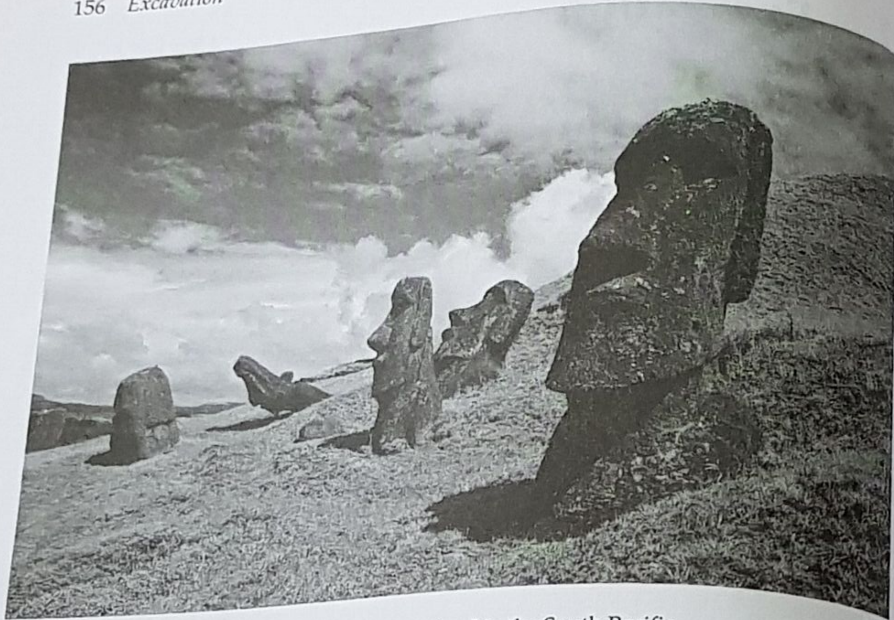
7 Excavation

CHAPTER OUTLINE



Ancestral statues, *moiae*, on (Rapa Nui) Easter Island in the South Pacific. (Anharris / Thinkstock by Getty Images)

PREVIEW

Excavation, once the primary activity of archaeologists, is now the strategy of last resort because it destroys the archaeological record. Chapter 7 describes the process of archaeological excavation, various approaches to site testing and investigation, and the basics of recording and stratigraphic observation. We stress that there's no such thing as a standardized way of digging archaeological sites. Much of the chapter is devoted to summaries of some of the major challenges faced by excavators. We also discuss the ethical issues surrounding the excavation of human burials.

We all have dreams of digging into a mysterious, undisturbed tomb. Suddenly, you come across a sealed door. You break down the door and find yourself in an undisturbed, gold-strewn sepulcher that puts Tutankhamun's burial chamber to shame. But in reality, modern archaeological **excavation** is a precise, slow-moving process, working with trowels and brushes, often without a spectacular find, from one day to the next.

In this chapter we describe some of the basic principles of excavation and many excavation problems that archaeologists can encounter in the field. Realize, though, that each site presents distinctive challenges and requires modification of the basic principles enumerated here.

Planned Excavation: Research Design

Archaeological excavation is not digging by formula, but a carefully managed process that requires constant creative thinking. There are general methodologies for excavation, but the appropriate one varies from site to site and from moment to moment as an excavation proceeds. In a way, excavation is a process of negotiation that balances acquiring the maximum amount of information against potential destruction and the needs of contemporary society. All excavations, whether of a tiny hunter-gatherer campsite, a deep cave visited sporadically for thousands of years, a farming village, a city mound, or a shipwreck, require careful planning, which culminates in the research design. A dig can take you to intensely hot African valleys, to sacrificial burials high in the Andes, or deep into tropical rain forests. Some people spend their entire careers excavating in urban settings, deep under the modern streets of London, New York, or Mexico City. Excavation is, as the British archaeologist Martin Carver remarks, "the greatest fun imaginable – exciting, companionable, poetic, like a theatre group, there for each other whether the run is to be long or short" (Carver, 2009: 115). How right he is! A well-run excavation is truly a unique intellectual and social experience.

The first principle of excavation is that digging is destructive. As archaeologist Kent Flannery once remarked, we are the only scientists who murder their informants (our sites) when we question them! The archaeological deposits so carefully examined during a dig are destroyed forever. Site contents are removed to a laboratory, permanently divorced from their context in time and space in the ground. And this is a radical difference from other disciplines: A chemist can readily re-create the conditions of a basic experiment, a biographer can return to the archives to reevaluate the complex events in a politician's life, but an archaeologist's archives are destroyed during the dig. All that remains from an excavation are the finds from the trenches, the unexcavated portions of the site, and the photographs, notes, and drawings that record the excavator's observations for posterity. One of the tragedies of archaeology is that much of the available archaeological data have been excavated under far from scientific conditions. Our archives of information are uneven at best. Increasingly, the ethics of archaeological research require absolutely minimal excavation consistent with acquiring essential scientific information.

Discovery

The Princess of Khok Phanom Di, Thailand, 1984

Charles Higham of the University of Otago in New Zealand is one of the world's experts on the archaeology of Southeastern Asia. Working closely with Thai archaeologists, he has made spectacular discoveries of early rice-farming villages and well-established Bronze Age settlements. In 1984, he began excavations at the large Khok Phanom Di mound on the floodplain of the Bang Pakong River. From a previous test excavation carried out by a Thai colleague, he knew that the occupation deposits were nearly 30 feet (9 meters) deep, the mound resting on layers of shell midden debris. In the trial pit, Higham spotted "the hollow eye sockets of some prehistoric person," so he knew he would probably find burials (see Figure 7.1).

After digging through the uppermost levels, he found lighter, sandier soil about 3 feet (1 meter) below the surface. He cleaned the surface of the deposit carefully and spotted the telltale outline of the dark filling of a grave. Soon the excavators uncovered a row of graves close to the foundation of a raised platform with a building on it. Their trowels traced the walls of beautifully polished black vessels, many of them decorated with curvilinear designs. Higham's excitement mounted as he uncovered fourteen burials. From the platform, "I could look down the row of skeletons and see the remains of men, women, and children, and even a tiny grave with the intertwined bones of two newly born infants, probably twins. It looked like a family group running through a couple or more generations" (Higham, 1994: 283).

The excavation penetrated downward into a large burial chamber, uncovering a pyramid of clay cylinders once destined to become pots. When the pyramid was removed, the skeleton of a woman in her mid-thirties appeared, her wrist muscles well formed, probably from kneading clay. She had borne one or two children. Her chest was covered with tiny shell beads and a necklace of large, white, I-shaped beads. Higham lifted the top half of the body in a single block of soil and dissected it in the laboratory, where he recovered no less than 120,787 shell beads, once sewn on to two ornate upper garments. The princess must have shimmered in the sunlight, her wealth and social position coming from her expertise at potmaking, evidenced by the burnished polishing pebbles found by her feet and the broken vessels covering her legs. Just 6 feet (2 meters) away, Higham found another, identical grave covered by another heap of clay cylinders; this was the grave of an infant only fifteen months old. The child was adorned with the same decoration as her mother and lay with a tiny potmaking anvil, a smaller version of the anvils used by adults, by her side. Higham is convinced that this was the princess's daughter.

By the time the excavation finished six months later, Higham had recovered another 139 burials, representing seventeen to twenty generations of expert potters who had traded pots to obtain exotic shell ornaments. But none of them rivaled the splendor of the Princess of Khok Phanom Di.

The treasure hunter ravages a site in search of valuable finds and keeps no records. Archaeologists demolish sites as well, but with a difference: They create archives of archaeological information that document contexts for the objects they take back to the laboratory with them. Although they have destroyed the site forever, they have created a data bank of information in its place, the only archive their successors will be able to consult to check their results. Archaeologists have serious responsibilities: to record and interpret the significance of the layers, houses, food remains, and artifacts in their sites and to publish the results for posterity. Without accurate records and meaningful

Figure 7.1 Excavation at Khok Phanom Di, Thailand. The site yielded not only spectacular burials but important evidence for early rice cultivation.
(Charles Higham)

publication of results, an excavation is useless. Many CRM investigations in North America are now funded under contracts that require prompt reporting, even if only for limited circulation.

A couple of generations ago, an archaeologist's first inclination was to dig sites to solve problems. Nowadays, there is increased awareness that excavation destroys irreplaceable evidence of the past, and we dig only when we must. Anyone who excavates without serious attention to record keeping and all of the other processes of excavation is committing vandalism of an unforgivable kind.

At the core of every modern archaeological excavation lies a sound research design, a design that very often has a regional rather than a specific site focus (see Chapter 6). The research design is developed to answer specific questions and to acquire maximum information with minimum disturbance of finite archaeological resources. It is, of course, a flexible, ever-changing plan, modified as hypotheses are tested, proved wrong, validated, or refined as a result of knowledge acquired in the ongoing excavation. When the National Park Service decided to excavate and stabilize Mound A, a 1,000-year-old *Mississippian* earthwork once surrounded by a wooden palisade in the *Shiloh Mound Complex* on the Tennessee River, the excavator, David Anderson, had to balance investigation of the mound and its complex internal structure, revealed by remote sensing, with the need to protect it against the encroaching Tennessee River, which was eroding the archaeological deposits. The research design included a program of dispersed test pits and the excavation of a 2-meter- (6.5-foot-) wide step trench into two sides and across the top of the mound (see Figure 7.2). At the same time, a stabilizing program was put into place, which made assumptions about the amount of loss to be expected over the next half century. The research design, which involved the work of scientists from a wide array of disciplines, posed a number of specific questions to be investigated, most of them revolving around the construction of Mound A as well as information on the cultural changes, including possibly maize agriculture, that took place over the site's history. Finally, the plan outlined the stages of fieldwork to be undertaken, as well as access and safety measures to be implemented. Plans were also laid for consultations with the local Chickasaw Nation as excavation proceeded.

Good research designs extend beyond the excavation itself. The end products of even a month's excavation on a moderately productive site are boxes upon boxes of potsherds, stone tools, animal bones, and other finds that have been cleaned, sorted, and bagged in the field. Rolls of drawings and stacks of computer disks hold valuable stratigraphic information. So do digital images, photographs, and hundreds of pages of field notes compiled by excavation staff as the long days of toil continue. At the same time, radiocarbon and soil samples are collected for later analysis. Freshwater shells and charcoal fragments are packed for shipment to specialist investigators. It takes months to analyze the notes and finds from even a small excavation. The dozens of boxes, hundreds of notebook pages, and megabytes of computer input contain a vast array of data that must be collated to reconstruct what happened at the site. Laboratory work arising from the Shiloh excavation consumed years of hard work. It follows, then, that the excavation research design is constantly reevaluated to determine the future course of the dig and to monitor the long months of analysis and interpretation that follow. The days when a site was dug simply because it "looked good" are long gone.

The organization of even a moderate-sized excavation requires careful planning at the implementation stage of the research design. One classic example of such planning back in the 1970s comes from the Midwest. Illinois archaeologists James Brown and Stuart Struever spent many field seasons excavating the *Koster* site in the lower Illinois River

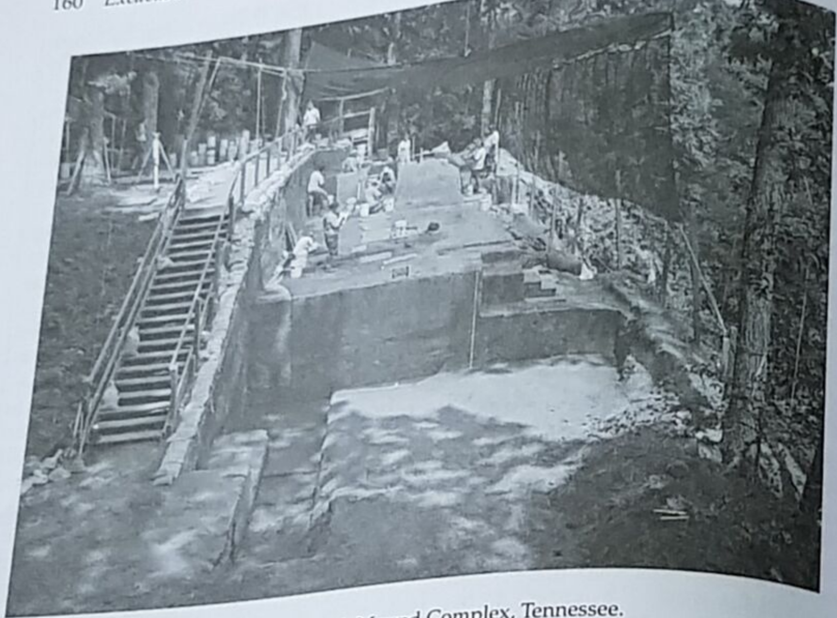


Figure 7.2 Excavations at Mound A, Shiloh Mound Complex, Tennessee. (National Park Service, Southeastern Region)

Valley. Here, at least twelve human occupations are represented at one site, the earliest of which dates to before 5100 B.C. Koster is a deep site, probably abandoned before A.D. 1000 after generations of Indians had settled at this favorable locality. It offered Brown and Struever a unique opportunity to examine the changing cultures of the inhabitants over more than 6,000 years. But the organizational problems were enormous. Koster is more than 30 feet (9 meters) deep, with each of the twelve cultural horizons separated from its neighbor by zones of sterile soil. Brown and Struever were fortunate in that they were able to treat each occupation level of this large site as an entirely separate digging operation.

The archaeologists had two options. One was to dig small test trenches and obtain samples of pottery and other finds from each stratigraphic level. But this approach, although cheaper and commonly used, was inadequate for the problems to be investigated at the Koster site. The excavators were interested in studying the origins of agriculture in the lower Illinois Valley. Brown and Struever therefore decided to excavate each living surface on a sufficiently large scale to study the activities that had taken place there. This procedure would enable them to examine minute economic changes. Thus the emphasis in the Koster excavations was on isolating the different settlement types that lay one on top of the other.

In developing the Koster research design, Brown and Struever needed to control a mass of complex variables that affected their data. In order to acquire immediate feedback on the finds made during the excavations, they organized a data-processing system

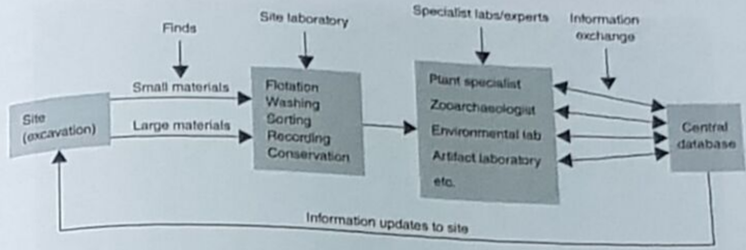


Figure 7.3 Flow chart of the organization of an archaeological excavation.

that was elaborate for its day, sorting the animal bones, artifacts, vegetable remains, and other discoveries on location in the field. The tabulated information on each sorted find was then fed by remote access terminal to a computer many miles away. The excavators had instant access to the latest data from the dig. This system meant that the overall research design could be modified while an excavation was still in progress (see Figure 7.3).

The Koster site, although conducted a quarter century ago, is a classic example of academic research and elaborate research design that used complex computer technology. The dig employed dozens of people each field season. Most excavations, whether academic or CRM, operate on a far smaller scale, but the ultimate principles are the same: sound research design, very careful recording of all data, and scientifically controlled excavation. The Koster excavation was designed, like all good digs, to solve specific research problems formulated in the context of a sound research design.

In the final analysis, archaeological excavation is dissection: dissection of each layer of a site to understand how it was formed and what happened there in the past. This is a three-dimensional process where the excavator dissects the deposit, then turns it into a meticulous set of records, set down in writing or digitally, drawn, and photographed. Martin Carver, already quoted, who is famous for his spotless excavations, considers them laboratories for a surgical activity – and he is right.

Types of Excavation

People commonly ask the same questions when they visit an excavation. How do you decide where to dig? What tools do you use? Why are your trenches in this configuration? How deep do you excavate? Every site differs in its complexity and special problems, but here are some general principles.

You can decide where to dig on a site by the simple, arbitrary choice of a spot that has yielded a large number of surface finds or one where traces of stone walls or other ancient structures can be seen above ground. When Richard Daugherty dug the Ozette whale-hunting site on the Washington coast (see Chapter 9, p. 224), he began by digging through the place where the largest occupation sequence seemed to be. Why? He needed to obtain as complete a cultural sequence as possible. The logical way to do so was to dig through the deepest part of the site. There was, of course, no guarantee that his trench would penetrate to the earliest part of the whale-hunters' site. But his choice was a practical way to start attacking the fundamental questions of when and

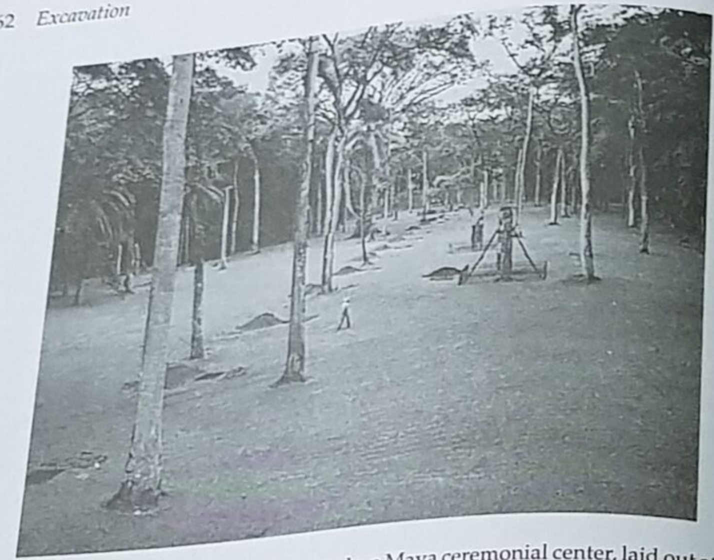


Figure 7.4 A line of test pits at Quirigua, Guatemala, a Maya ceremonial center, laid out at 49.2-foot (15-meter) intervals and aligned with the site grid.
(University of Pennsylvania Museum, Philadelphia)

for how long the whale hunters lived at Ozette. Similar decisions have been made at thousands of other sites all over the world.

Site Testing

In these days of subsurface radar technology and sophisticated geomorphological studies, site testing has become more sophisticated than it was even a few years ago. However, a number of testing approaches amplify such data or are used as stand-alone ways of deciding whether a site is worth further investigation or to establish its date, function, or type of occupation. Such methods are especially important on CRM projects where time is short and extensive areas have to be surveyed and test-excavated.

Augurs and other forms of borers can be used to explore archaeological deposits – especially hydraulic corers, which provide column samples of subsurface layers and allow one to follow conspicuous or distinctive strata over considerable distances, even if they are buried far beneath the surface.

However, the **test pit** remains the most useful way of obtaining preliminary information on stratigraphy and culture history in advance of larger-scale excavation. Some test trenches are small control pits, dug carefully as a way of anticipating subsurface stratigraphy and occupation layers. Such excavations are reference points for planning an entire dig. More often, test pits are laid out in lines and over considerable distances to establish the extent of a site and the basic stratigraphy in different areas (see Figure 7.4). Sometimes their locations are selected by statistical means, other times on the basis of surface finds or exposed features. Kent Flannery once called such trenches "telephone booths," an apt description of small cuttings placed to acquire highly specific information.

Shovel pits are a variation on the test pit theme, usually used in surface survey to trace occupation deposits. They are little more than small holes dug with a shovel a few inches below the surface and are much used to establish the boundaries of shallow settlement sites and features.

The Process of Dissection

How do you dissect a stratified archaeological site? Obviously, there is no one standardized way of excavating them, for they vary infinitely in their size, preservation conditions, and complexity. Some of the most complex excavations are even conducted underground, such as those in London deep under high-rise buildings and in subway stations (see Figure 7.5).

There are, however, some widely used dissection methods:

Geometric Method. Here, the excavator lays out a rectangular trench, then levels the surface within before taking the deposits down in thin spits, or arbitrary layers, up to 4 inches (10 centimeters) thick. As the excavation proceeds, the exposed walls display the stratigraphic profile. The horizontal surface consists of the same layers truncated and seen from the top. By recording both sets of layers, the researcher obtains a three-dimensional picture of the entire deposit from top to bottom. This is

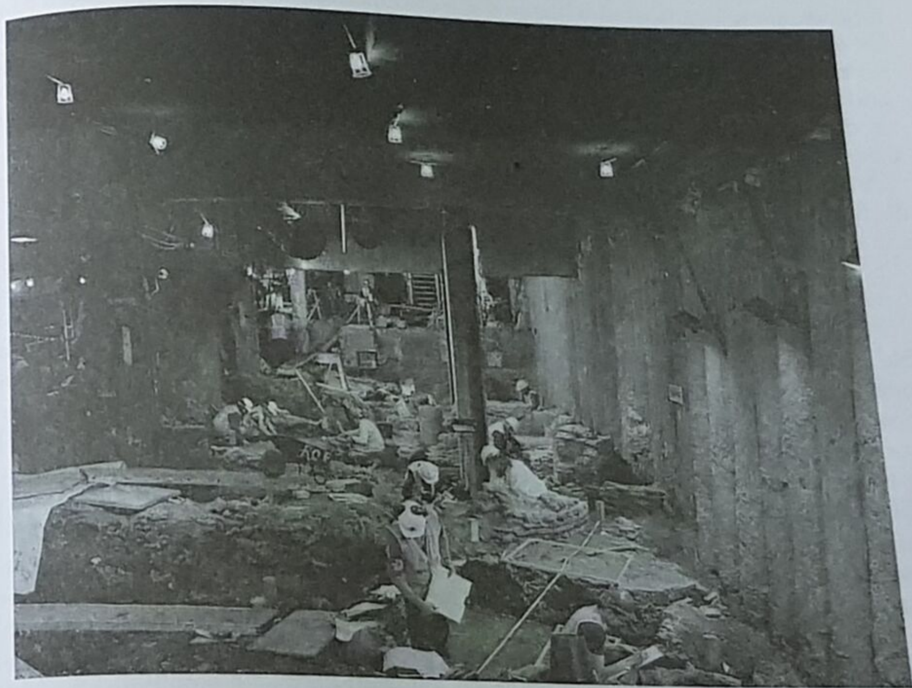


Figure 7.5 Excavations under a high-rise building in the heart of the city of London show the complexities of modern urban archaeology.
(Museum of London, Archaeology)

an efficient way of excavating and recording a site, but it has the disadvantage that one never looks at the layers for what they actually are – the record can be called somewhat inhuman in terms of recording ancient human behavior. BF used this method extensively to excavate mounded farming villages, where the stratigraphic layers are very hard to see and where he was working with unskilled workers.

Sampling. In these days of high digging costs and CRM projects, archaeologists rely more heavily on statistical sampling than their predecessors did. Sampling is used in digging shell heaps or dense accumulations of occupation debris containing thousands of artifacts. Obviously, only a small sample of a large garbage heap can be dug and analyzed. To ensure validity of the statistical samples, some form of unbiased sampling must be used to choose which part of a site is to be dug.

Sampling is the science of controlling and measuring the reliability of information through the theory of probability. Sampling techniques allow us to ensure a statistically reliable basis of archaeological data from which we can make generalizations about our research data. Most archaeologists make use of **probabilistic sampling**, a means of relating small samples of data in mathematical ways to much larger populations. The classic example of this technique, commonly used in the disciplines of statistics and statistical theory, is the political opinion poll, testing national feelings from tiny samples, perhaps as few as 1,500 people. In archaeology, probabilistic sampling improves the likelihood that the conclusions reached from a survey or excavation on the basis of the samples are relatively reliable.

The use of formal sampling techniques in archaeology is still in an early stage. Simple **random sampling** is used when nothing is known ahead of excavation. It can be used, for example, when an archaeologist wishes to obtain an unbiased sample of artifacts from an ancient shell mound. One can arrive at this result by laying out a rectangular grid of squares on a site and then selecting the squares to be dug by using a table of random numbers. The excavated samples are thus chosen at random rather than on the basis of surface finds or other considerations.

Stratified sampling, whereby the investigator uses previous knowledge of an area, such as its topographic variation, to structure further research, enables one to sample some selected units intensively and others less thoroughly.

Sampling excavation is a variant on the geometric method, which gives multiple views of the stratigraphic sequence at different points. The great British excavator Sir Mortimer Wheeler put his boxes in shallow sites in formal grids covering a considerable area, allowing him to monitor the stratified layers in the "baulks" between the boxes. Once excavation and recording was complete, he would then remove the baulks, knowing that he had tight control over the stratigraphy (Figure 7.6). North American excavators commonly use random sampling to place their boxes, expanding them, joining them, or linking them if this is judged necessary. This approach has the advantage of being quicker and providing a quick impression of a site. It is most successful with relatively homogeneous sites like shell middens, but has the disadvantage that different activities take place at different locations within a site and you may miss some of them.

Stratigraphic excavation is the hardest form of dissection, for it involves exposing each layer, one by one, and as they lie in the ground. If you have well-colored, sharp layers, stratigraphic excavation – while challenging – is relatively straightforward. If the layers have decayed or are less well defined, then difficulties proliferate. With stratigraphic excavation, you record as you go along, following a sequence of defining the layer, which can be a feature, a posthole or an occupation horizon, then recording, removing, and recording it again, perhaps in a broader context of other features exposed nearby.

Figure 7.6 Mortimer Wheeler-style excavation using baulks and boxes at the Jinhsa site near Chengdu, China, *c.* 1000 B.C. (Excavation displayed in the site museum.) (Best View Stock / Alamy)

Stratigraphic excavation is notoriously difficult in caves and rockshelters visited repeatedly over long periods of time. Almost invariably, you are working in a restricted space, which means your trenches will be vertical cuts into the stratified deposits. In many places where stratigraphic excavation is the norm, researchers tend to expose large, continuous areas – horizontal excavations – that expose large numbers of individually recorded components. The advantage is that you expose the entire area of a single deposit, like the central precincts of a small farming village, but this approach places heavy responsibility on those who record individual features. It is hard, too, to obtain an overall check on the stratigraphy.

Vertical and Horizontal Excavation

Many people make a somewhat arbitrary distinction between **vertical** and **horizontal (area) excavation**.

Vertical Excavation

Some of the world's most important sites have been excavated on a small scale by vertical excavation, digging limited areas for specific information on dating and stratigraphy. Vertical trenches can be used to obtain artifact samples, to establish sequences of ancient building construction or histories of complex earthworks, and to salvage sites threatened with destruction. Vertical excavation comes into its own in small sites such as caves and rockshelters, where space is limited and the excavators have to cope with hidden boulders from ancient rock falls and other such obstructions. Sometimes the deposits spill out from the cave itself to the steep slope in front of the site, necessitating the use of a long, stepped vertical cutting, as was the case at the *Klasies River Cave* in South Africa, which records some of the earliest activities of *Homo sapiens* in tropical Africa.

Dust Cave lies in a limestone bluff on the middle Tennessee River in northwestern Alabama. Extensive early hunter-gatherer occupations, dating between about 8000 and 1600 B.C., reach a depth of 16.4 feet (5 meters). Excellent conditions preserved animal bones and plant materials, as well as such features as hearths, pits, and clay floors. Archaeologists from the University of Alabama sunk 6.5-foot by 6.5-foot (2-meter by 2-meter) test pits into the cave floor. When they located stone artifacts, they excavated a large 6.5-foot by 39-foot (2-meter by 12-meter) cutting down to sterile bedrock. The excavators dug the cave using the stratified layers of human occupation as their guide, each being dissected meticulously. All the occupation deposits passed through ¼-inch (6-millimeter) mesh screen, while large samples were processed through water to obtain seeds and other minute plant remains, a technique known as flotation (see Chapter 11). They identified the different human occupation stages by using highly diagnostic stone projectile points that changed significantly over time. We return to this important excavation in Chapter 11.

Vertical excavation is also important when investigating the banks and ditches of such sites as Roman forts or Iron Age encampments like *Maiden Castle* in England, and is widely used when investigating *Adena* and Hopewell burial mounds in North America (Figure 7.7).

Horizontal Excavation

Horizontal, or area, digs are commonly associated with stratigraphic excavation, exposing large areas of a site to uncover house plans or settlement layouts. As a general rule, the only sites that are completely excavated are very small hunter-gatherer camps, isolated structures, and burial mounds. With larger settlements, all one can do is excavate several portions of the site in order to sample areas representative of the entire settlement. Again, modern archaeological ethics require minimal horizontal excavation consistent with the carefully controlled objectives of the investigation.

Horizontal excavation is highly effective with small hunter-gatherer sites, such as the artifact-and-bone scatters at Olduvai Gorge and other early human sites in East Africa, where the position of every stone flake and animal bone is recorded in place. Such an approach also works well with complex structures like Iroquois longhouses, which survive as complexes of decayed wooden postholes buried under a few inches of topsoil (see Figure 7.8). Such structures were often expanded, rebuilt, or sited on top of another structure, resulting in a jigsaw puzzle of posthole patterns that can be deciphered only with a large area excavation.

An excellent example of horizontal excavation exposed the Grewe site, a *Hohokam* farming village in the modern-day Phoenix area (Figure 7.9). Here the excavators exposed about two dozen courtyard groups, complexes of semi-subterranean pithouses that shared central courtyards and food roasting pits. The groups in turn surrounded a large central plaza. The largest courtyard group contained twenty-six houses and covered more than 6,500 square feet (604 square meters). Careful excavation revealed that only a few houses in each group were occupied at one time, most of the households comprising no more than about ten people. Furthermore, the courtyard groups were

Figure 7.7 Vertical excavation on a British Iron Age hill fort and its fortifications in 1937: a classic example of Sir Mortimer Wheeler's meticulous excavation methods, which were the foundation of modern excavation methods in Europe. This famous picture of an exemplary vertical trench has set standards for generations. (Society of Antiquaries of London)

occupied for varied lengths of time, some for centuries, others for a few generations. This may show that ownership of houses and compounds passed from one generation to the next, sometimes over long periods of time.

Large, open area excavations require accurate recording over considerable distances, made much easier when the position of houses and finds can be recorded with a **total data station**, an electronic distance-measuring device with recording computer, which records data that can be downloaded to laptop computers at the end of the day's work.

Any form of horizontal excavation is expensive, even if earthmoving machinery is used to remove sterile overburden, but it provides a unique, overall, horizontal view of human occupation or of entire human settlements obtainable in no other way (see Chapter 14 opener).

The arbitrary subdivision between vertical and horizontal excavation has some merit and is commonly used. However, it disguises a much more flexible reality. What matters is to use the appropriate methods for the site and problem at hand. Excavating a site with ill-defined layers, or the backfilling of a ditch or large burial pit, may be best

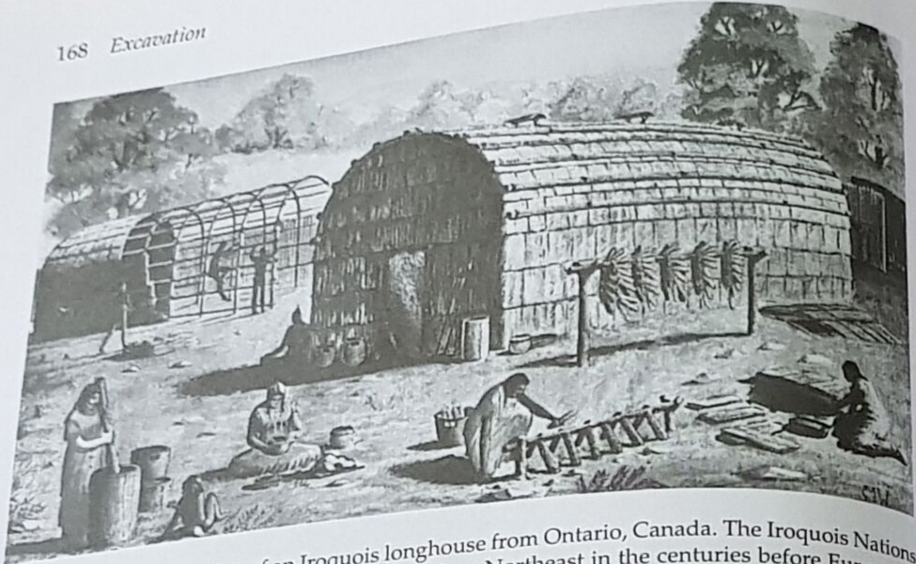


Figure 7.8 A reconstruction of an Iroquois longhouse from Ontario, Canada. The Iroquois Nations dominated much of the North American Northeast in the centuries before Europeans arrived. Many settlements comprised close groupings of fortified longhouses. (Stock Montage, Inc. / Alamy)

achieved by the geometric methods. Stratigraphic excavation works best for sites with easily distinguishable layers. What matters is establishing how things actually were in the past. As Martin Carver remarks, "An archaeological deposit is a three-dimensional artifact, only seen once and never seen whole. It deserves an analytical approach that is special to itself, not just to be dissected and recorded, but to be studied" (Carver, 2009: 123). A good excavation is as creative an activity as writing a book – and is redesigned every time you put a spade into the ground.

Digging, Tools, and People

How do you do the digging? Much depends on the type of site you are excavating. A huge burial mound on the Ohio River may be more than 20 feet (6 meters) deep. Much of the sterile deposit covering the burial levels is removed with earthmoving machinery and picks and shovels. Earthmoving machinery in particular is now widely used on CRM excavations such as at the Grewe site to save time, where its use has been brought to a fine art, involving minimal destruction (see Figure 7.9). But as soon as the archaeologists reach layers in which finds are expected, they dig with meticulous care, removing each layer in turn, recording the exact position of their finds upon discovery. Smaller caves or cemeteries are excavated centimeter by centimeter. The earth surrounding the finds is passed through fine screens so that tiny beads, fish bones, and myriad small items can be found.

Excavation is in part a recording process, and accuracy is essential. The records will never be precise unless the dig is kept tidy at all times. The trench walls must always be straight. Why? So you can record the layers you are digging and follow them across the site. Surplus soil is dumped well away from the trenches so it does not cascade into the dig or have to be shifted when new areas are opened. The excavation is a laboratory and should be treated as such.

Figure 7.9 Pithouses and courtyard groups exposed by area excavation at the Grewe site, Arizona. (Arizona Department of Transportation and Northland Research / Douglas Craig)

All archaeological digs are headed by a director, who is responsible both for organizing the excavation and for overseeing the specialists and diggers. Many larger academic and CRM digs involve a team of specialist experts who work alongside the excavators. When digging the famous Late Bronze Age site of about 1100 B.C. at *Flag Fen* in eastern England, archaeologist Francis Pryor worked with a timber expert, a paleontologist, soil scientists, experts on ancient metallurgy and mammal bones, and even a specialist in prehistoric beetles. The only way to study this complex site was to develop a team approach that looked at the site in a broad environmental setting. A really large excavation in Mesopotamia or Mesoamerica can involve dozens of people – specialist archaeologists, a team of resident experts in other fields including an architect, graduate student trainees, and volunteer or paid workers who do much of the actual excavation. CRM projects involve closely knit teams of professional excavators and specialists who ensure compliance and proper recovery and interpretation of data.

In Chapter 15, we describe some of the ways in which you can obtain digging experience.

The traditional symbols of the archaeologist at work are the shovel and the triangular-bladed bricklayer's trowel. In fact, archaeologists use many other digging tools in their work. Earthmoving machinery, once despised, has become a necessity in these days of high costs and quick-moving CRM excavation driven by contractors' deadlines. In the hands of an expert operator, a front loader, bulldozer, or backhoe with toothless bucket are remarkably delicate implements for removing sterile soil and surprisingly thin slivers of overburden. On occasion, earthmoving equipment has been used to excavate sites doomed in the face of road construction. The right piece of equipment is capable of removing even thin arbitrary levels of a site with soft deposits, which are then passed through screens to recover the artifacts in them. Meanwhile, the archaeologists focus on hand excavation of important features.

Despite widespread use of mechanical earthmovers, most excavation still proceeds by hand. Picks, shovels, and long-handled spades carry the brunt of the heavy work. But the most common archaeological tool used in North America is the diamond-shaped trowel with straight edges and a sharp tip. With it, soil can be eased from a delicate specimen or an unusual discoloration in the soil can be scraped clean. Trowels are used for tracing delicate layers in walls, clearing small pits, and other exacting jobs. They are rarely out of the digger's hand.

Household brushes and paintbrushes often come in handy, the former for soft, dry sediments and for cleaning trenches, and the latter for freeing fragile objects from the soil. Even fine artists' brushes have their uses – cleaning beads, decaying ironwork, or fine bones. Enterprising archaeologists visit their dentists regularly, if only to obtain regular supplies of worn-out dental instruments, which make first-rate fine-digging tools! And so do 6-inch (15-centimeter) nails ground to different shapes. A set of fine screens for sifting soil for small finds, several notebooks and graph paper, tapes, plumb bobs, surveyors' levels, and a compass are just a few of the items that archaeologists need to record their excavations and process their finds. Increasingly, laptop computers, iPads, portable GPS units, electronic recording equipment, and smartphones are part of the archaeologist's field kit because they provide fast, accurate ways of recording features, finds, and stratigraphy.

Recording

No dig is worth more than its records. Excavation notebooks provide a day-to-day record of each trench, of new layers and significant finds. Before any trench is measured out, the entire site is laid out on a grid of squares. Important finds, or details of a house or a storage pit, are measured on the site plan by simple three-dimensional measuring techniques or with an electronic recording instrument (see Figure 7.10a and b). It is information from your records, as well as the artifacts from the dig, that form the priceless archive of your excavation. If the records are incomplete, the dig is little better than a treasure hunt.

Stratigraphic Observation

The laws of superposition and association lie at the very core of archaeology, for they provide the context of archaeological finds in time and space. The layers of archaeological sites, be they natural or humanly created, form much more quickly than geological levels, but they are subject to the same law of superposition. Thus the excavated stratigraphic

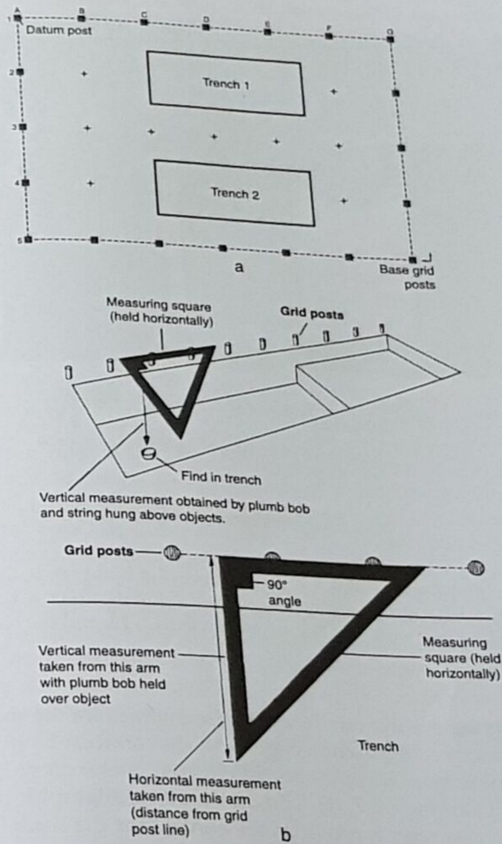


Figure 7.10 Recording under ideal (grossly simplified) conditions. (*a*) Two trenches laid out with a grid. (*b*) The principle of three-dimensional recording using carefully set grid posts. Today, excavators usually use electronic recording systems, but the underlying principles are the same.

profiles through an archaeological site represent a sequence of layers that have formed through time. Stratigraphic observation is the process of recording, studying, and evaluating stratified layers in archaeological sites, layers that were deposited horizontally but are studied in the vertical (time) dimension.

Stratigraphic observation involves not only recording the layers but also confirming that they do, in fact, represent a sequence in time. Many factors can disturb stratified layers. For instance, rabbits can burrow through soft earth, or later occupants of a house may dig into underlying layers to construct storage pits, build foundations, or even

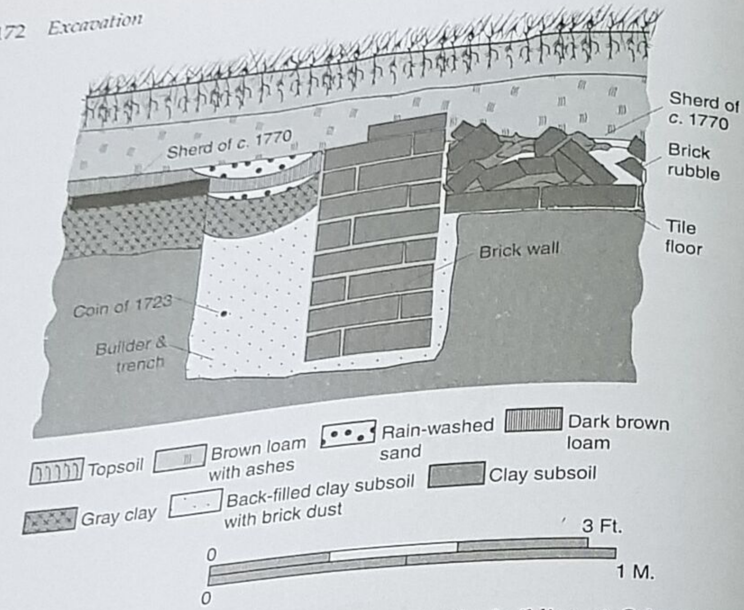


Figure 7.11 Dating the construction and the destruction of a building at *Colonial Williamsburg*, Virginia, by its associated artifacts. Judging from the coin of A.D. 1723, the builder's trench for the stone wall was dug no earlier than 1723, and the building fell into ruin before 1820.

bury the dead. This is where the law of association comes in, for the artifacts associated with stratified, undisturbed archaeological layers can then be placed in a relative chronology, and, if radiocarbon samples are dated from one or more layers, perhaps in an absolute one as well (see Figure 7.11). Thus, accurate stratigraphic observation is the cornerstone of all excavation, for it provides the context for the studies of artifacts and human behavior that are the central goals of all excavation.

Reading a stratigraphic profile is an art, for you have not only to record the layers but to interpret them as well, taking account of the natural formation processes as well as of human activities. This means watching for the subtle color changes resulting from the decay of adobe brick on pueblo sites; the thin lines of hearths used for a short time, whose edges have spilled down a slight slope; and the loosely packed outline of a rabbit burrow used and abandoned many centuries ago. Often the changes are so subtle that they appear only as a slight color change or a minute difference in the texture of the soil. Only patience produces an accurate interpretation of a stratigraphic profile – looking at the trench wall in different lights, at dawn or in the oblique light of evening, wetting down dry strata with a fine water spray, even looking at the wall from below. All these tricks and many others help you interpret complex stratigraphic jigsaw puzzles, even on small sites.

Let us now turn from general principles to some specific excavation problems that will give you an insight into the multitude of challenges awaiting fieldworkers. As we

indicated in Chapter 3, archaeological sites, in all shapes and sizes, are the basis for all field investigations. All contain traces of human activity in the form of artifacts, structures, and food remains. Archaeologists most commonly classify sites by their functions – that is to say, by the activities that took place within them. It is no coincidence that these various site categories present different excavation problems.

Excavation Problems

Open Campsites and Villages

Small sites, often little more than scatters of artifacts that were once places where specific tasks were performed, are probably the most common archaeological sites. However, the most obvious and most interesting locations are habitation sites, places where people have lived and carried out many activities. Hunter-gatherers have occupied temporary camps for short periods since the earliest millennia of prehistory. Where preservation conditions are good, archaeologists can sometimes identify such settlements, represented by concentrations of stone artifacts and broken animal bones, as well as the stone foundations of long-abandoned brush shelters or the depressions of pithouses sunk partially into the ground (see Figure 7.9 on p. 169). Such concentrations have been found in the Great Basin of the American West, in the arctic North, and also in sub-Saharan Africa.

Many hunter-gatherer camps are hard to identify from the surviving archaeological record (see Figure 7.12). The same is not true of later farming villages, which were usually occupied longer, resulting in the accumulation of considerable quantities of occupation debris as well as substantial house foundations. In about 9500 B.C., the inhabitants of the Abu Hureyra village in Syria's Euphrates Valley, one of the earliest farming villages in the world, dwelt in a tiny settlement of square, mud-brick houses with courtyards, separated by narrow alleyways. The house foundations and numerous animal bones, as well as other artifacts, enabled excavator Andrew Moore to trace the extent and nature of the settlement. Iroquois farmers in the northeastern United States built substantial wood-and-bark longhouses, which were occupied over several generations and constantly modified (see Figure 7.8 on p. 168). The decayed postholes from the walls provide an excellent record of Iroquois dwellings, often clustered in close juxtaposition in palisaded settlements.

Caves and Rockshelters

Cave people, complete with clubs, long hair, and brutish manners, are one of the popular stereotypes of newspaper cartoonists. Caves and convenient rocky overhangs did indeed serve as human dwellings from very early times but were by no means the only home bases used by hunter-gatherers. The Late Ice Age people of southwestern France, famous for their rock art, occupied great rockshelters and caves in the deep river valleys of the Dordogne during the late Ice Age, between about 40,000 and 12,000 years ago. The *Danger* and *Hogup* caves in Utah reflect thousands of years of hunter-gatherer occupation. The dry environment of the desert preserved wooden objects and basketry as well as minute details of economic life. And the dry caves of Tehuacán Valley in south-central Mexico provide part of the history of how maize cultivation developed in the New World.

Cave and rockshelter excavations are some of the hardest digs to carry out successfully (see Figure 7.13). The ground below cliff overhangs usually consists of ash and other debris piled up through successive human occupations. Sterile soils may interrupt