2 What is Left?
The Variety of the Evidence

The relics of past human activity are all around us. Some of them were deliberate constructions, built to last, like the pyramids of Egypt, the Great Wall of China, or the temples of Mesoamerica and India. Others, like the remains of the Maya irrigation systems of Mexico and Belize, are the visible relics of activities whose aim was not primarily to impress the observer, but which still command respect today for the scale of the enterprise they document.

Most of the remains of archaeology are far more modest, however. They are the discarded refuse from the daily activities of human existence: the food remains, the bits of broken pottery, the fractured stone tools, the debris that everywhere is formed as people go about their daily lives.

In this chapter we define the basic archaeological terms, briefly survey the scope of the surviving evidence and look at the great variety of ways in which it has been preserved for us. From the frozen soil of the Russian steppes, for instance, have come the wonderful finds of Pazyryk, those great chieftains' burials where wood and textiles and skins are splendidly preserved. From the dry caves of Peru and other arid environments have come remarkable textiles, baskets, and other remains that often perish completely. And by contrast, from wetlands, whether the swamps of Florida or the lake villages of Switzerland, further organic remains are being recovered, this time preserved not by the absence of moisture, but by its abundant presence to the exclusion of air.

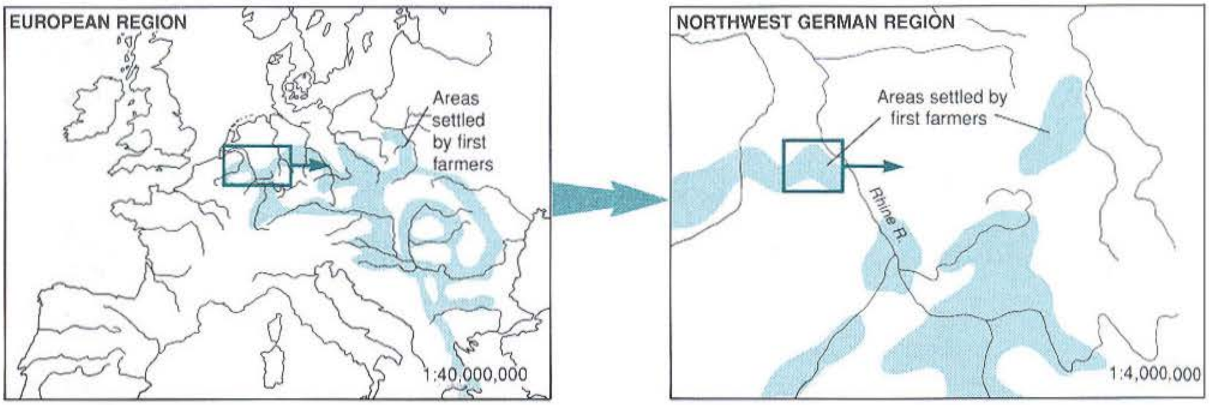
Extremes of temperature and of humidity have preserved much. So too have natural disasters. The volcanic eruption that destroyed Pompeii and Herculaneum (box, pp. 22–23) is the most famous of them, but there have been others, such as the eruption of the Ilopango volcano in El Salvador in the 2nd century AD, which buried land surfaces and settlement remains in a large part of the southern Maya area.

Our knowledge of the early human past is dependent in this way on the human activities and natural processes that have formed the archaeological record, and on those further processes that determine, over long periods of time, what is left and what is gone for ever. Today we can hope to recover much of what is left, and to learn from it by asking the right questions in the right way.

BASIC CATEGORIES OF ARCHAEOLOGICAL EVIDENCE

Undoubtedly one of the main concerns of the archaeologist is the study of *artifacts* – objects used, modified, or made by people. But, as the work of Grahame Clark and other pioneers of the ecological approach has demonstrated (Chapter 1), there is a whole category of non-artifactual *organic and environmental remains* – sometimes called "ecofacts" – that can be equally revealing about many aspects of past human activity. Much archaeological research has to do with the analysis of artifacts and these organic and environmental remains that are found together on *sites*, themselves most productively studied together with their surrounding landscapes and grouped together into *regions*.

Artifacts are humanly made or modified portable objects, such as stone tools, pottery, and metal weapons. In Chapter 8 we look at methods for analyzing human technological prowess in the mastery of materials for artifacts. But artifacts provide evidence to help us answer all the key questions – not just technological ones – addressed in this book. A single clay vessel or pot can be the subject of several lines of inquiry. The clay may be tested to produce a date for the vessel and thus perhaps a date for the location where it was found (Chapter 4), and tested to find the source of the clay and thus give evidence for the range and contacts of the group that made the vessel (Chapters 5 and 9). Pictorial decoration on the pot's surface may be used in a



typological sequence (Chapter 3), and tell us something about ancient beliefs, particularly if it shows gods or other figures (Chapter 10). And analysis of the vessel's shape and any food or other residues found in it can yield information about the pot's use, perhaps in cooking, as well as about ancient diet (Chapter 7).

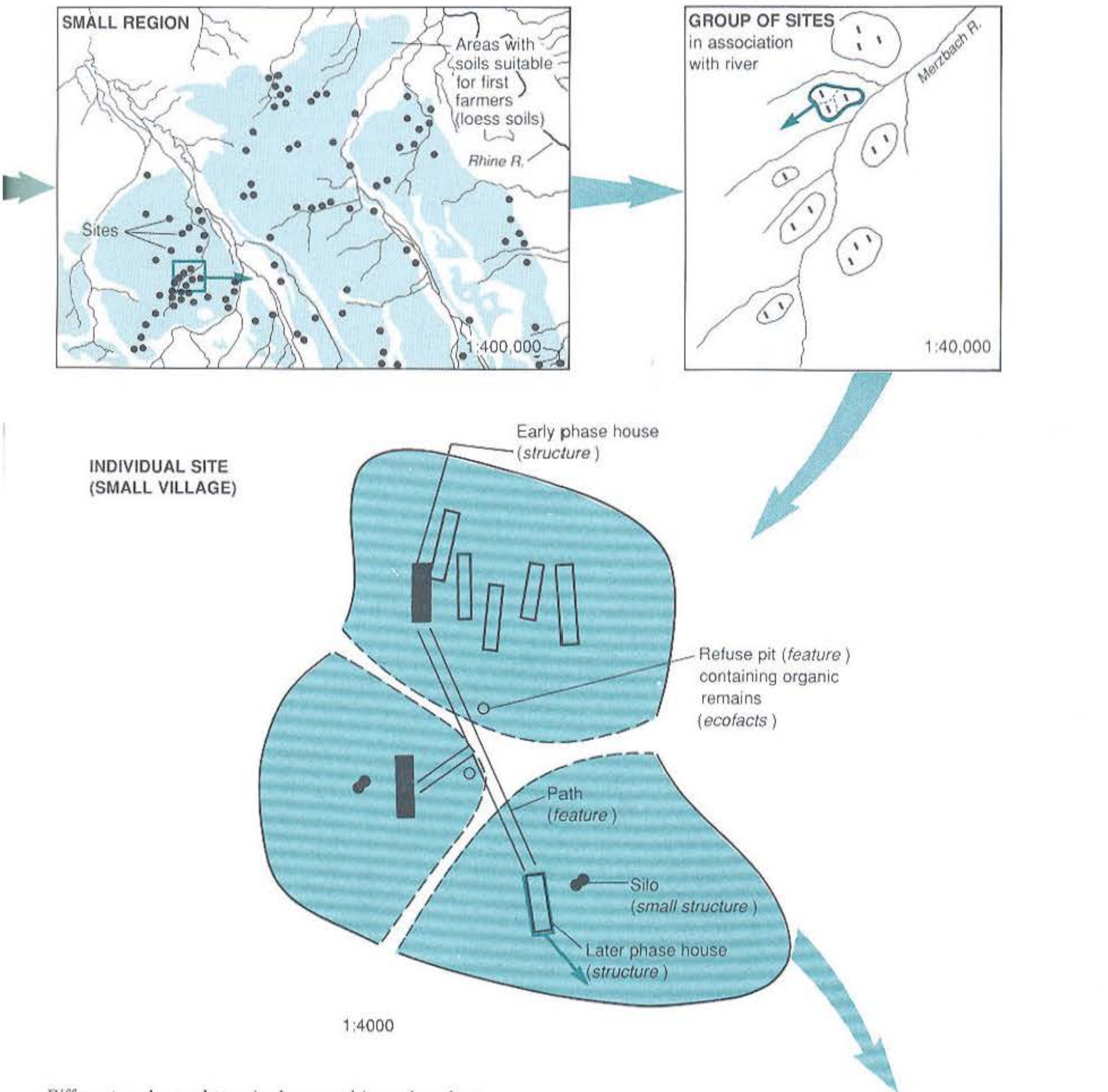
Some researchers broaden the meaning of the term "artifact" to include all humanly modified components of a site or landscape, such as hearths, postholes, and storage pits – but these are more usefully described as *features*, defined in essence as non-portable artifacts. Simple features such as postholes may themselves, or in combination with remains of hearths, floors, ditches, etc., give evidence for complex features or structures, defined as buildings of all kinds, from houses and granaries to palaces and temples.

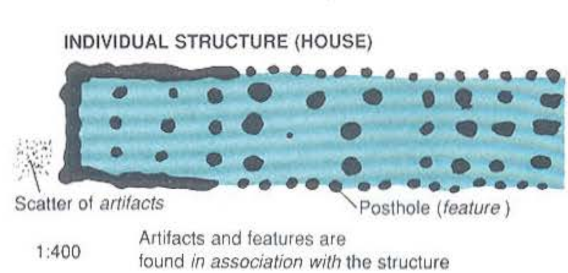
Non-artifactual organic and environmental remains or ecofacts include animal bones and plant remains, but also soils and sediments – all of which may shed light on past human activities. They are important because they can indicate, for example, what people ate or the environmental conditions under which they lived (Chapters 6 and 7).

Archaeological sites may be thought of as places where artifacts, features, structures, and organic and environmental remains are found together. For working purposes one can simplify this still further and define sites as places where significant traces of human activity are identified. Thus a village or town is a site, and so too is an isolated monument like Serpent Mound in Ohio or Stonehenge in England. Equally, a surface scatter of stone tools or potsherds may represent a site occupied for no more than a few hours, whereas a Near Eastern tell or mound is a site indicating human occupation over perhaps thousands of years. In Chapter 5 we consider the great variety of sites in more detail and look at the ways in which archaeologists classify them and study them regionally – as part of the investigation of settlement patterns. Here, however, we are more concerned with the nature of individual sites and how they are formed.

The Importance of Context

In order to reconstruct past human activity at a site it is crucially important to understand the *context* of a find, whether artifact, feature, structure, or organic remain. A find's context consists of its immediate *matrix* (the material surrounding it, usually some sort of sediment such as gravel, sand, or clay), its *provenience* (horizontal and vertical position within the matrix), and its association with other finds (occurrence together with other archaeological remains, usually in the same matrix). In the 19th century the demonstration that stone tools were associated with the bones of extinct animals in sealed deposits or matrices helped establish the idea of humanity's high antiquity (Chapter 1). Increasingly since then archaeologists have recognized the importance of identifying and accurately recording associations between remains on sites. This is why it is such a tragedy when looters dig up sites indiscriminately looking for rich finds, without recording matrix, provenience, or associations. All the contextual information is lost. A looted vase may be an attractive object for a collector, but far more could have been learnt about the society that produced it had archaeologists been able to record where it was found (in a tomb, ditch, or house?) and in association with what other artifacts or organic remains (weapons, tools or animal bones?). Much information about the Mimbres people of the American Southwest has been lost forever because looters bulldozed their sites, hunting for the superbly painted – and highly sought after – bowls made by the Mimbres 1000 years ago (box, p. 552).





Different scales and terminology used in archaeology, from the continental region (opposite page, top left) to the individual structure (right). In this representation of the pattern of settlement of Europe's first farmers (5th millennium BC), the archaeologist might study – at the broader scale – the interesting association between sites and light, easily worked soils near rivers (see Chapter 7). At the smaller scale, the association – established by excavation (Chapter 3) – of houses with other houses and with structures such as silos for grain storage raises questions, for example, about social organization and permanence of occupation at this period.

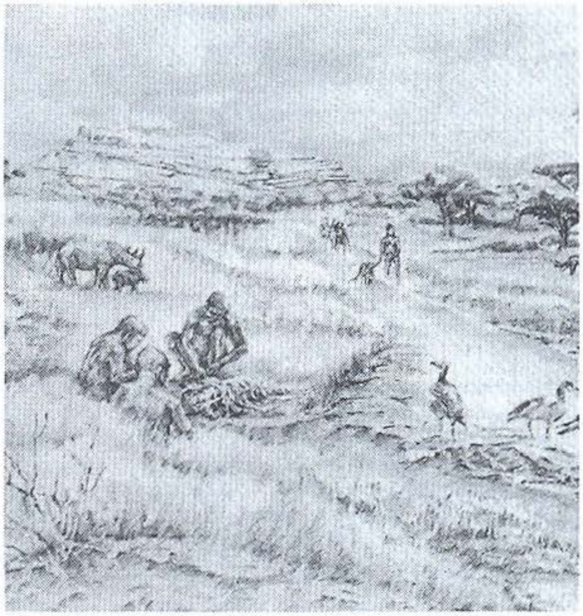
When modern (or ancient) looters disturb a site, perhaps shifting aside material they are not interested in, they destroy that material's *primary context*. If archaeologists subsequently excavate that shifted material, they need to be able to recognize that it is in a *secondary context*. This may be straightforward for, say, a Mimbres site, looted quite recently, but it is much more difficult for a site disturbed in antiquity. Nor is disturbance confined to human activity: archaeologists dealing with the tens of thousands of years of the Old Stone Age or Paleolithic period know well that the forces of nature – encroaching seas or ice sheets, wind and water action – invariably destroy primary context. A great many of the Stone Age tools found in European river gravels are in a secondary context, transported by water action far from their original, primary context.

FORMATION PROCESSES

In recent years archaeologists have become increasingly aware that a whole series of *formation processes* may have affected both the way in which finds came to be buried and what happened to them after they were buried – i.e. their taphonomy (see box pp. 284–85).

The American archaeologist Michael Schiffer has made the useful distinction between ***cultural formation processes*** (C-transforms) and noncultural or ***natural formation processes*** (N-transforms). C-transforms involve the deliberate or accidental activities of human beings as they make or use artifacts, build or abandon buildings, plow their fields and so on. N-transforms are natural events that govern both the burial and the survival of the archaeological record. The sudden fall of volcanic ash that covered Pompeii (box, pp. 22–23) is an exceptional N-transform; a more common one would be the gradual burial of artifacts or features by wind-borne sand or soil. Likewise the transporting of stone tools by river action, referred to above, is an example of an N-transform. But the activities of animals on a site – burrowing into them or chewing bones and pieces of wood – are also N-transforms.

At first sight these distinctions may seem of little interest to the archaeologist. In fact they are vital to the accurate reconstruction of past human activities. It may be important, for instance, to know whether certain archaeological evidence is the product of human or non-human activity (the result of C-transforms or N-transforms). If you are trying to reconstruct human woodworking activities by studying cutmarks on timber, then you should learn to recognize certain kinds of marks made by beavers using their teeth and to distin-



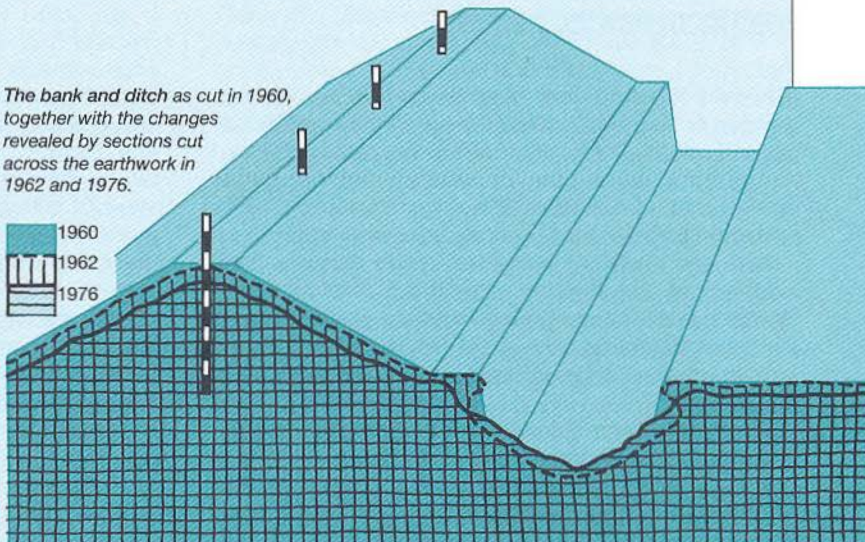
Early humans as mighty hunters (left) or mere scavengers (right)? Our understanding of formation processes governs the way in which we interpret associations of human tools with animal bones from the fossil record in Africa.

EXPERIMENTAL ARCHAEOLOGY

One effective way to study formation processes is through long-term experimental archaeology. An excellent example is the experimental earthwork constructed on Overton Down, southern England, in 1960.

The earthwork consists of a substantial chalk and turf bank, 21 m (69 ft) long, 7 m (25 ft) wide, and 2 m (6 ft 7 in) high, with a ditch cut parallel to it. The aim of the experiment has been to assess not only how the bank and ditch alter through time, but also what happens to materials such as pottery, leather, and textiles that were buried in the earthwork in 1960. Sections (trenches) have been – or will be – cut across the bank and ditch at intervals of 2, 4, 8, 16, 32, 64, and 128 years (in real time, 1962, 1964, 1968, 1976, 1992, 2024, and 2088): a considerable commitment for all concerned.

The bank and ditch as cut in 1960, together with the changes revealed by sections cut across the earthwork in 1962 and 1976.



On this timescale, the project is still at a relatively early stage. But preliminary results are interesting. In the 1960s the bank dropped some 25 cm (10 in) in height and the ditch silted up quite rapidly. Since the mid-1970s, however, the structure has stabilized. As for the buried materials, tests after 4 years showed that pottery was unchanged and leather little affected, but textiles were already becoming weakened and discolored.

The 1992 excavations revealed that preservation was better in the chalk bank, which is less biologically active, than in the turf core where textiles and some wood had completely disappeared. The structure itself had changed little since 1976, though there was considerable reworking and transport of fine sediment by earthworms. The experiment has already shown that many of the changes that interest archaeologists occur within decades of burial, and that the extent of these changes can be far greater than had hitherto been suspected.

guish these from cutmarks made by humans using stone or metal tools (Chapter 8).

Let us take an even more significant example. For the earliest phases of human existence in Africa, at the beginning of the Old Stone Age or Paleolithic period, great theoretical schemes about our primitive hunting ability have been based on the association between stone tools and animal bones found at archaeological sites. The bones were assumed to be those of animals hunted and slaughtered by early humans who made the tools. But studies of animal behavior and cutmarks on animal bones by C.K. Brain, Lewis Binford, and others suggest that in many cases the excavated bones are the remains of animals hunted by other predator animals and largely eaten by these. The humans with their stone tools would have come upon the scene as mere scavengers, at the end of a pecking order of different animal species. By no means everyone agrees with this scavenging hypothesis. The point to emphasize here is that the issue can best be resolved by improving our techniques for distinguishing between cultural and natural formation processes – between human and non-human activity. Many studies are now focusing on the need to clarify how one differentiates cutmarks on bones made by stone tools from those made by the teeth of animal predators (Chapter 7). Modern experiments using replica stone tools to cut meat off bones are one helpful approach. Other kinds of experimental archaeology can be most instructive about some of the formation processes that affect physical preservation of archaeological material (see box, above).

The remainder of this chapter is devoted to a more detailed discussion of the different cultural and natural formation processes.

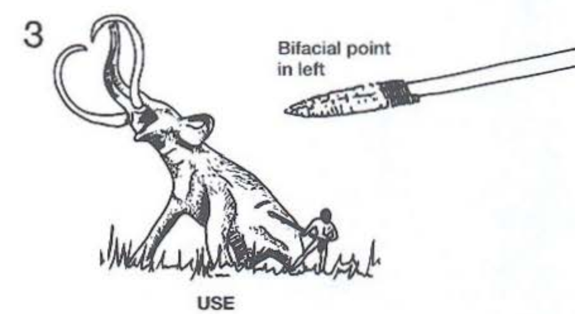
CULTURAL FORMATION PROCESSES – HOW PEOPLE HAVE AFFECTED WHAT SURVIVES IN THE ARCHAEOLOGICAL RECORD

One may separate these processes rather crudely into two kinds: those that reflect the original human behavior and activity before a find or site became buried; and those (such as plowing or looting) that came after burial. Now of course most major archaeological sites are formed as the result of a complex sequence of use, burial, and reuse repeated many times over, so that a simple two-fold division of cultural formation processes may not be so simple to apply in practice. Nevertheless, since one of our main aims is to reconstruct original human behavior and activity, we must make the attempt.

Original human behavior is often reflected archaeologically in at least four major activities: in the case of a tool, for example, there may be

1 acquisition of the raw material;
2 manufacture;
3 use; and finally
4 disposal or discard when the tool is worn out or broken. (The tool may of course be reworked and recycled, i.e. repeating stages 2 and 3.)

Similarly a food crop such as wheat will be acquired (harvested), manufactured (processed), used (eaten), and discarded (digested and the waste products excreted) – here one might add a common intermediate stage of storage before use. From the archaeologist's point of view the critical factor is that remains can enter the archaeological record at any one of these stages – a tool may be lost or thrown out as inferior quality during manufacture, a crop may be accidentally burnt and thus preserved during processing. In order accurately to reconstruct the original activity it is therefore crucial to try to understand which of the stages one is looking at. It may be quite easy to identify, say, the first stage for stone tools, because stone quarries can often be recognized by deep holes in the ground with piles of associated waste flakes and



An artifact may have entered the archaeological record at any one of these four stages in its life cycle. The archaeologist's task is to determine which stage is represented by the find in question.

blanks which survive well. But it is much more difficult to know beyond reasonable doubt whether a sample of charred plant remains comes from, say, a threshing floor or an occupation floor – and this may also make it difficult to reconstruct the true plant diet, since certain activities may favor the preservation of certain species of plant. This whole controversial issue is discussed further in Chapter 7.

Deliberate burial of valuables or the dead is another major aspect of original human behavior that has left its mark on the archaeological record. In times of conflict or war people often deposit prized possessions in the ground, intending to reclaim them at a later date but sometimes for one reason or another failing to do so. These *hoards* are a prime source of evidence for certain periods, such as the European Bronze Age, for which hoards of metal goods are common, or later Roman Britain, which has yielded buried treasures of silver and other precious metals. The archaeologist, however, may not find it easy to distinguish between hoards originally intended to be reclaimed and valuables buried perhaps to placate supernatural powers (placed for example at a particularly dangerous part of a crossing over a bog) with no reclamation intended.

How archaeologists set about trying to demonstrate belief in supernatural powers and an afterlife is the subject of Chapter 10. Here we may note that, in addition to hoards, the major source of evidence comes from *burial of the dead*, whether in simple graves, elaborate burial mounds, or giant pyramids, usually with grave-goods such as ceramic vessels or weapons, and sometimes with painted tomb-chamber walls, as in ancient Mexico or Egypt. The Egyptians indeed went so far as to mummify their dead (see below) – to preserve them, they hoped, for eternity – as did the Incas of Peru, whose kings were kept in the Temple of the Sun at Cuzco and brought outside for special ceremonies.

Human destruction of the archaeological record might be caused by burials of the kind just described being dug into earlier deposits. But people in the past deliberately or accidentally obliterated traces of their predecessors in innumerable other ways. Rulers, for instance, often destroyed monuments or erased inscriptions belonging to previous chiefs or monarchs. A classic example of this occurred in ancient Egypt, where the heretic pharaoh Akhenaten, who tried to introduce a new religion in the 14th century BC, was reviled by his successors and his major buildings were torn down for reuse in other monuments. A Canadian team led by Donald Redford has spent many years recording some of these reused stone blocks at Thebes and has successfully matched them with the help of a computerized database in order to reconstruct (on paper), like a giant jigsaw, part of one of Akhenaten's temples.

Some human destruction meant to obliterate has inadvertently preserved material for the archaeologist to find. Burning, for example, may not always destroy. It can often improve the chances of survival of a variety of remains such as of plants: the conversion into carbon greatly increases the powers of resistance to the ravages of time. Clay daubing and adobe usually decay, but if a structure has been fired, the mud is baked to the consistency of a brick. In the same way thousands of clay writing tablets from the Near East have been baked accidentally or deliberately in fires and thus preserved. Timbers too may char and survive in structures, or at least leave a clear impression in the hardened mud.

Today human destruction of the archaeological record continues at a frightening pace, through land drainage, plowing, building work, looting, etc. In Chapter 14 we discuss how this affects archaeology generally and what the potential implications are for the future.

NATURAL FORMATION PROCESSES – HOW NATURE AFFECTS WHAT SURVIVES IN THE ARCHAEOLOGICAL RECORD

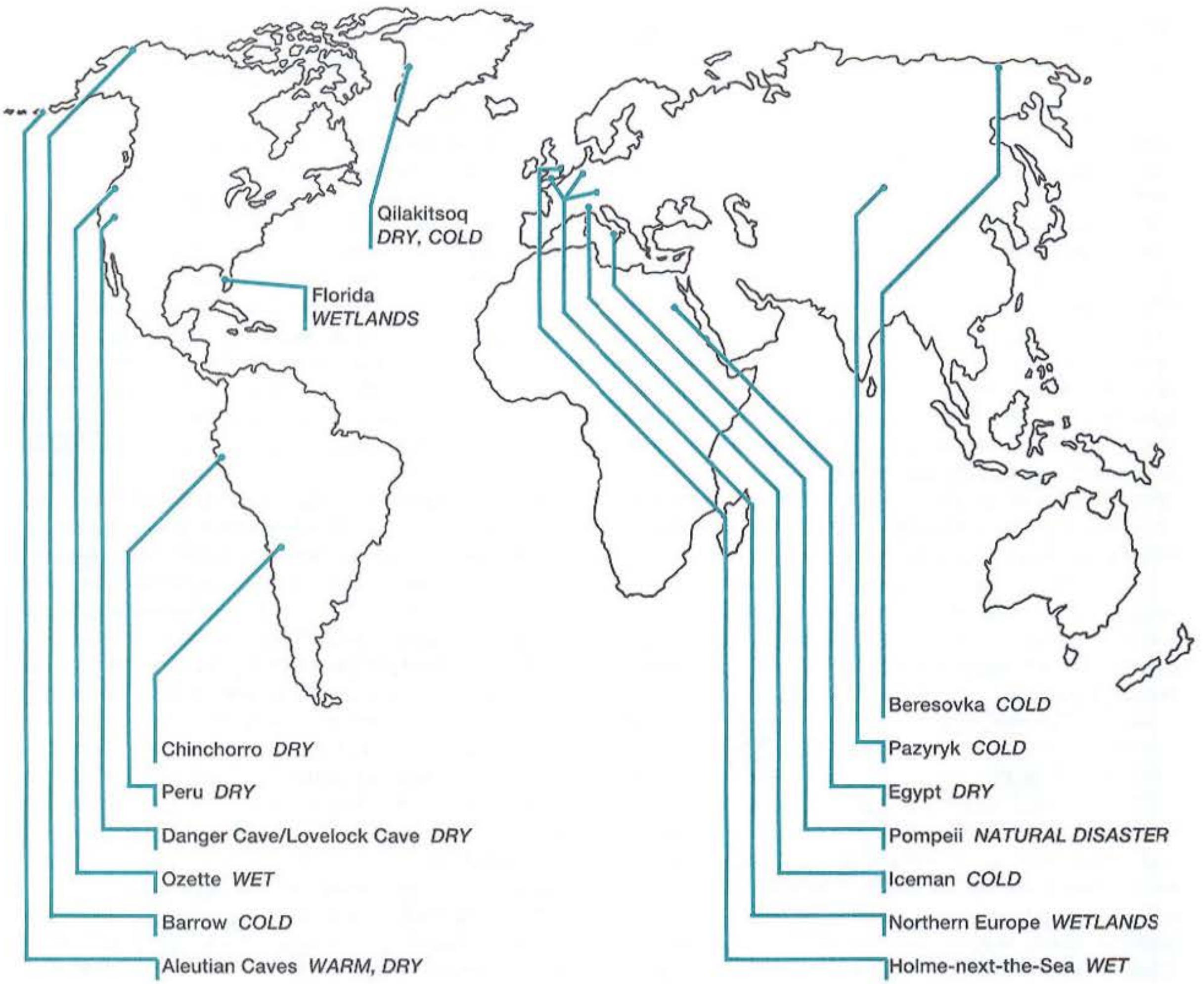
We saw above how natural formation processes such as river action can disturb or destroy the primary context of archaeological material. Here we will focus on that material itself, and the natural processes that cause decay or lead to preservation.

Practically any archaeological material can survive in exceptional circumstances. Usually, however, inorganic materials survive far better than organic ones.

Inorganic Materials

The most common inorganic materials to survive archaeologically are stone, clay, and metals.

Stone tools survive extraordinarily well – some are over 2 million years old. Not surprisingly they have always been our main source of evidence for human activities during the Old Stone Age, even though wooden and bone tools (which are less likely to be



The major sites and regions discussed in this chapter where natural formation processes – from wet to very dry or cold conditions – have led to exceptionally good preservation of archaeological remains.

preserved) may originally have equalled stone ones in their importance. Stone tools sometimes come down to us so little damaged or altered from their primary state that archaeologists can examine microscopic patterns of wear on their cutting edges and learn, for example, whether the tools were used to cut wood or animal hides. This is now a major branch of archaeological inquiry (Chapter 8).

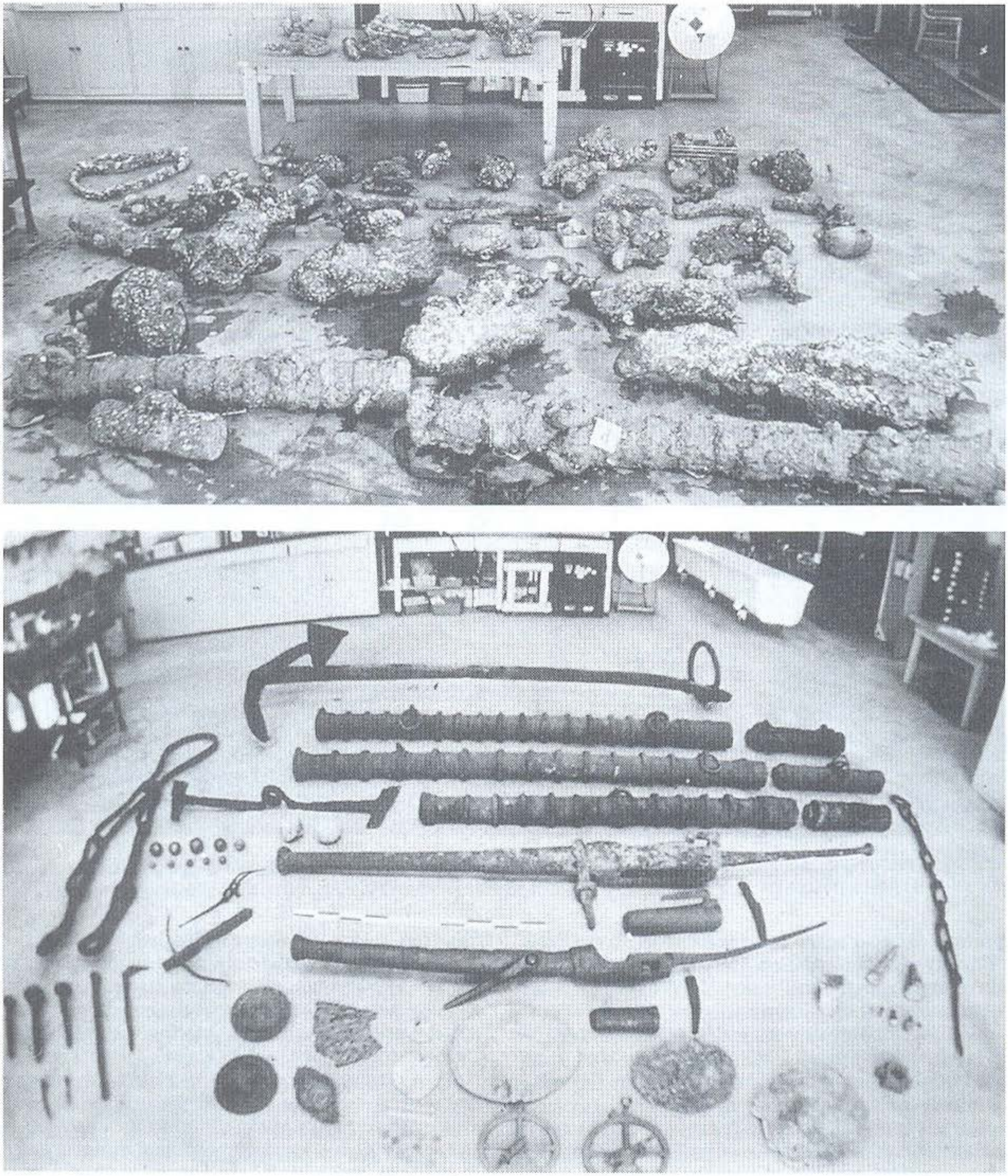
Fired clay, such as pottery and baked mud-brick or adobe, is virtually indestructible if well fired. It is therefore again not surprising that for the periods after the introduction of pottery making (some 16,000 years ago in Japan, and 9000 years ago in the Near East and parts of South America) ceramics have traditionally been the archaeologist's main source of evidence. As we saw at the beginning of this chapter, pots can be studied for their shape, surface decoration, mineral content, and even the food or other residues left inside them. Acid soils can damage the surface of fired clay, and porous or badly fired clay vessels or mud brick can become fragile in humid conditions. However, even disintegrated mud brick can help to assess rebuilding phases in Peruvian villages or Near Eastern tells.

Metals such as gold, silver, and lead survive well. Copper, and bronze with a low-quality alloy, are

Mud brick survives well in the dry conditions of the Near East. Here archaeologists excavate the massive mud-brick wall foundations of the Oval Temple at Khafaje, Iraq, dating from 2650–2350 BC.

attacked by acid soils, and can become so oxidized that only a green deposit or stain is left. Oxidation is also a rapid and powerful agent of destruction of iron, which rusts and may likewise leave only a discoloration in the soil. However, as will be seen in Chapter 8, it is sometimes possible to retrieve vanished iron objects by making a cast of the hollow they have left within the soil or within a mass of corrosion.

The sea is potentially very destructive, with underwater remains being broken and scattered by currents, waves, or tidal action. It can on the other hand cause metals to be coated with a thick, hard casing of metallic salts (such as chlorides, sulphides, and carbonates) from the objects themselves; this helps to preserve the artifacts within. If the remains are simply taken out of the water and not treated, the salts react with air, and give off acid which destroys the remaining metal. But the use of electrolysis – placing the object in a chemical solution and passing a weak current between it and a surrounding metal grill – causes the destructive salts to move slowly from the cathode (object) to the anode (grill), leaving the metal artifact clean and safe. This is a standard procedure in underwater archaeology and is used on all types of objects from cannons (see illus. overleaf) to the finds recently recovered from the *Titanic*.



Metal artifacts from a 1554 shipwreck in the Caribbean, before and after conservation. Use of electrolysis (see p. 57) has revealed a unique group of 16th-century armaments, anchors, and navigational instruments.

Organic Materials

Survival of organic materials is determined largely by the matrix (the surrounding material) and by climate (local and regional) – with the occasional influence of natural disasters such as volcanic eruptions, which are often far from disastrous for archaeologists.

The *matrix*, as we saw earlier, is usually some kind of sediment or soil. These vary in their effects on organic material; chalk, for example, preserves human and animal bone well (in addition to inorganic metals). Acid soils destroy bones and wood within a few years, but will leave telltale discolorations where postholes or hut foundations once stood. Similar brown or black marks survive in sandy soils, as do dark silhouettes which used to be skeletons (see Chapter 11).

But the immediate matrix may in exceptional circumstances have an additional component such as metal ore, salt, or oil. Copper can favor the preservation of organic remains, perhaps by preventing the activity of destructive micro-organisms. The prehistoric copper mines of central and southeast Europe have many remains of wood, leather, and textiles. Organic packing material found between copper ingots on the 14th-century BC Uluburun shipwreck, off the coast of southern Turkey (box, pp. 374–75), also survived for the same reason.

Salt mines such as those of Iron Age Hallstatt, Austria, have helped preserve organic finds. Even more remarkably, a combination of salt and oil ensured the preservation of a woolly rhinoceros at Starunia, Poland, with skin intact, and the leaves and fruits of tundra vegetation around it. The animal had been carried by a strong current into a pool saturated with crude oil and salt from a natural oil seep, which prevented decomposition: bacteria could not operate in these conditions, while salt had permeated the skin and preserved it. Similarly, the asphalt pits of La Brea, Los Angeles, are world famous for the prodigious quantities and fine condition of the skeletons of a wide range of prehistoric animals and birds recovered from them.

Climate plays an important role too in the preservation of organic remains. Occasionally one can speak of the "local climate" of an environment such as a cave. Caves are natural "conservatories" because their interiors are protected from outside climatic effects, and (in the case of limestone caves) their alkaline conditions permit excellent preservation. If undisturbed by floods or the trampling feet of animals and people, they can preserve bones and such fragile remains as footprints, and sometimes even plant fibers such as the short length of rope found in the Upper Paleolithic decorated cave of Lascaux, France.

More usually, however, it is the regional climate that is important. *Tropical climates* are the most destructive, with their combination of heavy rains, acid soils, warm temperatures, high humidity, erosion, and wealth of vegetation and insect life. Tropical rainforests can overwhelm a site remarkably quickly, with roots that dislodge masonry and tear buildings apart, while torrential downpours gradually destroy paint and plasterwork, and woodwork rots away completely. Archaeologists in southern Mexico, for example, constantly have to battle to keep back the jungle. From one field season to the next, primary growth of more than 2 m (6 ft 7 in) in height may appear in areas that had been totally cleared the year before. On the other hand, one can also look on jungle conditions as benign, in that they hinder looters from easily reaching even more sites than they do already.

Temperate climates, as in much of Europe and North America, are not beneficial, as a rule, to organic materials; their relatively warm but variable temperatures and fluctuating precipitation combine to accelerate the processes of decay. In some circumstances, however, local conditions can counteract these processes. At the Roman fort of Vindolanda, near Hadrian's Wall in northern England, over 1300 letters and documents, written in ink on wafer-thin sheets of birch and alderwood, have been found by the archaeologist Robin Birley. The fragments, dating to about AD 100, have survived because of the soil's unusual chemical condition: clay compacted between layers in the site created oxygen-free pockets (the exclusion of oxygen is vital to the preservation of organic materials), while chemicals produced by bracken, bone, and other remains effectively made the land sterile in that locality, thus preventing disturbance by vegetation and other forms of life.

A different example of freak preservation in temperate conditions occurred at Potterne, a Late Bronze Age refuse heap in southern England dating to about 1000 BC. Whereas bones normally become mineralized through the percolation of groundwater, in this site bones – as well as unburnt seeds and pottery – have been preserved because a mineral called glauconite (a mica) has translocated from the greensand bedrock and entered into a stable compound with the organic materials.

Natural disasters sometimes preserve sites, including organic remains, for the archaeologist. The most common are violent storms, such as that which covered the coastal Neolithic village of Skara Brae, Orkney Islands, with sand, the mudslide that engulfed the prehistoric village of Ozette on America's Northwest Coast (box, overleaf), or volcanic eruptions such as that of

WET PRESERVATION: THE OZETTE SITE

A special kind of waterlogging occurred at the Ozette site, Washington, on the U.S. Northwest Coast. About AD 1750, a huge mudslide buried part of a whale-hunting settlement. The village lay protected for two centuries – but not forgotten, for the descendants of the village kept the memory of their ancestors' home alive. Then the sea began to strip away the mud, and it seemed as if the site would fall prey to looters. Local people called on the government to excavate the site and to protect the remains. Richard Daugherty was appointed to organize the excavation. As the mud was cleared with high-pressure hoses, a wealth of organic material came to view.

Several cedarwood long houses, up to 21 m (68 ft 3 in) in length and 14 m (45 ft 6 in) wide, were found, with adzed and carved panels (painted with black designs including wolves and thunderbirds), roof-support posts, and low partition walls. These houses contained hearths, cooking platforms, sleeping benches, and mats.

Over 50,000 artifacts were recovered in a fine state of preservation – almost half in wood or other plant material. The most spectacular was a block of red cedar, a meter high, carved in the form of a whale's dorsal fin. Even ferns and cedar leaves had survived, together with an abundance of whale bones.

The project was an excellent example of cooperation between archaeologists and indigenous peoples. The Makah Indians value the contribution made by archaeologists to the understanding of their past, and have built a museum to display the finds.

PERISHABLE ARTIFACTS FROM OZETTE

Woven material *1330 baskets • 1466 mats • 142 hats • 37 cradles • 96 tump lines • 49 harpoon sheaths*

Weaving equipment *14 loom uprights • 14 roller bars • 10 swords • 23 spindle whorls • 6 spools*

Hunting equipment *115 wooden bows and fragments • 1534 arrow shafts • 5189 wooden arrow points • 124 harpoon shafts • 22 harpoon finger rests • 161 plugs from seal-skin floats*

Fishing equipment *131 bent wood halibut hooks • 607 curved halibut hook shanks • 117 blanks for making hooks • 7 herring rakes • 57 single-barbed hooks • 15 double-barbed hooks*

Containers *1001 wooden boxes and fragments • 120 wooden bowls and fragments • 37 wooden trays*

Watercraft *361 canoe paddles and fragments • 14 canoe bailers • 14 canoe fragments*

Miscellaneous *40 game paddles • 45 carved miniature items (canoes, figurines, etc.) • 52 carved wooden clubs • 1 carved effigy of a whale fin inlaid with sea-otter teeth*

General view *from the south of the area around the Ozette site. Vancouver Island lies on the horizon.*

A Makah Indian crew member (above) cleans a basket found on the site. (Above right) Another crew member measures a piece of wood in one of the Ozette houses.

Richard Daugherty (below) with the carved cedar representation of the dorsal fin of a whale. It was inlaid with over 700 sea-otter teeth arranged in the shape of a thunderbird holding a serpent in its claws.

Wooden clubs from the site. (Above, left to right) Head of a seal club; an owl head on a shaman's club; a face on the handle end of a seal club.

DRY PRESERVATION: THE TOMB OF TUTANKHAMUN

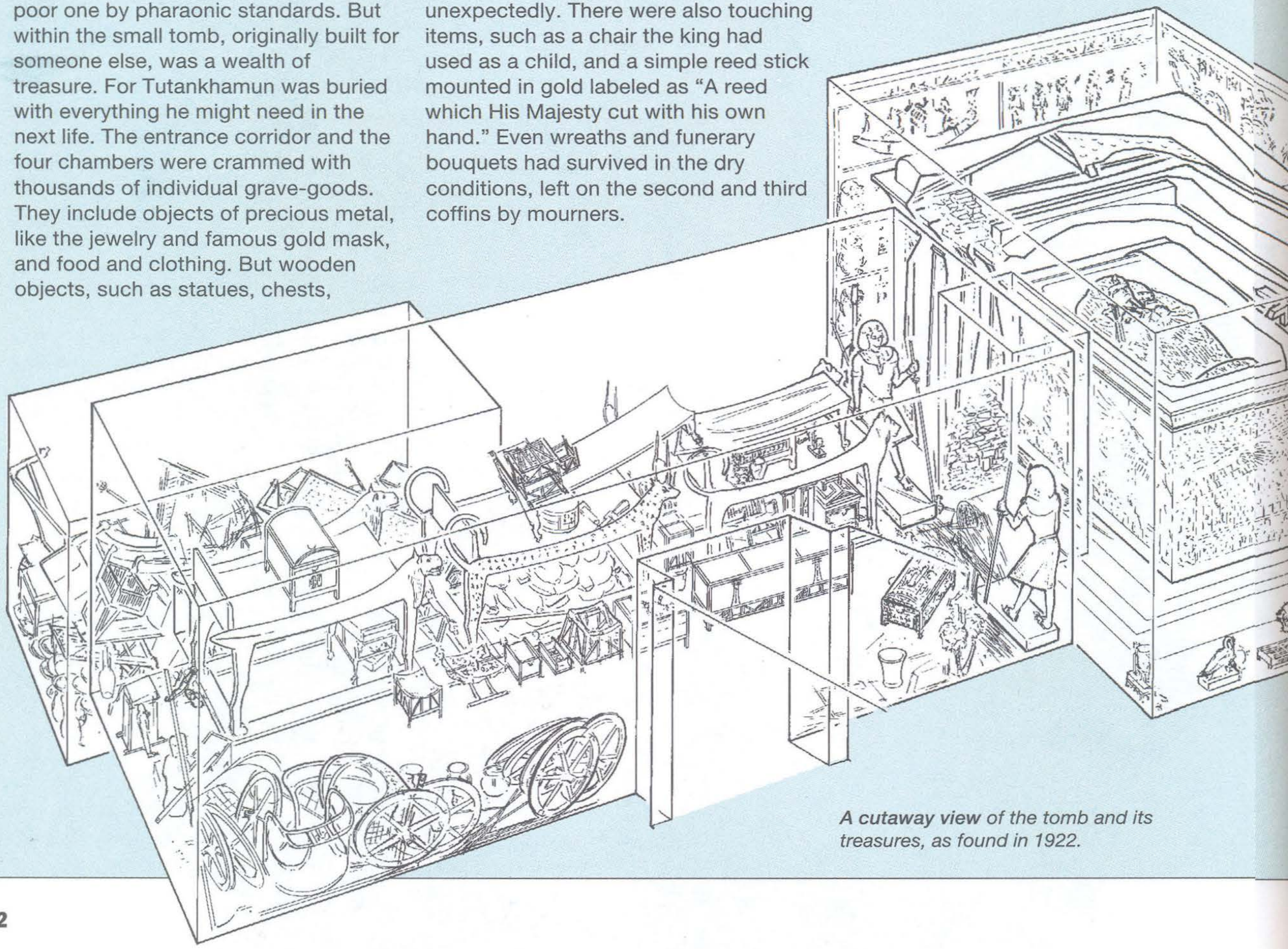
The arid conditions that prevail in Egypt have helped preserve a wide range of ancient materials, ranging from numerous written documents on papyrus (made of the pith of a Nile water plant) to two full-size wooden boats buried beside the Great Pyramid at Giza. But the best-known and most spectacular array of objects was that discovered in 1922 by Howard Carter and Lord Carnarvon in the tomb at Thebes of the pharaoh Tutankhamun, dating to the 14th century BC.

Tutankhamun had a short reign and was relatively insignificant in Egyptian history, a fact reflected in his burial, a poor one by pharaonic standards. But within the small tomb, originally built for someone else, was a wealth of treasure. For Tutankhamun was buried with everything he might need in the next life. The entrance corridor and the four chambers were crammed with thousands of individual grave-goods. They include objects of precious metal, like the jewelry and famous gold mask, and food and clothing. But wooden objects, such as statues, chests, shrines, and two of the three coffins, make up a large part of the tomb's contents. The human remains – the mummies of the king and his two stillborn children – have been the subject of scientific analysis more than once. A lock of hair found separately among the grave-goods has been analyzed and is thought to come from a mummy in another tomb believed to be Tiye, the young king's grandmother.

The grave furniture was not all originally intended for Tutankhamun. Some of it had been made for other members of his family, and then hastily adopted when the young king died unexpectedly. There were also touching items, such as a chair the king had used as a child, and a simple reed stick mounted in gold labeled as "A reed which His Majesty cut with his own hand." Even wreaths and funerary bouquets had survived in the dry conditions, left on the second and third coffins by mourners.

FINDS FROM TUTANKHAMUN'S TOMB

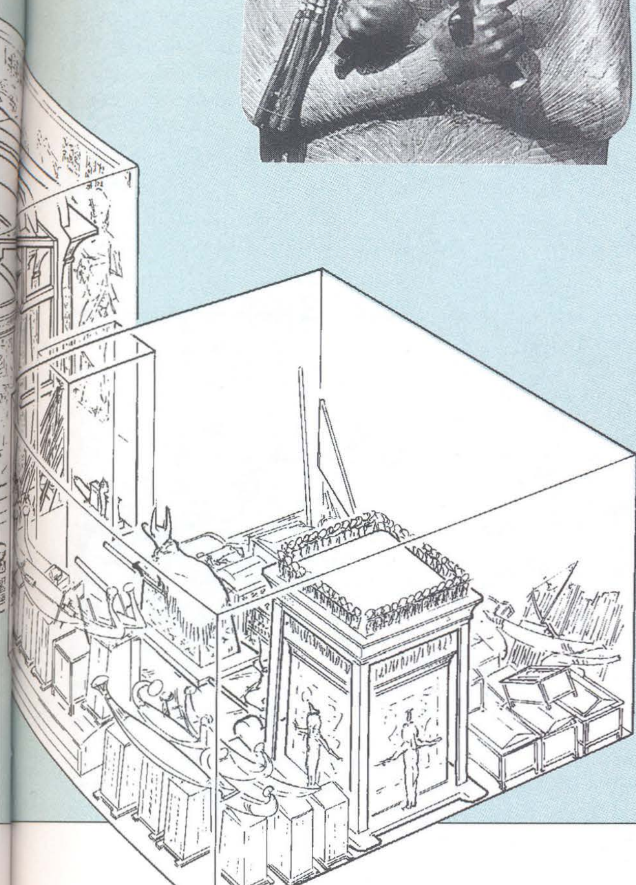
Archery equipment • Baskets • Beds • Bier • Boat models • Boomerangs and throwsticks • Botanical specimens • Boxes and chests • Canopic equipment • Chairs and stools • Chariot equipment • Clothing • Coffins • Cosmetic objects • Cuirass • Divine figures • Fans • Foodstuffs • Gaming equipment • Gold mask • Granary model • Hassocks • Jewelry, beads, amulets • Lamps and torches • Mummies • Musical instruments • Portable pavilion • Regalia • Ritual couches • Ritual objects • Royal figures • Sarcophagi • Shabti figures and related objects • Shields • Shrines and related objects • Sticks and staves • Swords and daggers • Tools • Vessels • Wine jars • Writing equipment



***A cutaway view** of the tomb and its treasures, as found in 1922.*

A "mannequin" of the young king. Modeled in wood, and painted over a layer of gesso (a kind of plaster), it may have been used as a tailor's dummy for the king's clothing or jewelry.

***The outermost** of Tutankhamun's three coffins was made of cypress wood, overlaid with gold foil.*



Vesuvius which buried and preserved Roman Pompeii under a blanket of ash (box, pp. 22–23). Another volcanic eruption, this time in El Salvador in about AD 595, deposited a thick and widespread layer of ash over a densely populated area of Maya settlement. Work here by Payson Sheets and his associates has uncovered a variety of organic remains at the site of Cerén, including palm and grass roofing, mats, baskets, stored grain and even preserved agricultural furrows. As will be seen in Chapter 6, volcanic ash has preserved part of a prehistoric forest at Miesenheim, in Germany.

Apart from these special circumstances, the survival of organic materials is limited to cases involving extremes of moisture: that is, arid, frozen, or waterlogged conditions.

Preservation of Organic Materials: Extreme Conditions

Dry Environments. Great aridity or dryness prevents decay through the shortage of water, which ensures that many destructive micro-organisms are unable to flourish. Archaeologists first became aware of the phenomenon in Egypt (see Tutankhamun box), where much of the Nile Valley has such a dry atmosphere that bodies of the predynastic period (before 3000 BC) have survived intact, with skin, hair, and nails, without any artificial mummification or coffins – the corpses were simply placed in shallow graves in the sand. Rapid drying out or desiccation, plus the draining qualities of the sand, produced such spectacular preservative effects that they probably suggested the practice of mummification to the later Egyptians of the dynastic period.

The pueblo dwellers of the American Southwest (*c.* AD 700–1400) buried their dead in dry caves and rockshelters where, as in Egypt, natural desiccation took place: these are not therefore true, humanly created mummies, although they are often referred to as such. The bodies survive, sometimes wrapped in fur blankets or tanned skins, and in such good condition that it has been possible to study hair styles. Clothing (from fiber sandals to string aprons) also remains, together with a wide range of goods such as basketry, feathered ornaments, and leather. Some far earlier sites in the same region also contain organic remains: Danger Cave, Utah (occupied from 9000 BC onward), yielded wooden arrows, trap springs, knife handles, and other wooden tools; Lovelock Cave, Nevada, had nets; while caves near Durango, Colorado, had preserved maize cobs, squashes, and sunflower and mustard seeds. Plant finds of this type have been crucial in helping to reconstruct ancient diet (Chapter 7).

The coastal dwellers of central and southern Peru lived – and died – in a similarly dry environment, so that it is possible today to see the tattoos on their desiccated bodies, and admire the huge and dazzlingly colorful textiles from cemeteries at Ica and Nazca, as well as basketry and featherwork, and also maize cobs and other items of food. In Chile, the oldest deliberately made mummies have been found at Chinchorro, preserved again by the aridity of the desert environment (see p. 427).

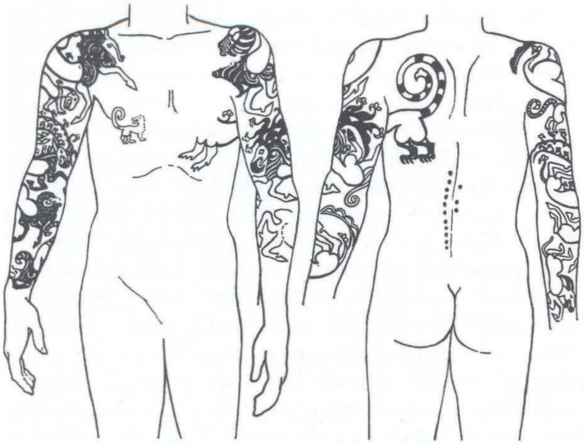
A slightly different phenomenon occurred in the Aleutian Islands, off the west coast of Alaska, where the dead were kept and naturally preserved in volcanically warmed caves that were extremely dry. Here the islanders seem to have enhanced the natural desiccation by periodically drying the bodies by wiping or suspension over a fire; in some cases they removed the internal organs and placed dry grass in the cavity.

Cold Environments. Natural refrigeration can hold the processes of decay in check for thousands of years. Perhaps the first frozen finds to be discovered were the numerous remains of mammoths encountered in the permafrost (permanently frozen soil) of Siberia, a few with their flesh, hair, and stomach contents intact. The unlucky creatures probably fell into crevices in snow, and were buried by silt in what became a giant deep-freeze. The best known are Beresovka, recovered in 1901, and baby Dima, found in 1977. Preservation can be still so good that dogs find the meat quite palatable and they have to be kept well away from the carcasses.

The most famous frozen archaeological remains are undoubtedly those from the burial mounds of steppe nomads at Pazyryk in the Altai, southern Siberia, dating to the Iron Age, about 400 BC. They comprise pits dug deep into the ground, lined with logs, and covered with a low cairn of stones. They could only have been dug in the warm season, before the ground froze solid. Any warm air in the graves rose and deposited its moisture on the stones of the cairn; moisture also gradually infiltrated down into the burial chambers, and froze so hard there during the harsh winter that it never thawed during subsequent summers, since the cairns were poor conductors of heat and shielded the pits from the warming and drying effects of wind and sun. Consequently, even the most fragile materials have survived intact – despite the boiling water that had to be used by the Soviet excavator, Sergei Rudenko, to recover them.

The Pazyryk bodies had been placed inside log coffins, with wooden pillows, and survived so well that their spectacular tattoos can still be seen. Clothing included linen shirts, decorated caftans, aprons, stockings, and headdresses of felt and leather. There were also rugs, wall-coverings, tables laden with food, and horse carcasses complete with elaborate bridles, saddles, and other trappings. A further well-preserved burial has been found in the region, containing a female accompanied by six horses and grave-goods including a silver mirror and various wooden objects.

Similar standards of preservation have also been encountered in other circumpolar regions such as Greenland and Alaska. The Barrow site is a good case in point (see box). Another Alaskan example comes from St. Lawrence Island, where the permafrost has yielded the body of an Inuit woman with tattooed arms



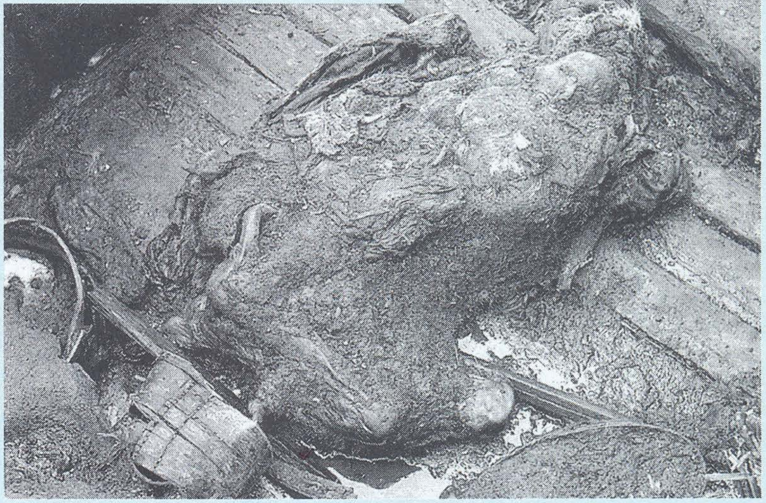
Frozen conditions of southern Siberia helped to preserve the remarkable finds from burial mounds of steppe nomads at Pazyryk dating from about 400 BC. (Left) Tattoo pattern on the torso and arms of a chieftain. (Right) Drawing of part of a Pazyryk wall-hanging in appliquéd felt, showing a horseman approaching an enthroned figure.

COLD PRESERVATION 1: THE BARROW SITE

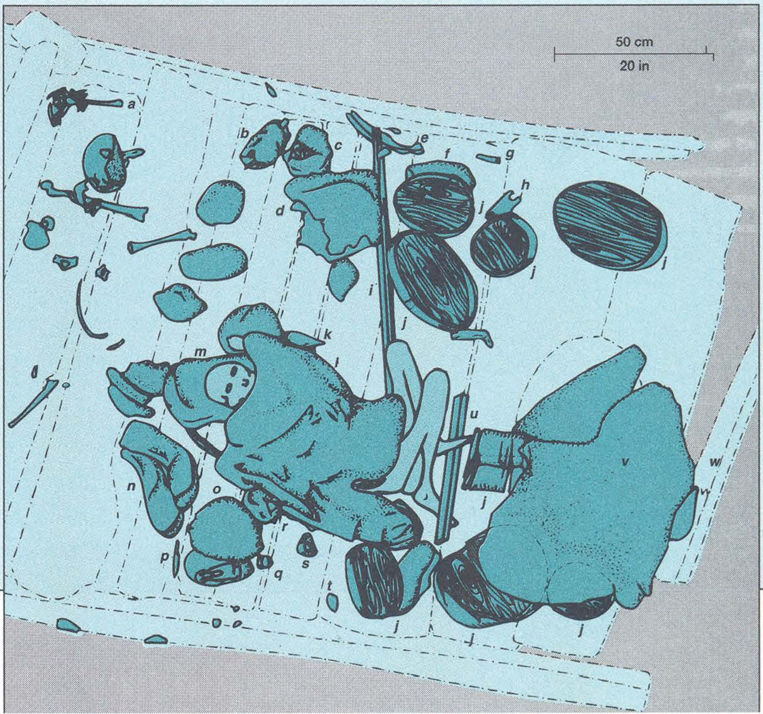
Many former living sites of Inuit, such as those of the Thule culture north of Hudson Bay, have fragile materials in a good state of preservation: wood, bone, ivory, feathers, hair, and eggshell. In the early 1980s, a driftwood-and-sod house was excavated by Albert Dekin and his colleagues at Utqiagvik, modern Barrow, on Alaska's north coast.

Built by Inupiat about 500 years ago, the house had been destroyed one winter's night by a storm which brought a mass of ice crashing down on its sleeping occupants. Like the Pazyryk tombs (see main text), the ruined house had been infiltrated by summer meltwater, which then froze permanently. Inside the solid earth, the excavators found the intact bodies of two women, while the bones of three youngsters lay nearer the surface (and thus had not been permanently frozen). Dekin and his colleagues also found clothing of caribou and sealskin; implements in a wide range of materials, including a wooden bucket; and tools and weapons arranged in kits according to function and season. Winter hunting equipment, for example – including snow goggles, ice picks, and harpoons – was stored in skin bags.

An autopsy on the two women – carried out with the permission of the modern community, to which all the bodies were later returned for reburial – showed that they had been adequately nourished in life, but had suffered from anthracosis (black lungs, from breathing smoke and oil-lamp fumes during the long winters) and also atherosclerosis (a narrowing of the arteries caused by deposits of cholesterol and fat, the result of a diet rich in whale and seal blubber). The older woman had recovered from pneumonia, but may also have suffered from trichinosis, a painful parasite infection of the muscles, perhaps caused by eating raw polar-bear meat.



One of the two female bodies (above; below) found on the house floor. KEY: a, wood snow-goggles; b, skin-wrapped arrowpoints; c, skin bag with weights; d, hide fragment; e, whalebone ice pick; f, polar-bear-hide mitten; g, ivory comb; h, baleen comb; i, wood shaft; j, wood buckets; k, wood ladle; l, hide blanket; m, skin bag used as pillow; n, boots; o, gut bag; p, antler arrowpoint; q, baleen container; r, skin bag with sewing kit; s, bird-skin bag; t, slate blade; u, wood slat; v, walrus hide; w, ceramic pot.



COLD PRESERVATION 2: THE ICEMAN

The world's oldest fully preserved human body was found in September 1991 by German hikers near the Similaun glacier, in the Ötztaler Alps of South Tyrol. They spotted a human body, its skin yellowish-brown and desiccated, at an altitude of 3200 m (10,500 ft). It was four days before the body and its accompanying objects were removed by Austrian authorities and taken to Innsbruck University. There were already suspicions that the corpse might be old, but nobody had any idea just how ancient. The Iceman is the first prehistoric human ever found with his everyday clothing and equipment, and presumably going about his normal business; other similarly intact bodies from prehistory have been either carefully buried or sacrificed. He brings us literally face to face with the remote past.

The body was handed to the Innsbruck Anatomy department for treatment, after which it was placed in a freezer at -6° C (21° F) and 98 percent humidity. Subsequent investigation determined that the corpse – called Similaun Man, Ötzi, or simply the "Iceman" – had lain *c.* 90 m (300 ft) inside Italy, and he was returned there, to a museum in Bolzano, in 1998. Considerable work has been carried out on the objects that accompanied the Iceman but, apart from scans of his body and radiocarbon dating, very little has yet been done with the corpse. Fifteen radiocarbon dates have been obtained from the body, the artifacts, and the grass in the boots: they are all in rough agreement, falling in a range of 3365–2940 BC, averaging at 3300 BC.

According to the investigators, the Iceman was probably overcome by exhaustion on the mountain – perhaps caught in a fog or a blizzard. After death, he was dried out by a warm autumn wind, before becoming encased in ice. Since the body lay in a depression, it was protected from the movement of the glacier above it for 5300 years, until a storm from the Sahara laid a layer of dust on the ice that absorbed sunlight and finally thawed it out.

What Did He Look Like?

He was a dark-skinned male, aged in his mid- to late 40s, with a cranial capacity of 1500–1560 cc. Only about 1.56–1.6 m (5ft 2 in) tall, his stature and

The Iceman, *the oldest fully preserved human, as found in 1991, emerging from the melting ice that had preserved him for over 5000 years.*

morphology fit well within the measurement ranges of Late Neolithic populations of Italy and Switzerland. Preliminary analysis of his DNA confirms his links to northern Europe.

The corpse currently weighs only about 54 kg (120 lb). His teeth are very worn, especially the front incisors, suggesting that he ate coarse ground grain, or that he regularly used them as a tool; there are no wisdom teeth, which is typical for the period, and he has a marked gap between his upper front teeth.

When found he was bald, but hundreds of curly brownish-black human hairs, about 9 cm (3.5 in) long, were recovered from the vicinity of the body and on the clothing fragments. These had fallen out after death and it is possible he had a beard. His right earlobe still retains traces of a pit-like, sharp-edged rectangular depression, indicating that he once probably had an ornamental stone fitted there.

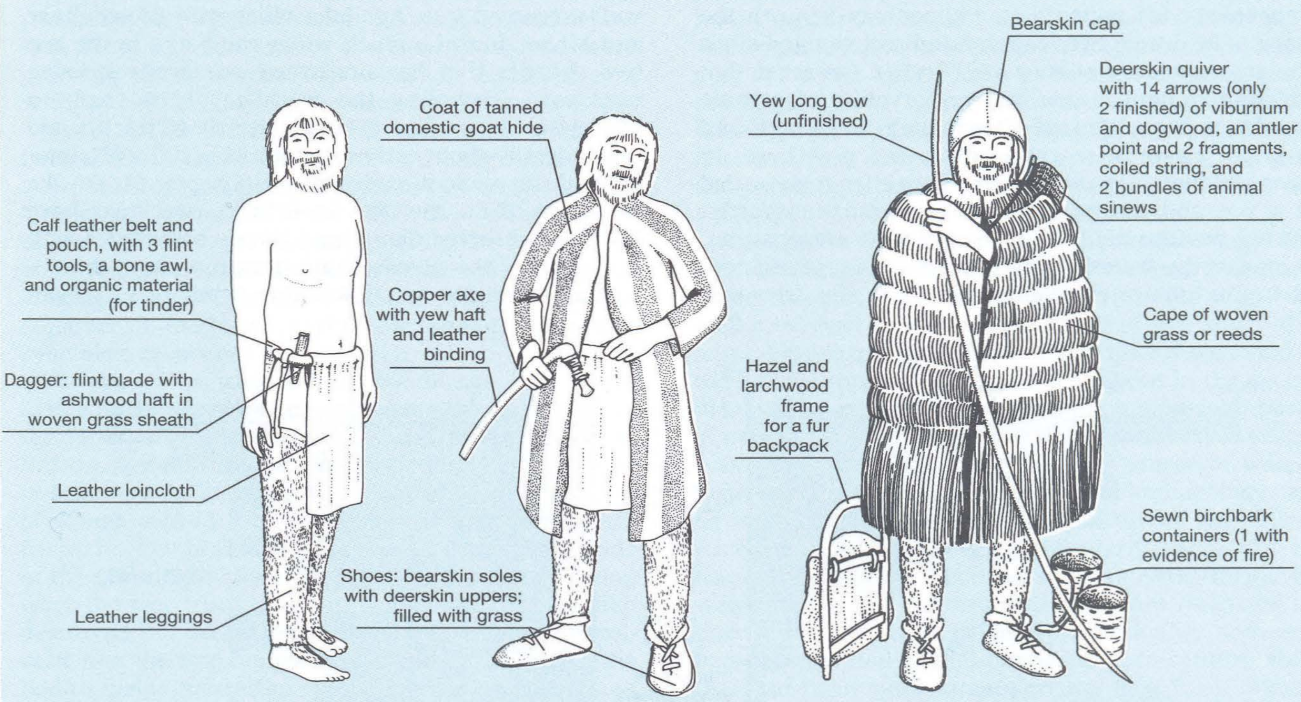
A body scan has shown that the brain, muscle tissues, lungs, heart, liver, and digestive organs are in excellent condition, though the lungs are blackened by smoke, probably from open fires, and he has hardening of the arteries and blood vessels. The isotopic composition of his hair (see p. 309) suggested that he had been a strict vegetarian for the last few months of his life, but traces of meat have been found in his colon, and his final meal appears to have consisted of meat (probably ibex), wheat, plants, and plums.

Traces of chronic frostbite were noted in one little toe and 8 of his ribs were fractured, though these were healed or healing when he died. A fracture to left arm and severe damage to the left pelvic area occurred during his recovery from the ice.

Groups of tattoos, mostly short parallel vertical blue lines were discovered on both sides of his lower spine, on his left calf and right ankle, and a blue cross on his inner right knee. These marks may be therapeutic, aimed at relieving the arthritis which he had in his neck, lower back, and right hip.

His nails had dropped off, but one fingernail was recovered. Its analysis revealed not only that he undertook manual labor, but also that he experienced periods of reduced nail growth corresponding to episodes of serious illness – 4, 3, and 2 months before he died. The fact that he was prone to periodic crippling disease may help explain how he fell prey to adverse weather and froze to death.

The items found with him constitute a unique "time-capsule" of everyday life, many made of organic materials that were preserved by the cold and ice. An great variety of woods and a range of sophisticated techniques of working with leather and grasses were used to create the collection of 70 objects, which add a new dimension to our knowledge of the period.



The equipment and clothing of the Iceman are a virtual time-capsule of everyday life – over 70 objects were found associated with him.

dating to the early centuries AD. More southerly regions can produce the same effect at high altitude, for instance the Inca-period tomb at Cerra El Plomo in the Andes, which contained the naturally freeze-dried corpse of a boy wearing a camelid-wool poncho; or the 5300-year-old Iceman found preserved in the ice in the Alps near the border between Italy and Austria (see box, pp. 66–67).

In Greenland, the Inuit bodies of Qilakitsoq, dating to the 15th century AD, had also undergone natural freeze-drying in their rock-overhang graves protected from the elements; their tissue had shrunk and become discolored, but tattoos were still visible (see box, pp. 444–45), and their clothes were in particularly fine condition.

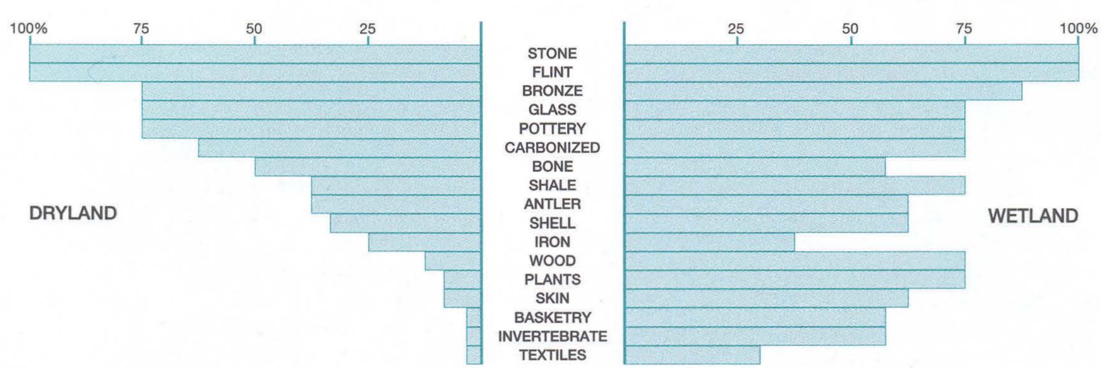
A more modern example of natural refrigeration can be found in the Arctic graves of three British sailors who died in 1846 on the expedition of Sir John Franklin. The bodies were perfectly preserved in the ice of northern Canada's Beechey Island. In 1984 a team led by the Canadian anthropologist Owen Beattie simply removed samples of bone and tissue for an autopsy, before reburying the corpses.

Waterlogged Environments. A useful distinction in land archaeology (as opposed to archaeology beneath the sea) can be drawn between dryland and wetland sites. The great majority of sites are "dry" in the sense that moisture content is low and preservation of organic remains is poor. Wetland sites include all those found in lakes, swamps, marshes, fens, and peat bogs. In these situations organic materials are effectively sealed in a wet and airless (anaerobic or, more correctly, anoxic) environment which favors their preservation, as long as the waterlogging is more or less permanent up to the time of excavation. (If a wet site dries out, even only seasonally, decomposition of the organic materials can occur.)

One of the pioneers of wetland archaeology in Britain, John Coles, estimates that on a wet site often 75–90 percent, sometimes 100 percent, of the finds are organic. Little or none of this material, such as wood, leather, textiles, basketry, and plant remains of all kinds, would survive on most dryland sites. It is for this reason that archaeologists are turning their attention more and more to the rich sources of evidence about past human activities to be found on wet sites. Growing threats from drainage and peatcutting in the wetlands, which form only about 6 percent of the world's total land area, give this work an added urgency.

Wetlands vary a great deal in their preservative qualities. Acidic peat bogs are kind to wood and plant remains, but may destroy bone, iron, and even pottery. The famous lake sites of the Alpine regions of Switzerland, Italy, France, and southern Germany on the other hand preserve most materials well.

Peat bogs, nearly all of which occur in northern latitudes, are some of the most important environments for wetland archaeology. The Somerset Levels in southern England, for example, have been the scene not only of excavations earlier this century to recover the well-preserved Iron Age lake villages of Glastonbury and Meare, but of a much wider campaign in the last two decades that has unearthed numerous wooden trackways (including the world's "oldest road," a 6000-year-old 1.6-km (1-mile) stretch of track), and many details about early woodworking skills (Chapter 8), and the ancient environment (Chapter 6). On the continent of Europe, and in Ireland, peat bogs have likewise preserved many trackways – sometimes with evidence for the wooden carts that ran along them – and other fragile remains. Other types of European



Survival rates for different materials in wet and ordinary dryland sites. Organic remains survive best in wetlands.

In 1998, erosion exposed this amazing monument, in peat levels dating to the Bronze Age, at Holme-next-the-Sea on England's Norfolk coast. An inverted oak tree, pushed into the ground with roots upwards, is surrounded by an oval ring of 54, close-set timber posts, mostly split oaks. Preserved by burial under sand and brine, it is thought to be a ritual structure, perhaps an "altar" for exposing corpses which would then be taken away by the sea. It has recently been tree-ring dated to c. 2050/2049 BC.

wetlands, such as coastal marshes, have yielded dug-out logboats, paddles, even fish-nets and fish-weirs.

Bog bodies, however, are undoubtedly the best-known finds from the peat bogs of northwest Europe. Most of them date from the Iron Age. The degree of preservation varies widely, and depends on the particular conditions in which the corpses were deposited. Most individuals met a violent death and were probably either executed as criminals or killed as a sacrifice before being thrown into the bog (see box, pp. 448–49). The best-preserved examples, such as Denmark's Tollund Man, were in a truly remarkable state, with only the staining caused by bogwater and tannic acid as an indication that they were ancient rather than modern. Within the skin, the bones have often disappeared, as have most of the internal organs, although the stomach and its contents may survive (Chapter 7). In Florida, prehistoric human brains have even been recovered (Chapter 11).

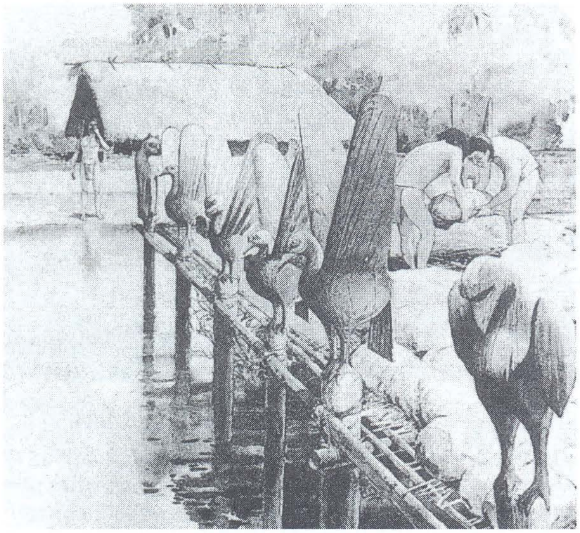
Occasionally, waterlogged conditions can occur inside burial mounds – a temperate-climate version of the Siberian phenomenon. The oak-coffin burials of Bronze Age northern Europe, and most notably those of Denmark dating to about 1000 BC, had an inner core of stones packed round the tree-trunk coffin, with a round barrow built above. Water infiltrated the inside of the mound and by combining with tannin exuding from the tree trunks, set up acidic conditions which destroyed the skeleton but preserved the skin (discolored like the bog bodies), hair, and ligaments of the bodies inside the coffins, as well as their clothing and objects such as birch-bark pails.

A somewhat similar phenomenon occurred with the ships that the Vikings used as coffins. The Oseberg ship in Norway, for example, held the body of a Viking queen of about AD 800, and was buried in clay, covered by a packing of stones and a layer of peat that sealed it in and ensured its preservation.

Lake-dwellings have rivaled bog bodies in popular interest ever since the discovery of wooden piles or house supports in Swiss lakes well over a century ago. The romantic notion of whole villages built on stilts over the water has, thanks to detailed research since the 1940s, given way to the idea of predominantly lake-edge settlements. The range of preserved material is astonishing, not simply wooden structures, artifacts, and textiles but, at Neolithic Charavines in France for example, even nuts, berries, and other fruits.

Perhaps the greatest contribution to archaeology that lake-dwellings and other European wetland sites have made in recent years, however, is to provide abundant well-preserved timber for the study of tree rings, the annual growth rings in trees. In Chapter 4 we explore the breakthrough this has brought about in the establishment of an accurate tree-ring chronology for parts of northern Europe stretching back thousands of years.

One might add that another rich source of waterlogged and preserved timbers in land archaeology can be found in the old waterfronts of towns and cities. Archaeologists have been particularly successful in uncovering parts of London's Roman and medieval waterfront, but such discoveries are not restricted to Europe. In the early 1980s New York City archaeologists excavated a well-preserved 18th-century ship that had been sunk to support the East River waterfront there. Underwater archaeology itself, in rivers and lakes and especially beneath the sea, is not surprisingly the richest source of all for waterlogged finds



Reconstruction of Okeechobee burial platform, Florida.

(box, p. 95). Coastal erosion can also reveal once submerged structures, such as the recently discovered prehistoric timber circle on the eastern coast of England.

The major archaeological problem with waterlogged finds, and particularly wood, is that they deteriorate rapidly when they are uncovered, beginning to dry and crack almost at once. They therefore need to be kept wet until they can be treated or freeze-dried at a laboratory. Conservation measures of this kind help to explain the enormous cost of both wetland and underwater archaeology. It has been estimated that "wet archaeology" costs four times as much as "dry archaeology." But the rewards, as we have seen above, are enormous.

The rewards in the future, too, will be very great. Florida, for example, has about 1.2 million ha (3 million acres) of peat deposits, and on present evidence these probably contain more organic artifacts than anywhere else in the world. So far the wetlands here have yielded the largest number of prehistoric watercraft from any one region, together with totems, masks, and figurines dating as far back as 5000 BC. In the Okeechobee Basin, for instance, a 1st-millennium BC burial platform has been found, decorated with a series of large carved wooden totem posts, representing an array of animals and birds. After a fire, the platform had collapsed into its pond. Yet it is only recently that wet finds in Florida have come to us from careful excavation rather than through the drainage that is destroying large areas of peat deposits and, with them, untold quantities of the richest kinds of archaeological evidence.

SUMMARY

The archaeological evidence available to us depends on a number of important factors: first, what people, past and present, have done to it (cultural formation processes); second, what natural conditions such as soil and climate have preserved or destroyed (natural formation processes); and third, our ability to find, recognize, recover, and conserve it. We can do nothing about the first two factors, being at the mercy of the elements and previous human behavior. But the third factor, which is the subject of this book, is constantly improving, as we understand better the processes of decay and destruction, and design research strategies and technical aids to make the most of what archaeological evidence actually survives.

FURTHER READING

Good introductions to the problems of differential preservation of archaeological materials can be found in:

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