The Record of the Past

CHAPTER OUTLINE

Answering Questions
Paleoanthropological Study

Archaeological Research
Dating Methods

Interpretations About the Past
Chapter Questions

- How can we learn about the past from fossil evidence?
- What is the archaeological record?
- What does the archaeological record tell us about past societies?
- How does prehistoric archaeology differ from historical archaeology and ethnoarchaeology?
- What are some of the basic techniques of locating archaeological sites?
- What are the basic techniques of archaeological excavation?
- How do archaeologists date their artifacts?

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Why study the human past? During the early history of anthropology, the answer to this question was straightforward. The study of fossils and artifacts of the past sprang out of a curiosity about the world and the desire to collect and organize objects. This curiosity was, in part, a reflection of the increasing interest in the natural world that arose with the Western scientific revolution beginning in the fifteenth century (see Chapter 3). For early collectors, however, the object was often an end in itself. Items were placed on shelves to look at, with little or no interest expressed in where the fossils might have come from or what the artifacts and their associated materials might tell about the people that produced them. Collectors of this kind are called antiquaries.

Early antiquarian collections often incorporated many different items in addition to fossils and archaeological materials. For example, the museum of Olaus Wormius, a seventeenth-century Danish scholar, included uniquely shaped stones, seashells, ethnographic objects, and curiosities from around the world, in addition to fossils and ancient stone tools. While these objects were sometimes described and illustrated with great care, they were not analyzed or interpreted to shed light on the evolution of life or on the lifeways of ancient humans. Of course, ancient coins, metal artifacts, and jewelry were recognized for what they were, but stone tools and even ancient pottery were generally regarded as naturally occurring objects or the work of trolls, elves, and fairies (Stebing 1994).

By the late eighteenth century, scholars started to move beyond the simple description of objects to an increasing appreciation of the significance of fossil remains and the material traces of ancient human societies. This appreciation fell within the context of a host of new observations in the natural sciences, including many about the geological record and the age of the Earth. In 1797, an English country gentleman named John Frere published an account of some stone tools he had found in a gravel quarry in Suffolk. Although brief, the description is tantalizing in terms of the changing attitude toward traces of the past. Fossilized bones of extinct animals and stone tools—actually Paleolithic hand axes—were found at a depth of more than twelve feet in a layer of soil that appeared undisturbed by more recent materials. Frere correctly surmised that the tools were “from a very remote period indeed, even beyond that of the present world” (Daniel 1981:39). This was a recognition of prehistoric archaeology.

The nineteenth century saw the first fossil finds of ancient human ancestors. They included the bones found in the Neanderthal Valley of Germany in 1856, now recognized as an archaic human species, Homo neanderthalensis, or Neandertal man (see Chapter 5). Although this was a historic discovery, the significance of the fossils was not realized at the time. Interpretations were diverse. Some scholars correctly interpreted the finds as an early human ancestor, but others variously dismissed the bones as those of a Cossack soldier, an elderly Dutchman, a powerfully built Celt, or a pathological idiot (Trinkaus and Shipman, 1993)! Information continued to accumulate, however, and by the end of the nineteenth century, the roots of modern archaeological and paleoanthropological study were well established.

This chapter examines the material record of the past and some of the techniques used by modern anthropologists to locate, recover, and date their discoveries. On one hand, this includes the bones and preserved remains used by paleoanthropologists to trace human origins. On the other hand, it deals with the material traces of human behavior which archaeologists focus on to interpret past cultures. In reality, the subdisciplines are often intertwined. Paleoanthropologists use excavation and surveying techniques similar to those used by archaeologists—or they rely on archaeologists—to locate and recover their finds. As to be discussed in Chapter 25, archaeological methods have also played an important role in forensic anthropology.

This book provides an overview of some of the techniques used and current interpretations. In reading
these discussions, it is important to remember that interpretations are constantly being revised. New fossils are constantly uncovered and archaeological sites exposed. Improved methods also modify the amount and kind of information available to researchers. Each of these discoveries adds to the amount of information available to interpret the past—and to evaluate and revise existing interpretations.

Answering Questions

Few modern archaeologists or paleoanthropologists would deny the thrill of finding a well-preserved fossil, an intact arrow point, or the sealed tomb of a king, but the romance of discovery is not the primary driving force for these scientists. In contrast to popular movie images, modern researchers are likely to spend more time in a laboratory or in front of a word processor than looking for fossils or exploring lost cities. Perhaps, their most fundamental desire is to reach back in time to understand our past more fully. This book deals with some of the major questions that have been addressed by paleoanthropologists and archaeologists: the evolution of the human species, the human settlement of the world, the origins of agriculture, and the rise of complex societies and the state.

Although anthropologists make an effort to document the record of bygone ages as fully as possible, they clearly cannot locate every fossil, document every archaeological site, or even record every piece of information about each artifact recovered. Despite decades of research, only a minute portion of such important fossil localities as those in the Fayum Depression in Egypt and Olduvai Gorge in Tanzania have been studied (see Chapters 4 and 5). In examining an archaeological site or even a particular artifact, many different avenues of research might be pursued (see the box “Engendering Archaeology: The Role of Women in Aztec Mexico” on page 22). For example, when investigating pottery from a particular archaeological site, some archaeologists might concentrate on the technical attributes of the clay and the manufacturing process (Rice 1987). Others might focus on the decorative motifs on the pottery and how they relate to the myths and religious beliefs of the people who created them. Still other researchers might be most interested in the pottery’s distribution (where it was found) and what this conveys about ancient trade patterns.

Research is guided by the questions about the past that the anthropologist wants to answer. In order to formulate these, the researcher reviews existing data that help place their research in wider context. The anthropologist also begins by being well-grounded in the different theoretical perspectives of anthropology that shape their questions. With this background, the anthropologist plans a research project. This is done in a systematic way, as outlined in the discussion of the scientific method in Chapter 1. To ensure that the data recovered are relevant to their questions, paleoanthropologists and archaeologists begin a project by preparing a research design in which the objectives of the project are set out and the strategy for recovering the relevant data is outlined. The research design must take into account the types of data that will be collected and how those data relate to existing anthropological knowledge. Within the research design, the anthropologist specifies what types of methods will be used for the investigation, what regions will be surveyed, how much of a site will be excavated, and how the artifacts will be analyzed. Generally, the research design is then reviewed by other anthropologists, who recommend it for funding by various government or private research foundations.

Paleoanthropological Study

Paleoanthropologists study the traces of ancient humans and human ancestors to comprehend the biological evolution of the human species and to understand the lifestyles of these distant relations. As will be discussed in Chapter 5, the behavior, diet, and activities of these early humans were very different from those of modern humans. Determining their behavior, as well as the age of the finds and the environment in which early humans lived, is dependent on an array of specialized skills and techniques. Understanding depends on the holistic, interdisciplinary approach that characterizes anthropology.

As in all anthropological research, a paleoanthropological project begins with a research design outlining the objectives of the project and the methodology to be employed. This would include a description of the region and the time period to be examined, the data that will be recovered, and an explanation of how the proposed research would contribute to existing knowledge. For example, researchers might target geological deposits of a specific location and age for examination because of the potential to discover the
The interpretation of the material record poses a challenge to archaeologists. It provides excellent evidence on some subjects—ancient technology, diet, hunting techniques, and the plan of an ancient settlement—but some topics are more difficult to address. What were the marriage customs, the political system, or the religious beliefs of the ancient inhabitants of a site? These factors are by nature nonmaterial and are not preserved archaeologically. Even documentary records may offer only limited insight on some topics.

In a fascinating study of gender among the Aztec of ancient Mexico, archaeologist Elizabeth Brumfiel utilized both the archaeological and the documentary record to provide new insights into the past (Brumfiel 1991, 2005). The Aztec civilization was flourishing in central Mexico when the Spanish reached the Americas. It had emerged as the principal state in the region by the fifteenth century, eventually dominating an area stretching from the Valley of Mexico to modern-day Guatemala, some 500 miles to the southwest. The capital, Tenochtitlán, was an impressive religious center built on an island in Lake Texcoco. The city’s population numbered tens of thousands when the Aztec leader, Montezuma, was killed during fighting with Spanish conquistadors led by Hernán Cortés in 1520. Within decades of the first Spanish contact, the traces of the Aztec empire had crumbled and been swept aside by European colonization.

Records of the Aztec civilization survive in documentary accounts recorded by the Spanish. The most comprehensive is a monumental treatise on Aztec life, from the raising of children to religious beliefs, written by Fray Bernardino de Sahagun (Brumfiel 1991). It is the most exhaustive record of a Native American culture from the earliest years of European contact. For this reason, it has been a primary source of information about Aztec life and culture.

Brumfiel was particularly interested in reconstructing the roles of women in Aztec society. Sahagun’s description of women focuses on weaving and food preparation. Regrettably, as Brumfiel points out, his work offers little insight into how these endeavors were tied to other economic, political, and religious activities. In addition, Sahagun does not discuss the origins of the common ancestors of humans and apes (see Chapter 4), the earliest branches on the human lineage, or the fossil record of the first modern humans (see Chapter 5).

The initial survey work for a paleoanthropological project often relies on paleontologists and geologists, who provide an assessment of the age of the deposits within the region to be studied and the likely conditions that contributed to their formation. Clues about the age may be determined through the identification of distinctive geological deposits and associated floral and faunal remains (see the discussion of dating methods and faunal correlation later in this chapter). Such information also helps in the reconstruction of the paleoecology of the region and, hence, the environment in which early human ancestors lived. **Paleoecology** (paleo, from the Greek, meaning “old,” and ecology, meaning “study of environment”) is the study of ancient environments.

Based on the information provided by paleontologists and geologists, more detailed survey work is undertaken to locate traces of early humans. Looking for such traces has been likened to looking for a needle in a haystack, except in this case the “looking” involves the scrutiny of geological deposits and the careful excavation of buried skeletal remains and associated material. This stage of the research may draw on the skills of the archaeologist, who is trained to examine the material...
remains of past societies (see discussion of “Archaeological Excavation” below).

**Fossils and Fossil Localities**

Much of paleoanthropological research focuses on the locating and study of fossil remains. Fossils are the preserved remains, impressions, or traces of living creatures from past ages. They form when an organism dies and is buried by soft mud, sand, or silt (Figure 2.1). Over time this sediment hardens, preserving the remains of the creature within. Occasionally, conditions may be such that actual portions of an organism are preserved—fragments of shells, teeth, or bones. But most fossils have been altered in some way, the decayed parts of bone or shell having been replaced by minerals or surrounding sediment. Even in cases in which fragments of bone or shell are present, they have often been broken or deformed and need to be carefully reconstructed. The unraveling of the genetic codes of living species has also led to debate over the classification. Despite the imperfection of the fossil record, a striking history of life on Earth has survived.

Paleoanthropologists refer to places where fossils are found as **fossil localities**. These are spots not comment on some of his own illustrations that show women involved in such undertakings as healing and marketing. Interpretations based solely on Sahagun’s descriptions seemed to marginalize women’s roles in production as non-dynamic and of no importance in the study of culture change.

To obtain a more holistic view of women in Aztec society, Brumfiel turned to other sources. The Aztecs also possessed their own records. Although most of them were sought out and burned by the zealous Spanish priests, some Aztec codices survive. These sources indicate that textiles were essential as tribute, religious offerings, and exchange. Many illustrations also depict women in food production activities. In addition to various categories of food, the codices show the griddles, pots, and implements used in food preparation.

Independent information on these activities is provided by the archaeological record. For example, the relative importance of weaving can be assessed by the number and types of spindle whorls (perforated ceramic disks used to weight the spindle during spinning) that are found in large numbers on archaeological sites. Archaeological indications of dietary practices can be inferred from ceramic griddles, cooking pots, jars, and stone tools used in the gathering and preparation of food.

Brumfiel notes that the most interesting aspect of archaeological data on both weaving and food preparation is the variation. Given the static model of women’s roles seen in the documentary records, a uniform pattern might be expected in the archaeological data. In fact, precisely the opposite is true. Evidence for weaving and cooking activities varies in different sites and over time. Brumfiel suggests that the performance of these activities was influenced by a number of variables, including environmental zones, proximity to urban markets, social status, and intensified agricultural production.

Food preparation, essential to the household, was also integral to the tenfold increase in the population of the Valley of Mexico during the four centuries preceding Spanish rule. As population expanded during the later Aztec period, archaeological evidence indicates that there was intensified food production in the immediate hinterland of Tenochtitlán. Conversely, the evidence for weaving decreases, indicating that women shifted from weaving to market-oriented food production. These observations are not borne out at sites further away from the Aztec capital. In more distant sites, women intensified the production of tribute cloth with which the Aztec empire transacted business.

Brumfiel’s research provides insights into the past that neither archaeological nor documentary information can supply on its own. She was fortunate to have independent sources of information that she could draw on to interpret and evaluate her conclusions. Her interpretation of Aztec life provides a much more dynamic view of women’s roles. The observations are also consistent with the view of the household as a flexible social institution that varies with the presented opportunities and constraints. Brumfiel’s work underscores the importance of considering both women’s and men’s roles as part of an interconnected, dynamic system.

**Points to Ponder**

1. In the absence of any documentary or ethnographic information, how can archaeologists examine the gender of past societies?
2. Can we automatically associate some artifacts with men or with women?
3. Would interpretations vary in different cultural settings?
where predators dropped animals they had killed, places where creatures were naturally covered by sediments, or sites where early humans actually lived. Of particular importance in interpreting fossil localities is the *taphonomy* of the site—the study of the variety of natural and behavioral processes that led to the formation of the deposits uncovered. As seen in Figure 2.2, the taphonomy of an individual fossil locality may be complex and the unraveling of the history that contributed to its formation very challenging indeed.

*Figure 2.1* Only a small number of the creatures that have lived are preserved as fossils. After death, predators, scavengers, and natural processes destroy many remains, frequently leaving only fragmentary traces for researchers to uncover.
(Blumenschine 1995; Lyman 2002). The fossil locality may include traces of the activities of early humans—the artifacts resulting from their behavior, tool manufacture, and discarded food remains, as well as the remains of the early humans themselves. On the other hand, these traces may have been altered by a host of disturbances, including erosion by wind and rain and movement by wild animals.

Only a small number of the once-living creatures are preserved in the fossil record. After death, few animals are left to lie peacefully, waiting to be covered by layers of sediment and preserved as fossils. Many are killed by predators that scatter the bones. Scavengers may carry away parts of the carcass, and insects, bacteria, and weather quickly destroy many of the remains that are left. As a result, individual fossil finds are often very incomplete. Some areas might not have had the right conditions to fossilize and preserve remains, or the remains of early human ancestors that may be present might be so fragmentary and mixed with deposits of other ages to be of limited use. Another consideration is the accessibility of fossil deposits. Fossils may be found in many areas, but they often lie buried under deep deposits that make it impossible for researchers to study them and assess their age and condition. In other instances, however, erosion by wind or water exposes underlying layers of rock that contain fossils, thus providing the paleoanthropologist the chance to discover them—even as they are weathering away.

Once a fossil locality is found, systematic excavations are undertaken to reveal buried deposits. In excavating, paleoanthropologists take great pains to record a fossil’s context. Context refers to a fossil’s or artifact’s exact position in relation to the surrounding sediments and any associated materials. Only if the precise location and associations are known can a fossil be accurately dated and any associated archaeological and paleontological materials be fully interpreted.

After fossils have been removed from the ground, the detailed analysis of the finds begins. This starts with the careful cleaning of fossil remains and associated materials. Fossils are generally preserved in a hardened, mineralized deposit, and cleaning may be tedious and time-consuming. Careful study of fine-grained sediments sometimes reveals the preservation of minute fossils of shellfish, algae, and pollen. Improved techniques, such as computer and electronic scanning equipment, have revealed that images of the delicate structure in bones or the interior of a skull may be preserved in a fossil. Artifacts and faunal

Figure 2.2 A variety of different activities and events contribute to the formation of an individual fossil locality. These include activities by the early human ancestors, but also such natural processes as decomposition and decay, erosion by wind and rain, and movement of bones and artifacts by animals. Paleoanthropologists must try to decipher these different factors in interpreting the behavior of early human ancestors.
Material culture consists of the physical products of societies. This residue of the past is called material culture. On the artifacts—the physical remains of past societies—archaeologists investigate these material traces as evidence of societies to examine the values, beliefs, and norms that include attitudes, behaviors, and social structures. Archaeologists, however, use the term in a much broader sense to refer to a shared way of life that includes values, beliefs, and norms transmitted within a particular society from generation to generation. This view of culture includes agricultural practices, social organization, religion, political systems, science, and sports. **Culture** thus encompasses all aspects of human activity, from the fine arts to popular entertainment, from everyday behavior to the most deeply rooted religious beliefs. Culture contains the plans, rules, techniques, and designs for living.

In seeking to understand past cultures through their physical traces, archaeologists face an inherent difficulty. By its very nature, culture is nonmaterial—that is, it refers to intangible products of human society (such as values, beliefs, religion, and norms) that are not preserved archaeologically. Hence, archaeologists must rely on the artifacts—the physical remains of past societies. This residue of the past is called material culture. **Material culture** consists of the physical products of human society (ranging from weapons to clothing). The earliest traces of material culture are stone tools dating back more than two and a half million years: simple choppers, scrapers, and flakes. Modern material culture consists of all the physical objects that a contemporary society produces or retains from the past, such as tools, streets, buildings, homes, toys, medicines, and automobiles. Archaeologists investigate these material traces of societies to examine the values, beliefs, and norms that represent the patterned ways of thinking and acting within past societies.

Archaeological interpretation has historically been strongly influenced by cultural anthropology theory (Lamberg-Karlovsky 1989; Trigger 1989). **Cultural anthropology**—the study of modern human populations—helps archaeologists understand how cultural systems work and how the archaeological record might reflect portions of these systems. On the other hand, archaeology offers cultural anthropology a time depth that cannot be obtained through observations of living populations. The archaeological record provides a record of past human behavior. Clearly, it furnishes important insights into past technology, providing answers to such questions as “When did people learn to make pottery?’” and “How was iron smelted?’” However, artifacts also offer clues to past ideals and belief systems. Consider, for example, what meanings and beliefs are conveyed by such artifacts as a Christian cross, a Jewish menorah, or a Hopi kachina figure. Other artifacts convey cultural beliefs in more subtle ways. Everyday items, such as the knife, fork, spoon, and plate used in Americans’ meals, are not the only utensils suitable for the task; indeed, food preference itself is a culturally influenced choice.

The objectives of archaeological research vary tremendously in terms of the time periods, geographical areas, and research questions considered. Many researchers have examined the themes dealt with in this book: the behavior of early human ancestors, the initial settlement of the Americas, the origins of agriculture, and the emergence of complex political systems. However, other archaeologists have turned their attention to the more recent past and have examined the archaeological record of European colonization over the past five hundred years and nineteenth-century American society; they have even shed light on modern society by sifting through garbage bags and landfills.

### The Archaeological Record

The preservation of archaeological materials varies (Schiffer 1987). Look at the objects that surround you. How long would these artifacts survive if left uncared for and exposed to the elements? As is the case with the fossil record, the archaeological past is a well-worn and fragmentary cloth rather than a complete tapestry. Stone artifacts endure very well, and thus it is not surprising that much of our knowledge of early human lifeways is based on stone tools. Ceramics and glass may also survive very well, but iron and copper corrode, and organic materials, such as bone, cloth, paper, and wood, generally disappear quickly.

In some cases, environmental conditions that limit insect and microbial action and protect a site from...
Some archaeologists have the luxury of written records and oral histories to help them locate and interpret their finds. Researchers delving into ancient Egyptian sites, the ancient Near East, Greek and Roman sites, Chinese civilization, Mayan temples, Aztec cities, Islamic sites, biblical archaeology, and the settlements of medieval Europe can all refer to written sources ranging from religious texts to explorers’ accounts and tax records.

Why dig for archaeological materials if written records or oral traditions can tell the story? Although such sources may provide a tremendous amount of information, they do not furnish a complete record (Deetz 1996; Noel Hume 1983; Orser 2004). Whereas the life story of a head of state, records of trade contacts, or the date of a temple’s construction may be preserved, the lives of many people and the minutia of everyday life were seldom noted. In addition, the written record was often biased by the writer’s personal or cultural perspective. For example, much of the written history of Native Americans, sub-Saharan Africans, Australian Aborigines, and many other indigenous peoples were recorded by European missionaries, traders, and administrators, who frequently provided only incomplete accounts viewed in terms of their own interests and beliefs.

Information from living informants may also provide important information about some populations, particularly societies with limited written records. In recognizing the significance of such nonwritten sources, however, it is also necessary to recognize their distinct limitations. The specific roles oral traditions played (and continue to play) varied in different cultural settings. Just as early European chroniclers viewed events with reference to their own cultural traditions, so oral histories are shaped by the worldviews, histories, and beliefs of the various cultures that employ them. Interpreting such material may be challenging for individuals outside the originating cultures. The study of the archaeological record may provide a great deal of information not found in other sources and provide an independent means of evaluating conclusions drawn on the basis of other sources of information (see the box “Engendering Archaeology: The Role of Women in Aztec Mexico”). For example, it has proven particularly useful in assessing change and continuity in indigenous populations during the past five hundred years (DeCorse 2001; Lightfoot 2005).

In the Americas, during the past several decades, an increasing amount of work has concentrated on the history of immigrants who arrived in the last five hundred years from Europe, Asia, Africa, and other world areas. Archaeological studies have proven of great help in interpreting historical sites and past lifeways, as well as culture change, sociopolitical developments, and past economic systems. Among the most significant areas of study is the archaeology of slavery (Ferguson 1992; Singleton 1999). Although living in literate societies, slaves were prohibited from writing, were often illiterate, and thus left a very limited documentary record of their own. Archaeological data have been used to provide a much more complete picture of plantation life and slave society.

**Points to Ponder**

1. What are some different sources of “historical” information—written and orally preserved accounts—that you can think of? How are these different from one another in terms of the details they might provide?
2. Consider a particular activity or behavior important to you (for example, going to school, participating in a sport, or pursuing a hobby). How would evidence of the activity be presented in written accounts, oral histories, and the archaeological record?
exposure to the elements may allow for the striking preservation of archaeological materials. Some of the most amazing cases are those in which items have been rapidly frozen. An illustration of this kind of preservation is provided by the discovery in 1991 of the 5,300-year-old frozen remains of a Bronze Age man by hikers in Italy’s Tyrol Mountains (Fowler 2000). With the body were a wooden backpack, a wooden bow, fourteen bone-tipped arrows, and fragments of clothing. In other instances, a waterlogged environment, very dry climate, or rapid burial may create conditions for excellent preservation. Such unique instances provide archaeologists with a much more complete record than is usually found.

Places of past human activity that are preserved in the ground are called archaeological sites. Sites reflect the breadth of human endeavor. Some are settlements that may have been occupied for a considerable time, for example, a Native American village or an abandoned gold-mining town in the American West. Other sites reflect specialized activities, for instance, a ceremonial center, a burial ground, or a place where ancient hunters killed and butchered an animal.

Much of the archaeologist’s time is devoted to the study of artifacts—any object made or modified by humans. They include everything from chipped stone tools and pottery to plastic bottles and computers. Nonmovable artifacts, such as an ancient fire hearth, a pit dug in the ground, or a wall, are called features. In addition to artifacts and features, archaeologists examine items recovered from archaeological sites that were not produced by humans, but nevertheless provide important insights into the past. Animal bones, shells, and plant remains recovered from an archaeological site furnish information on both the past climatic conditions and the diet of the early inhabitants. The soil of a site is also an important record of past activities and the natural processes that affected a site’s formation. Fires, floods, and erosion all leave traces in the earth for the archaeologist to discover. All of these data may yield important information about the age, organization, and function of the site being examined. These nonartifactual organic and environmental remains are referred to as ecofacts.

As is the case with the recovery of fossils, the archaeologist takes special care to record the contexts in which archaeological materials are found, the artifacts’ specific location in the ground, and associated materials. Without a context, an artifact offers only a limited amount of potential information. By itself, a pot may be identified as something similar to other finds from a specific area and time period, but it provides no new information. If, however, it and similar pots are found to contain offerings of a particular kind and are associated with female burials, a whole range of other inferences may be made about the past. By removing artifacts from sites, laypersons unwittingly cause irreparable damage to the archaeological record.

**Locating Sites**

In 1940, schoolboys retrieving their dog from a hole in a hillside near Montignac, France, found themselves in an underground cavern. The walls were covered with delicate black and red paintings of bison, horses, and deer. The boys had discovered Lascaux Cave, one of the finest known examples of Paleolithic cave art. Chance findings such as this sometimes play a role in the discovery of archaeological remains, as well as paleoanthropological research, but researchers generally...
have to undertake a systematic examination, or survey, of a particular area, region, or country to locate sites. They will usually begin by examining previous descriptions, maps, and reports of the area for references to archaeological sites. Informants who live and work in the area may also be of great help in directing archaeologists to discoveries.

Of course, some archaeological sites are more easily located than others; the great pyramids near Cairo, Egypt; Stonehenge in southern England; and the Parthenon of Athens have never been lost. Though interpretations of their precise use may differ, their impressive remains are difficult to miss. Unfortunately, many sites, particularly some of the more ancient, are more difficult to locate. The settlements occupied by early humans were usually small, and only ephemeral traces are preserved in the ground. In many instances, they may be covered under many feet of sediment. Examination of the ground surface may reveal scatters of artifacts or discolorations in the soil, which provide clues to buried deposits. Sometimes nature inadvertently helps archaeologists, as erosion by wind or rain may expose sites. Archaeologists can also examine road cuts, building projects, and freshly plowed land for archaeological materials.

In the field, an archaeologist defines what areas will be targeted for survey. These areas will be determined by the research design, but also by environmental and topographical considerations, as well as the practical constraints of time and money. Archaeological surveys can be divided into systematic and unsystematic approaches (Renfrew and Bahn 2008). The latter is simpler, the researcher simply walking over trails, riverbanks, and plowed fields in the survey area and making notes of any archaeological material observed. This approach avoids the problem of climbing through thick vegetation or rugged terrain. Unfortunately, it may also produce a biased sample of the archaeological remains present; ancient land uses might have little correspondence with modern trails or plowed fields.

Researchers use many different methods to ensure more systematic results. In some instances, a region, valley, or site is divided into a grid, which is then walked systematically. In other instances, transects may provide useful information, particularly where vegetation is very thick. In this case, a straight line, or transect, is laid out through the area to be surveyed. Fieldworkers then walk along this line, noting changes in topography, vegetation, and artifacts.

**Subsurface Testing and Survey**

Because many archaeological sites are buried in the ground, many surveys incorporate some kind of subsurface testing. This may involve digging auger holes or shovel test pits at regular intervals in the survey, the soil from which is examined for any traces of archaeological material. This technique may provide important information on the location of an archaeological site, its extent, and the type of material represented.

Today, many different technological innovations allow the archaeologist to prospect for buried sites without lifting a spade. The utility of these tools can be illustrated by the magnetometer and resistivity meter. The proton magnetometer is a sensor that can detect differences in the soil’s magnetic field caused by buried features and artifacts. A buried foundation will give a different reading than an ancient road, both being different from the surrounding undisturbed soil. As the magnetometer is systematically moved over an area, a plan of buried features can be created.

Electrical resistivity provides similar information, though it is based on a different concept. A resistivity meter is used to measure the electrical current passing between electrodes that are placed in the ground. Variation in electrical current indicates differences in the soil’s moisture content, which in turn reflects buried ditches, foundations, or walls that retain moisture to varying degrees.

Although at times yielding spectacular results, techniques such as magnetometer and resistivity surveys are not without their limitations. Buried metal at a site may confuse the magnetic readings of other materials, and a leaking hose wreaks havoc with a resistivity meter. Both techniques may produce confusing patterns as a result of shallowly buried geological features such as bedrock.

**Remote Sensing**

An archaeologist was once heard to say that “one ought to be a bird to be a field archaeologist,”
Underwater Archaeology

Sunken ships, submerged settlements, and flooded towns: This wide variety of sites of different time periods in different world areas shares the need for specialized techniques to locate, excavate, and study them (Ballard 2008; Bass 2005; Koppel 2003; Menotti 2004). Although efforts were occasionally made in the past to recover cargoes from sunken ships, it was only with the invention and increasing accessibility of underwater breathing equipment during the twentieth century that the systematic investigation of underwater sites became feasible. Often artifacts from underwater sites are better preserved and so present a wider range of materials than those from land. Even more important, underwater sites are immune to the continued disturbances associated with human activity that are typical of most land sites. Shipwrecks can be compared to time capsules, containing a selection of artifacts that were in use in a certain context at a specific time. Archaeologists working on land seldom have such clearly sealed archaeological deposits.

A tantalizing example of an underwater archaeological project is the excavation and raising of the preserved remains of the Mary Rose, the pride of the young English navy and the flower of King Henry VIII’s fleet. The 700-ton warship, which was probably the first English warship designed to carry a battery of guns between its decks, foundered and sank in Portsmouth harbor on a warm July afternoon in 1545. Henry VIII, camped with his army at Southsea Castle, is said to have witnessed the disaster and heard the cries of the crew. In the 1970s, the site of the Mary Rose was rediscovered and was systematically explored by volunteer divers from around the world. The ship produced a spectacular array of over 14,000 artifacts, ranging from massive cannons to musical instruments, famed English longbows, and navigational equipment. Finds from the Mary Rose and the preserved portions of the hull can be seen at the Mary Rose Ship Hall and Exhibition at the H. M. Naval Base, Portsmouth, England (Marsden 2003, 2009).

Most people associate underwater archaeology with sunken ships, and this, in fact, represents an important part of the subdiscipline. However, rising sea levels or natural disasters may also submerge cities and towns. Research on settlements now underwater is providing increasing insight into early human settlement (Koppel 2003; Menotti 2004). As in the case of shipwrecks, the lack of oxygen and the sealed nature of the archaeological materials present special challenges in excavation, but also remarkable preservation. Such is the case of Port Royal, Jamaica, a flourishing trade center and infamous gathering place for pirates during the seventeenth century. In 1692, a violent earthquake and tidal wave submerged or buried portions of the city, preserving a record for future archaeologists. Excavations at the site spanning the last three decades have recovered a wealth of materials from seventeenth-century life (Hamilton and Woodward 1984).

Points to Ponder

1. Archaeological excavation on land is a meticulous and careful process. Discuss how excavation and recording methods would have to be modified to conduct archaeological research underneath the water.

2. Given the unique location and preservation found at underwater sites, why might they be more appropriate or important than land sites for considering certain types of research questions?

Applying Anthropology

and indeed, the perspective provided by aerial photography, sometimes called “aerial archaeology,” has been a boon to archaeologists (Daniel 1981:165). Experiments with aerial photography occurred prior to World War I, but it was during the war that its potential importance to archaeological surveys was recognized. Pilots noticed that some sites, invisible on the ground, were dramatically illustrated from the air. The rich organic soils found in archaeological sites, subtle depressions in the ground surface, or slight differences in vegetation resulting from buried features may be dramatically illustrated in aerial photographs. More recent technological innovations, such as the use of infrared, false color photography, help identify
differences in vegetation and make abandoned settlements and patterns of past land use more apparent. Aerial photography has proven very important in locating sites, but it is also of particular use in mapping and interpretation (Brophy and Cowley 2005; Kruckman 1987).

Of less use to archaeologists are photographs or images taken from extremely high altitudes by satellites or space shuttles. The scale of these pictures sometimes limits their use and their cost may make them beyond the reach of many researchers (Madry 2003; Madry et al. 2003). The potential application of such sophisticated techniques, however, has been well demonstrated. National Aeronautics and Space Administration (NASA) scientists, working with archaeologists have been able to identify ancient Mesopotamian and Mayan settlements and farmlands that had not been located with other techniques. *Space imaging radar*, which can detect features buried under six feet of sand, proved helpful in identifying ancient caravan routes on the Arabian Peninsula. These routes enabled researchers to locate the lost city of Ubar, a trade center that was destroyed around 100 A.D., and the city of Saffara on the Indian Ocean (Clapp 1998). As space age technology becomes both more refined and more affordable, it may provide an increasingly important resource for archaeologists (see box “Anthropologists At Work: Scott Madry”).

Archaeological Excavation

Archaeological surveys provide invaluable information about the past. The distribution of sites on the landscape offers knowledge about the use of natural resources, trade patterns, and political organization. Surveys also help define the extent of specific sites and allow for a preliminary assessment of their age and function. These data are invaluable in interpreting regional developments and how individual sites form part of a larger picture. However, depending on the project’s research objectives, an archaeologist may want more detailed information about individual sites. Once an archaeological site has been located, it may be targeted for systematic archaeological excavation (Figure 2.3).

Excavation is costly, time-consuming, and also destructive. Once dug up, an archaeological site is gone forever; it can be “reassembled” only through the notes kept by the archaeologist. For this reason, archaeological excavation is undertaken with great care. Although picks and shovels may occasionally come into play, the tools used most commonly are the trowel, whisk broom, and dustpan. Different techniques may be required for different kinds of sites. For example, more care might be taken in excavating the remains of a small hunting camp than a nineteenth-century house in an urban setting covered with tons of modern debris. On underwater sites, researchers must contend with recording finds using specialized techniques while wearing special breathing apparatus (see the boxes “Underwater Archaeology” and “George Fletcher Bass: Underwater Archaeologist”). Nevertheless, whatever the site, the archaeologist carefully records the context of each artifact uncovered, each feature exposed, and any changes in surrounding soil.

Work usually begins with the clearing of the site and the preparation of a detailed site plan. A grid is placed over the site. This is usually fixed to a datum point, some permanent feature or marker that can be used as a reference point and will allow the excavation’s exact position to be relocated. As in the case of other facets of the research project, the research design determines the areas to be excavated. Excavations of *midden* deposits, or ancient trash piles, often provide insights into the range of artifacts at a site, but excavation of dwellings might provide more information into past social organization, political organization, and socioeconomic status.

A question often asked of archaeologists is how deep they have to dig to “find something.” The answer is, “Well, that depends.” The depth of any given archaeological deposit is contingent upon a wide range of variables, including the type of site, how long it was occupied, the types of soil represented, and the environmental history of the area. In some cases, artifacts thousands or even hundreds of thousands of years old may lie exposed on the surface. In other cases, flooding, burial, or cultural
Figure 2.3  Excavation, archaeological plan, and artist’s reconstruction of an eighteenth-century slave cabin at Seville Plantation, St. Anne’s, Jamaica. The meticulous recording of excavated artifacts and features allows archaeologists to reconstruct the appearance of past settlements. In this case, eighteenth-century illustrations and written descriptions helped the artist add features, such as the roof, that were not preserved archaeologically.

Source: Courtesy of Douglas V. Armstrong, Syracuse University.
The value of aerial photography and high-tech satellite imagery in archaeology is well demonstrated, but the cost of such resources has often placed them beyond the reach of most archaeologists. But this situation is changing. Once the purview of governments and space programs, high altitude images are becoming both more common and of more general interest, and archaeologists are reaping the benefits.

A case in point is Google Earth, a popular desktop program that provides satellite imagery, allowing the user to zoom in on specific locals and even to track their own movements. The program is useful in getting directions and checking out vacation spots, as well as an aid in planning for a variety of non-profit and public benefit organizations. Archaeologist Scott Madry became curious about the potential use of Google Earth in his long-term research on the archaeology of Burgundy, France (Madry 2007). Madry is interested in the application of aerial photography, remote sensing, and geographic information systems technology to understand the interaction between the different cultures and the physical environment over the past 2,000 years. While he found that the images available on Google Earth were of limited use in his research area, the data available for a neighboring region that shared a similar environment and culture history proved spectacular. The images provided dramatic images of archaeological sites. Although many of these sites had been previously identified, the results demonstrated the potential of Google Earth as an archaeological research tool.

Google Earth is not the perfect solution for every research situation. The coverage is dependent of the images available and is of variable quality. Consequently, it is of limited use for some areas. Even in cases where good images are available, thick vegetation and tree cover may limit the use of both satellite images and aerial photography. Finally, while the images provided by Google Earth may help in locating and mapping sites, archaeologists still need to excavate.

**Points to Ponder**

1. What type of information do aerial photography and satellite images provide compared to archaeological excavation? What are the limitations of each method?
2. Consider the data that satellite imagery provides in light of the discussion of research designs and the questions archaeologists might ask. How do these questions shape the type of method employed?

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Bones and other archaeological remains are often fragmentary and must be excavated with great care. Here, an archaeologist works on one of the approximately 200 bodies—thought to date to pre-Columbian times—found at the construction site for a subway in Mexico City.

activities may cover sites with thick layers of soil. A clear illustration of this is seen in tells (settlement mounds) in the Near East, which sometimes consist of archaeological deposits covering more than 100 square acres many feet deep.

**Dating Methods**

How old is it? This simple question is fundamental to the study of the past. Without the ability to order temporally the developments and events that occurred in the past, there is no way to assess evolutionary change, cultural developments, or technological innovations. Paleoanthropologists and archaeologists employ many different dating techniques. Some of these are basic to the interpretation of both the fossil record and archaeological sites. Others are more appropriate for objects of certain ages or for particular kinds of materials (for example, volcanic stone, as opposed to organic material). Hence, certain techniques are more typically associated with archaeological research than paleoanthropological research, and vice versa. In any given project, several different dating techniques are used in conjunction with one another to independently validate the age of the materials being examined. Dating methods can be divided into two broad categories that incorporate a variety of specific dating techniques: relative dating and numerical dating. Accurate dating of discoveries depends upon both methods.

**Relative Dating**

Relative dating refers to dating methods that determine whether one particular fossil, artifact, fossil locality, or site dates before or after another. Relative dating methods do not provide an actual date, just an age relative to something else. The most basic relative dating method is stratigraphic dating, a technique pioneered by the seventeenth-century Danish scientist Niels Stensen (1638–1687). Today, Stensen is better known by the Latinized version of his name, Nicholas Steno. Steno was the first person to suggest that the hard rock where fossils are found had once been soft sediments that had gradually solidified. Because sediments had been deposited in layers, or strata, Steno argued that each successive layer was younger than the layers underneath. Steno’s law of superposition states that in any succession of rock layers, the lowest rocks have been there the longest and the upper rocks have been in place for progressively shorter periods. This assumption forms the basis of stratigraphic dating.

Steno was concerned with the study of geological deposits, but stratigraphic

Archaeologists taking notes from an excavation.
dating is also of key importance in dating archaeological materials (Figure 2.4). An archaeological site presents a complex layer cake of stratigraphic levels representing the accumulation of cultural material, such as trash and housing debris, as well as natural strata resulting from flooding, the decomposition of organic material, and the like. Layers associated with human occupation often accumulate to striking depths.

Like all relative dating methods, stratigraphic dating does not allow researchers to assign an actual numerical age to a fossil or artifact. Rather, it indicates only whether one fossil is older or younger than another within the same stratigraphic sequence. This technique is essential to paleoanthropological and archaeological interpretation because it allows researchers to evaluate change through time. However, researchers must take notice of any disturbances that may have destroyed the order of geological or archaeological deposits. Disturbances in the Earth’s crust, such as earthquakes and volcanoes, can shift or disrupt stratigraphic layers. Archaeological sites may be ravaged by erosion, burrowing animals, and human activity.

**Faunal Succession** One of the first people to record the location of fossils systematically was William Smith (1769–1839), the “father” of English geology (Winchester 2002). An engineer at a time when England was being transformed by the construction of railway lines and canals, Smith noticed that as rock layers were exposed by the construction, distinct fossils occurred in the same relative order again and again. He soon found that he could arrange rock samples from different areas in the correct stratigraphic order solely on the basis of the fossils they contained. Smith had discovered the principle of *faunal succession* (literally, “animal” succession). A significant scientific milestone, Smith’s observations were made sixty years before Darwin proposed his evolutionary theories to explain how and why life-forms changed through time.

Since Smith’s era, paleontologists have studied thousands of fossil localities around the world. Information on the relative ages of fossils from these sites provides a means of correlating the relative ages of different fossil localities and also casts light on the relative ages of fossils that are not found in stratigraphic context. Placing fossils in a relative time frame in this way is known as *faunal correlation*.

**Palynology** Remains of plant species, which have also evolved over time, can be used for relative dating as well. *Palynology* is the study of pollen grains, the minute male reproductive parts of plants. By examining preserved pollen grains, we can trace the adaptations vegetation underwent in a region from one period to another. In addition to helping scientists establish the relative ages of strata, studies of both plant and animal fossils offer crucial clues to the reconstruction of the environments where humans and human ancestors lived.

**Relative Dating Methods for Bones** Scientists can determine the relative age of bones by measuring the elements of fluorine, uranium, and nitrogen in the fossil specimens. These tests, which can be used together, are sometimes referred to as the *FUN trio*. Fluorine and uranium occur naturally in groundwater and gradually collect in bones after they are buried. Once absorbed, the fluorine and uranium remain in the bones, steadily accumulating over time. By measuring the amounts of these absorbed elements, scientists can estimate the length of time the bones have been buried. Nitrogen works in the opposite way. The bones of living animals contain approximately 4 percent nitrogen, and when the bones start to decay, the concentration of nitrogen steadily decreases. By calculating the percentage of nitrogen
remaining in a fossilized bone, scientists can calculate its approximate age.

The FUN trio techniques all constitute relative dating methods because they are influenced by local environmental factors. The amounts of fluorine and uranium in groundwater differ from region to region, and variables such as temperature and the chemicals present in the surrounding soil affect the rate at which nitrogen dissipates. Because of this variation, relative concentrations of fluorine, uranium, and nitrogen in two fossils from different areas of the world may be similar despite the fact that they differ significantly in age. The techniques are thus of greatest value in establishing the relative age of fossils from the same deposit. To some extent, these methods have been supplanted by more modern, numerical dating methods but they nevertheless present an important alternative means of validating the relative ages of fossil finds (see “The Piltdown Fraud” in Chapter 5).

Seriation

Unlike the methods discussed thus far that utilize geological, chemical, or paleontological principles, seriation is a relative dating technique based on the study of archaeological materials. Simply stated, seriation is a
The principles of seriation can be illustrated by examining stylistic changes in New England gravestones of the seventeenth, eighteenth, and nineteenth centuries. Unlike many artifacts, gravestones can be closely dated. To validate the principle of seriation, archaeologist James Deetz charted how colonial gravestone designs changed through time (Deetz 1996). His study of gravestones in Stoneham Cemetery, Massachusetts, as illustrated in Figure 2.5, demonstrates the validity of the method. In the course of a century, death’s-head motifs were gradually replaced by cherub designs, which in turn were replaced by urn and willow decorations. The study also illustrates how local variation in beliefs dating technique based on the assumption that any particular artifact, attribute, or style will appear, gradually increase in popularity until it reaches a peak, and then progressively decrease. Archaeologists measure these changes by comparing the relative percentages of certain attributes or styles in different stratigraphic levels in a site or in different sites. Using the principle of increasing and decreasing popularity of attributes, archaeologists are able to place categories of artifacts in a relative chronological order. Seriation was particularly important for chronologically ordering ceramics and stone tools before the advent of many of the numerical dating techniques discussed on the following page.
Numerical, or Absolute, Dating

In contrast to relative dating techniques, numerical dating methods (sometimes also referred to as “absolute” or “chronometric” methods) provide actual ages. For recent time periods, historical sources such as calendars and dating systems that were used by ancient peoples provide numerical dates. Mayan and Egyptian sites, for example, can often be dated by inscriptions carved into the monuments themselves (see the discussion of Writing Systems in Chapter 9). However, such written records only extend back a few thousand years and these sources are not available for many regions. Researchers have consequently explored a variety of methods to establish the age of fossil finds and archaeological discoveries.

During the nineteenth century, scientists experimented with many methods designed to pinpoint the numerical age of the Earth itself. Many of these methods were based on observations of the physical world. Studies of erosion rates, for instance, indicated that it had taken millions of years to cut clefts in the earth like the Grand Canyon in the United States. Other strategies were based on the rates at which salt had accumulated in the oceans, the Earth had cooled, and geological sediments had formed (Prothero 1989). By observing current conditions and assuming a standard rate at which these processes had occurred, scientists calculated the amount of time represented. These early approaches were flawed by a limited understanding of the complexity of natural processes involved and the range of local conditions. Therefore, these techniques at best provide only crude relative dating methods. In contrast to these early researchers, today’s scientists have a wide variety of highly precise methods of dating paleontological and archaeological finds (Aitken 1990; Brothwell and Pollard 2001).

Several of the most important numerical dating techniques used today are based on radioactive decay, a process in which radioisotopes, unstable atoms of certain elements, break down or decay by throwing off subatomic particles and energy over time. These changes can produce either a different isotope of the same element or another element entirely. In terms of dating, the significance of radioactive decay is that it occurs at a set rate regardless of environmental conditions, such as temperature fluctuations, amount of groundwater, or the depth below surface. The amount of decay that has taken place can be measured with a device called a mass spectrometer. Hence, by calculating how much decay has occurred in a geological specimen or an artifact, scientists can assign a numerical age to it.

Radiocarbon Dating  Radiocarbon dating, also known as carbon 14 dating, is perhaps the best known and most common numerical dating technique used by archaeologists. The technique of using radioactive decay as a dating tool was pioneered by Willard Libby, who received the 1960 Nobel Prize in chemistry for his work on radiocarbon dating. Radiocarbon dating, as its name implies, is based on the decay of carbon 14 ($^{14}$C), a radioactive (unstable) isotope of carbon that eventually decays into nitrogen. The concentration of carbon 14 in a living organism is comparable to that of the surrounding atmosphere and is absorbed by the organism as carbon dioxide ($\text{CO}_2$). When the organism dies, the intake of $\text{CO}_2$ ends. Thus, as the carbon 14 in the organism begins to decay, it is not replaced by additional radiocarbon from the atmosphere.

Like other radioisotopes, carbon 14 decays at a known rate that can be expressed in terms of its half-life, the interval of time required for half of the radioisotope to decay. The half-life of carbon 14 is 5,730 years.
By measuring the quantity of carbon 14 in a specimen, scientists can determine the amount of time that has elapsed since the organism died.

Radiocarbon dating is of particular importance to archaeologists because it can be used to date organic material that contains carbon, including fragments of ancient wooden tools, charcoal from ancient fires, and skeletal material. Dates of up to 80,000 years old have been obtained, but the technique is generally limited to dating materials less than about 60,000 years old (Plastino et al. 2001; Taylor and Southon 2007). The minuscule amounts of radiocarbon remaining in materials older than this make measurement difficult. Because of the time period represented, radiocarbon is of limited use to paleoanthropologists who may be dealing with fossil finds millions of years old. However, radiocarbon dating has become of great importance to archaeologists who deal with materials of more recent age.

**Potassium-Argon and Fission-Track Dating**

Several isotopes that exhibit radioactive decay are present in rocks of volcanic origin. Some of these isotopes decay at very slow rates over billions of years. Two radiometric techniques that have proven of particular help to paleoanthropologists and archaeologists studying early human ancestors are potassium-argon and fission-track dating. These methods do not date fossil material itself. Rather, they can be used to date volcanic ash and lava flows that are associated with fossil finds. Fortunately, many areas that have produced fossil discoveries were volcanically active in the past and can be dated by using these techniques. These methods have been employed at such fossil localities as the Fayum Depression in Egypt (see Chapter 4), Olduvai Gorge in Tanzania and Hadar, Ethiopia (see Chapter 5).

In potassium-argon dating, scientists measure the decay of a radioisotope of potassium, known as potassium 40 ($^{40}$K), into an inert gas, argon ($^{40}$Ar). During the intense heat of a volcanic eruption, any argon present in a mineral is released, leaving only the potassium. As the rock cools, the potassium 40 begins to decay into argon. Because the half-life of $^{40}$K is 1.3 billion years, the potassium-argon method can be used to date very ancient finds, and has thus been important in dating early hominid fossils. Although this technique has been used to date volcanic rocks a few thousand years old, the amount of argon is so small that it is more commonly used on samples dating over 100,000 years (McDougall and Harrison 1999).

Fission-track dating is based on the decay of a radioactive isotope of uranium ($^{238}$U) that releases energy at a regular rate. In certain minerals, microscopic scars, or tracks, from the spontaneous fissioning of $^{238}$U are produced. By counting the number of tracks in a sample, scientists can estimate fairly accurately when the rocks were formed. Fission-track dating is used to determine the age of geological samples between 300,000 and 4.5 billion years old, and thus it can provide independent confirmation on the age of strata using potassium-argon dating. Although this is generally a technique of more use to paleoanthropologists, it may also be used on manufactured glasses. Dates have been obtained on glass and pottery glazes less than 2,000 years old, and so it presents a technique of potential help to archaeologists studying the more recent past (Aitken 1990).

**Thermoluminescence Dating**

This dating method is also based on radioactive decay, but the technique operates slightly differently than the methods discussed above. It is based on the amount of electrons trapped in crystalline minerals. The electrons are primarily produced by the decay of three elements present in varying amounts in geological deposits: uranium, thorium, and a radioactive isotope of potassium ($^{40}$K). Hence, for accuracy, thermoluminescence dates should include an evaluation of the radioactivity in the surrounding soil so that the background radiation present in the deposit can be controlled for. As these elements decay, electrons are trapped in the crystals of the surrounding matrix. In order to be dated using the technique, artifacts must have been heated, as in the case of the firing of ceramics. Heating releases any trapped electrons; decay subsequently begins again and electrons once again start to accumulate in the crystal matrix of the object. By calculating the rate at which electrons have accumulated and measuring the amount of electrons trapped in a sample, the age can be determined.

The importance of thermoluminescence dating lies in the fact that it can be used to date artifacts themselves, as opposed to associated stratigraphic deposits, as in the case of potassium argon dating. Thermoluminescence dating has been particularly useful in dating ceramics—one of the most common artifacts found on sites dating to the last 10,000 years. It has, however, also been used in cases where stone tools have been heated during their manufacture or time of use (some stone becomes easier to work if heated). Similarly, it has been used in cases where the clay or stone of a hearth area has been heated; the key once again being that the sample has been heated at the time of use or manufacture to set the amount of accumulated electrons to zero. Dates of tens or hundreds of thousands of years have been obtained on stone tools (Aitken et al. 1993). The method has also proven very useful in differentiating modern fakes from ancient ceramic objects.

**Dendrochronology**

Dendrochronology is a unique type of numerical dating based on the annual growth rings found in some species of trees (Figure 2.6). Because a ring corresponds to a single year, the age of a tree can be determined by counting the number of rings. This principle was recognized as early as the late eighteenth century by the Reverend Manasseh Cutler, who
used it to infer that a Native American mound site in Ohio was at least 463 years old. The modern science of dendrochronology was pioneered in the early twentieth century by A. E. Douglass using well-preserved wood from the American Southwest.

Today tree-ring dating is a great deal more sophisticated than counting tree rings. In addition to recording annual growth, tree rings also preserve a record of environmental history: thick rings represent years when the tree received ample rain; thin rings denote dry spells. In more temperate regions, the temperature and the amount of sunlight may affect the thickness of the rings. Trees of the same species in a localized area will generally show a similar pattern of thick and thin rings. This pattern can then be overlapped with patterns from successively older trees to build up a master dendrochronology sequence. In the American Southwest, a sequence using the bristlecone pine has now been extended to almost 9,000 years ago. Work on oak sequences in Ireland and Germany has been used to create a master dendrochronology sequence dating back over 10,000 years.

The importance of this method is manifest. Dendrochronology has proven of great significance in areas such as the American Southwest, where the dry conditions often preserve wood. The growth rings in fragments of wood from archaeological sites can be compared to the master dendrochronology sequence, and the date the tree was cut down can be calculated. Even more important, dendrochronology provides an independent means of evaluating radiocarbon dating. Fragments dated by both techniques confirm the importance of radiocarbon as a dating method. However, wood dated by both techniques indicates that carbon 14 dates more than
3,000 years old are increasingly younger than their actual age. The reason for this lies in the amount of carbon 14 in the Earth’s atmosphere. Willard Libby’s initial radiocarbon dating calculations were based on the assumption that the concentration was constant over time, but we now know that it has varied. Dendrochronologies have allowed scientists to correct, or calibrate, radiocarbon dates, rendering them more accurate.

**Interpretations About the Past**

Views of the past are, unavoidably, tied to the present. As we discussed in Chapter 1, anthropologists try to validate their observations by being explicit about their assumptions. Prevailing social and economic conditions, political pressures, and theoretical perspectives all may affect interpretation. During the early twentieth century, bits and pieces of physical anthropology, archaeology, and linguistic information were muddled together to support the myth of a superior German race (Pringle 2006). Gustav Kossina, initially trained as a philologist, distorted archaeological interpretations to bolster chronologies that showed development starting in Germany and spreading outward to other parts of Europe.

Archaeological and historical information was also used to validate racist apartheid rule in South Africa. South African textbooks often proffered the idea that black, Bantu-speaking farmers migrating from the north and white and Dutch-speaking settlers coming from the southwest arrived in the South African hinterland at the same time. This interpretation had clear relevance to the present: Both groups had equal claim to the land. However, over the past two decades, a new generation of archaeologists has knocked the underpinning from this contrived history (Hall 1988). Archaeological evidence indicates that the ancestors of the black South Africans had moved into the region by 200 A.D., 1,500 years before the initial European settlement.

In these cases, versions of the past were constructed with dangerous effects on the present. More commonly, errors in interpretation are less intentional and more subtle. All researchers carry their own personal and cultural bias with them. Human societies are complex, and how this complexity is manifested archaeologically varies. These factors make the evaluation of interpretations challenging, and differences of opinion frequently occur.

Although there is no formula that can be used to evaluate all paleoanthropological and archaeological materials, there are useful guidelines. As seen in the preceding chapter, a key aspect of anthropological research is a systematic, scientific approach to data. Outmoded, incorrect interpretations can be revealed through the testing of hypotheses and replaced by more convincing observations. The validity of a particular interpretation can be strengthened by the use of independent lines of evidence; if they lead to similar conclusions, the validity of the interpretation is strengthened. Academic books and articles submitted for publication are reviewed by other researchers, and authors are challenged to clarify points and strengthen observations. In many cases the evaluation of a particular theory or hypothesis must await the accumulation of data. Many regions of the world and different aspects of the past are virtually unstudied. Therefore, any theories about these areas or developments must remain tentative and subject to reevaluation.

**Summary**

Paleoanthropologists and archaeologists examine different aspects of the human past. Paleoanthropologists concentrate on the evolution of humans as a biological species and the behavior of early human ancestors, whereas archaeologists are concerned with past human cultures—their lifestyles, technology, and social systems—through the material remains they left behind. To ensure that data relevant to the paleoanthropologists’ and archaeologists’ questions are recovered, projects begin with a research design that sets out the objectives and formulates the strategy for recovering the pertinent information. Both subdisciplines overlap and utilize experts from other fields to provide a holistic interpretation of the past.

Paleoanthropologists work with fossils, the preserved traces of past life. Places where fossils are found are termed fossil localities. The fossil record is far from complete; only a small portion of the creatures that have lived are preserved. Nevertheless, an impressive record of past life has survived. Careful study and improved technology reveal minute fossils of shellfish, algae, and pollen and images of the delicate structure in bones. Paleoanthropology integrates the fields of geology, paleontology, and archaeology, as well as physical anthropology, to provide a more holistic interpretation of the emergence and the behavior of early human ancestors.

The archaeological record encompasses all the material traces of past cultures. Places of past human activity
that are preserved in the ground are called archaeologi-
cal sites. Sites contain artifacts (objects made or modified
by humans), as well as other traces of past human activity
and a record of the environmental conditions that affected
the site. In studying archaeological materials, archaeologists
are particularly interested in the context, the specific loca-
tion of finds and associated materials. Understanding
the context is of key importance in determining the age, uses,
and meanings of archaeological materials. Specialized fields
of study in archaeology may require special approaches or
techniques. For example, historical archaeologists draw on
written records and oral traditions to help interpret archae-
ological remains. Underwater archaeologists require special
equipment to locate and excavate sites.

Archaeological sites provide important information
about the past, for example, the use of natural resources,
trade patterns, and political organization. Sites can be lo-
cated in many different ways. Often traces of a site may
survive on the ground, and local informants, maps, and
previous archaeological reports may be of help. To dis-
cover sites, archaeologists may survey areas, looking for
any indications of archaeological remains. Surface exami-
nations may be supplemented by subsurface testing to
identify buried deposits. Technological aids, such as the
magnetometer or resistivity meter, may also help archae-
ologists identify artifacts and features beneath the ground.

Depending on a project’s objectives, archaeological
sites may be targeted for excavation. Digging is always
undertaken with great care, and information about the
work is carefully recorded. Before excavation, a site is di-
vided into a grid, which allows each artifact to be carefully
located. The depth of an excavation depends on a num-
ber of variables, including the type of site, the length of
occupation, the soils present, and the area’s environmen-
tal history.

Dating of fossils and archaeological materials is of
key importance in the interpretation of the past. Without
the ability to place finds in their relative ages, there is
no way of assessing evolutionary change, technological
innovations, or cultural developments. Paleoanthropolo-
gists and archaeologists use many different dating tech-
niques that can be classified as either relative or absolute
dating methods. Methods such as stratigraphic dating,
faunal succession, and fluorine, uranium, and nitrogen
analyses provide only relative ages for finds in the same
deposits. Absolute techniques like radiocarbon dating,
potassium-argon dating, and dendrochronology can be
used to assign actual numerical ages to finds.

Interpretations of the past are inevitably influenced
by the present. At times theories have been used to sup-
port political ends, as seen in Nazi Germany and the
apartheid policies of South Africa. Researchers try to
avoid bias by employing systematic, scientific methodol-
gy. Theories can be revealed as false through testing
and replaced by more convincing arguments. These, in
turn, can be negated or strengthened by exploring new
lines of evidence. Archaeological theories, often derived
from cultural anthropology, help archaeologists concep-
tualize how cultures work and what aspects of a past cul-
ture might be preserved archaeologically. Ultimately, this
reflection provides a more complete explanation of the
dynamics of past cultures and culture change.

Questions to Think About

1. What are the distinct issues, concerns, and methods
   that distinguish paleoanthropology and archaeology?
2. How do the archaeological and fossil records differ in
terms of their content?
3. What is meant by the term historical archaeology? What are some ways
   in which archaeological research can improve our understanding of history?
4. What are the principal issues that you would address
   in preparing a research design for an archaeological
   or paleoanthropological project? What concepts,
   activities, and logistics would you consider?
5. A great deal of archaeological information can be
   obtained without moving a single shovelful of dirt.
   Describe three different methods used by archaeolo-
gists to explore sites in the field that are not depen-
dent upon excavation.
6. What are the principal differences between relative
   and absolute dating? Discuss two methods each of
   relative dating and absolute dating, describing the
   advantages and limitations of each.
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Key Terms

- aerial photography
- antiquaries
- archaeological sites
- context
- culture
- datum point
- dendrochronology
- ecofacts
- faunal correlation
- faunal succession
- features
- fission-track dating
- fossil localities
- law of supposition
- material culture
- paleocology
- palynology
- potassium-argon dating
- proton magnetometer
- radiocarbon dating
- relative dating
- research design
- resistivity
- seriation
- stratigraphic dating
- survey
- taphonomy
- thermoluminescence dating

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For further information about topics covered in this chapter, go to MyAnthroLab at www.myanthrolab.com and access the following readings in MyAnthroLibrary:

Stephen Ball, The Discovery of Archaeological Sites.
Timothy G. Bromage, Paleanthropology and Life History, and Life History of a Paleoanthropologist.

Cheryl Claassen, Gender and Archaeology.
Lukacs John R., Dental Deductions: Why and How Anthropologists Study Teeth.
Mark J. Lynott, Ethics in Archaeology.