silt from flooding covered former croplands and settled areas. Geographer Bill Woods thinks that overuse of woodlands for fuel, construction, and defense led to deforestation, flooding, and persistent crop failure. The result was the abandonment of Cahokia. Timber depletion is also indicated by studies of charcoal from excavations in the area. Apparently the quality of wood used in construction declined over time, suggesting that choice trees got scarcer. Cahokia is just one example of degradation that may have been caused by human behavior. Another example is the increasing saltiness of soils caused by evaporation of water from fields that have been irrigated over long periods of time, as in what is now southern Iraq.

States may sometimes decline because human behavior has increased the incidence of disease. For example, many lowland Mayan cities were abandoned between 1200 and 1000 B.P. Explanations of this collapse have ranged from overpopulation to resource depletion. But another factor may have been the increasing incidence of yellow fever. The clearing of forests and the consequent increase of breeding sites for mosquitoes may have favored the spread of the disease from areas farther south in Central America. Or the planting of particular trees by the Mayans in their urban areas may have increased the populations of co-resident monkeys who carried the disease (which

mosquitoes transmitted to people).

Another reason that some states have collapsed appears to be overextension. This is often one of the reasons given for the decline of the Roman Empire. By the time of its fall, beginning about 1800 years ago, the Empire had expanded throughout the Mediterranean region and into northwestern Europe. That huge area may simply have been too large to administer. "Barbarian" incursions on the peripheries of the Empire went unchecked because it was too difficult, and too costly, to reinforce these far-flung frontiers. Sometimes these incursions became wholesale invasions. These invasions were exacerbated by famines, plagues, and poor leadership. By the time the last Roman Emperor of the West was deposed in A.D. 476, the Empire had withered to virtually nothing.

Finally, internal conflict because of leaders' mismanagement or exploitation have been put forward to explain the collapse of states. For example, historian Peter Charnais has argued that the Byzantine Empire (the eastern half of the Roman Empire) collapsed because large, powerful landholders had been allowed to absorb the land of too many small holders, creating a group of overtaxed, exploited peasants with no interest in maintaining the empire. When the landholders began vying with the emperors for power, civil wars erupted, leading to disunity that left the empire vulnerable to conquest.

Many other ideas have been put forward to explain collapse--ranging from catastrophes to almost mystical factors such as "social decadence," but, as with theories for the origin of cities and states, no single explanation seems to fit all or even most of the situations where states have collapsed. While it is still not clear what specific conditions led to the Urban Revolution, or the collapse of those urban states in each of the "pristine" centers of civilization, the question of why states form and decline is a lively focus of research today, so more satisfactory answers may come out of ongoing and future investigations.



## Into the Anthropocene

We have seen our ancestors evolve from two million years ago until the recent past. We've seen the emergence of social behaviors that make us human—family, marriage, cities and states. We've seen the emergence of cognitive abilities that make us human—imagination, creativity, and the audacity to actively shape our world. Indeed, our power to shape the natural world led Nobel laureate Paul Crutzen to suggest that we should define a new geological epoch—the Anthropocene—an epoch marked by the dramatic changes humans have caused to the environment since the beginnings of the Industrial Revolution. As we enter this new Anthropocene, are there lessons we can learn from the two million years of our species' prehistory? Are there patterns that might tell us what is to come?

### What Happened in Prehistory?

One of the things that scholars have most widely suggested they see in the fragments of prehistory is human progress. In the 19th century anthropologists like Lewis Henry Morgan saw a universal trend in human prehistory towards improvement in living standards, morality, art and literature, and the like. The yardstick for measuring improvement was Western European society, and in that sense the idea of progress was a highly Eurocentric one. However, progress does not have to be measured against Europe. Progress can also refer to increased efficiency, diversity, scale, or the like, and in those ways there do seem to be progressive unilinear trends in world prehistory.

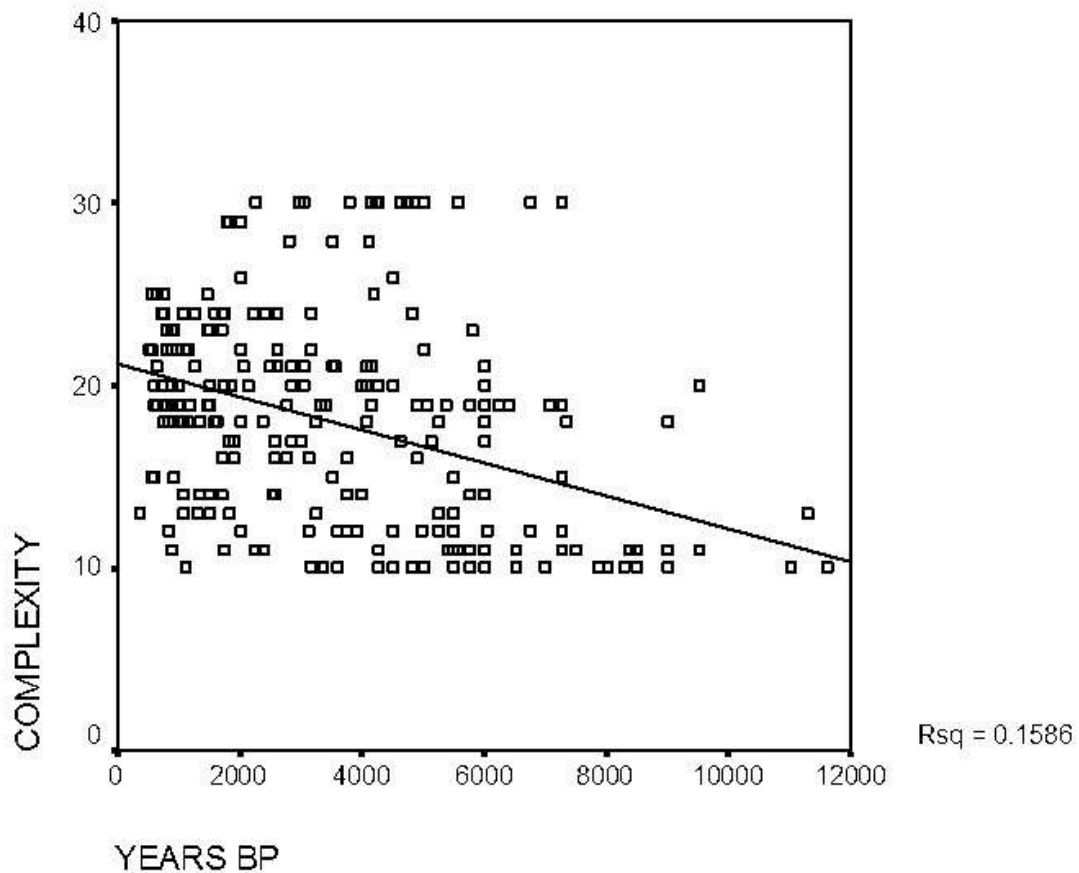


Figure 6.1 Scatterplot of Cultural Complexity by Years Before Present

We can see evidence of progress, if that is what we want to call it, in Figure 6.1, which presents cultural complexity plotted against time in years before present. Cultural complexity is measured by summing the scores on

10 items that anthropologists tend to agree are related to complexity, including things like population density and social stratification. The scale was developed by anthropologists George Peter Murdock and Catherine Provost in order to compare societies in terms of their relative complexity, but they make clear that their scale is only one way to look at complexity. Like progress, complexity can mean many things. Here the focus is on societal scale, integration, and technology.

Each point plotted in Figure 6.1 represents a single archaeological culture. The culture's horizontal position reflects the midpoint of the time period in which it existed, and the tradition's vertical position reflects the sum of its scores on the 10-item cultural complexity scale. The line running through the plot shows where the middle of all the cases is located and reflects the overall trend (if any) in the data. It is usually referred to as a regression line, although I prefer to call it a prediction line. Looking at Figure 6.1 we see that cultural complexity has generally increased over time (from 12,000 years ago at the far right to the present at the far left of the plot). It is important to note that this trend is highly unlikely to be due to chance (statistics suggest it would occur less than one time in 1000 by chance), and thus reflects a "real" trend in prehistory.

Note that not all cultures have followed the overall trend towards increased complexity. Throughout prehistory there have been some cultures that score lower on the cultural complexity scale than the trend would predict (one can use the line running through the plot to suggest predicted values at any given point in time, which is why I like to call it a prediction line), and some that score higher. In other words, not all cultures change in exactly the same way over time, so the idea that there is some universal evolutionary process going on does not seem to be supported. However, there is clearly a unilinear evolutionary trend towards greater cultural complexity, one that we can see more clearly in Figure 6.2.

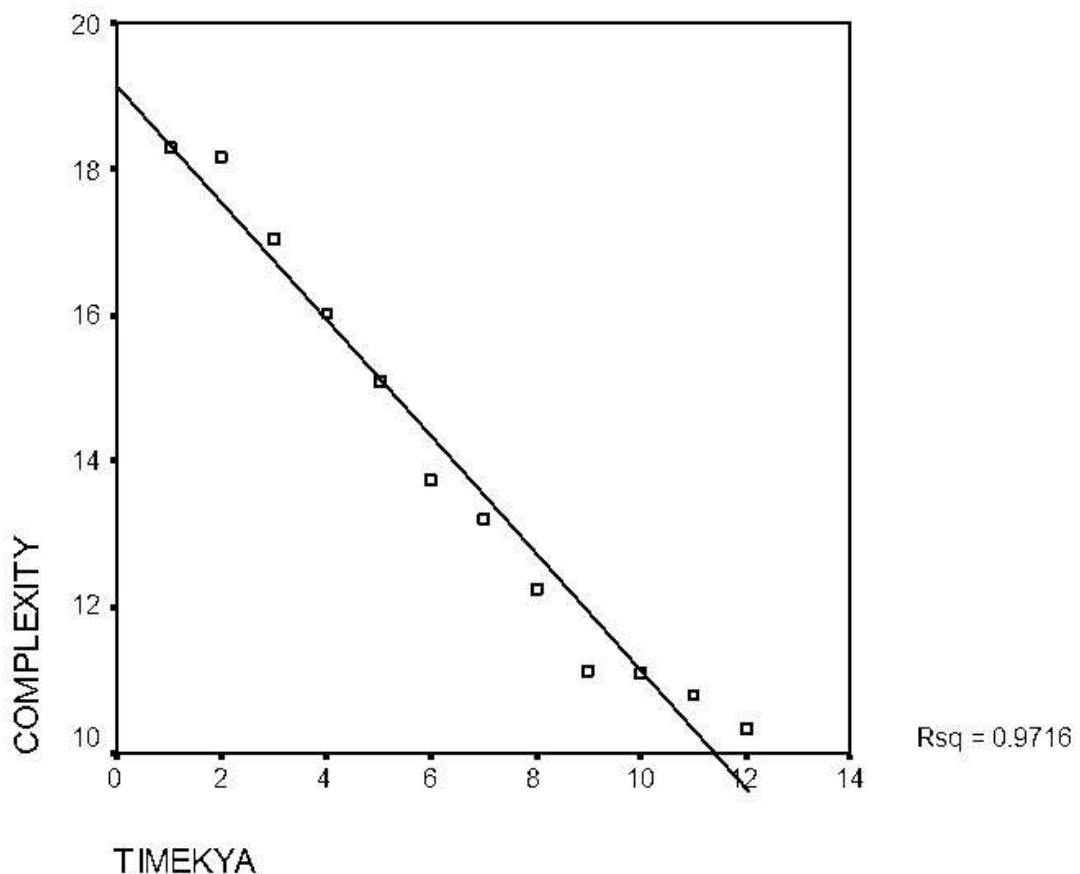


Figure 6.2 Scatterplot of Average Cultural Complexity by Thousands of Years Ago.

Figure 6.2 shows a plot of the average score on the cultural complexity scale plotted against time in years before present in 1000-year intervals for the last 12,000 years. The average score for each time is based on the cultural complexity scores for all the cultures in existence at that time. A culture that existed for two or three

thousand years was counted in each of the two or three time periods for which an average was calculated. The unilinear evolutionary trend towards greater cultural complexity is dramatically illustrated here; indeed, the trend is so strong that given a cultural complexity value for one point in time you can predict the value for the next point in time with 97% accuracy (that's what the number to the right of the plot means).

**Population Growth**

But what accounts for this image of "progress" in cultural complexity? One answer, widely accepted among archaeologists, is population growth. By most estimates, human population has been growing steadily for at least the last 30,000 years. Thirty thousand years ago there were only about two million people on earth. By 15,000 years ago there were more than six million people on earth, and by 10,000 years ago there were nearly nine million people on earth. Today the earth houses a staggering seven billion people (although a large proportion of those people—more than half—have been born during my lifetime). Clearly there has been an overall trend towards higher population, and we know from our look at the Neolithic Revolution and the Urban Revolution that population growth seems to be an important variable to understanding those fundamental transformations in human culture.

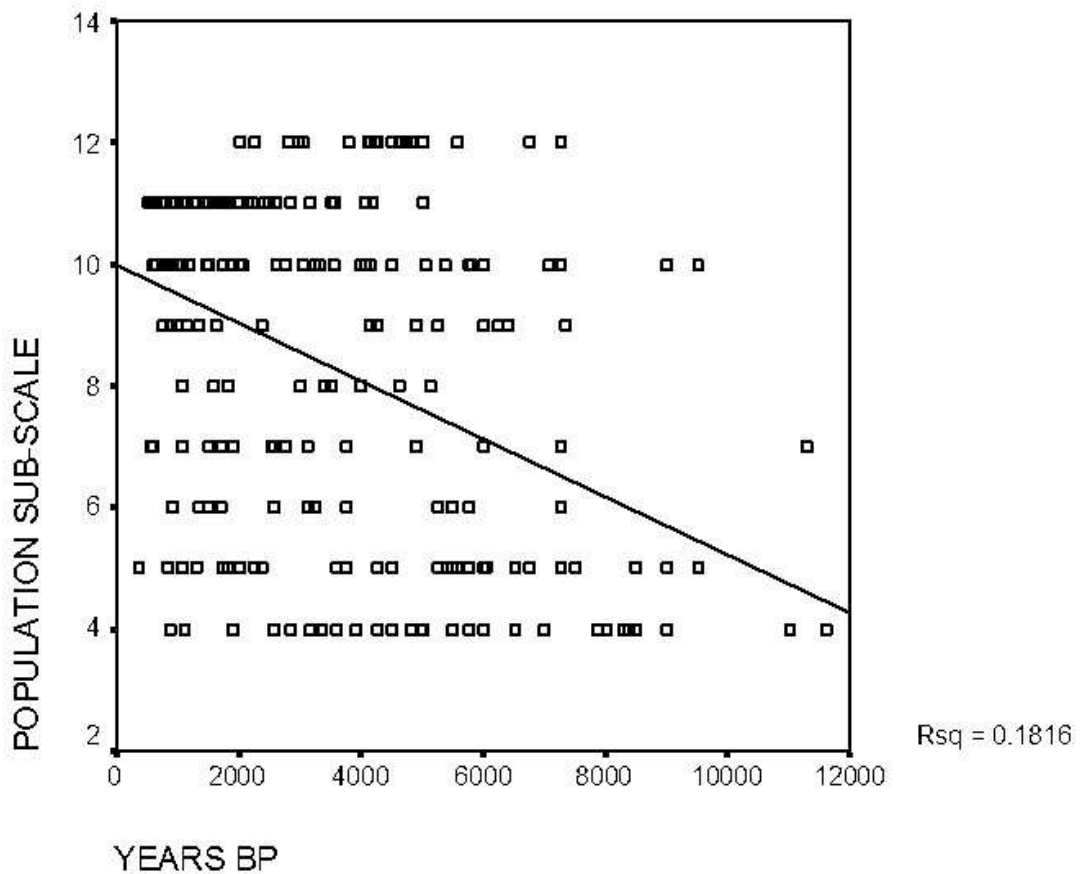


Figure 6.3 Scatterplot of Population Sub-Scale by Years Before Present.

Figure 6.3 provides evidence to back up the idea that there has been a significant trend towards population growth over the past 12,000 years. This figure is based on an analysis of the cultural complexity scale done by anthropologist Gary Chick. He found that the scale appears to conflate two distinct sub-scales, one which relates to population, and other which relates to technology. Plotted here are the sum of those items that Chick argued formed a population scale. What we see in Figure 6.3 is a unilinear trend towards increased population over the past 12,000 years. Indeed, statistically this relationship is stronger than the one for overall cultural complexity.

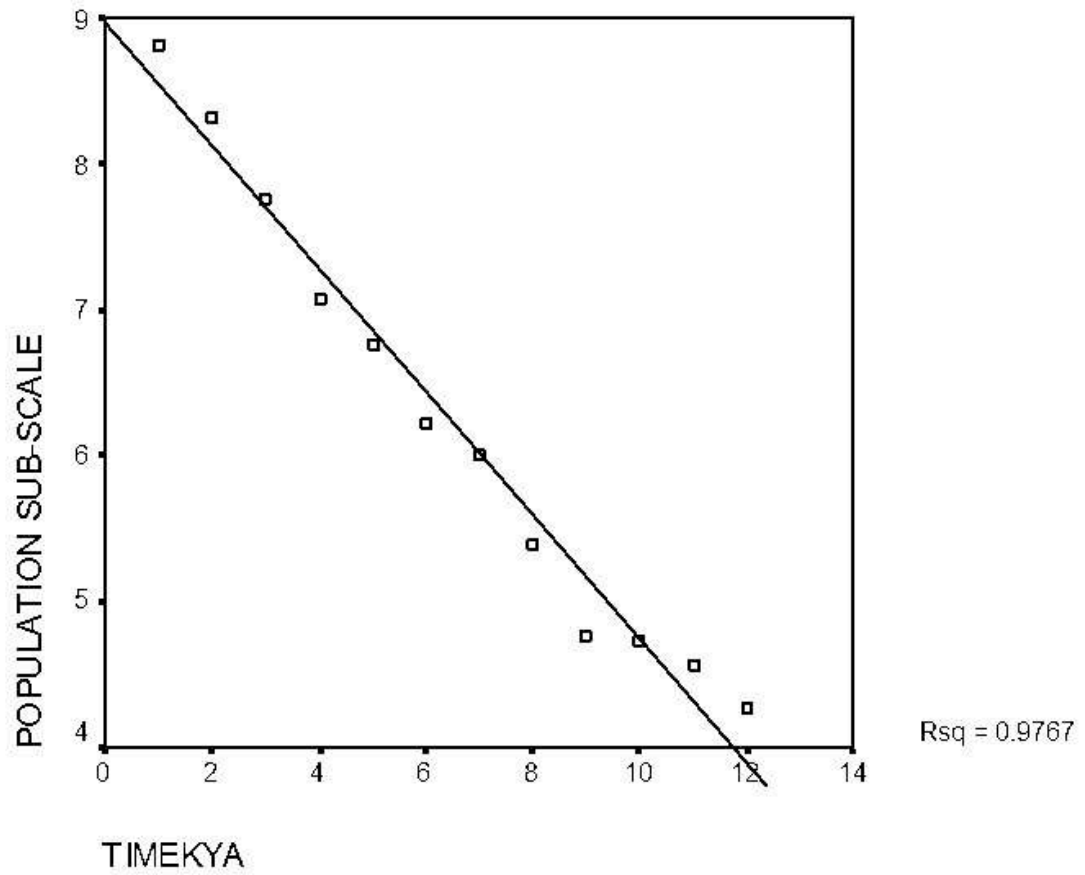


Figure 6.4 Scatterplot of Average Population Sub-Scale by Thousands of Years Ago.

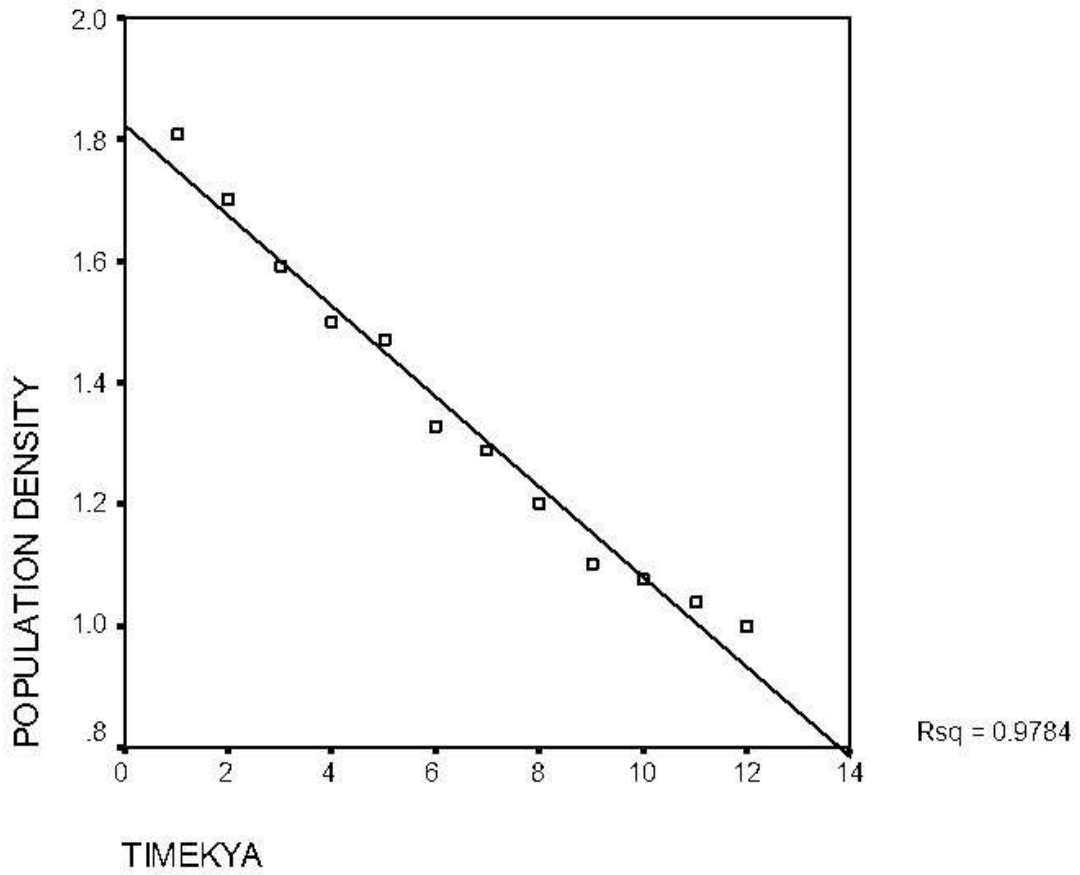


Figure 6.5 Scatterplot of Average Population Density by Thousands of Years Ago.

We can simplify Figure 6.3 by taking averages at 1000-year intervals as we did for cultural complexity in Figure 6.2. The results of doing so are presented in Figure 6.4. Here again we can see a clear growth trend in population over the past 12,000 years. We can see a similar trend if we look simply at the variable Density of Population, which we have used several times in the preceding chapters. Figure 6.5 shows the average score on Density of Population at 1000-year intervals and, again, a strong trend is apparent. Does this mean that population growth caused cultural complexity to increase? Many archaeologists would say yes, but these data alone do not allow us to make such a conclusion. All we can say is that "progress" in both cultural complexity and population are clearly evident in prehistory.

***Technological Innovation***

A second answer to the question of what might account for the image of "progress" in cultural complexity is technological innovation. As archaeologist V. Gordon Childe put it, "Technological progress is of course conspicuous. In the one direction of control over external nature men have been extending their capacities for half a million years" (1936:160). Support for Childe's statement can be seen in Figures 6.6, 6.7, and 6.8. Let's take a look at each of these figures individually.

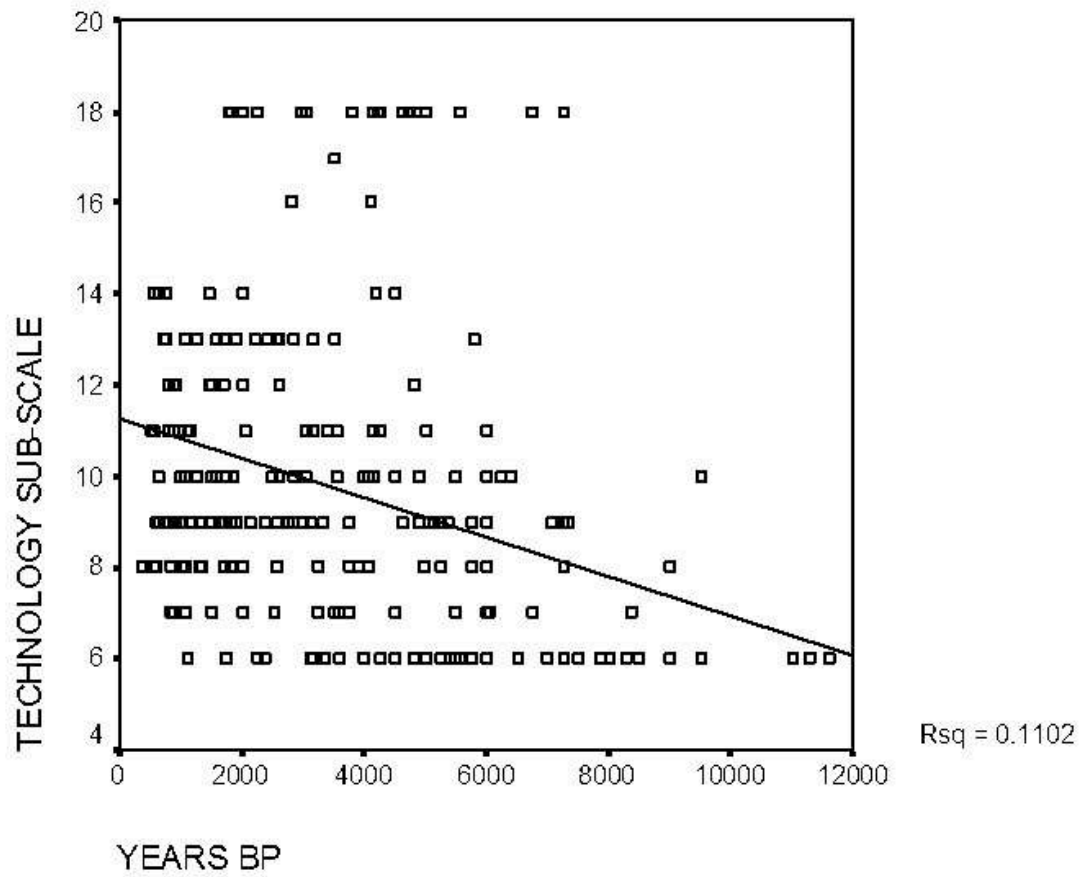


Figure 6.6 Scatterplot of Technology Sub-Scale by Years Before Present

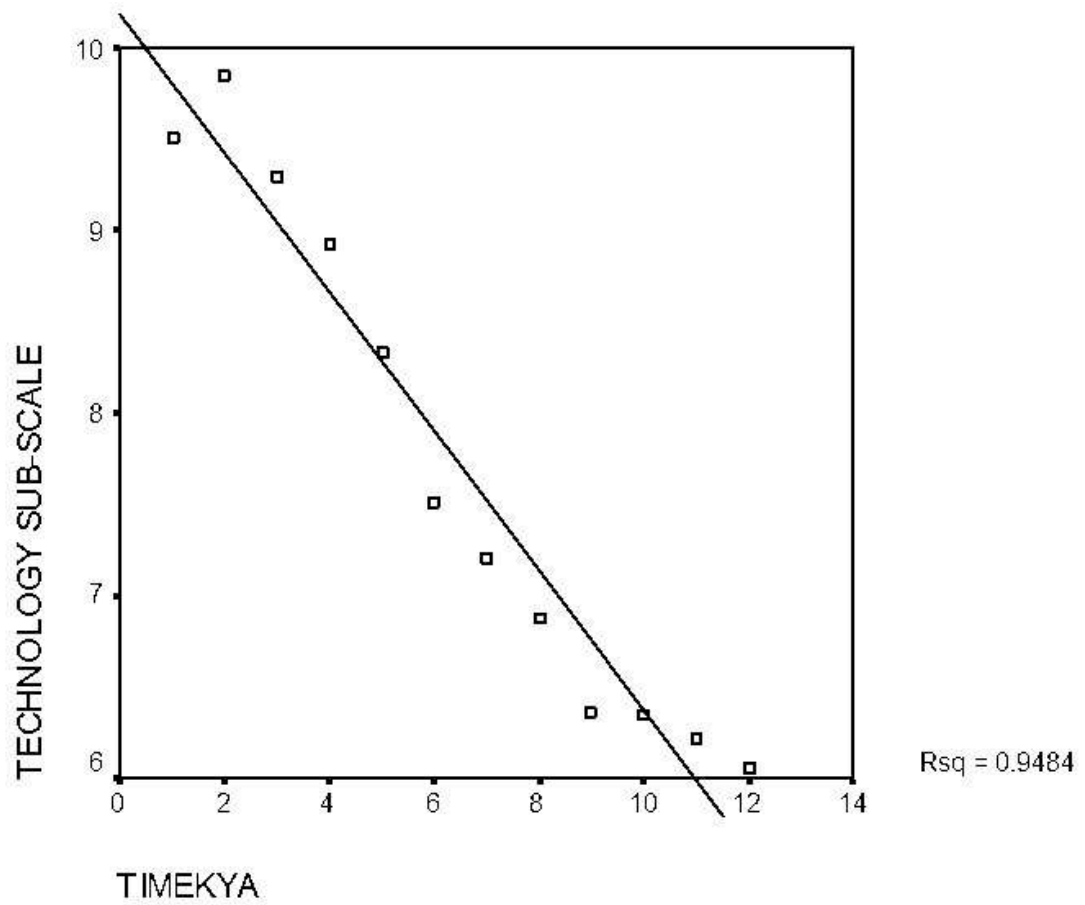


Figure 6.7 Scatterplot of Average of Technology Sub-Scale by Thousands of Years Ago

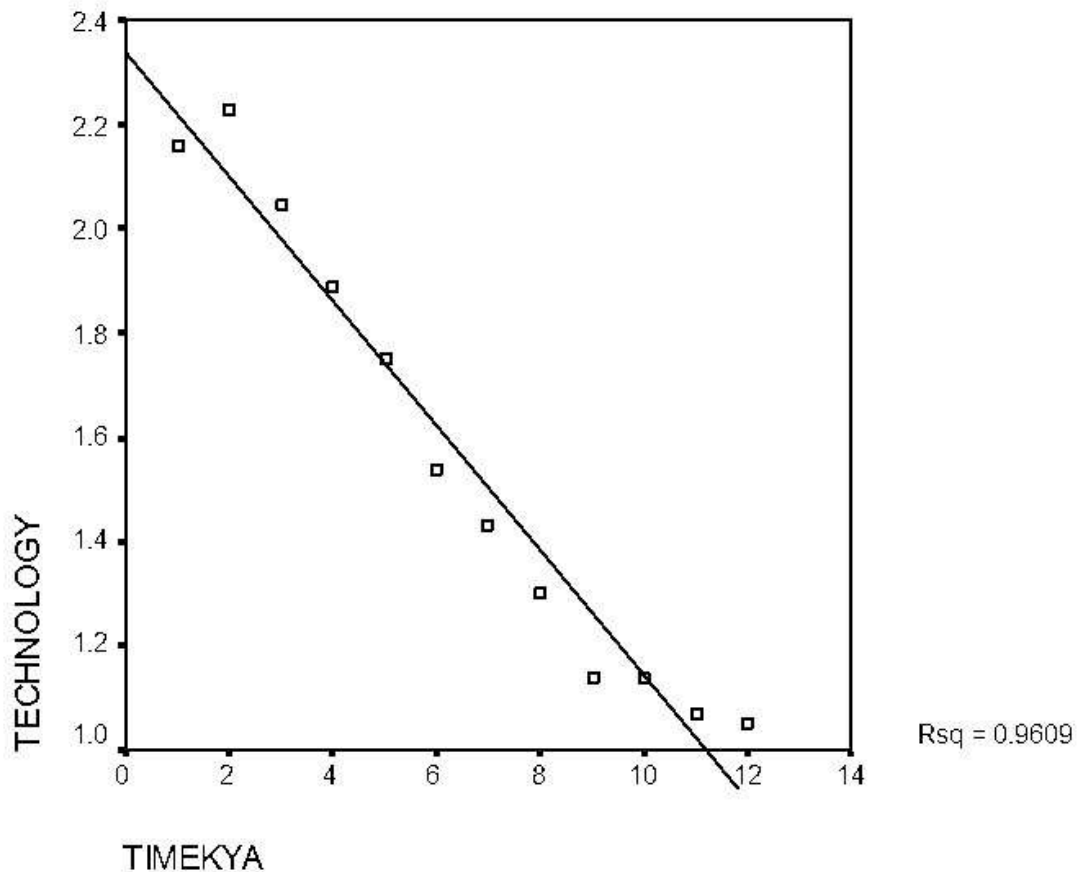


Figure 6.8 Scatterplot of Average of Technological Specialization by Thousands of Years Ago

Figure 6.6 shows the technology sub-scale that Chick identified within the cultural complexity scale plotted against years before present. Once again, we can see a clear trend, although with an interesting set of high-scoring cases that may warrant additional research. Figure 6.7 shows the average score on the technology sub-scale plotted at 1000-year intervals, and again illustrating an obvious trend. Finally, Figure 6.8 shows the average score on the Technological Specialization variable plotted in 1000-year intervals for the last 12,000 years. As with the other two figures, we can see clearly that technology, however measured, has increased at a fairly regular pace over the past 12,000 years.

What might explain this "progress" in technology, and how might it be associated with cultural complexity? Childe, following earlier scholars such as Morgan and Friedrich Engels, argued that

If the whole long process disclosed in the archaeological and literary records be surveyed, a single directional trend is most obvious in the economic sphere in the methods whereby the most progressive societies secure a livelihood. In this domain it will be possible to recognize radical and indeed revolutionary innovations... (1942:14-15)

As I discussed in the introduction, Childe identified four such revolutions in human prehistory and history, two of which I used in this book: the Neolithic revolution (the evolution of food production); the urban revolution (the rise of states); the revolution in human knowledge (writing); and the industrial revolution. With each such "revolution", human groups became larger, more politically and economically sophisticated, and more culturally complex.

Anthropologist Leslie White took a somewhat different tack on the relationship between technology and complexity. He suggested that technological innovation and the growth of cultural complexity were products of an overall process of humans obtaining more energy from their environment. As he explained "cultural development is the process of increasing the amount of energy harnessed and put to work per capita per year, together with all the



consequences attendant upon this increase” (*The Evolution of Culture* 1959:42). The “consequences attendant upon” mechanisms, usually technological, that allowed for increased energy capture included population growth, political centralization, economic specialization, and other aspects of what we have called cultural complexity.

For both Child and White, the link between technology and complexity exists because

The social organization of the use of tools and machines is an important aspect of the technological process. Such things as division of labor, specialization, cooperation, systematization, and rationalization may affect the operation of the technological process very considerably. (White 1959:55)

In other words, the way in which technology is integrated into the existing culture is just as important as the technology itself. Perhaps more significantly, culture strongly affects the ways in which technology might be used. As White explains

Technologies exist and function within social systems and are consequently conditioned by them. A social system may stimulate the technology it embraces, encourage full and free exercise of its functions, and promote its growth and development. Or it may restrict free technological exercise and expression and impose curbs upon its growth. (1959:27)

Technological innovation and cultural complexity are linked, therefore, because the two continually affect one another--technology shapes culture and culture conditions the manner in which new innovations are employed.

### ***Interdependence***

A second image that some archaeologists have seen in the fragments of prehistory is increasing interdependence both between and among human populations. One aspect of increasing interdependence that we experience every day is globalization. For example, I was recently in China where there seemed to be a Kentucky Fried Chicken franchise on every corner. When I returned to my home in Appleton, Wisconsin, I found to my surprise that my community has no less than eight Chinese restaurants. But sharing tastes in food is not the only aspect of globalization we regularly experience. In the United States we are well aware of our dependence on oil from other nations, while in China the people are well aware of their dependence on manufacturing goods for export to other nations. As Kwame Appiah and Henry Louis Gates put it, "we all participate, albeit from different cultural positions, in a global system of culture" (*Dictionary of Global Culture* 1997:xi).

This "global system of culture" was not always present. We might envision something like a common culture among humans until the Upper Paleolithic era, when human groups began to move into more diverse environments and develop local adaptations. But for the last 40,000 years at least, human cultures appear to have been primarily diverging, rather than becoming more interdependent. Is globalization only a recent phenomenon, or do our data suggest that growing interdependence has been a trend for some time?

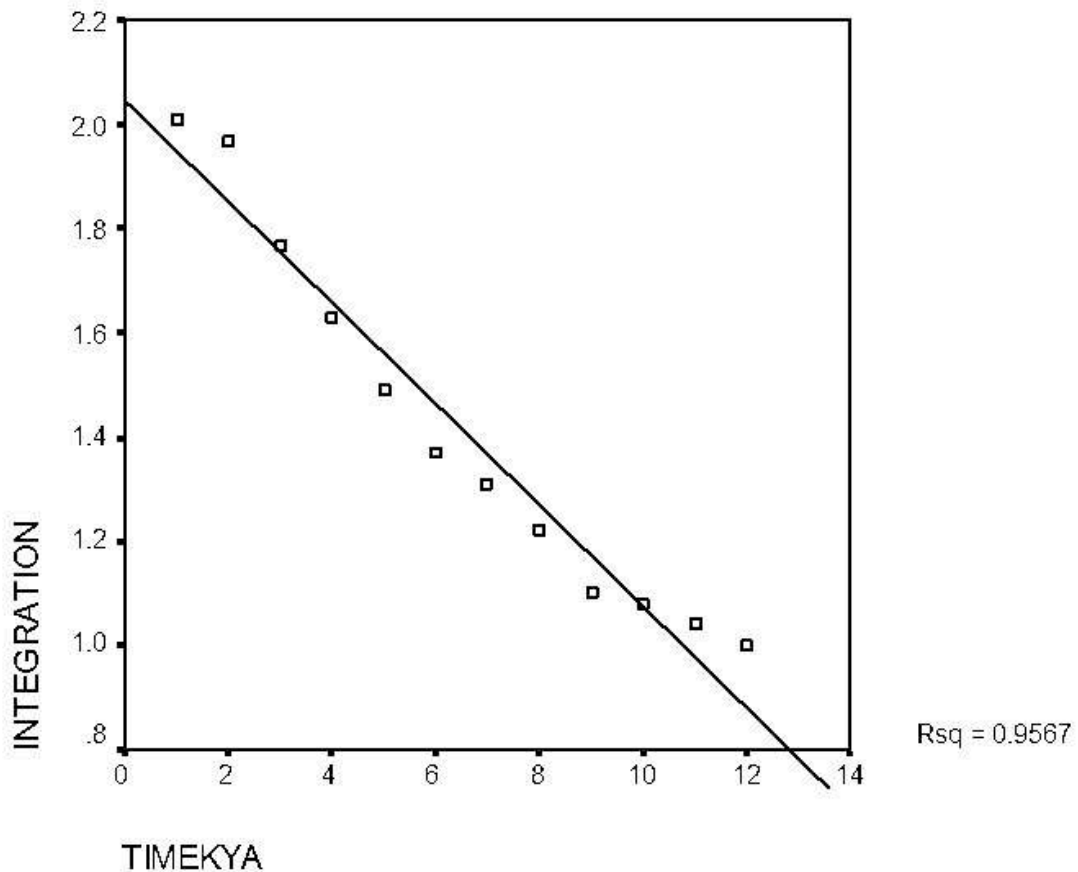


Figure 6.9 Scatterplot of Integration by Time in Thousands of Years Ago.

Figure 6.9 shows the average score on the Political Integration variable, which we looked at in the last chapter, at 1000-year intervals for the last 12,000 years. As with the other variables we have considered, there is a strong linear relationship. Average Political Integration has been steadily increasing for 12 millennia. Since the Political Integration variable essentially measures the number of communities that are unified within a single polity, we can see that over time autonomous communities have tended to become part of higher order political units, and this suggests that over time interdependence among local populations has increased. What does this mean for our understanding of global interdependence? It appears to suggest that what we are experiencing today is the outcome of at least 12,000 years of growing interdependence among populations.

It is interesting to note that, in theory at least, we should be able to follow the prediction line on the graph upwards and predict that in 1000 years global integration will have increased by about 10 percent. Unfortunately, integration seems to have increased far more than that in only the past few decades. Today, as I noted earlier, all humans live in state societies, so that all societies should be coded with a value of 3 on the Political Integration variable on the X-axis (which represents today). It would seem that political integration has seen a dramatic leap in the past two or three centuries. So while the globalization we experience today is the outcome of 12,000 years of growing interdependence, it is also the outcome of what appears to be a unique period of extremely rapid growth. The same can be said for population, which has been growing with astounding speed for the past 200 years. Technology, too, seems to be far outpacing the prediction line that the last 12,000 years would suggest.

Recognizing the unusual speed of current globalization, population growth, and technological innovation is important, for it shows us the uniqueness of our current situation, and clearly illustrates how important it is for us to understand our past. Without knowledge of our past we would not be able to perceive the current conditions of rapid growth, to understand the exceptional, and perhaps dangerous, situation our world is in, nor to use that understanding to help shape our future. We live in a time of unprecedented change--change that follows a general pattern established in prehistory, but accelerated to a pace that seems impossible to sustain. Let me explain what I mean by that, and offer my own interpretation of what happened in prehistory.

## The Control of Nature

The image I see when I look at the fragmentary puzzle of prehistory is one of increasing human control over the natural world. Here's how I see it: About two million years ago early *Homo* developed culture and began to manipulate the environment with culture, a development I call the Behavioral Revolution. At first these manipulations of the environment were simple extensions of human capabilities--stone and bone tools to augment teeth and hands. Later, perhaps 1.5 million years ago, *Homo erectus* began to use culture as a way to create artificial environments through shelter, clothing, and fire. The cultural extension of human capabilities continued through the development of more diverse and sophisticated tools as well. At some point during the Upper Paleolithic, *Homo sapiens* developed a secondary world—a world of creativity and imagination, a world that encompassed the past and future, the natural and the supernatural, a world that allowed humans to conceive of dramatically new ways to control the natural world in which they lived. I have called this development the Cognitive Revolution.

Beginning perhaps 12,000 years ago, humans began to actively manipulate the plants and animals upon which they subsisted, and developed food production. In this development, the Neolithic Revolution, humans made a radical leap from using the natural world to actively shaping the natural world to better suit their own needs. Over time, questions about how the environment would be used, and issues surrounding sustainability of soils, animal herds, and other resources became focused in the hands of small groups of individuals. Initially, decisions were in the hands of kin groups or perhaps communities, but over time they were given over to (or taken over by) elites, chiefs, and, later, kings. Thus, within a few thousand years after implementing food production, humans developed cities and states and created specialists who controlled environmental manipulation—the Urban Revolution.

I am not alone in seeing human control over the natural world as the image emerging from the fragments of prehistory. Indeed, this is essentially the image that both Childe and White saw. However, Childe and White envisioned the increased human control over the natural world as a universal phenomenon, one in which all peoples in all cultures played a role, if not at the same time, at least in the same manner. I view it much more as a unilinear rather than universal process, with control directed by an increasingly attenuated group of people. Among Neolithic societies kin groups and perhaps whole communities made decisions about how the natural world would be shaped (through agricultural fields, irrigation systems, and the like). In early urban states the government decided. Today single organizations like corporations, or powerful multi-national organizations like the International Monetary Fund, make decisions about the natural world that impact millions of people. These organizations, whose membership is made up primarily of European and North American elites, exert vast power over the earth. Far from being a universal trend, most people today are largely disenfranchised from decisions about how we shape the world around us.

What happened in prehistory? Humans evolved into animals that use culture to shape the natural world to suit their needs. To be human means to be at once dependent upon the natural world and continually shaping its characteristics. The important lesson in this answer, one that becomes more pressing when we consider the explosive increase in the rate of cultural change in recent centuries, and how that change has moved us into the Anthropocene, is that we must be careful to shape the world in ways that are sustainable, both in terms of natural resources and in terms of culture itself. We all know that natural resources are inherently limited, and while culture may not have any limits in quantity, there do seem to be limits in terms of scale and conflict. We need to be mindful not to exceed them. For me, that is the main lesson we should take from prehistory. If we don't heed the lessons of the past, we may well lose our future.

## Bibliographical Essay

There are two major sources for this work. The first is my textbook *World Prehistory: Two Million Years of Human Life* (Upper Saddle River, NJ: Prentice-Hall, 2003) and the nine-volume *Encyclopedia of Prehistory*, edited by myself and Melvin Ember (New York: Kluwer, 2001-2002). The data sets used to make the tables and charts in Chapters 4, 5, and 6 were published in the journal *World Cultures* (Volume 14, Issue 1, Fall 2003) as part of my "Atlas of Cultural Evolution." I was strongly influenced by Vere Gordon Childe's two masterful works, *Man Makes Himself* (New York: Mentor Books, 1936) and *What Happened in History?* (New York: Penguin, 1942). I was also influenced by a number of classic works on cultural evolution, especially Elman Service's *Origins of the State and Civilization: The Processes of Cultural Evolution* (New York: Norton, 1975) and Leslie White's *The Evolution of Culture* (New York: McGraw-Hill, 1959).

In writing the chapters on the Behavioral Revolution and the Cognitive Revolution I relied upon a variety of works, especially research articles published in the journals *Science* and *Nature*. An invaluable source was the journal *Evolutionary Anthropology*, which covers current topics in human evolution in an informative but non-technical way. Also useful were John Fleagle's *Primate Evolution and Adaptation* (San Diego: Academic, 1999), Richard Klein's *The Human Career: Human Biological and Cultural Origins* (Chicago: University of Chicago, 2009), Robert Boyd and Joan Silk's *How Humans Evolved* (New York: Norton, 2011), and Colin Renfrew's *Prehistory: The Making of the Human Mind* (New York: Modern Library, 2009).

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Obviously, this is a very brief list of sources, but they point to ones that are accessible through most public libraries.