



3.63 Part of the Staffordshire hoard, the largest Anglo-Saxon hoard of gold and silver metalwork ever found. Unearthed in July 2009 by a metal detectorist (working with the landowner's permission), it comprises more than 1,500 high-quality pieces, mostly linked to weaponry, such as sword pommels. Thought to date to the seventh or eighth century CE, the hoard contained 5 kg (11 lb.) of gold and 1.3 kg (2.9 lb.) of silver. It has been valued at £3.2 million (nearly \$4 million).

dig holes without recording or reporting the finds they make, which are therefore without context. There are now thirty thousand metal detectorists in Britain alone. The official British Portable Antiquities Scheme (see feature, p. 587) seeks to harness their enthusiasm for archaeological benefit. One of the great successes of recent years of the Portable Antiquities Scheme has been the discovery by an amateur detectorist of the remarkable Staffordshire hoard of Anglo-Saxon gold and silver metalwork [3.63].

Geochemical Analysis. Geochemical analysis involves taking samples of soil at intervals (such as every 1 m/3 ft.) from the surface of a site and its surroundings, and measuring their elemental content. In the past, topsoil was considered to be too disturbed and unstratified, and so devoid of archaeological information; it was often removed mechanically and quickly, without investigation. Now, it is clear that even the surface of an archaeological site that appears totally disturbed can yield important chemical information. Organic components of occupation debris may disappear, while the inorganic ones remain: of these, magnesium or calcium can be analyzed, but it is the phosphates that are the most diagnostic and easily identified. High phosphate concentrations may be the only surface sign of an archaeological site. Tests on sites in England, examining samples taken at 20-cm (8-in.) intervals from the surface downward, have confirmed that undisturbed archaeological features in the subsoil can be accurately reflected in the topsoil.

The phosphate method can also be valuable for the interpretation of sites with no apparent internal architectural features, and can help clarify the function of different parts of an excavated site. For example, in a Romano-British farmstead at Cefn Graianog, North Wales, J. S. Conway took soil samples at 1-m (3-ft.) intervals from the floors of excavated huts and from neighboring fields, and mapped their phosphorus content as contour lines. In one building, a high level of phosphorus across the middle implied the existence of two animal stalls with a drain for urine running between them. In another, the position of two hearths was marked by high readings.

Geochemical methods can also reveal what processes or activities were being carried out in the past. Portable infrared spectrometers first appeared in the late 1980s, and today, portable instruments, such as **X-ray fluorescence (XRF) spectrometers** and scanners, are routinely employed to give a detailed analysis of the chemical composition of soils, pigments, calcite, limestone, plaster, ash, and so on, without the need to take samples. One major advantage of handheld devices is that such instruments avoid a reliance on off-site laboratories where samples previously had to be sent for analysis, often causing months of delay.

Excavation

So far, we have discovered sites and mapped as many of their surface and subsurface features as possible. But, despite the growing importance of survey, the only way to check the reliability of surface data, confirm the accuracy of remote sensing techniques, and actually see what remains of these sites and obtain dates, is to excavate them. As mentioned before, survey can tell us a little about a large area, but only excavation can tell us a great deal about a relatively small area.

Excavation retains its central role in fieldwork because it yields the most reliable evidence for the two main kinds of information archaeologists are interested in: (1) human activities at a particular period in the past; and (2) changes in those activities from period to period. Very broadly speaking, contemporary activities take place horizontally in space, whereas changes in those activities occur vertically through time. It is this distinction between horizontal slices of time and vertical sequences through time that forms the basis of most excavation methodology.

In the horizontal dimension, archaeologists demonstrate contemporaneity—that activities did indeed occur at the same time—by proving to their satisfaction through excavation that artifacts and features are found in association in an undisturbed context. Of course, as we saw in Chapter 2, there are many formation processes that may

Geophysical Survey at Roman Wroxeter



Covering an area of nearly 78 ha (193 acres), Roman Wroxeter, or Viroconium Cornoviorum, was the fourth-largest urban center in the province of Britannia and the capital of the Cornovii tribe. It is important today because, unlike so many other Roman towns in Britain, Wroxeter has survived largely without

damage and has not been covered by any succeeding modern settlement.

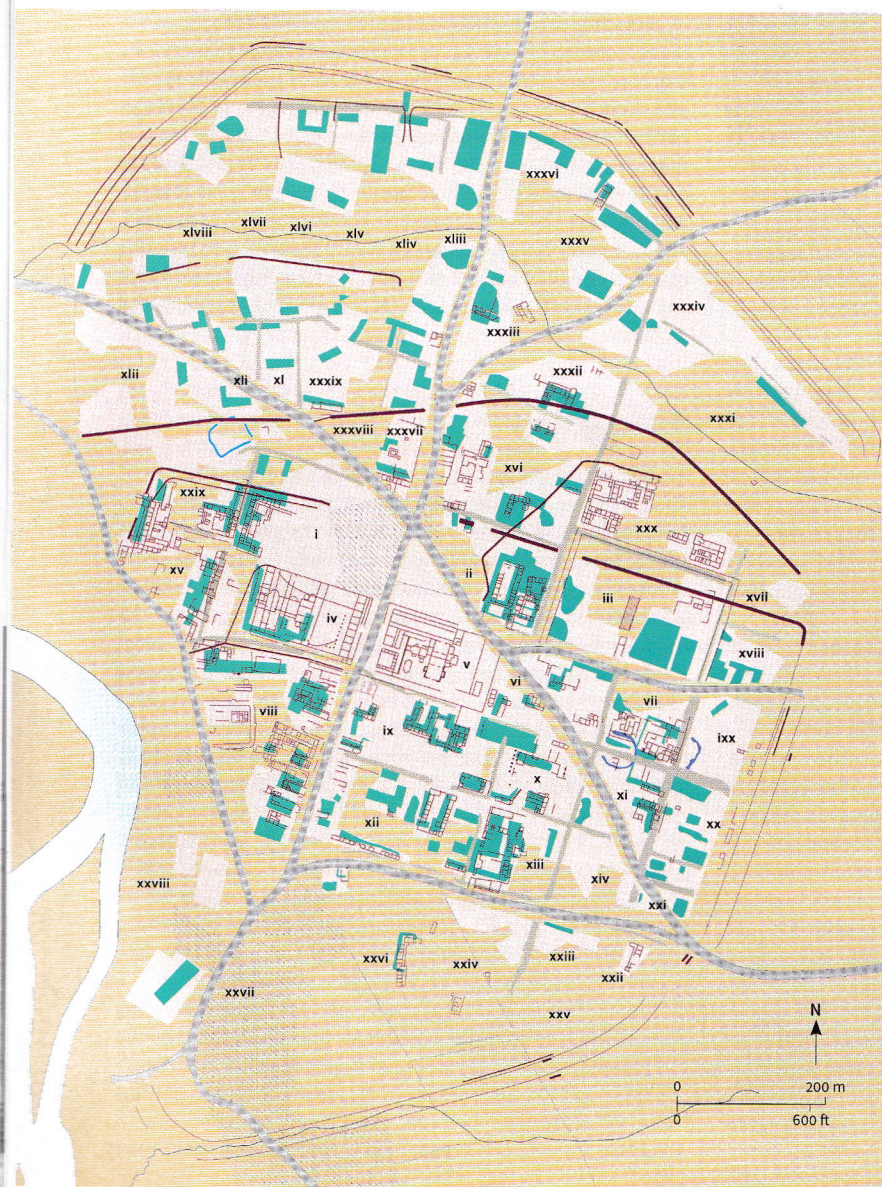
The town attracted archaeological attention in 1859, with extensive excavations being carried out on the public buildings of the town by antiquarians. After 1945, modern large-scale excavations were undertaken by Graham Webster (1913–2001) and Philip Barker (1920–2001),

but excavation is not the only source of information for the development of the town. Intensive aerial survey over many years has provided important evidence for the layout of the town and its possible development, allowing the teasing out of a number of phases and the compilation of a town plan of considerable detail [3.64].

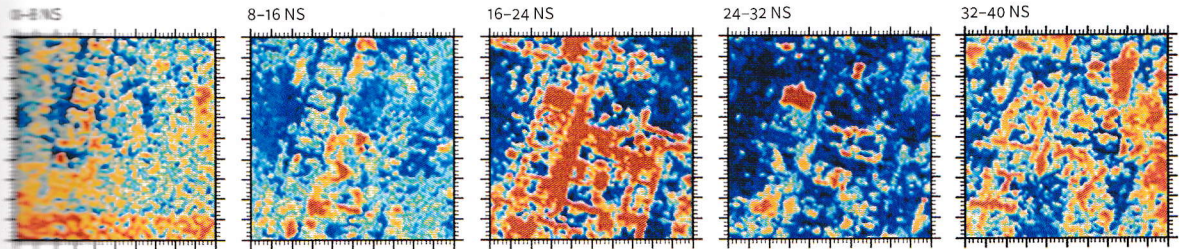
A great deal of information is therefore available for the site and its history, from the construction of a fortress for Roman legions XIV and XX by 60 CE, and the foundation of the *Civitas Cornoviorum* (the settlement's citizen body, united by law), through to the intriguing evidence for post-Roman occupation. The information is, however, extremely variable. Modern excavation has uncovered only a very small part of the site, certainly less than 1 percent of the total, while aerial photography is not effective over the whole area, frequently identifying only the stone buildings and not even all of these. Consequently, so little was known about large parts of the city that perhaps 40 percent of the best-preserved Roman city in Britain was effectively *terra incognita*.

Surveying the City

Wroxeter Hinterland Project (1994–97) set out to study the effect of the town on its hinterland, and it was realized that a more complete plan of the interior was essential as part of this work. It was decided to carry out a geophysical survey of the whole of the available city. Given the size of the area, a radical solution was required to achieve this. The project was undertaken over several years by an international team of British and foreign geophysicists, including national bodies such as English Heritage and commercial groups such as GSB Prospection. Their activities and results



3.64 A composite plan of Roman Wroxeter based on the aerial photo plots of buildings (in red) and those buildings visible in the magnetometry plot (in green). The shaded areas represent activity within the town but without specific plans visible.



are impressive: nearly 63 ha (156 acres) were covered by **fluxgate gradiometer** survey, representing more than 2.5 million data points, and nearly 15 ha (37 acres) by resistance survey. More than 5 ha (12 acres) of ground-penetrating radar data are now available for use in time-slicing software (for information on the depth of features see pp. 107–8), and myriad other techniques, including seismics, conductivity, and cesium magnetometry, were used [3.65, 3.66]. Some techniques were employed to a lesser extent but still provide invaluable comparative results.

Results

The result of this work is the most extensive and complete plan currently available for a Romano-British civitas capital [3.67]. There is evidence for elite buildings concentrated largely in the center and southwest of the town, with artisan quarters generally to the east and north. Dense pitting in the northwestern quarter of the town may relate to agro-industrial activities, such

as tanning, concentrated in a specialized industrial area. A rectangular space at the highest point of the town on the eastern side may be interpreted as the *forum boarium* (cattle market).

Equally important among the fluxgate gradiometer data is the phenomenon of reversed magnetic data in the northeastern quarter of the town. This seems most reasonably interpreted as evidence for a major fire that swept across the town, causing changes in the magnetic properties of the building stone as it was burned.

Geophysics has also provided a glimpse into the prehistory of the site: a number of Bronze Age ring ditches can be recognized within the survey data, and a small enclosure and associated fields appear to underlie the defenses that can be related to the reorganization of the early Roman landscape.

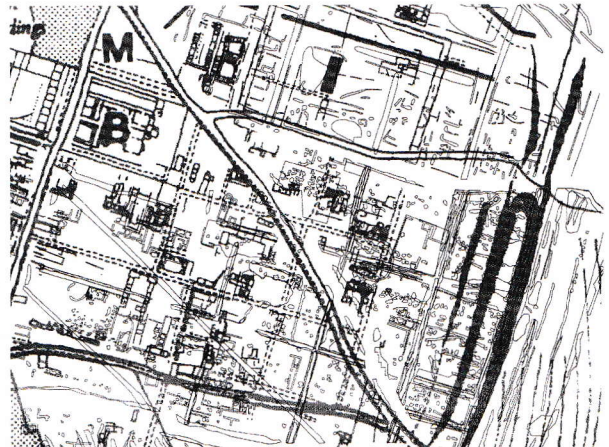
The plan derived through geophysics at Wroxeter is superbly detailed—and all without any expensive and destructive spadework. A key advantage is that, unlike

most archaeology, this is a repeatable experiment. As technologies improve, we can revisit the town and learn more about it. The study is therefore important not simply because of the extent or even the quality of the data, but because it is an integral part of a larger ongoing research program.

3.65 (Above) The time-sliced radar plots of one building in the survey.

3.66 (Below, left) The team at Wroxeter setting up equipment for a ground-penetrating radar survey.

3.67 (Below, right) A detail of the plan of Roman Wroxeter derived from David Wilson's aerial photographic study and the magnetometer survey.



disturb this primary context. One of the main purposes of the survey and remote sensing procedures outlined in the earlier sections is to select for excavation sites, or areas within sites, that are reasonably undisturbed. On a single-period site, such as an East African early human campsite, this is vital if human behavior at the camp is to be reconstructed at all accurately. But on a multiperiod site, such as a long-lived European town or West Asian tell, finding large areas of undisturbed deposits will be almost impossible. Here, archaeologists try to reconstruct during and after excavation just what disturbance there has been, and then decide how to interpret it. Clearly, adequate records must be made as excavation progresses if the task of interpretation is to be undertaken with any chance of success. In the vertical dimension, archaeologists analyze changes through time by the study of stratigraphy.

Stratigraphy. As we saw in Chapter 1, one of the first steps in comprehending the great antiquity of humankind was the recognition by geologists of the process of stratification—that layers or strata are laid down, one on top of the other, according to processes that still continue [3.68]. Archaeological strata (the layers of cultural or natural debris visible in the side wall of any excavation) accumulate over much shorter periods of time than geological ones, but nevertheless conform to the same law of superposition. Put simply, this states that where one layer overlies another, the lower was deposited first. An excavated vertical profile showing a series of layers, therefore, constitutes a sequence that has accumulated through time.

Chapter 4 explores the significance of this for dating purposes. Here we should note that the law of superposition

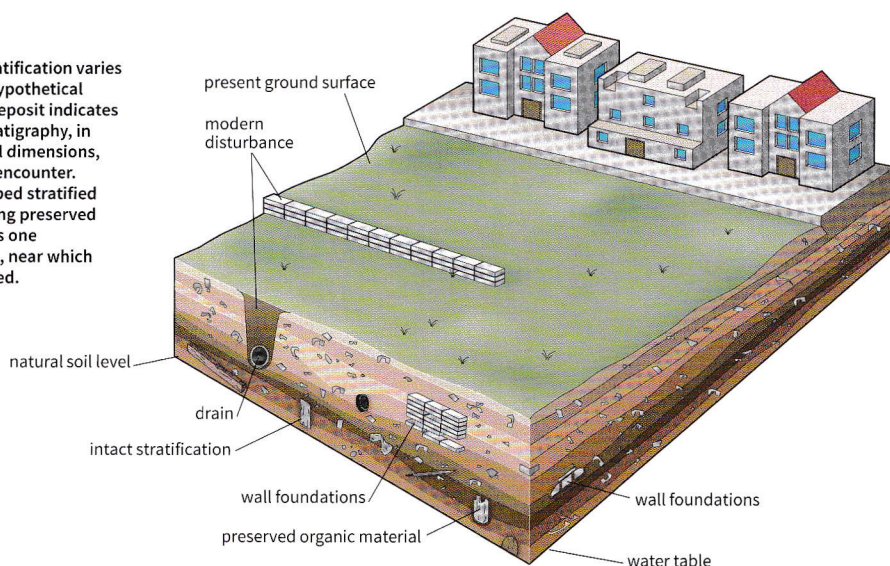
refers only to the sequence of deposition, not to the age of the material in the different strata. The contents of lower layers are indeed usually older than those of upper layers, but the archaeologist must not simply assume this. Pits dug down from a higher layer or holes made by burrowing animals (even earthworms) may introduce later materials into lower levels. Occasionally, strata can become inverted, as when they are eroded all the way from the top of a bank to the bottom of a ditch.

Archaeologists have developed an ingenious and effective method of checking that artifacts—so far, mostly of stone or bone—discovered in a particular deposit are contemporaneous and not intrusive. They have found that, in a surprising number of cases, flakes of stone or bone can be fitted back together again—reassembled in the shape of the original stone block or pieces of bone from which they came. At the British Mesolithic site of Hengistbury Head in Dorset, for example, reanalysis of an old excavation showed that two groups of flint flakes, found in two different layers, could be refitted. This cast doubt on the stratigraphic separation of the two layers and demolished the original excavator's argument that the flints had been made by two different groups of people. As well as clarifying questions of stratification, these **refitting** or **conjoining** exercises are transforming archaeological studies of early technology (see Chapter 8).

Stratigraphy, then, is the study and validation of stratification—the analysis in the vertical (time) dimension of a series of layers in the horizontal (space) dimension, although in practice few layers are precisely horizontal.

What are the best excavation methods for retrieving this information?

3.68 The complexity of stratification varies with the type of site. This hypothetical section through an urban deposit indicates the kind of complicated stratigraphy, in both vertical and horizontal dimensions, that the archaeologist can encounter. There may be few undisturbed stratified layers. The chances of finding preserved organic material increase as one approaches the water table, near which deposits may be waterlogged.



Methods of Excavation

Excavation is both costly and destructive, and therefore is never undertaken lightly. Wherever possible, the non-destructive approaches outlined earlier should be used to meet research objectives in preference to excavation. But assuming excavation is to proceed, and the necessary funding and permission to dig have been obtained, what are the best methods to adopt?

This book is not an excavation or field manual, and the reader is referred for detailed information to the texts listed at the end of this chapter and in the Notes. In addition, the case studies presented in the following pages and in Chapter 13 (and many of the features in other chapters) provide good examples of numerous different kinds of excavations in practice. A few days or weeks spent on a well-run dig are worth far more than reading any book on the subject. Nevertheless, some brief guidance as to the main methods can be given here.

It goes without saying that all excavation methods need to be adapted to the research question in hand and the nature of the site. It is no good digging a deeply stratified urban site [3.69], with hundreds of complex structures, thousands of intercutting pits, and tens of thousands of artifacts, as if it were the same as a shallow Paleolithic open site, where only one or two structures and a few hundred artifacts may survive. On the Paleolithic site, for example, there is some hope of uncovering all the structures and recording the exact position or provenience, vertically and horizontally, of every single artifact. On the urban site, there is no chance of doing this, given time and funding constraints. Instead, a sampling strategy (see feature, p. 82) has to be adopted, and only key artifacts such as coins (important for dating purposes, see p. 146) will have their provenience recorded with three-dimensional precision, the remainder being allocated simply to the layer and perhaps the grid square in which they were found.

We have already reintroduced the idea of the vertical and horizontal dimensions. These are as crucial to the methods of excavation as they are to the principles behind excavation. Broadly speaking, excavation techniques can be divided into:

- 1 those that emphasize the vertical dimension, by cutting into deep deposits to reveal stratification;
- 2 those that emphasize the horizontal dimension, by opening up large areas of a particular layer to reveal the spatial relationships between artifacts and features in that layer.

Most excavators employ a combination of both strategies, but there are different ways of achieving this. All presuppose that the site has been surveyed and a grid of squares created to aid in accurate recording.

Shovel Test Pits (STPs) and Evaluation Trenches.

These are often the first form of excavation undertaken at an archaeological site. The purpose of these small pits is to gain a preliminary idea of what lies beneath the surface. They are often dug into the ground at consistent distances from each other. In Europe, they are traditionally in the form of 1-m (3-ft.) squares; but in some parts of North America small round holes are dug, about the diameter of a dinner plate, and less than 1 m (3 ft.) deep. These pits help disclose what an area has to offer, and help identify the extent of a possible site, while analysis and plotting of the material retrieved from them by screening (sieving) of the soil can produce maps showing areas with high



3.69 Urban archaeology: excavations at St. Martin-in-the-Fields in London uncovered many human remains, including a Roman sarcophagus and a collection of Saxon graves.

concentrations of different kinds of artifacts. This method is commonly employed as part of site surveys for CRM projects in areas of the United States with poor surface visibility, such as forested areas of the East Coast.

Evaluation trenches have often proved to be more effective than 1-m (3-ft.) squares. These trenches, around 20–50 m (65–164 ft.) long, are usually laid out on a grid or target specific features that have already been detected by other methods (e.g. air photography or geophysical survey), and expose a certain percentage of the area, typically 2 to 5 percent. Thousands of such trenches are dug in Britain alone every year.

Site Grids and Open-Area Excavation. The site grid is laid out from a datum, which is simply a selected location that serves as a reference point for all horizontal and vertical measurements taken at the site, so that the site can be accurately mapped and the exact location of any artifact or feature can be recorded in three dimensions. Increasingly, the use of a Total Station (see p. 97) is removing the need to lay out a grid. The Wheeler box-grid seeks to satisfy both vertical and horizontal requirements by retaining intact balks of earth between the squares of the grid so that different layers can be traced and correlated across the site in vertical profiles. Once the general extent and layout of the site have been ascertained, some of the balks can be removed and the squares joined into an open excavation to expose any features, such as a mosaic floor, that are of special interest. The box-grid method is still widely used in parts of South Asia where it was introduced by Wheeler in the 1940s [3.70]. It remains popular as it enables large numbers of untrained workers in individual boxes to be easily supervised by small numbers of staff.

Advocates of **open-area excavation**, such as the English excavator Philip Barker, criticize the Wheeler method, arguing that the balks are invariably in the wrong place or wrongly oriented to illustrate the relationships required from sections, and that they prevent the distinguishing of spatial patterning over large areas. It is far better, these critics say, not to have such permanent or semipermanent balks, but to open up large areas and only to cut vertical sections (at whatever angle is necessary to the main site grid) where they are needed to elucidate particularly complex stratigraphic relationships. Apart from these running sections, the vertical dimension is recorded by accurate three-dimensional measurements as the dig proceeds and reconstructed on paper after the end of the excavation. The introduction since Wheeler's day of more advanced recording methods, including field computers, makes this more demanding open-area method feasible, and it has become the norm in much of British archaeology.

The open-area method is particularly effective where single-period deposits lie near the surface, as for instance with remains of Native American or European Neolithic longhouses. Here, the time dimension may be represented by lateral movement (a settlement rebuilt adjacent to, not on top of, an earlier one), and it is essential to expose large horizontal areas in order to understand the complex pattern of rebuilding. Large open-area excavations are often undertaken in applied or compliance archaeology (salvage or rescue archaeology), when land is going to be destroyed—otherwise farmers are naturally opposed to stripping large areas of plow-disturbed soil.

Sometimes, if time and money are short, and structures lie sufficiently close to the surface, the topsoil can simply be scraped away over large areas, as was done to good effect at



3.70 Box-grid excavation trenches at Anuradhapura's Abhayagiri Buddhist monastery, Sri Lanka. The earth left intact in between excavation squares allows different layers to be traced and correlated across the site in vertical profiles.

Tell Abu Salabikh, in Iraq, by Nicholas Postgate, in studying the large-scale layout of an early Mesopotamian city.

In Britain, a method known as strip-map-and-sample is used, which allows large areas to be investigated and relationships between features and finds to be assessed. It is particularly suited to cases where extensive areas are under threat of development (such as by quarries or construction projects). The strip involves removing the top layer, often a plowsoil, with a mechanical excavator; the exposed surface is then cleaned manually and any archaeological features are mapped using survey technology, such as GPS or Total Stations, drawn, and photographed. An accurate site plan is then compiled, showing the relations between the remains. Decisions are then made as to which features to excavate—this is the sample process—with the sampling level generally agreed in consultation with the local county archaeologist.

No single method, however, is ever going to be universally applicable. The rigid box-grid, for instance, has rarely been employed to excavate very deep sites, such as West Asian tells, because the trench squares rapidly become uncomfortable and dangerous as the dig proceeds downward. One solution commonly adopted is **step-trenching**, with a large area opened at the top that gradually narrows as the dig descends in a series of large steps. This technique was used effectively at the Koster site, Illinois [3.71].

Another solution to the problem of dangerously deep excavations—and that was successfully adopted on the salvage excavations at Coppergate, York (see Chapter 19), and at Billingsgate, London—is to build a cofferdam of sheet piling around the area to be dug. Cofferdams have also been used in shipwreck excavations, either to control the flow of water—as on a Revolutionary War (War of Independence, 1775–83) wreck at Yorktown, Virginia [3.72]—or to pump out the water altogether. Cofferdams are expensive and the dig must be well funded.

Obviously, each site is different and adaptation to its conditions is required, for example, by following the natural geological strata or the cultural layers instead of using arbitrary spits or imposing a false regularity where it does not exist. Whatever the method of excavation—and the illustrations on pp. 118–19 show other techniques,



3.71 (Above, right) The Native American site of Koster, in the Illinois River Valley. Large horizontal areas were uncovered to locate living floors and activity zones. For the vertical dimension to be analyzed at this deep and complex site, high steps were cut as the excavation descended. Fourteen occupation levels were identified, dating from c. 7500 BCE to 1200 CE.

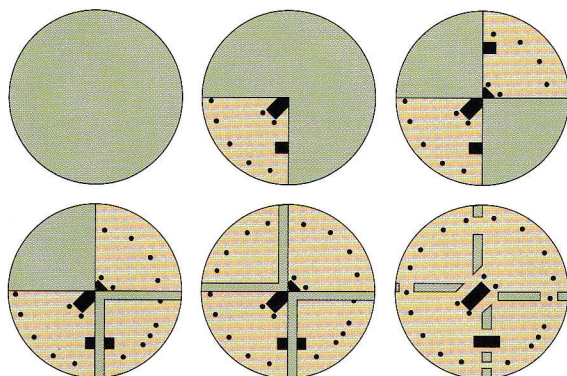
3.72 (Right) Excavation using a cofferdam: the wreck of the merchant brig designated YO 88 at Yorktown, Virginia, scuttled during the Revolutionary War. Here the cofferdam was employed to clear murky water, creating optimum conditions for thorough underwater excavation of the vessel.



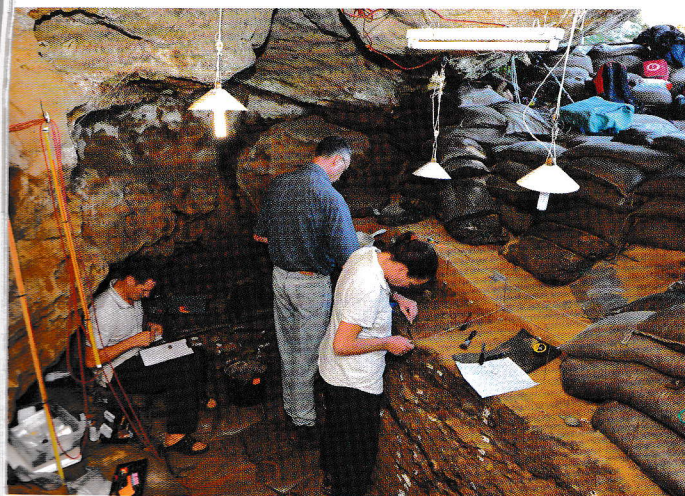


3.73 (Left) Excavation methods: sectioning a burial mound at Moundville, Alabama.

3.74 (Below, center left) Six stages of the quadrant method for excavating burial mounds. The objective is to expose subsurface features while retaining four transverse sections for stratigraphic analysis.



3.75 (Below) Excavators at work in Blombos Cave, South Africa (see p. 401). Cave excavations pose numerous challenges, not least due to often poorly lit and confined conditions. Cave sediments can be very complex, with barely perceptible changes from one layer to the next, so meticulous recording controls are needed.

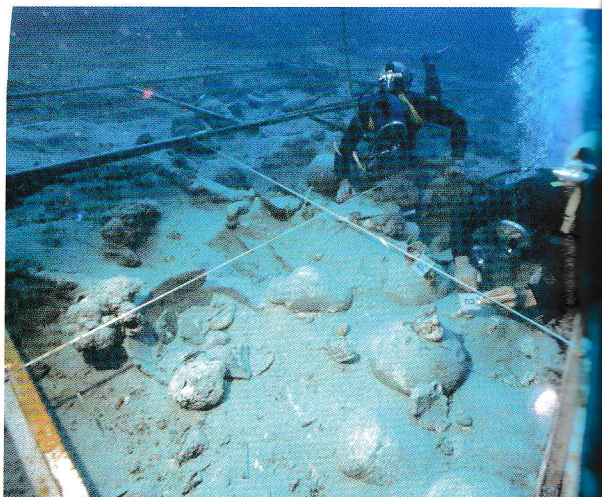


e.g. for the excavation of burial mounds and cave sites [3.73–3.75]—a dig is only as good as its methods of recovery and recording. Since excavation involves destruction of much of the evidence, it is an unrepeatable exercise. Well-thought-out recovery methods are essential, and careful records must be kept of every stage of the dig.

Underwater Excavation. Underwater archaeology is generally considered to have been given its first major impetus during the winter of 1853–54, when a particularly low water level in the Swiss lakes exposed enormous quantities of wooden posts, pottery, and other artifacts. It was significantly developed in the 1960s during Honor Frost's underwater excavation of Gelidonya in Turkey (see feature p. 33). The method has examined a wide variety of sites including wells, sinkholes, and springs (e.g. the great sacrificial well at Chichén Itzá, Mexico); submerged lakeside settlements; and marine sites ranging from shipwrecks to sunken harbors (e.g. Caesarea, Israel) and drowned cities (e.g. Port Royal, Jamaica).

Submersible craft, scuba-diving gear and rebreathers and exosuits enable divers to work for ever longer periods reaching sites at previously impossible depths [3.76]. As a result, the pace and scale of discovery have greatly increased. More than a thousand shipwrecks are known.

3.76 Underwater excavation techniques: measuring and recording finds *in situ*.



in shallow Mediterranean waters, but recent explorations using deep-sea submersibles, such as miniature uncrewed submarines—remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs)—with sonar, high-powered lighting, and video cameras, have begun to find Roman wrecks at depths of up to 850 m (2,790 ft.). Two Phoenician wrecks packed with amphorae (storage jars), discovered off the coast of Israel, are the oldest vessels ever found in the deep sea.

Excavation underwater is complex and expensive (not to mention the highly demanding post-excavation conservation and analytical work that is also required). Once underway, the excavation may involve shifting vast quantities of sediment, and recording and removing bulky objects as diverse as storage jars, metal ingots, and cannon. George Bass, founder of the Institute of Nautical Archaeology in Texas, and others have developed many helpful devices, such as baskets attached to balloons to raise objects, and air lifts (suction hoses) to remove sediment. If the vessel's hull survives at all, a three-dimensional plan must be made so that specialists can later reconstruct the overall form and lines, either on paper or as a model or full-size replica (see feature, pp. 120–21). In some rare cases, such as that of England's *Mary Rose* (sixteenth century CE), preservation is sufficiently good for the remains of the hull to be raised, funds permitting.

Excavating sunken vessels reveals not only how they were constructed, but also aspects of shipboard life, cargoes, trade routes, early metallurgy, and glassmaking. We look in more detail at two projects: the Red Bay Wreck, off Canada (see feature, pp. 120–21), and the Uluburun Wreck, off Turkey (pp. 383–85).

Recovery and Recording of the Evidence

As we saw above, different sites have different requirements. The aim is to recover and plot the three-dimensional provenience of every artifact from a shallow single-period Paleolithic or Neolithic site, an objective that is simply not feasible for the urban archaeologist. On both types of site, a decision may be made to save time by using mechanical diggers to remove topsoil (but note that topsoil can contain useful archaeological information, see p. 111); but thereafter the Paleolithic or Neolithic specialist will usually want to screen (or sieve) as much excavated soil as possible in order to recover tiny artifacts, animal bones, and, in the case of wet screening (see Chapter 6), plant remains [3.77]. The urban archaeologist, however, will only be able to adopt screening much more selectively, as part of a sampling

strategy, for instance where plant remains can be expected to survive, as in a latrine or garbage pit.

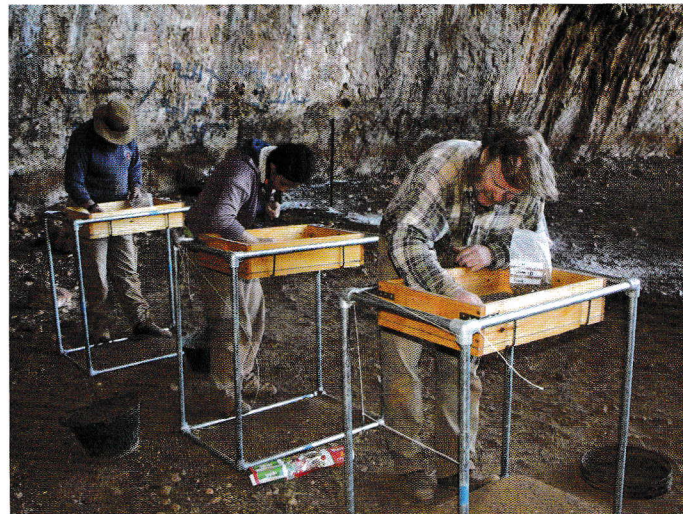
Decisions need to be made about the type of screening to be undertaken, the size of the screen and its mesh, and whether dry or wet screening will yield the best results. Naturally all these factors will depend on the resources of the excavation project, the period and scale of the site, whether it is dry or waterlogged, and what kind of material can be expected to have survived and to be retrievable.

Once an artifact has been recovered, and its provenience recorded, it must be given a number, which is entered in a catalogue book or field computer and on the bag in which it is to be stored. Day-to-day progress of the dig is recorded in site notebooks, or on data sheets preprinted with specific questions to be answered (which helps produce uniform data suitable for later analysis by computer).

Unlike artifacts, which can be removed for later analysis, features and structures usually have to be left where they were found (*in situ*) or are destroyed as the excavation proceeds to another layer. It is imperative to record them, not simply with written description in site notebooks but also with accurately scaled drawings and photography. The same applies to vertical profiles (sections); and, for each horizontally exposed layer, good overhead photographs, taken from a stand or tethered balloon, are also essential.

Three-Dimensional Modeling in Excavation

Digital technologies have revolutionized excavation and site recording in archaeology. Since digging is by its very nature destructive, a method that can accurately record and preserve the site in an alternative way is of great value. Three-dimensional modeling allows the archaeologist to



3.77 Screening: archaeologists at Haua Fteah Cave in northeast Libya screen excavated dirt through a mesh to recover tiny artifacts, animal bones, and other remains.

Excavating the Red Bay Wreck



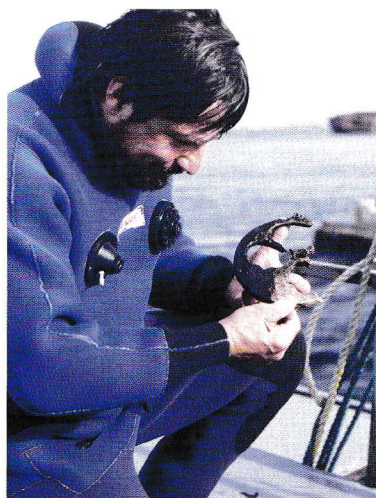
Underwater archaeology, in conjunction with archival research and

land archaeology, has yielded a detailed picture of whaling undertaken by Basque fishing vessels at Red Bay, Labrador, in the sixteenth century CE. The Basques were the largest suppliers to Europe at this time of whale oil, an important commodity used for lighting and in products such as soap.

In 1977, prompted by the discovery in Spanish archives that Red Bay had been an important whaling center, the Canadian archaeologist James A. Tuck began an excavation on the island closing Red Bay harbor. Here he found remains of structures for rendering blubber into whale oil. The next year, Robert Grenier led a team of Parks Canada underwater archaeologists in search of the Basque galleon *San Juan*, which the archives said had sunk in the harbor in 1565 [3.78].

3.78 (Below) The project director Robert Grenier examines the remains of an astrolabe (navigational instrument) from Red Bay.

3.79 (Below, right) A structural plan of the wreck on the harbor bottom (2-m/6-ft. grid squares).

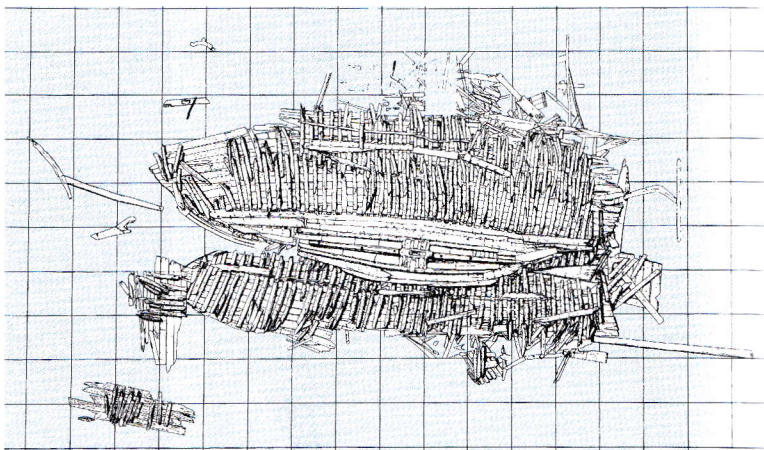


Discovery and Excavation

A wreck believed to be that of the *San Juan* was located at a depth of 10 m (33 ft.) by towing a diver behind a small boat. A feasibility study carried out in 1979 confirmed the site's potential, and from 1980 to 1985 Parks Canada undertook a survey and excavation project that employed up to fifteen underwater archaeologists, backed up by between fifteen and twenty-five support staff, including conservators, draftspersons, and photographers. Three more galleons

were discovered in the harbor, but only the *San Juan* was completely excavated [3.79]. The dig was controlled from a specially equipped barge, anchored above the site which contained a workshop, storage bays for artifacts, a crane for lifting timbers, and a compressor able to run twelve air lifts for removing silt. Seawater was heated on board and pumped down through hoses direct to the divers' suits to maintain body warmth in the near-freezing conditions, allowing for 14,000 hours of diving.

3.80 A model, at a scale of 1:10, to show how the galleon's surviving timbers may have fitted together. (Right) The outline of the ship now forms part of the logo of the UNESCO 2001 Convention on the Protection of the Underwater Cultural Heritage.



An important technique devised during the project was the use of latex rubber to mold sections of the ship's timbers in position underwater, thereby reproducing accurately the hull shape and details such as toolmarks and wood grain. The timbers were then raised to the surface for precise recording and later reburied on site.

Analysis and Interpretation

On the evidence of the meticulous drawings and molds, a 1:10 scale model was constructed as a research tool to help reveal how the vessel had been built, and what it had looked like [3.80]. Many fascinating details emerged, for instance that the 14.7-m (48-ft.) long keel and its adjacent row of planks (garboard strakes) had—most unusually for this size of ship—been carved from a single beech tree. Nearly all the rest of the vessel was of oak. In overview, the research model revealed a whaling ship with fine lines, far removed from the round, tubby shape commonly thought typical of sixteenth-century merchant vessels. DNA testing of the whale bones provided strong evidence that the bowhead whale was the target species of the Basques in the western North Atlantic and not the right whale, as previously thought.

As the cultural material listed on this page indicates, a wealth of artifacts from the wreck sheds light on the cargo, navigational equipment, weaponry, and life on board the unlucky galleon. Thanks to the integrated research design of this Parks Canada project [3.81]—the largest ever undertaken in Canadian waters—many new perspectives are emerging on sixteenth-century Basque seafaring, whaling, and shipbuilding traditions. A five-volume comprehensive report, *The Underwater Archaeology of Red Bay*, was published by Grenier and others in March 2007.

Cultural Material Found at Red Bay

THE VESSELS

Whaling ship believed to be the *San Juan*:

- Hull timbers (more than 3,000)
- Fittings: *capstan, rudder, bowsprit*
- Rigging: *heart blocks, running blocks, shrouds, other cordage*
- Anchor
- Iron nail fragments

Three other whaling ships Six small boats, some used for whaling

RECOVERED ARTIFACTS

Cargo-related:

- Wooden casks (more than 10,000 individual pieces)
- Wooden stowage articles: *billets, chocks, wedges*
- Ballast stones (more than 13 metric tons [14.3 US tons])

Navigational Instruments:

- Binnacle
- Compass
- Sand glass
- Log reel and chip
- Astrolabe

Food storage, preparation, and serving:

- Ceramics: *coarse earthenware, majolica*
- Glass fragments
- Pewter fragments
- Treen: *bowls and platters*
- Basketry
- Copper-alloy spigot key

Food-related:

- Cod bones
- Mammal bones: *polar bear, seal, cow, pig*
- Bird bones: *ducks, gulls, auk*
- Walnut shells, hazelnut shells, plum pits, bakeapple seeds

Clothing-related:

- Leather shoes
- Leather fragments
- Textile fragments

Personal items:

- Jetton (a gambling token)
- Gaming piece
- Comb

Weaponry-related:

- Verso (swivel gun)
- Lead shot
- Cannonballs
- Wooden arrow?

Tool-related:

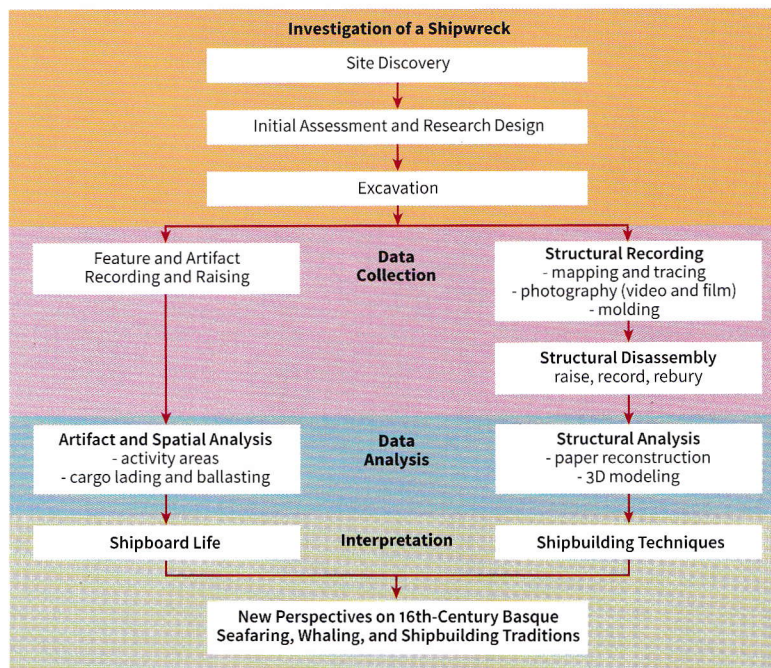
- Wooden tool handles
- Brushes
- Grindstone

Building material:

- Ceramic roof-tile fragments

Whaling-related:

- Whale bones



3.81 The flowchart outlines the process of investigation, data collection, data analysis, and interpretation.

Jamestown Rediscovery: The Excavation Process



On May 13, 1607, a hundred English colonizers established a settlement on Jamestown Island in Virginia. Soon

under attack from Native Americans, these gentlemen, soldiers, and laborers quickly built a wooden fort. The periodic resupply of settlers and stores, investment by the sponsoring Virginia Company

of London, and the discovery of a cash crop, tobacco, kept the venture alive. Ultimately, Jamestown proved to be the first permanent English colony—and so the birthplace of modern America and the British Empire. For centuries, the site of the fort was thought to have been eroded away by the adjacent James River, but archaeological excavations from 1994 onward by the Jamestown Rediscovery project have proved that the so-called lost

site actually escaped erosion. Most of the fort and more than 1.7 million artifacts have been recovered, at least half of these dating to the first three struggling years of settlement.

The Jamestown Rediscovery research design is straightforward yet multidimensional: uncover, record, and interpret the remnants of the James Fort; determine the original and evolving fort plan; learn as much as possible about the daily lives of the settlers and the Virginia Native Americans; and record prehistoric and post-James Fort occupations. From the outset, it was clear that the best way to record and recover all this was a hybridized excavation process combining the traditional grid-based control system with open-area excavation [3.82]. A thorough documentary search was also essential, both to pinpoint the areas to investigate and to reassess continually the records in light of new and more complex questions raised by the digging.

The Ongoing Field Process

Initially, a grid of 3-m (10-ft.) squares is employed in each area to be excavated, facilitating the recording of artifacts deposited in post-fort layers (usually eighteenth- to nineteenth-century plowed soil, or soil deposited in 1861 during the construction of a Civil War earthwork). Once the seventeenth-century level is exposed, the traditional grid is replaced with a feature-based open-area recording method. At this stage, both physical remains and variations in soil color and texture together delineate features: building foundations, fireplaces, postholes, cellars, wells, pits, ditches, and graves [3.83]. These defined contexts are assigned ascending Jamestown Rediscovery (JR) numbers, which are then entered into a Total Station-guided GIS site map [3.84]. The size and shape of the open area depends on the extent of clearly defined features, such as rectangular configurations of postholes or other aligned and related deposits.

3.82 Grid-based (foreground) and open-area (background) excavations at the James Fort.



The decision to excavate features partially or fully, or to leave them unexcavated, depends on whether or not they can be associated with other known James Fort/Jamestown period (1607–24) remains, such as wall lines. More recent features are usually mapped but left unexcavated. Once it is decided that a given feature is probably a remnant of the fort occupation, excavation determines the cultural deposition sequence, indicated by changes in the soil color and/or texture, or inclusions of strata. Each layer is then sequentially assigned a letter of the alphabet (excluding the letters I, O, and U). In this manner, the JR number and letter permanently label each individual feature, and the layers within them, as distinct contexts. Most contexts are then drawn, photographed, systematically archived, and eventually linked to the GIS site map.

The artifacts are recovered in two stages: as the feature layers are excavated, and then as the loose spoil is wet or dry screened (the latter either by hand or mechanically) [3.85]. The specific screening process employed depends on the age and integrity of the context. The resulting artifact collections are washed, conserved, and catalogued in a laboratory on site, permanently carrying their JR number and letter, and also assigned an interpretive master context (such as “structure 185,” “pit 8,” “well 3,” etc.).

Soil samples of individual layers are collected and archived for future flotation and/or chemical analysis. Once selected features in an area have been excavated and/or recorded, that area is covered with a geotextile (protective sheets) fabric and backfilled, usually with 50 cm (20 in.) of soil. As of 2011, about 15 percent of features in the fort had been partially or fully excavated, with the remainder preserved for future investigation [3.86, p. 124].

Collections Management

After initial cleaning, artifacts are sorted according to conservation requirements, balancing the need for rescue and long-term preservation with interpretive potential. A number of techniques, including X-ray recording and mechanical/



3.83 (Top) Arms and armor in a backfilled metalworking shop/bakery cellar are first exposed with open-area excavation and then delicately recovered.

3.84 (Above) Features such as this James Fort well, viewed here by visitors to Historic Jamestowne, are recorded by Total Station for entry into the GIS site map.

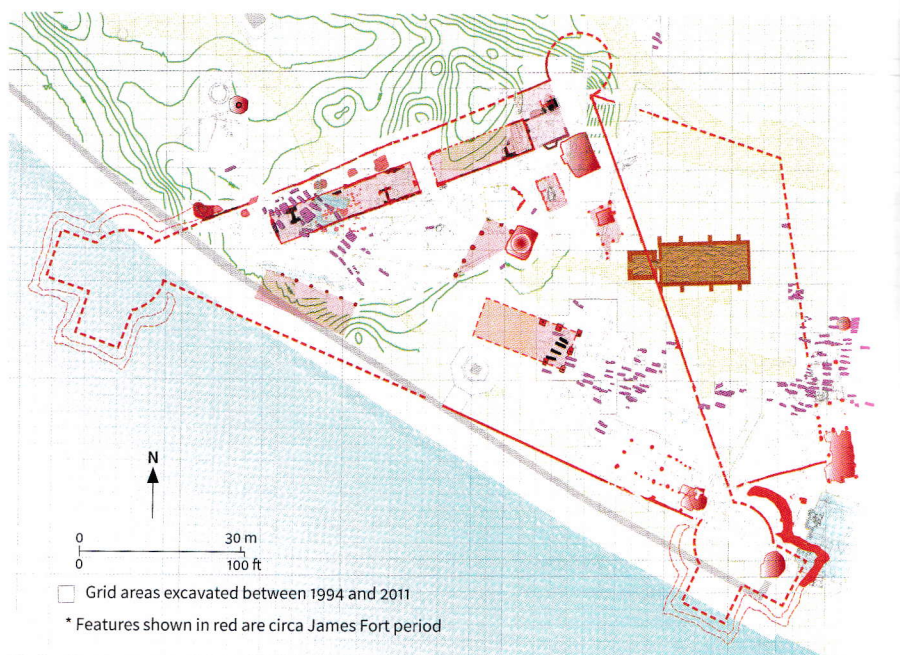
3.85 (Left) Wet screening using pressurized hoses and a series of graduated mesh screens.

3.86 (Right) A GIS site map of the James Fort open-area excavations, 1994–2011.

3.87 (Below, right)

A reconstruction of James Fort based on excavated evidence and historical records.

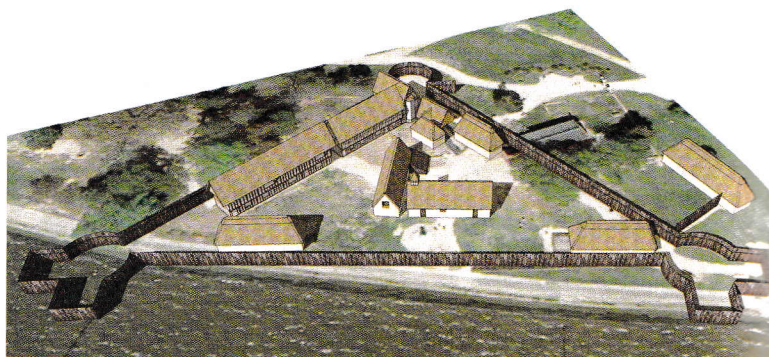
3.88 (Bottom) The Jamestown research collection in the climate-controlled vault during the catalogue and comparative context stage of analysis.



chemical treatments, are applied to metallic objects and organic materials.

The computer cataloguing program is straightforward and searchable, making use of minimal attribute fields (number, material, form, and design) but with the ability to enter other useful data in a separate field. To facilitate analysis and publication, the digital catalogue is linked to the GIS site map so that plans, photos, and artifacts can be interpreted at a single computer station [3.87]. In accord with their conservation requirements, all objects are held or archived in an appropriate environment (ranging from extremely low-humidity spaces with stable room temperature to unheated warehouse storage) [3.88]. Descriptive reports are generated for each year of the excavation, but interpretation is limited because of the ongoing nature of the project.

William M. Kelso

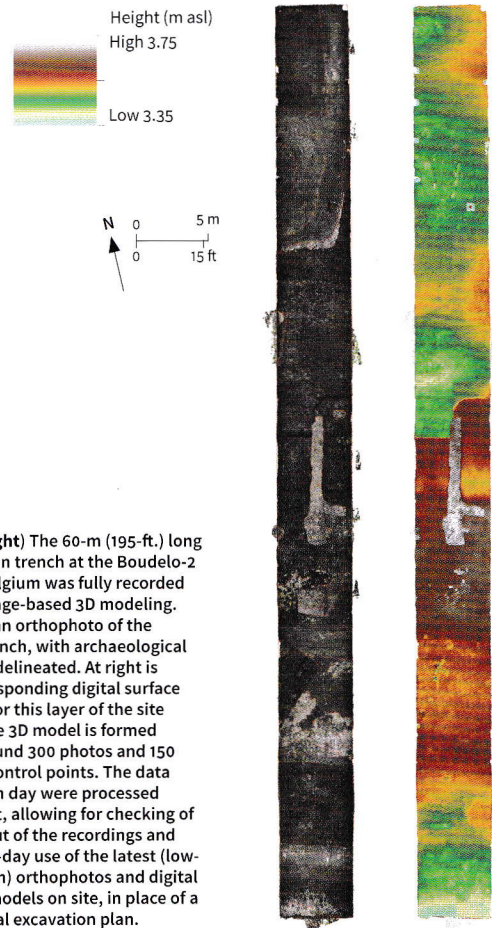


move away from the traditional two-dimensional record (plans, drawings, sections, profiles, photographs) to a model that can enhance current and future understanding of the site. There is no longer any need for the time-consuming process of drawing by hand—at which few people were really skilled—as archaeological recording becomes paperless.

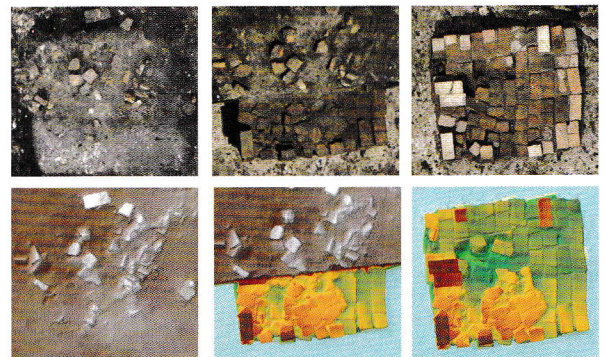
Three-dimensional computer-generated models of excavations are created before the work starts, and then every stage of the excavation is documented in the same way as with paper recording as work progresses. At the end of the day, everyone involved in the work can visit the virtual dig, as if they were standing on the site itself as the work took place. They can examine the evidence as it appears, and pool their expertise to interpret it. In contrast to three-dimensional laser scanning, which requires expensive and specialized equipment to produce high-quality results, the new method needs nothing more than a simple camera and some software—in other words, it is cheap and accessible to all.

For example, if archaeologists are digging a burial, they no longer need to draw the skeleton and grave in plan view; instead, they simply take a series of digital photos (usually anywhere between fifteen and eighty), from as many angles as possible, at every stage of the excavation as the burial is uncovered. Software programs such as PhotoScan can then generate the three-dimensional contours of the burial from the photos, as well as digitized plans of the skeleton. The method need not be applied only to small-scale digs or individual features. During an excavation campaign in 2012 of the Boudelo-2 site in Belgium, a twelfth- to thirteenth-century Cistercian abbey on reclaimed medieval wetland, a 60-m (195-ft.) long soil profile and all unearthed brick structures were recorded both by image-based three-dimensional modeling and by traditional manual recording techniques [3.89, 3.90]. The work then proceeded to a complete three-dimensional recording of the excavation.

To generate a three-dimensional model, an overlapping set of high-quality photos and at least three ground control points (GCPs) with known *x*, *y*, and *z* coordinates are required (recorded by GPS) in order to achieve an absolute georeferencing of the scene, so that accurate metric information can be obtained and orthophotos and digital surface models can be computed [3.97, 3.98, p. 129]. The PhotoScan software generates the three-dimensional models, which are processed immediately after the recording. The orthophotos and the DSMs (which help to study height variations at the site's surfaces as layers are removed) are used as an excavation plan in the field. The automated process makes it possible to process the data overnight, so they are ready for use in the field the next day as low-resolution models. Production of



3.89 (Right) The 60-m (195-ft.) long excavation trench at the Boudelo-2 site in Belgium was fully recorded using image-based 3D modeling. At left is an orthophoto of the entire trench, with archaeological features delineated. At right is the corresponding digital surface model. For this layer of the site alone, the 3D model is formed from around 300 photos and 150 ground control points. The data from each day were processed overnight, allowing for checking of the output of the recordings and also next-day use of the latest (low-resolution) orthophotos and digital surface models on site, in place of a traditional excavation plan.



3.90 The recording of a single brick structure from Boudelo-2: the excavation process is visualized in a series of orthophotos (top three) and corresponding digital surface models (bottom three).

Excavating the Amesbury Archer



The burial of the individual who has come to be known as the Amesbury Archer was found 5 km (3 miles)

from Stonehenge and is one of the best-furnished (“rich”) Bell Beaker (Copper Age) burials ever discovered in Europe [3.91, 3.92]. The archaeological evidence indicates that the individual was a 35- to 45-year-old man, who died c. 2380–2290 Cal BCE (calibrated)—a century or two after the main building phase at Stonehenge—and had the status of a warrior and a metalworker.

The grave was discovered next to another (“the Companion”), 3 m (10 ft.) away, in a routine developer-funded excavation by the independent unit Wessex Archaeology prior to construction of a new school. The topsoil was removed using a mechanical excavator, and all the archaeological features visible as dark marks against the chalk were surveyed with a Total Station.

Standard excavation and recording methods were employed. The graves were assigned numbers sequentially and the shape of each was planned before excavation. The soil was removed with a mattock until the first objects were found.

After that, excavation was by trowel, small metal tools (plasterer’s leaves), and paint brushes.

A wooden chamber had been built in the grave of the Amesbury Archer. The gap between this and the natural chalk had been packed with loose chalk. The skeleton was planned in a scaled drawing and photographed [3.93]. Its condition was also recorded. Initially, soil samples were taken from around the throat, stomach, hands, and feet. This is done routinely when excavating burials to make sure that small bones that might not be seen during excavation (e.g. finger bones) are retrieved. Each sample is given a unique number and is later wet screened in the laboratory. When the bones of the skeleton were removed, they were put into bags in anatomical groups (e.g. left rib bones) to speed up future analysis.

The discovery of a gold ornament in the grave [see 3.91] put a different complexion on the excavation. On the basis that such an ornament might be anticipated to have a pair, and also that it was likely to be found in a burial of high social status, it was decided to retain all the soil from the grave in addition to the samples previously taken. Soil that had already been removed



3.91 (Above) The gold ornaments from the grave, each only 22 mm ($\frac{7}{8}$ in.) long, are some of the oldest gold objects yet found in Britain.

3.92 (Below) The Amesbury Archer. The dark object is the stone tool for metalworking.

3.93 (Below, left) Planning the grave and grave goods. As the site could not be made secure, excavation of the burial continued into the night.



The Amesbury Archer's grave goods

Costume

- 2 gold hair ornaments
- antler clothespin
- shale belt-ring
- oyster shell perforated for wearing as a pendant

Weaponry

- 18 flint arrowheads
- 2 antler's stone wristguards
- 3 copper knives
- flint knives
- blanks for making arrowheads

Metalworking

- stone metalworking tool, probably an anvil
- 2 tusks (found with the stone) possibly used for polishing metal objects

Tools

- antler tool for flintworking
- flint knives
- flint blades
- flint scrapers for working leather
- fire-making set of flint blade and iron pyrites nodule

Food consumption

- 5 Bell Beaker pots
- traces of dairy-based products

Unidentified objects

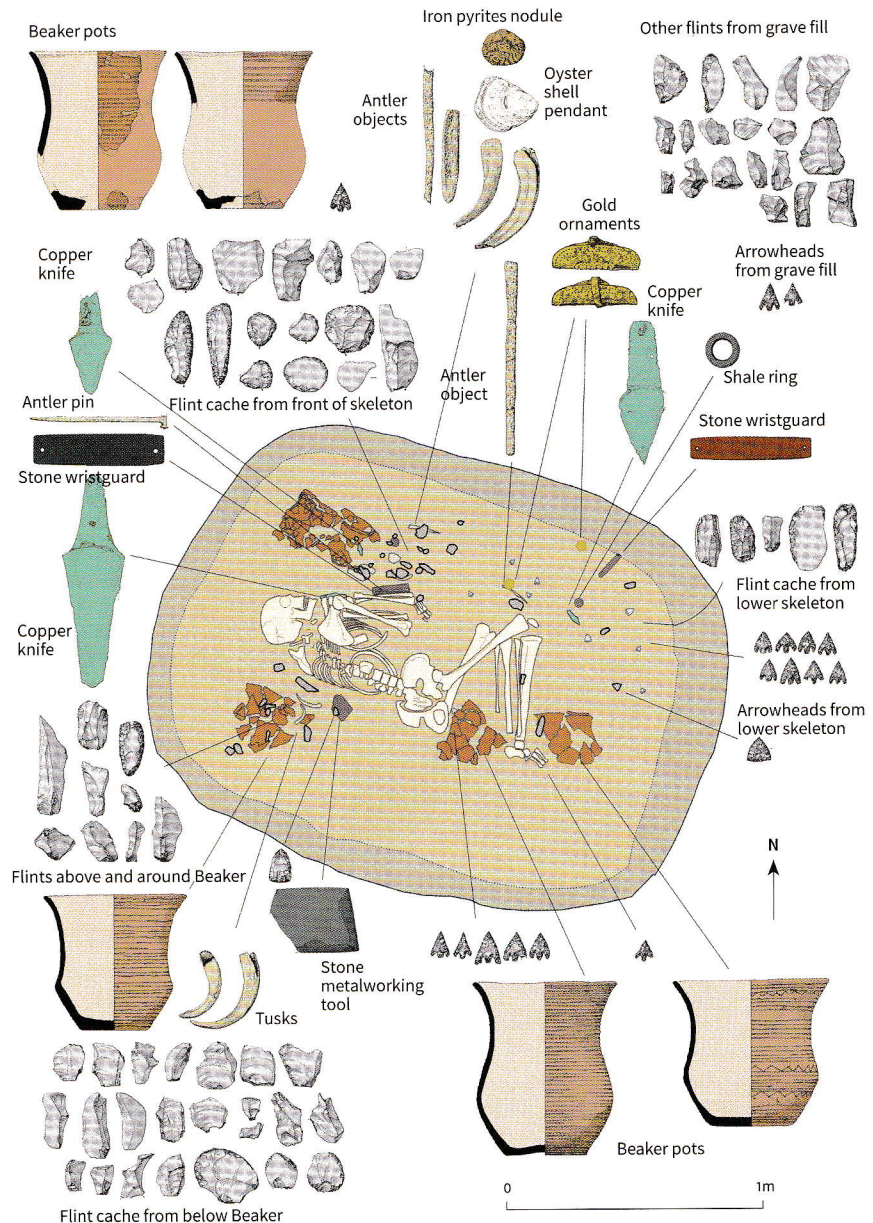
- 2 pieces of antler strip from a bow?

3.94 The Amesbury Archer's grave goods.

from the grave and deposited nearby was retrieved, and all the soil from the grave was subsequently wet screened for artifact retrieval.

The Finds and Their Analysis

More than a hundred objects were found in the Archer's grave, including eighteen flint arrowheads and two stone archer's wristguards—hence the name given to the individual by the excavators [3.94]. As the objects had been placed next to the body, they were assigned the same context number as the skeleton, and each find was allocated a unique number. A record sheet was made for each find and its location



was also plotted on a scaled drawing and surveyed in three dimensions [3.95, p. 128]. Photographs were taken throughout.

After excavation all the finds were assessed before cleaning. This was to ensure that delicate evidence, such as food residues on pots and usewear on flint tools, was not accidentally damaged. This

assessment stage is particularly important in unexpected discoveries as it is the opportunity to prepare a detailed research design and to assess the time and costs necessary for analysis and publication. Conservation and sampling requirements for materials analysis were decided on and studies of objects were made before

Wessex Archaeology										Inhumation Burial Record	
Site Code: 50875		Site Name: BOSCOMBE DOWN III									
Site sub-division: -					Context number: 1291						
Cut by: -					Stratigraphic relationships						
Fill of: [1289]					1290						
Completeness: c. 99%					This context = 1291						
Posture: FLEKED ON LHS					1285						
Alignment: NW/SE, HEAD TO NW											
Disturbance/condition: LITTLE/NO DISTURBANCE/V. GOOD											
Type of intervention: HAND, LEAF, WOODEN TOOLS, BRUSHES											
X co-ord:		Y co-ord:		Z co-ord:							
Sample no.	Skull	L. hand	R. hand	L. foot	R. foot	Thorax	Pelvic	Base	Other		
	7388	7341		7342	7344	7339	7340	7345-6	WHOLE SKELETON		
Description: RIGHT SHOULDER SLUMPED TO NE. LEGS FLEKED AT 45°. RIGHT FOOT OVER LEFT FOOT, LEFT ARM UNDER BODY + HAND SLUMPED OUT UNDER PELVIS. RIGHT ARM BENT UP UNDER RIGHT SHOULDER. HEAD RESTING ON LHS. THORAX HAS SLUMPED TO NE. LEFT PATELLA NOT FOUND AT EXCAVATION, POSSIBLY IN SAMPLES. CONT'D					Associated finds: SEE CONTINUATION SHEETS						
Skeleton removal (shade bones present)					Begging checklist						
C. 100% COMPLETE (LIFTS AT MOVE) Vertebrae: Cervical (7/7) Thoracic (12) Lumbar (5/5) Skull: [X] Mandible: [X] Vertebrae (no.): [X] Hyoid bone: [] Sesamoid bone: [] Hands: [X] Upper limb: [X] Pelvic bones: [X] Lower limb: [X] Feet: [X] Ribs: [X] All recovered					☒ Skull ☒ Mandible ☒ Vertebrae (no.) ☐ Hyoid bone ☐ Sesamoid bone ☒ Hands ☒ Upper limb ☒ Pelvic bones ☒ Lower limb ☒ Feet ☒ Ribs						
Plans:	Sections:	BSW photographs:	Colour trans:	Digital photographs:							
266 A-E	266 A-E	#78, 4-27	615-72	78 0122-263							
Interpretation: FLEKED INHUMATION											
Recorded by: DML PBN		Date: 4/5/02		Checked by: ND		Date: 4/5/02					
☐ Continued on reverse											

WA 10

3.95 (Above) The Amesbury Archer's record sheet.

3.96 (Below) Flint arrowheads from the grave. The example at bottom right is a blank.

and after this sampling and conservation. The finds were then fully conserved and restored for museum display [3.96].

Interpretation

The analyses provided a wealth of information about the two men and their world (see list on this page). Radiocarbon dating shows that they lived within a generation or two of each other, and a rare nonmetric trait (an anatomical anomaly) in their foot bones shows that they were related. Similar gold hair ornaments were also found in both graves. Isotope studies suggest that the Amesbury Archer, who lived before the other man, had migrated from a colder climate, probably the Alpine region. The other man, who died aged between twenty and twenty-five, was born locally.



Analyses of the Amesbury Archer

Burial

Bones: sampled for radiocarbon dating and stable isotopes (carbon and nitrogen) for evidence of diet.

Teeth: sampled for oxygen and strontium isotope analyses for places of residence.

Osteology: bones studied for evidence of age, sex, diet, injuries, and disease.

Grave goods

Flint: microwear study for usewear traces.

Pottery: lipid analysis for traces of contents and thin-sectioning for places of manufacture.

Copper knives and gold ornaments: X-ray fluorescence (XRF; see Chapter 9) to determine metal content and origins of metal.

Stone archer's wristguard and stone tool for metalworking: XRF for type of stone and any traces of metal embedded in the metalworking tool.

Shale belt-ring: scanning electron microscope (SEM) and energy dispersive X-ray spectroscopy (EDS) analysis for chemical composition and origin.

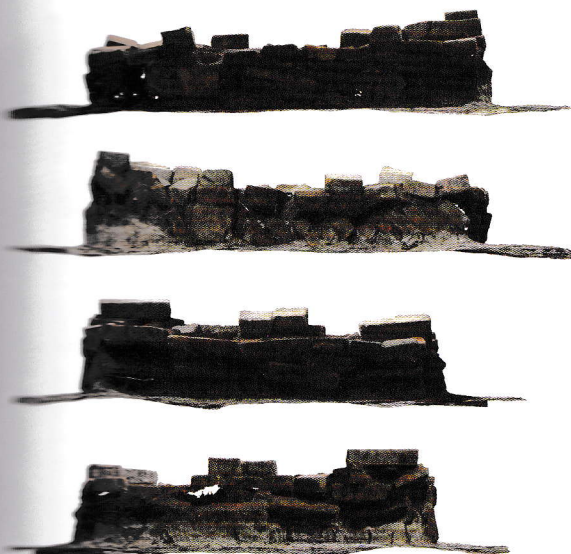
Conservation: identified traces of the wooden handles of the copper knives.

Restoration: for museum display.

The key find in interpreting the high status of the Amesbury Archer is the stone metalworking tool. His grave is the earliest of a metalworker so far found in Britain; coming from continental Europe, he would have had knowledge of metalworking and access to metal. This could have given him high status, and comparative studies show that, on the continent, metalworkers' burials were often very well furnished.

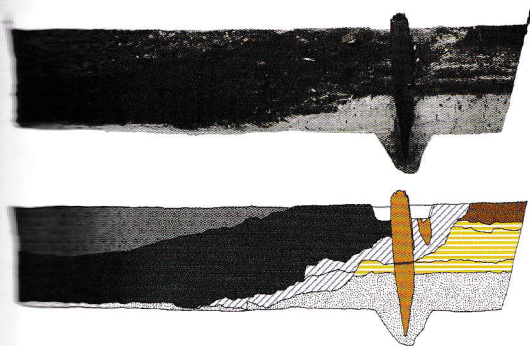
The isotope results helped rekindle interest in prehistoric migration and invasion in Britain and beyond, and attracted worldwide media interest. A comprehensive excavation report, *The Amesbury Archer and the Boscombe Bowmen*, was published in 2010.

Andrew Fitzpatrick



3.97 (Above) Vertical orthophotos show the structure at Boudelo-2 in profile from all four sides.

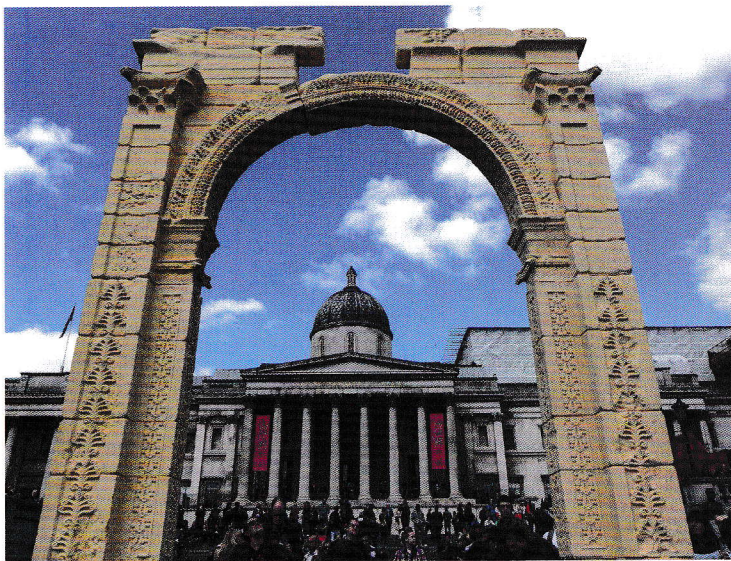
3.98 (Below) A vertical orthophoto of a section (with *in situ* post) from the Boudelo-2 site, and a digital drawing derived from this image.



high-resolution models takes far more time and can be obtained only after the fieldwork season is complete.

Labels, notes, descriptions, and interpretations are still necessary in the course of any excavation, and these more subjective aspects cannot be immediately added to the recording; hence they need to be stored elsewhere and linked to the excavation record later. Such data are first stored in database forms on tablet PCs (personal computers). These are now sufficiently robust and cheap for use in the field and have already proved invaluable at many sites—for example at Pompeii, where computer tablets replaced field notebooks some years ago.

The accurate documentation of three-dimensional shape and texture is of great importance in archaeology.



3.99 A reconstruction of the Arch of Triumph from Palmyra, Syria, on display in Trafalgar Square, London, in 2016. The original arch, built by the Romans some 1,800 years ago, was destroyed by so-called Islamic State militants in 2015. Based on 3D and 2D photographs taken before the destruction, the replica was modeled and in effect printed in real stone (albeit at two-thirds scale) using a computer-controlled milling machine. The arch has also been displayed in New York and other cities.

The combination of accurate metrics, three-dimensional shape, and detailed texture produces a far more objective and reliable record of an excavation, which can be revisited virtually—one can walk over the excavation surface or along profiles again. Using a digital format is time-efficient: information about an excavated unit's type, morphology, and contents can be recorded directly onto tablets and smartphones on site, replacing traditional paper recording forms and site notebooks, and immediately producing visually appealing graphics, which can be an important educational tool. In addition, the three-dimensional excavation data can be compared and fused with the results of the geophysical survey undertaken beforehand.

Computer technology is advancing so rapidly that new software developments, together with decreasing costs and increasing computer power, will undoubtedly further streamline and improve many aspects of excavation in the next few years [3.99]. Digital data capture, however, is not a panacea for all situations; computers may introduce their own bias to matters of observations and interpretation, injecting their own issues of subjectivity. Archaeologists need to always consider what a digital output is actually telling them.

Excavating an Urban Site



Archaeological sites in continuously occupied towns and cities present two special challenges. The first is

how to identify, record, and interpret the features left by centuries of building and rebuilding, which may result in meters of complex archaeology. The second concerns the economic pressures of modern development. In the case of the modern City of London, which lies on top of Roman Londinium, these are particularly acute [3.100]. Archaeological work has to be rigorously planned and integrated with demolition and construction programs to avoid expensive delays.

Bloomberg Excavation

The 1.2-ha (3-acre) site lies over a buried river, known today as the Walbrook. In the 1950s limited excavations revealed

the remains of a third-century CE Roman temple to the god Mithras. In 2010 the global financial information company Bloomberg decided to redevelop the site for its European headquarters. A Museum of London Archaeology (MOLA) project manager was integrated into the Bloomberg design team.

Planning and Strategy

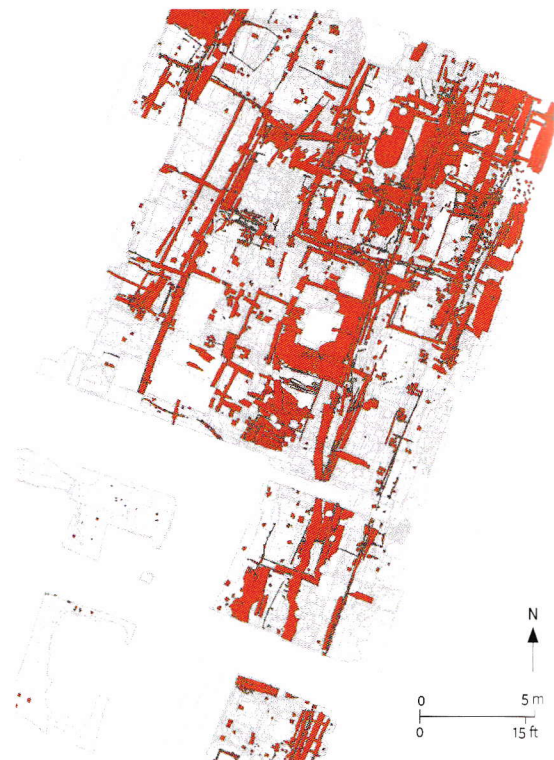
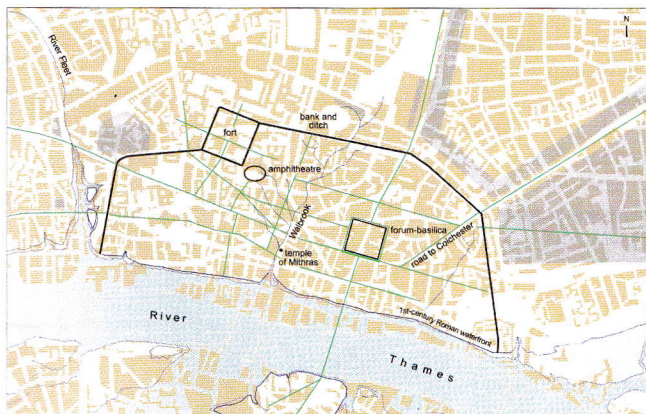
Desk-based research and site work by MOLA showed that, despite the destruction in the 1950s, up to 7 m (23 ft.) of waterlogged deposits might have survived in certain areas. An area of 650 sq. m (2,130 sq. ft.) needed to be excavated. The first challenge was to find a way to secure the edges of this deep (12 m or 40 ft.) excavation without destroying significant archaeological deposits in the process. Temporary trenches were opened and borehole probing undertaken, allowing hard obstructions,



3.100 (Below) Roman London was occupied for nearly 400 years, leaving deep and complex archaeological deposits. These survive under the modern City of London, creating unique challenges for archaeologists.

3.101 (Above, right) A team of fifty archaeologists from MOLA excavated the Bloomberg London site for more than six months. It is the most extensive and important excavation to take place in the City of London for twenty-five years.

3.102 (Right) The GIS can be interrogated to provide sophisticated analysis of the distribution of artifacts, archaeological features and environmental material. In this view, all of the Roman timbers have been highlighted. These were archaeologically surveyed on site and the data added to the GIS, with corresponding context information and dendrochronological dates.



such as Roman timber and medieval masonry, to be located, recorded, and removed; 15-m (50-ft.) sheet piles were then driven into the ground along the perimeter.

Some of the key research objectives were to understand local landscape formation processes and how these influenced the siting of the earliest settlement, the management and use of the Walbrook, and the landscape contemporary with the Roman temple.

Field Techniques

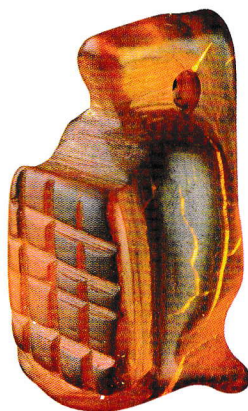
A MOLA project officer acted as the principal site director, supported by senior archaeologists supervising specific areas of the site. Specialists, such as geoarchaeologists, joined the excavation when necessary. The whole team was trained in specific skills such as timber recording and identifying Roman ceramics [3.101].

Urban sites, with their hundreds of interrelated and intercutting deposits, require the use of a single-context recording system, whereby evidence of each archaeological event or process is allocated a context number, planned on an individual sheet of transparent drawing film, and recorded on a context sheet. Every find or environmental sample is attributed to its context, linking each aspect of the project to its origin on the site and allowing the archaeology to be reconstructed after the excavation [3.102]. Use of the Harris matrix (a diagram representing the stratigraphic relationship of the contexts) is vital.

While the value of digital recording continues to grow, detailed hand recording on site is still the most efficient way of capturing the complexity of this stratigraphy. Each plan is then digitized and combined with the context details and the artifactual and environmental information held within the MOLA Oracle database.

Post-Excavation Analysis and Public Engagement

The excavation produced a huge archaeological assemblage: 3 metric tons (3.3 US tons) of Roman pottery, nearly 400 fragments of wooden writing tablets, and the best assemblage of Roman textiles from Roman Britain [3.103, 3.104].



3.103, 3.104 This amber gladiatorial amulet and leather shoe were among the 14,000 small finds recovered from the Roman levels of the site. Once these remarkable artifacts have been reconverted, post-excavation analysis will reveal more about them.



The project officer and senior archaeologists conduct the post-excavation analysis, checking the site archive and producing site-wide Harris matrices to enable the assessment of artifacts and environmental data. The stratigraphic team continues with the bulk of the analysis, working closely with specialists.

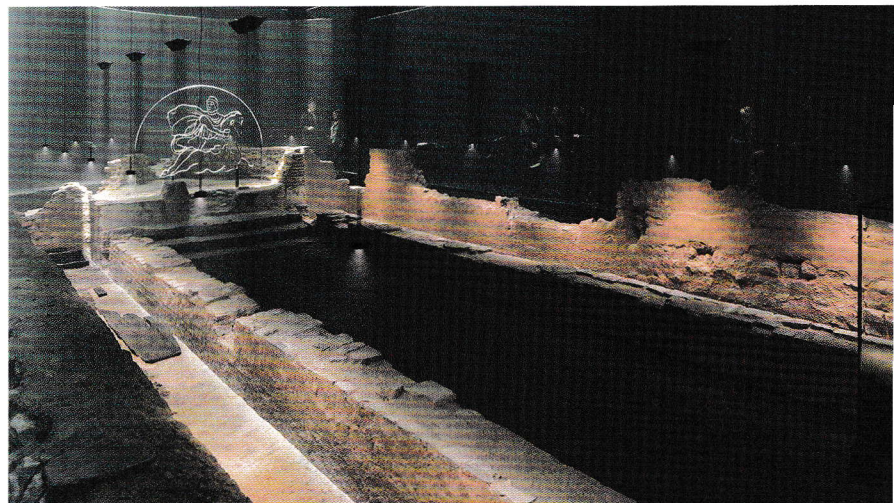
This analysis phase leads to hard copy and digital publication covering the stratigraphic sequence (focusing on the Roman period), the finds, and the writing tablets.

The project also implemented a public engagement strategy, which involved creating the Walbrook Discovery Program blog, professionally video-recording the excavation and interviews with site staff,

and an oral history project capturing the memories of visitors to the 1950s temple excavations. Bloomberg has celebrated the archaeology of the site in a permanent public display within the building (Londonmithraeum.com), featuring an immersive reconstruction of the remains of the Temple of Mithras and more than 600 of the artifacts recovered from the excavation [3.105]. Opened in 2017, the display was visited by more than 100,000 people in its first year alone.

Sophie Jackson

3.105 London Mithraeum uses light sculpture, haze, and sound to bring the temple's remains to life.



Forensic Archaeology

Forensic archaeology combines **biological anthropology** and archaeological techniques, and is a field where the relevance of archaeological evidence is presented in modern courts of law. Forensic archaeological evidence usually relates to the recovery of individual homicide victims or to the excavation of mass graves for the conviction of those accused of genocide. This specialist type of archaeology additionally has a place in the recovery and identification of victims in the aftermath of fires, seen most starkly in the Grenfell Tower fire in London in 2017. Its effective deployment as a technique requires an understanding of skeletal anatomy and decay mechanisms, as well as how buried layers can be formed and disturbed. The same rules of stratigraphy apply to a person buried yesterday as to a person buried 2,000 years ago.

The application of archaeological theory to criminal investigation first began to be recognized in the 1980s, notably in the recovery of bodies from political killings found in mass graves in South America. Similar work followed in Rwanda, Costa Rica, and most notably in the regions of the former Yugoslavia following the Srebrenica massacre in 1995 [3.106]. Around the same time, police forces in the United Kingdom

became aware of the value of applying developed archaeological techniques in the search for, and recovery of, concealed burials. It was clear that methods of remote survey—geophysics, aerial photography, and LiDAR—could all have a role to play in identifying disturbances caused by victims being buried. If the grave could be found, then excavation of the victim's remains could be undertaken using refined archaeological techniques.

Although conventional archaeological techniques are employed, the forensic context results in a number of significant differences. Ancient buried bodies tend to be skeletal and stable, whereas recently buried victims are probably undergoing a process of decay that can significantly affect the value of search techniques and recovery methods. The interrogation of the buried data will also differ from that used in conventional excavation. When forensic archaeologists excavate the burial of a homicide victim, questions focus on evidence that may throw light on the type of murder, for example whether it was a premeditated or a second-degree murder. How was the grave dug and what implement was used? Was it dug in a hurry or had it been carefully prepared? Are there traces of materials in the grave (e.g. leaves

or soils) that might lead to other locations and provide further leads?

The study of ancient populations produces generic data on factors such as stature, diet, longevity, and general trauma. The individuals concerned in most excavations of prehistoric burials are anonymous, but in a forensic context the victim has a name, identification has to be proven, and excavation needs to expose and recover the victim in such a way as to maintain the evidence that will allow the pathologist to ascertain cause and manner of death.

The grave may also contain evidence to link the offender to the burial of the victim. “Every contact leaves a trace” is the underlying principle of forensic science both in the grave and on the body itself. Here, the evidence may not be of a type the archaeologist is familiar with—fibers from clothes; traces of hair, paper, human materials, and flakes of paint—all carefully recovered and recorded from within the fill of the grave and maintained securely until presented in court. The avoidance of contamination from other layers and from the archaeologists themselves is paramount.

The systematic methods of survey, excavation, and recovery, as well as the techniques of bioarchaeology, are all brought to bear with great effect and success in forensic investigations. But it remains novel, unfamiliar territory for archaeologists, who find themselves working closely with forensic scientists, pathologists, crime-scene investigators, and criminal profilers as part of a larger, integrated investigative network. The goal is to bring about justice for the buried victims and closure for their families.



3.106 A forensic archaeologist working for the International Commission on Missing Persons (ICMP) on an excavation at a mass grave site at Budak near Srebrenica in Bosnia and Herzegovina.

Processing and Classification

In a similar way to excavation itself, the processing of excavated materials in the field laboratory is a specialized activity that demands careful planning and organization. For example, no archaeologist should undertake the excavation of a wet site without having on hand team members who are expert in the conservation of waterlogged wood and facilities for dealing with such material. Many manuals are now available that deal with such conservation problems. Of course, not only artifacts are recovered but also *ecofacts* (organic and environmental remains), and we shall see how they may be selected for dating (Chapter 4) or for analysis (Chapters 6 and 7).

Only two basic aspects of field-laboratory procedure will be discussed briefly here. The first concerns the cleaning of artifacts, the second is artifact classification. In both cases, the archaeologist needs always to consider in advance the kinds of questions the newly excavated material might be able to answer. Thorough cleaning of artifacts, for example, is a traditional part of excavations worldwide, but many of the new scientific techniques discussed in Part II make it clear that artifacts should not be cleaned thoroughly before a specialist has had a chance to study them. For instance, we now know that food residues are often preserved in pots, and blood residues may be present on stone tools (see Chapter 7). The chances of such preservation need to be assessed before evidence is destroyed by cleaning.

Nevertheless, most artifacts eventually have to be cleaned to some degree if they are to be sorted and classified. Initial sorting is according to broad categories, such as stone tools, pottery, and metal objects. These categories are then subdivided or classified to create more manageable groups that can later be analyzed [3.107, p. 134]. Classification is commonly done on the basis of three kinds of characteristics or **attributes**:

- 1 *surface* attributes (including decoration and color);
- 2 *shape* attributes (dimensions as well as shape itself);
- 3 *technological* attributes (primarily raw material).

Artifacts found to share similar attributes are grouped together into artifact types—hence the term *typology*, which simply refers to the creation of such types.

Typology dominated archaeological thinking until the 1950s and still plays an important role. The reason for this is straightforward. Artifacts make up a large part of the archaeological record, and typology helps archaeologists create order in this mass of evidence. As we saw in Chapter 1, C. J. Thomsen demonstrated early on that artifacts could be ordered in a Three Age System, or sequence of stone, bronze, and iron. This discovery underlies the

continuing use of typology as a method of dating—of measuring the passage of time (see Chapter 4). Typology has also been used as a means of defining archaeological entities at a particular moment in time. Groups of artifact (and building) types at a particular time and place are termed *assemblages*, and groups of assemblages have been taken to define **archaeological cultures**. These definitions are also long established, having first been systematically defined by Gordon Childe in 1929 when he stated:

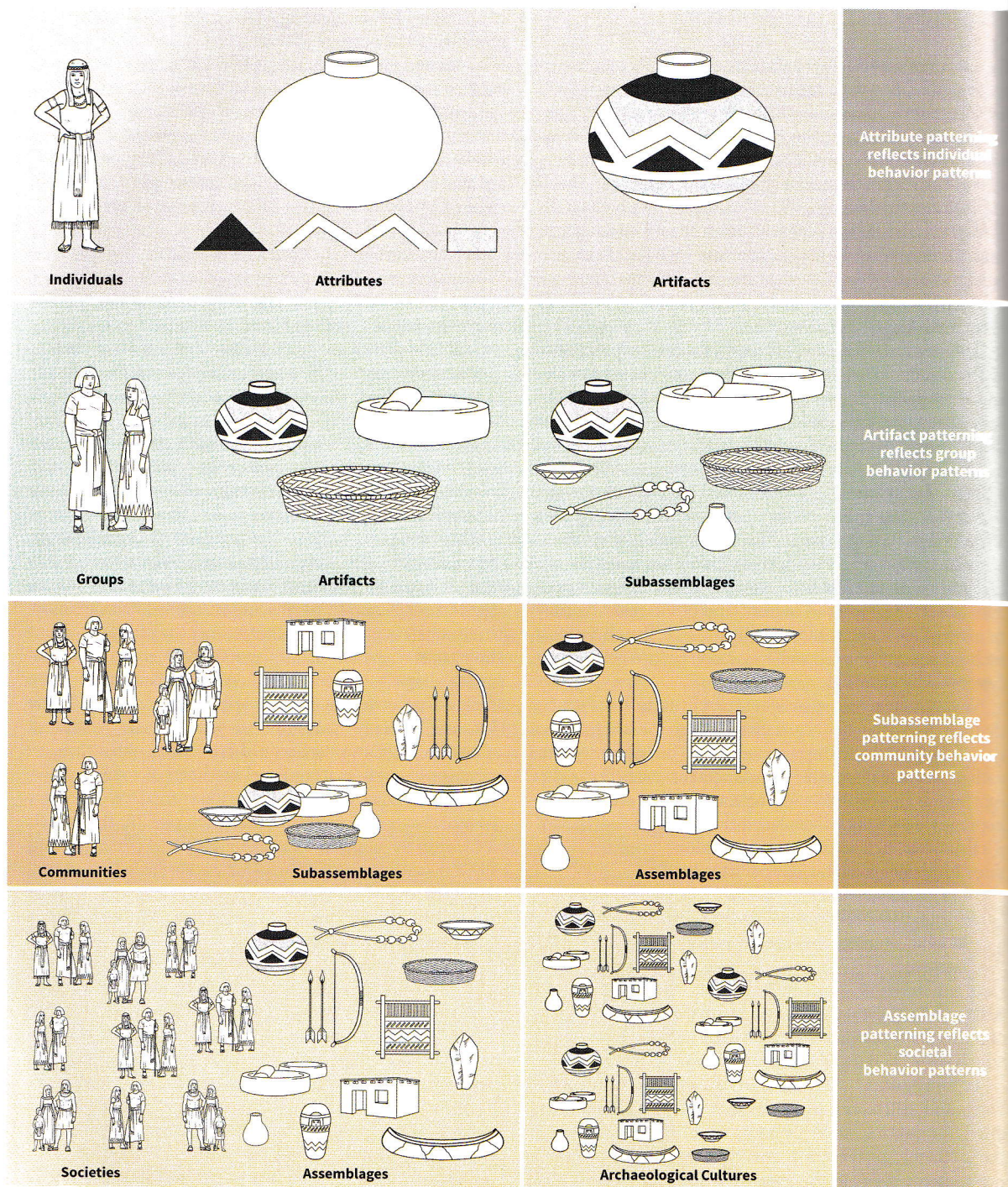
We find certain types of remains—pots, implements, ornaments, burial rites, and house forms—constantly recurring together. Such a complex of associated traits we shall term a “cultural group” or just a “culture.” We assume that such a complex is the material expression of what today would be called a “people.”

As we shall see in Part II, the difficulty comes when one tries to translate this terminology into human terms and to relate an archaeological culture with an actual group of people in the past.

This brings us back to the purpose of classification. Types, assemblages, and cultures are all artificial constructs designed to put order into disordered evidence. The trap that former generations of scholars fell into was to allow these constructs to determine the way they thought about the past, rather than using them merely as one means of giving shape to the evidence. We now recognize more clearly that different classifications are needed for the different kinds of questions we want to ask. A student of ceramic technology would base a classification on variations in raw material and methods of manufacture, whereas a scholar studying the various functions of pottery for storage, cooking, and so on might classify the vessels according to shape and size. Our ability to construct and make good use of new classifications has been immeasurably enhanced by computers, which allow archaeologists to compare the association of different attributes on thousands of objects at once.

Post-excavation work in the laboratory or store does not cease with cleaning, labeling, and classification. Curation is also very important, and the conservation of objects and materials plays a major role not only in the arrangement of long-term storage, but also in collections management in general. The material needs to be preserved and made readily available for future research, reinterpretation, and in some cases display to the public, whether permanently or in temporary exhibitions.

In conclusion, it cannot be stressed too strongly that all the effort put into survey, excavation, and post-excavation analysis will have been largely wasted unless the results are published (see Chapter 15).



3.107 A diagram showing terms used in archaeological classification, from attributes (shape, decoration) of a pot to the complete archaeological culture, developed by American archaeologist James Deetz (1930–2000).

The column on the right gives the inferred human meaning of the terms. The extent to which one can draw behavioral inferences from such classification is discussed in Chapter 12.

Summary

- The first step of any archaeological excavation is the development of a *research design*, which consists of formulating a clear question to answer, collecting and recording evidence, processing and analyzing that evidence, and the publication of the results.
- Archaeologists locate the whereabouts of sites through both ground reconnaissance and aerial survey. *Ground reconnaissance* can take several forms including surface survey. *Surface survey* involves walking across potential sites and noting concentrations of features or artifacts to gain some idea of the site's layout. *Aerial survey* is done with the aid of aerial imagery, much of which is already available in libraries and collections and on the Internet. Images taken from a kite, balloon, plane, or satellite often reveal site features that are not visible on the ground. From these images, preliminary maps and plans can be made.
- Mapping is the key to the accurate recording of most survey data. Geographic information systems (GIS), a collection of computer hardware and software that manages and manipulates geographic data, is one of the primary tools archaeologists use to map sites.
- Archaeologists employ several methods of obtaining subsurface information prior to excavation. Some of these methods are *nondestructive*, meaning they do not require ground to be broken during the collection of information. *Ground-penetrating radar* (GPR), for example, uses radio pulses to detect underground features. *Electrical resistivity* and *magnetic survey*, metal detectors, as well as *geochemical* techniques, are also used to gather information before excavation.
- Excavation plays a central role in fieldwork as it reveals human activities at a particular period in the past and changes in that activity over time. Stratigraphy is based on the *law of superposition*, that is, if one layer overlies another, the lower was deposited first. Excavation is costly and destructive and should be undertaken only if research questions cannot be answered by nondestructive survey techniques.
- Artifacts that share similar *attributes* are often grouped together and the act of creating such groups is called *typology*. Groups of artifacts from a particular time and place are called *assemblages*. These assemblages are often used to define *archaeological cultures*.

Further Reading

Useful introductions to methods of locating and surveying archaeological sites can be found in the following:

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- Wiseman, J. R. & El-Baz, F. (eds.). 2007. *Remote Sensing in Archaeology*. Springer: Berlin.
- Among the most widely used field manuals are:
- The journal *Archaeological Prospection* (since 1994).
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- Zimmerman, L. J. & Green, W. (eds.). 2003. *The Archaeologist's Toolkit*. (7 vols.) AltaMira Press: Walnut Creek, CA.