PART ONE

THE PAST IS A FOREIGN COUNTRY: GETTING FROM HERE TO THERE

INTRODUCTION  QUESTIONS OF TIME AND ETHICS
CHAPTER 1  GETTING STARTED IN ARCHAEOLOGY
CHAPTER 2  PUTTING THE PICTURE TOGETHER

Archaology is the study of the human past through the traces of the past that exist in the present. After reading this introduction, you should understand:

• The structure of the discipline of archaeology.
• The fundamental elements of archaeological ethics.
Introduction: Questions of Time and Ethics

The thing the Time Traveller held in his hand was a glittering metallic framework, scarcely larger than a small clock, and very delicately made. There was ivory in it, and some transparent crystalline substance. “This little affair,” said the Time Traveller, resting his elbows on the table and pressing his hands together above the apparatus, “is only a model. It is my plan for a machine to travel through time.” (Wells [1895] 1984, 39)

Time travel, as imagined by H. G. Wells in his visionary novel *The Time Machine* and by others in countless subsequent films and books, remains a tantalizing impossibility. We cannot climb into the saddle of an apparatus, or for that matter the seat of a DeLorean, that will whisk us back in time. We are rooted firmly in the present.

Archaeologists have developed a solution to the problem of time travel that is every bit as intricate as the mechanism built by Wells’s hero. Archaeological excavation and analysis is a highly developed scientific discipline that allows us a means of access to the human past. Archaeology does not take us into the past, but enables us to read the traces of the past that exist with us in the present.

A simple “thought experiment” can give a sense of how archaeology works. Imagine a building that you are familiar with, perhaps your family home or a school you have attended. Picture how this structure looks today, and then attempt to remove any elements that were added in the past 20 years. If the building is old, try pushing back 40, 60, or even 100 years. Now extend your view to encompass a larger landscape, perhaps a neighborhood or a town. Although we cannot reenter the past, we are surrounded by its material traces. Uncovering and understanding these traces is the archaeologist’s task (Figure I.1).

Because archaeological remains can take many forms—objects made or modified by people, organic material, geological features—the discipline of archaeology is diverse. As a result, archaeology is often found spread across academic disciplines. In the United States, archaeology is considered a subfield of anthropology, and departments of archaeology are rare. Anthropologists study the diversity of human experience, and archaeology provides an important bridge between biological anthropologists and anthropologists studying modern society and culture. Archaeology also provides time depth and gives a clear material focus to anthropology. Archaeologists working on the ancient civilizations of Mesopotamia, Egypt, and the biblical world are often found in departments of Near or Middle Eastern studies, while archaeologists of classical Greece and Rome are usually in departments of classics or art history. Archaeologists are also employed as curators in museums.

Archaeologists today tend to work outside of the university or museum setting. In the United States, most professional archaeologists are employed by private companies, dedicated to excavating and surveying areas in advance of impending construction. This type of archaeology, usually referred to as cultural resource management, or CRM, is critical to preserving our heritage in the face of development. CRM is increasingly a global enterprise and includes firms that operate internationally. Other archaeologists work in various branches of the government, particularly the National Park Service. Archaeologists working in the public sector play a critical role in the protection and preservation of our cultural heritage.
role in both the preservation and the presentation of cultural heritage (Figure I.2). Archaeologists have also begun to find employment in law enforcement, interdicting illegally traded artifacts and halting illegal excavation. Finally, archaeologists contribute to the development of methods of forensic science and remain active in projects documenting crime scenes, both on the local level and internationally in conjunction with investigations of war crimes.

Training in archaeology is based on a combination of university course work and practical experience. Most professional archaeologists have advanced training, at least at the master’s level. Archaeological research is expensive, supporting both the process of excavation and the scientific analysis of the recovered materials. For CRM firms, the costs of excavation are paid by the landowner, as required by law. In most cases, the firm has to bid for a contract, the terms of which bind and limit the firm. Academic and museum-based archaeologists have the luxury of pursuing projects that develop from a program of research rather than from the imperatives of development. However, to pursue research, it is necessary to raise funds from government and private agencies. In the United States, the National Science Foundation and the National Endowment for the Humanities provide critical funding for archaeological research.

Archaeology is a varied field of study, and archaeologists follow a range of career paths. However, the discipline is bound both by shared methods and interests and by a shared ethic. Archaeologists have recently begun to recognize the importance of exploring and codifying archaeological ethics (Figure I.3). The Register of Professional Archaeologists (RPA) was founded in 1998 as a listing of archaeologists with both graduate training and practical experience who agree to abide by an explicit code of conduct and standards of research performance (www.rpanet.org/). The Society for American Archaeology has set out the following eight principles of archaeological ethics (www.saa.org/public/resources/ethics.html):

- **Stewardship.** The archaeological record is irreplaceable, and archaeologists are responsible for acting as stewards, working for long-term conservation and protection of the archaeological record. Stewards are caretakers and advocates who work for the benefit of all people. The archaeological record includes archaeological materials, sites, collections, records, and reports.

- **Accountability.** Archaeologists are accountable to the public and must make an effort to consult actively with all groups affected by their research.

- **Commercialization.** Archaeologists should discourage and avoid the enhancement of the commercial value of archaeological objects, particularly those not curated in public institutions or those inaccessible to the public.

- **Public Education and Outreach.** Archaeologists should reach out to and cooperate with interested members of the public.

- **Intellectual Property.** Original materials and documents from archaeological research should not be treated as personal possessions. After a limited and reasonable time, these materials should be made available to others.
• Public Reporting and Publication. Knowledge gained from archaeological research should be published within a reasonable length of time to a wide range of interested publics. If necessary for the preservation of a site, its location and nature may be obscured in publications.
• Records and Preservation. Archaeologists should actively work for the preservation of archaeological records and reports.
• Training and Resources. Archaeologists must have adequate training, facilities, and support before carrying out research.

Archaeologists study the past, but they work for the present and the future. Although we are motivated by the excitement of discovery, we are also compelled by the importance of conservation. The practical decision of how much of a site to excavate offers an example of maintaining a balance between exploration and conservation. While archaeologists might like to clean out every nook and cranny of a site as they search for critical pieces of data, such an approach is acceptable only in situations where the site faces imminent destruction. In all other cases, the desire to explore is tempered by the imperative of leaving material for future generations of archaeologists who may arrive with new methods capable of unlocking aspects of the archaeological record that are inaccessible today.

From Indiana Jones to Lara Croft, archaeologists have become popular movie heroes. The irony is that the reality of archaeology is much closer to moviemaking than to the exploits of a movie hero. Like making a film, archaeology involves the logistics of working with a team on location, for long hours, and with an eye toward pragmatic compromise. Like filmmakers, archaeologists do a great deal of unglamorous pre- and postproduction work. Archaeology calls less for bravery in battle than it does for the courage to take creative leaps based on intuition. The result of archaeological research is not triumphantly grasping a trophy, but rather reaching conclusions that open an entirely new vista of questions.

SUMMARY
• Because archaeological remains can take many forms, including objects made or modified by people, organic material, and even geological features, the discipline of archaeology is highly varied.
• In the United States and Canada, the academic discipline of archaeology is usually found in departments of anthropology, as well as in departments of Near or Middle Eastern studies, classics, and fine arts.
• Most archaeologists today work outside of academia, in either cultural resource management firms or government agencies.
• Archaeological ethics are based on the idea that archaeologists should act as stewards of the archaeological record.

REVIEW QUESTIONS
1. Can you think of a place you are familiar with where the physical remains of the past are apparent?
2. How does stewardship of the archaeological record differ from ownership?
3. In what ways do archaeologists work for the future?
GETTING STARTED IN ARCHAEOLOGY

This chapter introduces you to how archaeologists find and excavate sites, as well as to the basics of archaeological laboratory research. After reading the chapter, you should understand:

• The goals of archaeological survey.
• The methods of horizontal and vertical excavation.
• The use of quantification in artifact and ecofact analysis.
• The methods used to construct an archaeological chronology.
A surveyor works at the Chac restoration site in Mexico.
We experience the past at almost every instant. Think of how you hear a piece of music. You do not simply hear a succession of notes as they unfold in time. Rather, your hearing of each note is shaped by your memory of the preceding notes and your anticipation of what is to come. The human present is created through a fusion of past, present, and future.

As humans, we live in a present shaped by our consciousness of the past. Our sense of the past exists in our memories—in our visual, auditory, and olfactory images and sensations. Athletes also speak of a “body memory” that allows them to carry out elaborate, fine-tuned sequences of action. But memory goes far beyond our minds and our bodies. Writing systems and, more recently, computer technologies store memory externally. Anthropologists speak of collective memories—particularly memories of traumas, such as the events of September 11—that are held by a group rather than being the property of an individual. Objects and places can also embody memory; most families have heirlooms that carry a memory and a direct connection to previous generations (Lillios 1999).

Archaeology is a science that probes the depths of the human past. But archaeology is not time travel: Archaeologists and the objects they study remain firmly anchored in the present. The essential trick of archaeology is how to use static objects that exist in the present to infer the dynamics of past societies (Binford 1983). Put more simply, the goal of archaeological method is to be able to use the objects we dig up to understand the lives of people who lived in the past.

The goal of this chapter is to introduce you to archaeological method—to show you how archaeologists look at the world. We begin with fieldwork, first the way that archaeologists locate sites and then how sites are excavated. Archaeological excavation draws heavily on tools used in geology, so we also take time to consider aspects of geological stratigraphy. We then move to the laboratory to see how the objects recovered in excavations and surveys are analyzed. We pay particular attention to the quantitative methods archaeologists use to glean information from the totality of the recovered material.

1.1 Reading the Landscape

The first challenge facing archaeologists is finding the traces of human action. The purpose of an archaeological survey is to map the physical remains of human activity. The scale of surveys can range from an entire region to the surface of a single site. The evidence recorded can be as fine grained as individual stone tools and potsherds or as massive as large standing structures.

Survey Design

The most obvious reason for carrying out an archaeological survey is to discover sites, be they sunken ships, buried cities, or hunter–gatherer camps. But archaeologists also use surveys to understand the distribution of sites within a region, how sites are distributed across the landscape, or where different activities took place within a site. In some cases, the goal is to determine whether sites will be destroyed by construction projects. Often, there is pressure to gain as complete a picture as possible at the lowest possible cost.

Archaeological surveys must be designed with the goals of the project in mind (Banning 2002). Simply recording everything is rarely possible, or even necessary, so archaeologists usually determine a strategy to sample the survey area. Statistical sampling in archaeological survey works on the same basis as in a public-opinion poll. In both cases, a carefully selected sample is used to represent a larger population. The
goals of survey research can range widely. In an important survey project carried out in southern Iraq, Robert McCormick Adams and his colleagues were able to trace the hierarchy of settlements surrounding the large urban centers of early Mesopotamia (Adams and Nissen 1972). Archaeologists working across the western United States have used similar survey methods to track the mobility of small-scale societies of hunter–gatherers (Kelly 1988).

#### Geological Factors

It would be naïve to expect that we can simply walk across the landscape and find traces of all past human activity. Archaeological survey must take into consideration geological factors that affect the preservation and visibility of sites. Often, sites are so deeply buried that no artifacts are visible on the surface. Early prehistoric sites in East Africa, such as Olduvai Gorge, are examples of this kind of deeply buried context. At Olduvai Gorge, sites can be discovered only where natural erosion has cut through the accumulation of sediments, exposing fossil- and artifact-bearing levels.

Although erosion is often the archaeologists’ indispensable ally, erosion can also complicate the interpretation of survey results. In many cases, stream channels have cut through archaeological sites and redeposited material far downstream. Archaeologists must take care to determine whether archaeological material picked up on a survey is actually in the place where it was originally deposited or whether it has been redeposited by erosion. Archaeologists refer to material that is in the place where it was originally deposited as **in situ**. It is often possible to identify archaeological material that has been transported by water on the basis of characteristic wear patterns and the absence of very small fragments.

#### Recovery Methods and GIS

Most surveys involve little more than a team of archaeologists walking slowly, with heads bent, across the landscape. The problems faced in surface collection vary tremendously according to the context of the research. On the one hand, in locations where there is heavy brush coverage, actually seeing artifacts can be extremely challenging (see Figure 1.1). On the other hand, there are areas where one is walking on a “carpet of artifacts”—a situation that is problematic because one has to decide what to pick up and record.

In a depositional environment, where there is a constant buildup of sediments, artifacts may not always be found on the surface. In such a context, many archaeologists rely on a strategy of digging small test pits to find buried artifacts. The type of survey and the extent of available resources together determine the placement of the test pits.

Archaeologists draw on a wide range of technologies to increase their ability to detect archaeological deposits and to collect and organize spatial information:

- Methods of remote sensing, including aerial and satellite photography, play a critical role both in discovering sites and in orienting exploration (see the Remote Sensing Toolbox in Chapter 10, p. 273).
• Geophysical techniques are used to gain an idea of what lies below the surface of a site without having to excavate, allowing archaeologists to detect invisible features. The two main geophysical methods used in archaeological survey are magnetometry and ground-penetrating radar (see the Geophysical Methods Toolbox in Chapter 13, p. 353).
• The precise location of archaeological sites can be determined with handheld Global Positioning System (GPS) receivers.

Archaeologists have access to a wide range of geographical information. Satellite images, aerial photographs, topographic maps, and the coordinates of locations of sites already found make up a rich body of data. Geographical Information Systems (GIS) are suites of software applications that allow spatial data to be brought together and consolidated. GIS software works as a series of layers or overlays that the software sets to the same scale (see Figure 1.2). Imagine that you have a series of “documents,” including an aerial photograph of a site, a topographic map of the region in which the site is located, a soil map of the same region, and, from a survey, the coordinates of archaeological finds at the site (Wheatley and Gillings 2002). For any one of these documents to be used in a GIS environment, the exact longitude and latitude of two or three points in the area covered by the map must be known, allowing the document to be georeferenced. Once the image is georeferenced, it must be digitized as either a digital or a raster image. A digital image is one in which all points are digitized; a raster image is simply a scanned picture. Once each of the documents is digitized and georeferenced, all of them are ready to be treated as layers by a GIS program. The program will overlay the images at a uniform scale and location. One can then see how a particular site lies relative to the find spots identified in survey, the distribution of soils, the hydrology, and the topography of the area. GIS programs come with tools to both visualize and analyze these data. To help archaeologists visualize a region, topographic maps can be used to create three-dimensional models of the terrain and to statistically test the association of find spots with elevation, slope, and soils. One popular application is to analyze the “viewshed”—what would have been visible to a person from a given spot in the landscape.

When GIS was first introduced, they were used largely within an ecological framework, looking at relationships between site locations and the availability of natural resources. Other applications were developed to model migration routes and to predict where sites would likely be found. In recent years, a number of archaeologists have begun to use GIS software as a means of exploring the way people in the past would have experienced the environment.

1.2 Excavation

The archaeological “time machine” consists of simple tools such as trowels, screens, and levels. The fundamental characteristic of archaeological excavation is the careful attention paid to recording the context in which artifacts are discovered. Intensive documentation is what distinguishes archaeological excavation from vandalism and looting.
**Horizontal Excavation**

In A.D. 79, the Roman city of Pompeii was rapidly buried by volcanic material from the eruption of Mount Vesuvius. The archaeological site at Pompeii preserves the last moments of the city in often gruesome detail (see Figure 1.3). Pompeii provides a unique snapshot of life in a Roman city at a single moment in time. The effort to reconstruct such a moment is one of the major goals of archaeological excavation. At most sites, time is not frozen quite as spectacularly as at Pompeii, and archaeologists must work with fragmentary remains that have been significantly altered by both subsequent occupants of the site and natural processes.

When archaeologists work to reconstruct a particular moment in time, it is necessary to excavate broad areas of a site. Such an approach is referred to as **horizontal excavation**. This is contrasted with **vertical excavation**, which focuses on the sequence of occupations of the site. Figures 1.4 and 1.5 show examples of horizontal and vertical excavations.

Horizontal excavations can be carried out on any type of site, from simple hunter–gatherer camps to large urban centers. The French prehistorian André Leroi-Gourhan was among the pioneers of horizontal excavation (Leroi-Gourhan 1984). At the site of Pincevent in the Paris Basin, Leroi-Gourhan excavated a prehistoric hunter–gatherer encampment from the Magadalenian period. These people left behind no traces of architecture, yet by carefully mapping every stone tool and every animal bone found on the site, Leroi-Gourhan was able to reconstruct the locations of tents and estimate the number of family groups using the site. Pincevent was a perfect site for this undertaking because it had only one major layer of occupation, which had been rapidly buried by river silts.

---

**Figure 1.3** A moment frozen in time. Excavation of casts of bodies trapped in volcanic ash at Pompeii.

**Figure 1.4** Example of a horizontal excavation: An Iroquoian longhouse at Crawford Lake, Ontario. Remains of this structure are postholes (marked by sticks), pits, and a large sweat lodge.

**Figure 1.5** Excavations at the Koster site in Illinois uncovered a long sequence of occupations and provide an example of a vertical excavation. The archaeologists working at the Koster site were able to chart changes in the environment and human activities over a period spanning 8,000 years.
Another ideal setting for horizontal excavation, on a much grander scale, is offered by the city of Amarna in Egypt. A new capital city, Amarna was constructed by Akhenaton as part of his program of religious reformation (1350 B.C.). Following Akhenaton’s death, his reforms were repudiated and his city abandoned, never to be reoccupied. Excavations at Amarna have exposed large parts of the city plan, giving us an invaluable perspective on New Kingdom Egyptian town planning (Kemp 2006).

Vertical Excavation

Most archaeological sites include more than a single period of occupation. Many archaeologists are drawn to sites with a lengthy history of occupation because their interest is in long-term processes of culture change. Several archaeologists have emphasized that sites such as Pincevent and Amarna are in fact quite rare and also more complex than they at first seem. Thus, for all archaeologists, an understanding of how sites develop over time is critical. Vertical excavations focus on exposing the record of a sequence of occupation. Emphasis is placed more on excavating the entire depth of deposits than on opening large horizontal areas. In vertical excavation, archaeologists analyze the sequence of deposits, or stratigraphy, of the site. The basic concepts of stratigraphy are drawn from geology; applied to archaeology, they have led to the development of methods of archaeological stratigraphy that take into account the particular characteristics of archaeological sites.

GEOLOGICAL STRATIGRAPHY. When sediments are deposited in an undisturbed environment, a stratigraphic sequence will develop over time. The buildup of sediments is said to be stratigraphic in that it follows the law of superposition, which states that, in any undisturbed depositional sequence, each layer is younger than the layer beneath it. A stratigraphic sequence can be either continuous or discontinuous. In a continuous sequence, the sediments or rocks are uniform throughout, with no clear breaks. In a discontinuous sequence, there are clear breaks in either the types of rocks or the types of sediments. In a discontinuous sequence, it is possible to identify discrete layers, or, as they are often called in archaeology and geology, strata. Geological strata can be characterized either by the type of rock or sediment they consist of or by the fossils they contain.

The surface of the earth is not an undisturbed depositional environment. The movements of the plates of the earth’s crust cause mountain chains and rift valleys to form. Volcanic activity brings igneous rocks from the earth’s mantle to the surface. Erosion by wind, water, and glaciers breaks down and transports rocks and sediments. As a result of all of this activity, the law of superposition applies only in localized contexts where deposition has taken place. The geological science of stratigraphy has as its goal the correlation of strata across wide areas.

In many cases, geologists drill deep into the earth to gather samples for stratigraphic analyses. Such exploratory work is essential in prospecting for minerals and oil. In other cases, such as road cuts that slice through part of a hill, it is possible to see stratigraphy directly. The exposure left by a road cut, or by natural erosion as shown in Figure 1.6,
is called a stratigraphic section or profile. If the rocks in the profile are sedimentary rocks—rocks that have formed from sediments in a depositional environment—we can apply the law of superposition to deduce that the rocks lower down in the sequence are older than those higher up. Often, in road cuts, the folding of the rocks from the processes associated with mountain building is apparent, and we can follow strata along their folds. Of course, one does need to make sure that what one is looking at is actually sedimentary rock. In many cases, what one sees in a road cut consists of either metamorphic rocks, which have formed deep in the earth’s crust at high temperature and pressure, only to be thrust out onto the surface as the result of uplift, or igneous rocks, which have squeezed through the crust from the earth’s mantle. The law of superposition does not necessarily apply to these kinds of rocks.

**HOW ARCHAEOLOGICAL SITES FORM.** Most environments on the surface of the earth can be classified as either erosional or depositional—locations where sediment is being either carried away or deposited, respectively. Buried archaeological sites form in depositional environments. In some cases, artifacts are deposited on a surface and then, over time, become incorporated into the geological strata. Most early prehistoric sites were formed in this way. In discussing the stratigraphy of such sites, one is usually referring to the position of the archaeological deposits in geological strata.

On most archaeological sites, *stratigraphy* refers to the accumulation of strata that result from a combination of geological and anthropogenic deposits. **Anthropogenic deposits** are produced by human activities ranging from building fires on ephemeral hunter–gatherer camp sites to erecting the palaces and fortifications of great cities. For village and city sites, it is necessary to understand the methods and materials used in their construction, and it is also important to understand how structures decay and collapse. In many areas, the main construction material used until recently has been unbaked mud brick. As mud brick structures fall out of use, they are usually eroded along the base, which causes them to collapse. The resulting collapsed house forms a mound of earth that was simply leveled out before new structures were built. As layers of collapsed mud brick houses accumulate, large artificial mounds, known in the Middle East as **tels**, often develop. In areas where wood or stone was the main building material, such mounds will not form because wood will decay and stones are liable to be reused.

**ARCHAEOLOGICAL STRATIGRAPHY.** Archaeological sites are rarely, if ever, a simple “layer cake” of strata. **Archaeological layers** or strata emerge only through the process of stratigraphic analysis (see Figure 1.7). The basic units of archaeological sites are **depositional units**—material that was deposited at a particular point in time. In practice, depositional units go by many names, including *locus* and *stratigraphic feature*.

Any process that has led to the accumulation of material on an archaeological site is considered to be a depositional event. Because deposition is not continuous on archaeological sites, archaeologists are able to define depositional units. What makes the concept of depositional units confusing is that they can be of many types, including walls, floors, and the infill of pits.

In practice, interpreting an archaeological sequence often hinges on paying attention to the relationships among depositional **anthropogenic deposits** Deposits that result from human activity. Human activities range from building fires on ephemeral hunter–gatherer camp sites to erecting the palaces and fortifications of great cities.

**depositional unit** The material deposited at a site at a particular point in time.

**FIGURE 1.7** At the site of Hammath Tiberius in northern Israel, a crude stone wall and pillars are cut into an earlier mosaic floor. In most archaeological contexts, it is more difficult to identify construction phases.
the Past is a foreign country: Getting from here to there

units. One example of the types of problems faced in the field is determining the date of a burial pit (see Figure 1.8). The burial is not part of the depositional unit it cuts into. Rather, it is in superposition to the depositional unit, even though they are at exactly the same height. It is critical to find the surface of origin of the pit—the surface from which the pit was excavated.

Archaeologists use a range of methods to assist in a stratigraphic analysis:

- Soil micromorphology is used to characterize the accumulation of sediments at a microscopic scale (see the Geoarchaeology and Micromorphology Toolbox in Chapter 4, p. 108).
- The Harris matrix is a method for placing depositional units in stratigraphic order (see the Harris Matrix Toolbox in Chapter 7, p. 191).
- Taphonomic analysis examines the natural and cultural processes that have affected the formation of archaeological sites (see the Faunal Analysis and Taphonomy Toolbox in Chapter 2, p. 43).

Controlling Horizontal and Vertical Space

The critical task for archaeologists is to record the precise context, or provenience, of objects recovered during excavation. Control of horizontal and vertical space is essential to modern archaeological excavation. The first job on an archaeological site is to create a grid that covers the intended excavation area (see Figure 1.9). The size of the squares forming the grid varies from 1 square meter on early prehistoric
sites to 25 square meters (5 meters × 5 meters) on large excavations (see Figure 1.10). In some contexts, linear trenches are used rather than squares. The size of the squares and their spacing will depend on the goals of the excavation. If the goal is to get a sample representing an entire settlement, small squares might be distributed randomly across the site. If the goal is to get a broad exposure, excavation squares will cover a single continuous area. The grid is usually laid out with pegs and string. However, in cave sites, the grid can be suspended from high-tension wires anchored into the walls of the cave.

Control of vertical space requires the establishment of a fixed datum point, or, simply, datum, that serves as a reference for all depth measurements on the site (see Figure 1.9). Ideally, this datum is at a known elevation above or below sea level. It is essential, though not always easy, for the datum to be marked on an object or a location that will not be moved or damaged in the future. The datum point is the linchpin for the control of the excavation; loss of the datum point would make it difficult to return to the site and continue the excavation.

A wide range of tools is used for laying out grid squares and measuring depths relevant to the datum. Most excavations make use of a theodolite, which is able to measure both distance and elevation relative to a given point. Increasingly, archaeologists use digital surveying equipment during excavation, allowing for the precise recording and automatic storage of spatial data.

Excavating in square units makes it easier to draw plans of the layout of architectural remains and artifacts because one can measure the locations of objects and features with reference to the sides of the excavation square. The other advantage of excavating in square units is that the sides of the holes provide a record of the stratigraphic sequence. The sides of excavation units, known as stratigraphic profiles, show the stratigraphy of the site much in the way that a road cut gives a view of the geological stratigraphy (see Figure 1.11). Often, a one-half-meter area called a baulk is left standing around each excavation square to provide profiles. Baulks also facilitate movement around the excavation without trampling on newly exposed deposits. Drawings of the profiles left in baulks are critical records of a site’s stratigraphy. Great care is taken during the excavation to ensure that these profiles are protected and that they are as straight as possible.

**datum point** The linchpin for the control of excavation. It serves as a reference point for all depth measurements on the site.

**FIGURE 1.10** Excavation of Tel Knedig, Syria. The excavation consists of a series of square excavation units. Most of the baulks have been removed at this stage of excavation to provide a continuous view of the architecture.
During excavation, it is necessary to keep moving between a horizontal and a vertical perspective. In excavating an urban site, it is critical to think in terms of the architecture being excavated. However, if, at the same time, one does not keep in mind the site’s stratigraphy, there is the danger of erroneously combining walls from different phases of occupation.

**Recovery Methods**

The digging tools used in an archaeological excavation vary with the scale and goals of the project. Backhoes and bulldozers are often employed to dig exploratory trenches or to clear overlying deposits. Hand tools range from shovels and hoes to trowels and dental picks. Most excavations involve screening the excavated sediments to make sure that all artifacts are recovered. The size of the screen mesh is important in determining what sizes of objects will be recovered. If one of the goals of the excavation is the recovery of small artifacts and bones, then it is necessary to use a very fine mesh, together with water, to break up the sediments and move them through the screen. This process, called *wet screening*, is usually carried out by spraying water onto the sieve.

The recovery of botanical material (wood and seeds) requires special methods. In many locations, the most effective method is *flotation*, which involves vigorously mixing sediments in water. In the process, charred remains of seeds and wood float to the surface, while the mineral sediments settle to the bottom. The charred botanical material can then be skimmed off and dried for analysis. On sites where recovering botanical material is a high priority, it is possible to set up a system that will process sediments rapidly.

At every step of recovery, whether collecting objects from excavation, from the sieve, or from flotation, it is essential that the context from which the objects were recovered be carefully tracked. Every bucket of earth that goes to the sieve must be clearly labeled so that its precise context is known. After the earth is sieved, the label must be transferred to the bag of recovered objects. Ultimately, each object should be labeled in ink, with the label stating the exact provenience of the find.
Archaeological excavation is essentially a destructive act. One cannot go back and excavate an area a second time. What is destroyed in excavation is not, one hopes, archaeological objects. Rather, it is the context within which these objects are found—the matrix of depositional units—that is destroyed. The goal of recording methods is to allow archaeologists to go back and reconstruct that context on paper after excavation. Also, it is essential that all recovered objects be linked with as precise a provenience as possible.

There are almost as many recording systems as there are archaeologists. The basic unit is usually the depositional unit, also called a locus or stratigraphic feature. Each depositional unit has its own recording sheet, which includes plan maps at various stages of excavation, stratigraphic sections showing the relation among different depositional units, and a description of the contents of the depositional unit. A careful description of soil color and texture is often also included.

Architectural features can be treated as depositional units. In practice, many archaeologists prefer to treat walls and buildings separately from other depositional units. On excavations of urban sites, the excavation team often includes an architect whose job is to draw plans of architectural remains. Increasingly, digital media are being integrated into the process of excavation. Digital photography allows excavators to annotate photographs during the excavation and to point out significant details. Digital video allows for an ongoing recording of the excavation process.

1.3 Artifacts and Ecofacts

The objects recovered in excavations can be divided into artifacts and ecofacts. Artifacts are objects that show traces of human manufacture. Artifacts include tools and vessels, as well as the waste resulting from a manufacturing process. An example of a waste artifact is slag, a by-product of smelting ores. These are some of the major areas of archaeological artifact analysis:

- Lithic analysis is the study of stone tools (see the Stone Tools Toolbox in Chapter 3, p. 71).
- Ceramic analysis is the study of pottery and other objects made of fired clay (see the Hand-Built Pottery Toolbox in Chapter 8, p. 214).
- Metallurgy is the study of metal artifacts and the by-products of smelting (see the Metallurgy Toolbox in Chapter 14, p. 382).

Ecofacts are objects recovered from an archaeological context that are either the remains of biological organisms or the results of geological processes. The major areas of biological analysis include the following:

- Faunal analysis is the study of animal bones recovered on archaeological sites (see the Faunal Analysis and Taphonomy Toolbox in Chapter 2, p. 43).
- Paleoethnobotany is the study of archaeological plant remains, such as charred seeds and pollen (see the Paleoethnobotany Toolbox in Chapter 7, p. 196).
- Human osteoarchaeology is the study of the biological characteristics of human skeletal material recovered on archaeological excavations (see the Human Osteoarchaeology Toolbox in Chapter 13, p. 348).

Artifacts: Objects that show traces of human manufacture.

Ecofacts: Objects recovered from an archaeological context that are either the remains of biological organisms or the results of geological processes.
Wonderwerk Cave is a spectacular site located in the Northern Cape Province of South Africa, on the edge of the Kalahari. Although this is a remote area, our living conditions are quite good. We stay in small brick chalets built near the site, and most of the roads are tarred. The view from the cave is of an immense open space, a flat grassland that reaches to the horizon. A nice part of working at the site is that not only do we lack Internet access, but also we have to walk out to the main road to even get cell phone reception—a welcome break from my heavily connected life in Canada. However, this remote place is also the nexus of an international research team, as well as a diverse range of community interests. My role at Wonderwerk seems more like that of a ringmaster in a circus than that of an archaeologist.

It might be best to begin by explaining how I ended up working at this site. In the late 1990s, I was completing a project in Israel with my colleagues Liora Horwitz and Naama Porat. Liora is a faunal analyst, Naama is a geologist, and I am an archaeologist who specializes in stone tools, so we make a good team. We began looking for a new project that would allow us to continue to study the shift from the Lower Paleolithic to the Middle Paleolithic, or, as they are known in Africa, the Earlier to the Middle Stone Age. By chance, Liora was off to South Africa to visit family, which included a visit to her uncle’s farm in the Free State. En route, she stopped off in Kimberley, a diamond-mining city that is home to Peter Beaumont. Peter is famous for excavating sites of the time range we were interested in, and before I knew it, I was off to South Africa for an unforgettable tour with Peter.

The wealth of sites he showed us and the extent of the excavations he had carried out were simply staggering. We resolved to develop a project to analyze the collections from Peter’s excavations at Wonderwerk housed at the McGregor Museum, carry out small-scale field projects to document the stratigraphy on the site, and collect samples for geological and botanical analysis.

Seven years later we are still hard at work. Our research team has swelled to over 15 members from South Africa, England, Israel, Canada, and the United States. Our most exciting result is the dating of the base of the deposit at Wonderwerk to 2 million years ago. The stone tools from this stratum provide the earliest evidence for hominin cave occupation in the world. My job as the codirector of this project is not simply to analyze stone tools, but also to coordinate the activities of all the scientists working at the site. This is a fascinating undertaking, since each member of the team comes to the project with his or her own perspective, and meshing these perspectives is a tremendous challenge. We have also found ourselves involved in ongoing discussions with the local community. Wonderwerk Cave is a candidate for World Heritage status and a critical element of the tourism development in this area. Wonderwerk is also integrated into the local school curriculum, and all children from the area schools visit the site during their primary years. Combining the educational, tourism, and scientific potentials of this site is every bit as complex as the analysis of Earlier Stone Age stone tools. Days at Wonderwerk tend to be a bit unpredictable and are almost always interesting. A day that begins with conversations with local Tswana chiefs might also involve careful excavation and complex discussions of stratigraphy and geophysics. One couldn’t ask for much more.

**FIGURE 1.12** Taking samples for paleomagnetic dating of the early hominin occupation at Wonderwerk Cave, South Africa.
Ecofacts are studied with an eye toward reconstructing the ecological setting of the site or looking for evidence of human activity on the site. Often, these two goals are closely linked. For example, in studying the animal bones from a hunter–gatherer site, one needs to reconstruct the ecological setting in order to understand the occupants’ hunting strategies.

Archaeologists have developed conventions for representing objects in drawings. One example is the illustration of ceramic vessels, shown in Figure 1.13. The convention is to show a view of the outside of the vessel, including any surface treatment and decoration, on one side of the drawing. The other side of the drawing reveals a section through the vessel wall, which gives a sense of the thickness of the vessel and the shape of the rim and base. This convention can be used both with complete vessels and with fragments from the rim of the vessel—what archaeologists refer to as rim sherds. In drawing a rim sherd, the original diameter of the vessel is calculated on the basis of the arc of the fragment of the rim.

1.4 Biases in Preservation

Look around the room you are sitting in, and imagine what would be preserved thousands of years from now. Most organic materials, such as paper and leather, would be preserved only under remarkable conditions, such as rapid burial in an environment with no oxygen (e.g., a bog; see Figure 1.14). Valuable metals are likely to have been reused unless they are left behind when a site is abruptly abandoned or they are placed in a ritual context such as a tomb. Differences in preservation create a bias in what is found on archaeological sites. Archaeologists must take into consideration postdepositional processes—those events that take place after the site was occupied. Postdepositional processes can be caused by climate (such as...
frost heave) and biological agents (including termites, earthworms, and rodents), both of which can move material around the site and distort its stratigraphy. A number of archaeologists have pointed out that cultural practices, such as where garbage is disposed of, will also shape the archaeological record (Schiffer 1987).

**Taphonomy** is the study of the processes that affect organic remains after death. An important line of evidence for all taphonomic studies is traces found on the surface of bones recovered on archaeological sites. The overall condition of the surface of the bone can indicate whether it has been transported by water or has suffered significant chemical weathering. Chewing by animals ranging from rodents to bears often leaves characteristic marks on the surface of the bone. If a bone has passed through the digestive tract of an animal such as a hyena or a dog, the surface of the bone will show characteristic etching. Human action can often be detected through the identification of cut marks left when meat was sliced off the bone or the carcass was disarticulated with a stone tool. Human action can also be detected on the basis of percussion marks left when the bone is smashed open to access marrow.

### 1.5 Quantification and Sampling

In early excavations, representing what had been found was a simple process. One just took all the complete vessels and tools, placed them in a row, and snapped a photograph or made a sketch of the collection. Figure 2.8, shown on page 38, provides an excellent example of this. But this approach works only so long as one recovers complete artifacts and discards everything else. Today, archaeologists recover all artifacts, including broken pieces and waste, as well as a wide range of ecofacts. Only in rare cases is it possible to present each object individually. Certainly, unique pieces and artifacts of particular historical or artistic merit receive individual attention. However, the vast bulk of the material can be represented only by quantitative methods. The methods of **quantification** used by archaeologists range from simple databases, which provide counts of various types of objects, to sophisticated statistical techniques.

In analyses of large bodies of data, it is often possible to use a sampling strategy such that only a portion of the material is analyzed. In studying artifacts and ecofacts, archaeologists often rely on statistical sampling strategies to allow a true representation of the site to emerge without having to measure or describe every single object recovered. On many sites, the number of artifacts and ecofacts recovered is in the hundreds of thousands, making sampling an essential tool.

#### Counting Bones

Using quantitative methods requires that one understand the way these methods work. Problems that at first glance seem quite simple often turn out to be far more complex. For example, counting animal bones would seem to be quite a straightforward undertaking (Davis 1987). If one is able to identify the bones by species, then one should be able to make a chart illustrating the relative frequency of bones of different animals found on the site. This method of counting is known as number of identifiable specimens (NISP). Some archaeologists have argued that NISP does not provide an accurate quantitative picture of the relative frequency of different animals that make up an assemblage. To illustrate this point, imagine a site that produced the complete skeleton of a rabbit and 10 left tibias from cows. According to NISP, there would be more rabbits represented on the site than cows. But in fact, there are the remains of 1 rabbit and 10 cows. To get around this problem, some archaeologists prefer to use a method known as minimum number of individuals (MNI). According to this method, each skeletal element (i.e., left tibia or first upper premolar) is counted individually. The number of examples of a given element is then divided by the number of bones of that type that
occur in an individual skeleton. For example, there are two first upper premolars in any individual skeleton, so the number of upper premolars found would be divided by 2. It is quite likely that not all skeletal elements will indicate the same number of animals, so the largest number is used to determine the MNI for animals at the site. In the case just described, the MNI for rabbits would be 1, and the MNI for cows would be 10 (see Figure 1.15). Of course, if the goal of analysis is to make inferences about diet, we still have the problem that the meat yield of a rabbit is quite a bit smaller than the meat yield of a cow. One way to overcome this challenge is to multiply the number of individuals by the average weight of a carcass of the species. What this example highlights is the fact that the way objects are counted will shape the picture that emerges.

### Counting Artifacts

If you were asked to go through your kitchen and inventory its contents, you would create a list of appliances, utensils, and vessels. You would be unlikely to have much difficulty coming up with names for these various objects. Archaeologists working on colonial and historical periods in the United States have access to inventories, known as probate records, drawn up by assessors who went carefully through a person’s home after his or her death (Orser 2004). However, archaeologists working on prehistoric sites do not have access to lists of artifacts drawn up by the people who lived there at the time. One of the first steps of artifact analysis is to create a classification of the objects.

Most artifact classifications begin by defining major categories of objects. In your kitchen, you would be likely to separate appliances from vessels and utensils. You might then define vessels as objects used to hold food and utensils as tools used to process food by hand. It would then be rather simple to divide vessels into pots, pans, plates, and bowls and to divide utensils into forks, knives, and spoons. Archaeologists follow such a process, often sorting artifacts on the basis of their material of manufacture (e.g., bone tools, stone tools, pottery, metal).

Archaeologists usually want to go beyond simply reporting how many bowls and plates were found on a site. It is often critical to describe the detailed characteristics of the artifacts. Including this type of information, even in the inventory of your own kitchen, might be challenging. How do you describe a plate, a fork, or a knife? Archaeologists often develop detailed systems of classification based on types of artifacts. A **typology** is a list of artifact types for a particular archaeological context. Archaeologists use typologies to draw up an inventory of the artifacts they have found.
A good example of a typology is the list of types of ceramic vessels used in classical Greece (see Figure 1.16). These vessel types are known by the names the ancient Greeks gave them. Most archaeological typologies, however, are far more refined than a simple description of vessel types. The purpose of detailed archaeological typologies is to register nuances of style that reflect when and where an artifact was manufactured. A modern artifact that has undergone regular changes in form is the ubiquitous Coca-Cola bottle. Ever since a standard bottle was adopted for Coca-Cola in 1916, the shape and decoration of the bottle have changed regularly. These changes can be used as chronological indicators. For example, if you find a bottle with the logo “Coca-Cola” painted on it, the bottle must date to after 1958, the date when painted bottles first appeared (Orser 2004).

Archaeological typologies are often highly detailed, with dozens of types for each category of artifact. Once a typology has been developed, the number of objects belonging to each type can be counted to create a quantitative inventory of artifacts found in a particular context. Typologies are built from combinations of artifact attributes that the archaeologist intuitively selects to define the various types. An attribute is a particular characteristic of an artifact. For a simple ceramic bowl, one can observe a surprising number of attributes. Some of these attributes describe the clay out of which the bowl was made and the decoration applied to the bowl. Other attributes describe the shape of the bowl, including the form of the base, the curvature of the walls, and the shape of the rim. Still other attributes measure the size of the bowl. Some archaeologists see the value of typologies as limited, arguing that types can be defined only on the basis of a statistical analysis of the attributes of all of the vessels found in a context. Other archaeologists argue that the idea of vessel types should be discarded completely in favor of the analysis of attributes. From this perspective, artifact types are an unjustified abstraction that distort our picture of the archaeological record.

1.6 Creating a Chronology

Depositional units are dated on the basis of material recovered within the unit during excavation. This is one of the reasons it is so important to know the exact provenience of every recovered object. Objects can be dated by a variety of methods.
Ethnoarchaeology

Ethnoarchaeology refers to research carried out by archaeologists living with and observing communities in order to make a contribution to archaeology. Archaeologists bring to the study of modern cultures an intense interest in the material aspects of human lives. Ethnoarchaeological research covers a wide range of domains, including subsistence, technology, ideology, and site formation.

Much of our understanding of stone tool manufacture comes from ethnoarchaeological studies of societies that still use stone tools or have used them recently. Among the stone tool techniques studied by ethnoarchaeologists are ground stone axe manufacture in Papua New Guinea, flint knapping in Australia, obsidian tool manufacture and use in Ethiopia, and stone bead manufacture in India. All of these studies provide insight into the process of tool manufacture and the way tools are used. Ethnoarchaeological studies have also provided insight into how people think about the tools they are making. For example, on the basis of ethnoarchaeological research in Australia, Brian Hayden has questioned whether people making stone tools ever think about making a specific type of tool. Interestingly, in the group Hayden worked with, the focus of attention was on the type of edge produced, and the actual form of the tool was of little importance.

Ethnoarchaeological research also can provide a reminder of the limitations of the archaeological record. In 1974 and 1975, Robert and Priscilla Janes lived for 22 weeks with the Slavey Dene people in the Northwest Territory of Canada (Janes 1983). The Slavey Dene spend most of the year in Fort Norman, but move to seasonal camps during the late winter or early spring. The Janeses’ research examined the structure of one of these camps. According to David and Kramer (2001), the Janeses’ experience living with the Slavey Dene led them to recognize the “potential immensity of the gap . . . between the results of field archaeology and the richness of a living culture” (288). This gap is particularly wide in the case of hunter–gatherer societies, which made most artifacts out of perishable material.

In some cases, ethnoarchaeologists do not simply make observations, but rather collaborate with members of local communities to carry out experiments. During the 1970s, Peter Schmidt and his colleagues collaborated with members of a Haya community from northeastern Tanzania to smelt iron by traditional methods (Schmidt 1997). Because the Haya had not practiced traditional smelting for over 50 years, this project was guided by Haya elders who remembered participating in smelting operations as children. The resulting smelt was only partially successful, but it did provide an opportunity to carefully document the functioning of the iron furnace, as well as the processes involved in producing charcoal and in mining the clay used to build the furnace. The furnace produced in the experiment served as an important point of reference for the interpretation of archaeologically excavated furnaces.

Despite the obvious value of ethnoarchaeological research, some archaeologists have reservations about the use of ethnographic analogies in archaeology. Martin Wobst (1978) has written of the “tyranny of the ethnographic record,” which leads archaeologists to assume that the cultures they are investigating were similar to ethnographically known cultures. A slavish adherence to analogy can dull our awareness of those aspects of past societies that are unique and different from characteristics of societies living in the present. The use of ethnographic analogy is also not helpful in studying long-term processes of cultural change that last hundreds, thousands, or even tens of thousands of years and that are of particular interest to archaeologists.

**FIGURE 1.17** Richard Lee conducting fieldwork with San hunter-gatherers in Botswana.

are of a known date of manufacture. Coins are a good example of such artifacts. Artifacts with a known date of manufacture allow archaeologists to create an absolute chronology stated in terms of calendar years. Other artifacts can be placed within a regional chronology on the basis of style. Often, pottery is used to date archaeological sites because of frequent, identifiable changes in the shape and decoration of vessels. Frequently, chronologies based on artifact typology are relative chronologies that place assemblages in a temporal sequence not directly linked to calendar dates.

In most regional chronologies, artifacts are used to correlate the stratigraphic sequence of a site with the chronological framework for a region. In the absence of artifacts with a known date of manufacture, the relative frequency of different artifacts is used to fit a particular context into a regional chronology. The method of comparing the relative frequency of artifact types between contexts is known as seriation. The assumption behind seriation is that the frequency of an artifact form will increase gradually over time and then decline gradually after reaching a peak.

An important illustration of the principle that the frequency of an artifact form will increase gradually over time and then decline gradually after reaching a peak is found in shifting preferences for design motifs on gravestones in Colonial America, like the one shown in Figure 1.18 (Deetz 1996). From 1720 to 1750, the main motif used on gravestones was the death’s head. Between 1760 and 1780, the frequency of death’s heads declined as cherub motifs increased. The number of cherub motifs reached a peak between 1780 and 1789. After 1780, the frequency of cherub motifs gradually declined as that of urn and willow motifs increased.

A number of scientific methods have been developed for determining absolute dates of material recovered from archaeological sites:

- Radiocarbon dating measures the decay of carbon isotopes. Charcoal, bone, and other organic material can be dated with this method. Radiocarbon dating can be used for sites younger than 40,000 years. Accelerator Mass

![Figure 1.18](image-url)
Spectrometry (AMS) radiocarbon dating is an advanced method that can date extremely small samples (see the Radiocarbon Dating Toolbox on p. 26).

• Argon dating identifies the time of a volcanic eruption. Argon dating can be used on early hominin sites in contexts where there are layers of volcanic ash (see the Dating Early Hominin Sites Toolbox in Chapter 3, p. 76).

• Paleomagnetism measures reversals in the earth’s magnetic field. Paleomagnetism is most useful for dating early hominin sites (see the Dating Early Hominin Sites Toolbox in Chapter 3, p. 76).

• Luminescence dating methods are used to measure the uptake of radioactive material. Luminescence methods can be used to date soils (optically stimulated luminescence), animal teeth (electron spin resonance), and burnt flint (thermoluminescence) from early hominin sites. Particularly useful for the period between 300,000 and 30,000 years ago, luminescence can also be used for more recent periods to learn when pottery vessels were fired (see the Luminescence Dating Toolbox in Chapter 5, p. 123).

• Dendrochronology uses sequences of tree rings to date wood found on archaeological sites. In some areas of the world, the dendrochronological sequence has been established for a period of thousands of years (see the Dendrochronology Toolbox in Chapter 10, p. 275).

• Obsidian hydration measures the decay of the surface of obsidian artifacts. Obsidian hydration is often used on sites several thousand years old or younger.

Absolute dates can be expressed on a number of time scales. In this text, we employ a time scale that uses the birth of Christ as the point of reference. Dates after the birth of Christ can be expressed as years A.D. or years C.E. In this book, we use years A.D. Years before the birth of Christ can be expressed as years B.C. or years B.C.E. In this book, we use years B.C. When archaeologists work on early prehistoric sites, they tend to count years back from the present rather than using years B.C. In this book, such dates are expressed as years before present, or years B.P.

1.7 Comparison

Much of the work that takes place in an archaeological laboratory involves comparison. A comparative collection, which serves as a point of reference, is an important tool in archaeological research. Faunal analysis laboratories usually have an extensive reference collection of modern skeletons from known species. Preparing these collections is a laborious process involving the collection and defleshing of carcasses. Faunal reference collections are essential for identifying the bones found on archaeological sites.

The spatial scale of comparisons can vary. Intrasite comparisons look at differences between contexts within a single site. Comparing the size and contents of different houses to try to determine the social structure of a society is an example of an intrasite analysis. Intersite comparisons examine differences between two or more sites. Comparing the number of houses between sites in a region is an example of intersite analysis.

Archaeologists have often relied on analogies to descriptions of living cultures to help interpret archaeological remains. Some archaeologists practice “living archaeology,” using observations made in the present to help interpret archaeological remains. Two such techniques are the following:

• Ethnoarchaeology is research carried out by archaeologists living with and observing communities in order to make a contribution to archaeology (see the Ethnoarchaeology Toolbox on p. 23).

• Experimental archaeology involves attempts to replicate archaeological features or objects (see the Experimental Archaeology Toolbox in Chapter 6, p. 152).
Radiocarbon Dating

The story of radiocarbon dating begins in the upper atmosphere, where neutrons from cosmic rays bombard atoms of nitrogen to produce carbon-14 atoms. Carbon-14 is an isotope of carbon, which means that it is chemically identical to other forms of carbon, including carbon-12 and carbon-13. However, because of its extra neutron, carbon-14 is unstable, or radioactive. The half-life of carbon-14 is 5,730 years. Thus, in a sample of carbon-14, half of the atoms will decay to a more stable carbon isotope over a period of exactly 5,730 years. In other words, 1% of the sample will decay every 83 years.

Once carbon-14 atoms form in the atmosphere, they rapidly combine with oxygen to form molecules of carbon dioxide (CO₂). These molecules then spread through the atmosphere, the oceans, and the biosphere, entering plants through photosynthesis. Remarkably, the ratio between carbon-14 and nonradioactive molecules of carbon is the same throughout the atmosphere, the oceans, and the biosphere, known collectively as the carbon exchange reservoir.

Carbon-14 decays at a constant rate and is found in the same concentration throughout the carbon exchange reservoir. How do these facts allow us to use carbon-14 to date archaeological remains? Animals, trees, and plants are all part of the carbon exchange reservoir. While they live, these organisms maintain the same concentration of carbon-14 found throughout the reservoir. This is as true for you as it is for a tree. The tree exchanges carbon through photosynthesis, and you participate in the exchange reservoir by eating plants, or animals that eat plants. However, when a plant or animal dies, it ceases to exchange carbon. From that point in time, when the organism is removed from the carbon exchange reservoir, the concentration of carbon-14 begins to decay at the rate of 1% every 83 years, or 50% every 5,730 years.

Radiocarbon dating calculates the time since an organism was removed from the carbon exchange reservoir by measuring the concentration of carbon-14 relative to stable isotopes of carbon (carbon-13 and carbon-12). By calculating the amount of carbon-14 that has decayed, it is possible to determine when the organism stopped exchanging carbon. This event usually marks the death of the organism; however, in trees, it marks the end of an annual growth cycle (see the Dendrochronology Toolbox in Chapter 10, p. 275).

The impact of radiocarbon dating on archaeology has been nothing short of revolutionary. Carbon-14 provided the first means of finding an absolute age for archaeological discoveries, an achievement that earned W.F. Libby the Nobel Prize. In later chapters, we will look at two further developments of this method: calibration (see the Radiocarbon Calibration Toolbox in Chapter 6, p. 156) and accelerator mass spectroscopy, or AMS (see the AMS Radiocarbon Dating Toolbox in Chapter 8, p. 210).

Radiocarbon dating works for samples less than 40,000 years old, although some researchers are attempting to transcend this frontier. Almost all organic materials, including bone and wood, can be dated. All radiocarbon dates are reported with an error range that reflects statistical limits of the method, as well as limits in the precision of laboratory equipment. (To simplify the presentation, the error range is not given with dates in this book.)

1.8 Conservation and Display

The process of excavation also includes the conservation of excavated areas and, in some cases, the consolidation of remains for display (Figure 1.20). At the most basic level, it is essential that excavated areas be filled back in after excavation unless there is a clear plan for exhibition in place. When exhibition of the site is involved, the exposed remains need to be consolidated.

Recent excavations at the Neolithic site of Çatal Höyük, Turkey, directed by Ian Hodder, are unusual in that a consideration of the use of the site for exhibition is fundamental to the project as a whole (www.catalhoyuk.com). Çatal Höyük is well known for spectacular frescoes discovered in earlier excavations. Hodder and his team have worked to develop methods of preserving these frescoes and allowing them to be viewed by the public. They are also working to integrate the archaeological process into the exhibit. In a similar vein, excavations in historical Annapolis, Maryland, aim at providing the public the opportunity to engage in the reinterpretation of the history of that city (Leone, Potter, and Shackel 1987).

1.9 Cultural Resource Management

Most archaeological research in the United States takes place in the framework of cultural resource management (CRM), archaeology carried out with the aim of mitigating the effects of development. Archaeologists working in CRM must comply with legislation that is often complex and must also operate within a business environment. Negotiation with various stakeholders, including local communities, is increasingly an essential aspect of the work of a CRM archaeologist.

The legislation guiding CRM archaeology puts a heavy emphasis on the process to be followed in carrying out a project. There are three phases in the CRM process: identification, evaluation, and treatment (Barker 2009; Neumann, Sanford, and Harry 2010). In Phase 1, the identification stage, archaeologists combine survey with archival research to locate archaeological sites in the path of development. The scope of Phase 1 research can be quite massive, as is the case, for example, for surveys in advance of pipeline construction. In Phase 2, the evaluation stage, the significance of sites is determined. Because not listing a site as significant often leads to the site being destroyed without documentation, archaeologists tend to err on the side of caution in identifying sites as significant (Chandler 2009). Phase 2 often involves excavation of test pits across sites identified in Phase 1. Once a site has been evaluated as significant, it is necessary to determine a course of treatment. Often, it is possible to protect a site simply by altering the design of a project—for example, changing the course of a pipeline or highway to avoid a site. In other cases, an ephemeral site, such as a surface scatter of artifacts, can be collected as part of Phase 2 research. Phase 3, the mitigation stage, takes place when a site evaluated as significant will be damaged or destroyed. Mitigation involves intensive data recovery, usually by excavation. Once a CRM project is completed, a report must be compiled in compliance with legislation. The clients for CRM research may be government agencies or private contractors.
Community Archaeology

There is a general trend in archaeology toward including local communities in the process and the benefits of archaeological research (McGuire 2008). In recent years, some archaeologists have taken this idea a step further and worked to develop a truly community-based archaeology, in which the archaeologists relinquish to the local community at least partial control over their program of research (Marshall 2002). In many cases, archaeologists are trying to react with sensitivity to painful histories of colonialism and disenfranchisement. In a project at the site of Quseir in Egypt, Stephanie Moser and her colleagues (2002) have developed some guidelines for the practice of community Archaeology. They identify the following components for community archaeology projects:

1. communication and collaboration
2. employment and training
3. public presentation
4. interviews and oral history
5. development of educational resources
6. creation of a photographic and video archive
7. community-controlled merchandising

Moser and her colleagues make it clear that not all circumstances will fit this template and that community Archaeology must be sensitive to local conditions. However, the range of topics included gives a good sense of the complexity of adopting a community-driven approach. The project at Quseir addresses elements of economic development, including employment and training, as well as merchandising; aspects of local identity through the development of archives and oral history; and initiatives related to education. Some archaeologists, while appreciating the importance of a community-based approach, stress the complexities involved in such an undertaking. One of the most difficult problems is the definition of the community that is at the very root of Community Archaeology (Chirikure and Pwiti 2008). In many areas of the world, the definitions of communities are deeply contested. However, this issue can feed into the process of Community Archaeology as archaeologists are drawn into discussions of the construction of local identities.

FIGURE 1.21 An archaeologist at the George Mason plantation in Virginia talks with a group of elementary school students. How would you describe the interaction between the archaeologist and these members of the community?
Quantification is used to represent the large samples of artifacts and ecofacts recovered from archaeological excavations. Often, a sampling strategy is used to select a representative group of artifacts for study.

- Minimum number of individuals (MNI) and number of identifiable specimens (NISP) are two methods for quantifying animal bones.
- Quantitative studies of artifacts often rely on the use of typologies, in which the artifacts are classified according to a list of discrete types.
- In some cases, archaeologists analyze artifacts on the basis of a statistical analysis of their attributes. Attributes are particular characteristics of an artifact.

**KEY TERMS**

- absolute chronology, 24
- anthropogenic deposits, 13
- artifacts, 17
- attribute, 22
- cultural resource management (CRM), 27
- datum point, 15
- depositional unit, 13
- ecofacts, 17
- flotation, 16
- Geographical Information Systems (GIS), 9
- horizontal excavation, 10
- in situ, 8
- intersite, 25
- intrasite, 25
- law of superposition, 12
- postdepositional processes, 19
- provenience, 14
- quantification, 20
- relative chronology, 24
- seriation, 24
- strata, 12
- survey, 7
- taphonomy, 20
- typology, 22
- vertical excavation, 10
- wet screening, 16

**REVIEW QUESTIONS**

1. What is the difference between horizontal and vertical excavations? How would you decide which type of approach to choose in a given archaeological situation?
2. Are there limits to the kind of information archaeologists can recover?
3. Why do archaeologists use sampling?
4. Why is quantification important for archaeological analysis? What methods of quantification are used in the analysis of animal bones?
5. What is the difference between an analysis based on typology and an analysis based on attributes?

**MySearchLab® CONNECTIONS**


MySearchLab is designed just for you. Each chapter features a customized study plan to help you learn and review key concepts and terms. Dynamic visual activities, videos, and readings found in the multimedia library will enhance your learning experience.

Resources from this chapter:

- Watch on mysearchlab
  - Animated Stratigraphic Profile
- Listen on mysearchlab
  - Archaeology and Heirlooms
- Read on mysearchlab