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## Caves, Rockshelters, and Open-air Sites

The archaeological sites of our earliest ancestors fall into three types: caves, rockshelters, and open-air sites. Each has produced important evidence for the evolution of our species and the technologies they employed. Caves are generally described as subterranean passages that have three distinct elements: a light zone, where natural sunlight illuminates the entrance to the cave; an intermediate zone, where natural light penetrates but does not brightly illuminate the interior of the cave; and a dark zone, in which no natural light of any kind can be seen. There is a common belief that most of our ancestors were "cavemen" and lived in the deep interiors of caves, but this is a misconception. Although some of our ancestors, notably *Homo neanderthalensis* as well as our own species, used the light zones of caves for habitations, none ever used the dark zones of these spaces as habitations. However, there is ample evidence from the Upper Paleolithic of western Europe that dark zones were used for ritual purposes. Examples of caves used in this manner include Lascaux, Altamira, and Chauvet Cave.

Occasionally, however, remains of our ancestors are found deep in the dark zones of caves. Examples include Swartkrans in southern Africa and Sima de los Huesos in Atapuerca, Spain. At Swartkrans, the remains of australopithecines found in the caves appear to have been deposited by predators who consumed their prey while resting in trees above the entrance to the cave. The bones, some of which exhibited tooth marks, fell into the entrance, which later collapsed. At Sima de los Huesos, however, the remains of a Neanderthal-like species appear to

### DK 1

The Lower Paleolithic site of DK1 (Douglas Korongo) in Olduvai Gorge, Tanzania, dates to approximately 1.75 million years ago. Excavations lead by Mary Leakey in 1962 uncovered Olduwan artifacts, including choppers, polyhedrons, discoids, spheroids and scrapers, fragmented animal bones, and a partial *Homo habilis* skull. Associated with these remains was a circular concentration, 13–16 feet (4–5 meters) in diameter, of loosely piled basalt rocks on the same surface upon which the artifacts were found. Most of the rocks measured 4–10 inches (10–25 centimeters) long. The maximum height of the stone concentration was 11.8 inches (30 centimeters). The area immediately outside the stone circle, within a radius of about 20 inches (50 centimeters), was relatively void of stones. Leakey suggests that this feature was either the remnants of a stone windbreak or the base of a rough shelter. If this is the case, it may be the oldest structure in the world. Conversely, Potts argues that the circular feature was created naturally. He proposes that lateral tree roots growing into the lava deposit directly below the site broke it apart and brought the basalt rocks to the surface. Even if Potts is correct, there is no doubt that *Homo habilis* manufactured stone tools at DK1.

*—Shawn Bubel*

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## LE LAZARET

Le Lazaret cave is located in southern France. It was occupied sometime between 186,000 and 127,000 years ago. The spatial location of the Acheulean archaeological remains suggests the construction of a structure inside the cave. Lithic artifacts and fragmented animal bones were found concentrated between the cave wall and a line of large rocks in an area approximately 36 by 11 feet (11 by 3.5 meters). The excavators speculate that the rock line supported poles used to pitch a tent against the cave wall. Possible entrances are marked by two breaks in the rock line, where artifacts flow out of the structure. Two circular charcoal pockets, thought to be hearths, were located near the cave wall. Interestingly, a large number of small seashells were also found, which may have been attached to seaweed brought into the cave for bedding. Substantive evidence confirming the presence of a human-constructed shelter at Le Lazaret is absent, however.

*—Shawn Bubel*

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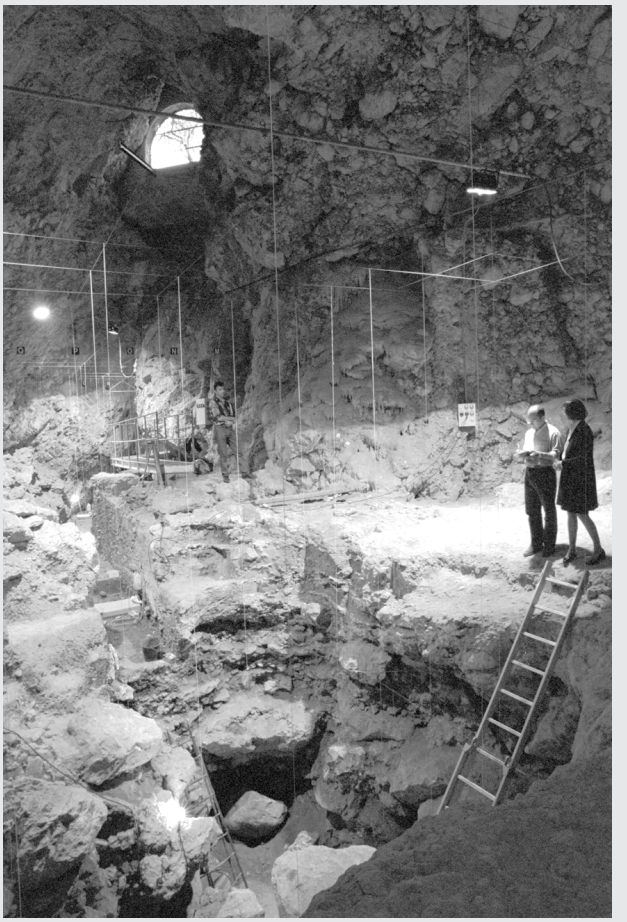

*Excavation at Le Lazaret cave in southern France. (Marc Charuel/Sygma/Corbis)*

have been intentionally deposited into the cave system essentially intact. This may represent a form of early mortuary, or burial practice, but since almost no other material aside from bones has been recovered from the cave, it is difficult to make this assertion.

Rockshelters are natural features that exhibit overhangs that protect inhabitants from wind, rain, snowfall, or other elements. Rockshelters do not have dark zones. In the modern era, hunters and gatherers use these overhangs for temporary camping stops or as habitations and occupied them for relatively long periods of time. These kinds of uses can also be seen deep in our prehistory.

Open-air sites are found in many different kinds of places upon the landscape. The simplest of these may be sites where someone had stopped to knap flint to make a stone tool. Here, the remains left behind would be very sparse. Some open-air sites are long-term habitations and contain the remains of structures and other features built by our ancestors. Depending on how long or how many times the sites were occupied, these sites can accumulate large amounts of artifacts.

Because they are relatively easy to locate, caves and rockshelters have been worked extensively by archaeologists seeking to obtain data about our deep past. In contrast, open-air sites

of early time periods are very difficult to locate because in many cases, they have been buried or destroyed by natural processes. However, to get a complete picture of the lifeways of our ancient ancestors, it is important to make an effort to discover sites of all three types, because each provides a slightly different picture of how people used the landscape in the past.

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## Fire

The ability to control fire is a milestone in human evolution. Where and when this was achieved is intensely debated, however. Many archaeologists suggest that fire was first controlled in Africa and that it is this skill that allowed the hominids to travel out of Africa into Asia and Europe. Others believe that fire was controlled long after the migration to regions outside Africa. Resolving this issue is complicated due to lack of preservation and the difficulty of distinguishing a natural fire from a cultural one.

Evidence for the earliest human-made fire may come from the sites of Koobi Fora and Chesowanja in Kenya. Baked clay deposits dating to 1.5–1.4 million years ago suggest purposely lit fires, although Isaac argues that naturally ignited smoldering vegetation could have produced the same results. Pieces of burned bone were found in cave deposits dating between 1.4 million and 1.0 million years ago at Swartkrans, South Africa. According to Brain and Sillen, the 270 charred bone fragments denote controlled fire use. Their experiments demonstrated that the bones were heated beyond what a natural fire would produce, but other scholars remain unconvinced. Similar disagreements relating to the dispersed ash found at the Cave of Hearths and Montagu Cave in South Africa persist.

Lower Paleolithic sites outside Africa are marked with the same problems. Dispersed charcoal was found at Torralba and Ambrona, Spain, as well as at Prezletice in the Czech Republic, but there is no way to prove human involvement. Alternatively, the circular feature of fire-cracked basalt rocks at the 700,000-year-old site of Kao Poh Nam, Thailand, could be the oldest campfire, but this discovery awaits authentication. What seems to be the oldest confirmed evidence of culturally made fire comes from Locality 1 at Zhoukoudian, China. Thick ash deposits, ash lenses, burned stones and bones, and charcoal pieces dating to as old as 600,000 years ago were found at the site. Although the thicker ash beds and some of the burned remains may have been deposited in the cave by natural processes, the ash lenses seem to attest to human activity. However, it is not until the Middle Paleolithic period (beginning around 250,000 years ago) that unequivocal evidence of human-made hearths is seen.

Regardless of when humans learned to control fire, they probably first obtained it from sources that were already burning, such as brush fires, volcanic eruptions, and oil and gas seepages. Early humans may have camped near or used the natural resource to scare off predators or warm themselves. Once they learned how to harness fire, they were able to use it at distant open-air and cave sites, especially those that required protection from predators.

*—Shawn Bubel*

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## Seeing Evidence of Fire in Deep Antiquity

When our ancestors began to control and use fire in their daily lives is a contentious issue in the discipline of archaeology. Fires, of course, can be created by natural events such as lightning strikes, and so it is crucial to define what kinds of evidence are unequivocal indicators of hominin or human activity. Ideally, the best evidence would be from hearths, or intentional facilities created by our ancestors to contain the fire. Burned or charred bone, burned artifacts, remains of wood ash, soil discolorations resulting from heating, and combinations of these found in a small, apparently bounded, space would be most convincing. Such features become very common after 130,000 years ago and thus indicate that *Homo sapiens sapiens* had full control of fire. But are there any earlier sites?

Because of problems of archaeological site preservation, the data on the deep antiquity of the use of fire is very scarce. Sites like caves or rockshelters, for example, are likely to preserve evidence of fire better than open-air sites. The two early sites that have the best, if still controversial, evidence for the controlled use of fire are Gesher Benot Ya'aqov in Israel, dated to approximately 800,000 years ago, and Zhoukoutien in China, which is dated to between 670,000 and 400,000 years ago. At Gesher Benot Ya'aqov, small concentrations of burned lithic debris are surrounded by scatters of unburned artifacts and animal bones. These concentrations may be hearths in the sense described above. At Zhoukoutien, thin strata of burned soils that contain charred and burned bones suggest hearths as well. Both of these sites fall within the time frame of *Homo erectus*, and fossil remains of this species have been recovered from Zhoukoutien.

Understanding when our ancestors began to use and control fire has a number of important implications for the history of our species. Fire

### ZHOUKOUDIAN

Zhoukoudian (Locality 1) is a cave site situated 30 miles (45 kilometers) southwest of Beijing. Excavations began in 1927, and since then remains of more than 40 *Homo erectus* individuals and roughly 100,000 artifacts belonging to the Chopper-chopping tool industry have been discovered. In addition, thick ash beds, ash lenses, burned stones and bones, and charcoal pieces were found throughout the 131 feet (40 meters) of deposits. Tattersall and Schwartz note that the thicker ash beds and some of the burned remains may have been deposited by natural processes, but most archaeologists are convinced that the ash lenses attest to learned fire technology. Based on recent dates acquired, the site was occupied for 350,000 years, between about 600,000 and 250,000 years ago. If *Homo erectus* is responsible for the ash lenses, Locality 1 may be the earliest site in the world with culturally made campfires.

*—Shawn Bubel*

*(Best View Stock)*

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would have made it possible for our ancestors to use the coldest environments on the planet. The absence of sites in much of the higher latitudes of the Northern Hemisphere before 400,000 years ago suggests that the controlled use of fire was not widespread before that. Fire is also important because cooking makes all foods more digestible. The common use of fire after 130,000 years ago may be a signal of one aspect of behavioral modernity in our species, one that may have given those groups who controlled it effectively a competitive edge over those who did not.

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## Introduction: The Tools and Technologies of Early Modern Humans, 100,000–10,000 Years Ago

With the appearance of anatomically modern humans after 100,000 years ago, stone tool technologies underwent a series of dramatic changes when contrasted to earlier periods of human evolution. For the preceding two million years, the pace of technological change was relatively slow, and new technologies and tool forms appeared fairly gradually. In contrast, after 100,000 years ago the pace of change in the range of flint knapping (stone toolmaking) technologies and the numbers of tool forms themselves intensified. These changes can be attributed to a number of factors, the most prominent of which was the expansion of niches occupied by our species. After 60,000 years ago, our ancestors began to move for the second time out of Africa and into a series of highly diverse ecological niches, including deserts, high plateaus, the subarctic, and tropical forests. Although the characteristics of an ecological niche do not in themselves determine the specific stone tool reduction strategies or the forms that tools take, it is clear that different niches created new constraints and opportunities for our ancestors regarding their subsistence adaptations and also that changes in stone tool technologies were an integral aspect of the process of adaptation to them.

The term "Upper Paleolithic" is often used to describe the stone tool technologies of this period, and historically it has been generally applied to technologies found in Europe and the Near East. This generic term is replaced with more regional and local terms as the number of dated tool assemblages from excavated archaeological contexts increases.

Although different niches led to the development of distinctive local technologies and tool forms, four general trends that crosscut these niches can be observed: the appearance of sophisticated bifacial reduction strategies, blade-core technologies, more special-purpose tools, and a wide range of composite tools.

Although bifacial technologies can be found as early as the Acheulean tradition, after 100,000 years ago bifacial tool reduction strategies became more sophisticated. Bifacial strategies conserve raw material because more finished forms can be made for a given quantity of raw material. Bifacial tools are those that are worked on two faces, and the most common of the tool forms produced by this technology are projectile points of different shapes and sizes, depending on the task for which they are intended. Tool functions served well by bifacial implements also include cutting and slicing soft materials ("knives" with thin sharp edges) and sawing or whittling wood, bone, or antler (tools with thicker edges).

Blade-core technologies create prismatic blades, which are long, thin, and narrow flakes. This reduction strategy conserves even more raw material than a bifacial strategy. Blades can be easily transformed into a wide variety of useful tools, including burins, scrapers, awls, and knives.

Throughout this period, the number of tool forms increases dramatically. New technologies

make this possible, but the appearance of such diversity in tool forms also means that our ancestors were using them for a wider range of activities. Ethnography informs us that tools become more specialized in their forms as they are turned to very specific tasks.

A good example of this is the set of tools used for hide working. Our ancestors used animal hides for shelter and also for clothing of different styles and qualities. To make simple cloaks of hide, it is only necessary to remove the fatty tissue on the inside of the hide to make it usable. Relatively large crude scraping tools are sufficient for this task. However, as clothing becomes more complex and requires more steps for its production, more tool forms are required. Although the larger tools may still be used for the initial steps of hide preparation, smaller tools with specific forms, perhaps hafted, may be used for finer work in which more control is required.

Another set of tool forms that appears during this period is that used to work bone, antler, and wood. Although it is likely that more distant ancestors used stone to work these materials, apparently these activities did not require special tool morphologies. In the Upper Paleolithic, special tool forms to work these materials become more common. Tools such as burins, easily made from prismatic blades, are used to score and groove bone or antler so that it can be carved or split more easily. The end products of bone working were tools such as barbed projectile points, bone or antler hafts, harpoons, and needles.

Composite tools are those made of more than one raw material. The simplest composite tool is a spear made of wood tipped with a stone or bone point. This kind of composite tool was probably made by *Homo neanderthalensis*. However, during the Upper Paleolithic, the range of composite tools increased dramatically. Many of these tools were used for hunting. For instance, wooden spear shafts were edged with small broken segments of prismatic blades (bladelets). This created a weapon that would tear flesh more effectively than a spear tipped with a stone point. One important innovation in hunting tools was to create so-called foreshafts, which were smaller bone or antler tools that were placed on the end of wooden spears. The stone tip would then be placed in the foreshaft. Archaeologists believe that foreshafts were created to preserve the most expensive part of the hunting equipment, which was the wooden shaft of the spear itself. Small, more specialized stone tools were used to make these foreshafts.

At the end of the Upper Paleolithic, primarily in the Near East, a new stone tool reduction strategy emerges, one based upon the creation of small blades, or microliths. The term "Epipaleolithic" is used to describe the cultures making these tools. Microblades are intentionally made very small blades that are used in composite tools similar to those made with snapped bladelets made during the Upper Paleolithic. Some archaeologists have argued that microlithic tools were used to make complex hunting weapons that were used to hunt a wider variety of animals, including smaller species that were ignored in previous periods. This change in stone tool technology and hunting strategy is coincident with increased reliance upon wild plants and increasing sedentism. Microlithic technologies became much more common across much of the Old World as deglaciation progressed.

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## Hands, Minds, and Tools

The ability to use tools is not restricted to humans. Chimpanzees in West Africa use sticks to batter the shells of nuts to crack them open. What distinguishes the use of tools among humans from the realm of other living creatures is the diversity and sophistication of tools for general and specialized use that humans have designed in the course of cultural history. The ability to use tools reaches beyond our species (i.e., *Homo sapiens sapiens,* or modern humans) into the remote past and includes various earlier hominins, the first being *Homo habilis*.

The earliest tools that were made of stone appear some 2.6 million years ago, found at sites in Ethiopia (Hadar and Gona regions) and Kenya (shore of Lake Turkana). According to their