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# The Prehistoric Archeology of Mammoth Cave

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## Abstract

The prehistory of the Mammoth Cave area has been of interest to archeologists for more than a century because of the remarkable preservation in the dry cave environment. Beginning with the antiquarian search for mummified bodies in the early nineteenth century up to the most modern scientific research, Mammoth Cave has revealed important information about the Native Americans who lived near and explored these cave systems beginning more than 5000 years ago. The first interest in Mammoth Cave may have simply been human curiosity, but by 3000 years ago Native Americans began mining several exotic minerals that form in the large, dry passages. They left behind tools and other remains from this mining effort that has been important for understanding the beginnings of the first farming societies in eastern North America and provides insight into their ritual and ceremonial life. By 2000 years ago, that mining ceased and Native Americans do not seem to have returned to the cave in any large numbers, although other caves in the area continued to be visited for other purposes. This is the story of the archeology of Mammoth Cave and what we have learned about the first Native Americans who explored its passages.

In the bluffs along the Green River and in the coves and hollows that carve up the sandstone plateau of Mammoth Cave National Park, known as the Chester Upland, cave entrances and rock overhangs or rockshelters can be found in abundance. Where these natural shelters are suitable—dry and roomy with relatively level floors—prehistoric Native Americans, ancestors of American Indians, left numerous remains from their past activities. They built fires, made stone tools from locally occurring chert (a fine-grained, silica-rich rock commonly found in limestone formations), butchered and cooked game animals and fish that were abundant in the region, gathered numerous plants for food and to make tools or shelter, and occasionally buried deceased members of their group in these shelters. They also explored the deep passages of many caves. This is the story of what we know about these prehistoric cave explorers, how

they used the deep caves, and about the archeology that has helped piece together this story.

Dr. Patty Jo Watson, who has spent a lifetime studying the prehistory of the Mammoth Cave area (Watson 1969, 1997), has called the aboriginal people who once traveled the labyrinthine routes of Mammoth and Salts Caves “the world’s greatest cave explorers.” This is not an exaggeration. Beginning some 4500–5000 years ago, prehistoric people began venturing into the remote depths of the large, dry passages of several caves that comprise the Mammoth Cave system. Bundling together dry river cane, weed stalks, or woody stems to make torches, they lit their way through large passages and tight crawlways leaving behind a trail of charred torch material and marks from their torches where they stoked them against the walls to keep them lit (Figs. 2.1 and 2.2). Archeologists have found evidence of this exploration upward of 6–8 km (4.7–5.0 miles) from any known natural cave entrance. Although some caves in other parts of the world were explored earlier, and perhaps used more intensively, no caves show such deep exploration and extensive use as Mammoth and Salts Caves in Mammoth

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Cave National Park. Indeed, Watson once wrote: “Virtually everywhere we have gone in Upper Salts, whether via the main passages or routes through the breakdown, we have found plentiful remains left by the aboriginal cave explorers” (1969: 3).

However, it was not just curiosity that enticed prehistoric people to explore Mammoth Cave. Beginning approximately 3000 years ago, the minerals that form in some dry passage ways, especially gypsum or calcium sulfate dihydrate, became of interest to these cave explorers and considerable effort was made to remove them. This mining ended about a millennium later for reasons unknown to us. From 2000 years ago until the first European-Americans and African-Americans began exploring Mammoth Cave in the late eighteenth century, there appears to have been little or no use of these large caves by Native Americans. Other caves in the region do show continued use, but not in the manner of Mammoth or Salts Caves. Before we go farther into the world of cave archeology, however, it is useful to set the stage above ground.

## 2.1 The Prehistory of Central Kentucky

The verdant Green River valley would have been a paradise for the first hunters and gatherers who ventured into this area during the Paleo-Indian Period. Very distinctive stone tools, identified as the Clovis artifact complex, first appeared in Kentucky at the end of the last Ice Age or the Late Pleistocene Epoch, possibly as early as 11,500 years ago. The climate was cooler and wetter than today and megafauna, such as woolly mammoths, mastodons, and giant ground sloths, still roamed North America. Some of these animals were most certainly hunted by Paleo-Indians, but the Green River valley was rich with numerous plant and animal food sources that we are more familiar with today: whitetail deer, wild turkey, fish, hickory nuts, and acorns. Several Clovis sites are known from the lower Green River valley outside of Mammoth Cave National Park, including sites in rockshelters and cave entrances. However, we have no evidence of Clovis people venturing into deep caves. What they thought of the yawning entrance to Mammoth Cave when it was first encountered, we will never know.

After the Ice Age, the Holocene or current climate period stabilized into the pattern we are familiar with today. Although megafauna became extinct, whitetail deer and other forest animals continued to be hunted. An increasingly important component of the diet during the early Holocene, or what archeologists call the Archaic Period, was fish and shellfish. In modern times, the Green River downstream of Mammoth Cave has been dredged and the river level raised by locks and dams for navigation, but formerly it teemed with a great diversity of freshwater mussels that could be



**Fig. 2.1** Torch marks on a cave wall. *Photograph by Ben Miller*



**Fig. 2.2** The unburned ends of torch remains, which can be found in dry caves

easily collected from the shallow rapids. Fish such as catfish, drum, and buffalo fish also could be taken easily in the deeper pools by hand line or collected from shoals when they were spawning. Add to this diet, nutritious nuts from hickory and black walnut trees, which are common in central Kentucky, and you have the basis of an extremely healthy diet and plentiful food resources for the Archaic Period Indians who lived in central Kentucky. There is abundant, well-preserved evidence of this Archaic Period lifestyle from deeply stratified shell middens that are found along the middle and lower Green River dating between 7000 and 3000 years ago. These sites are rich with the shells of freshwater mussels, the bones of fish and mammals, carbonized nutshells and seeds, and many artifacts made of bone and stone (Marquardt and Watson 2005).

The Archaic Period Indians also were very familiar with the Mammoth Cave region, as indicated by the numerous sites dating from this time period found throughout the park. The rugged country in Mammoth Cave National

Park—narrow river valley, steep ridges, and intervening karst valleys—is not particularly conducive to preserving large open-air sites, but rockshelters and cave entrances provided commodious living spaces. In 1916, Nels C. Nelson of the American Museum of Natural History was one of the first professional archeologists to conduct work at Mammoth Cave (Nelson 1917). Although Nelson collected representative artifacts from the interior of Mammoth and Salts Caves, his primary interest was in conducting excavations in the vestibule or antechamber to Mammoth Cave. From this work, Nelson determined that considerable camp refuse was present, indicating a relatively long period of occupancy by prehistoric Indians. He concluded “that all traces of maize growing, pottery making, and the production of polished stone implements characteristic of the Mound-builder culture as a whole are entirely absent” (1917: 68). That is, the artifact assemblage was from a stone-age culture, pre-dating the invention of pottery and the construction of earth works and burial mounds. In 2003, a small archeological testing project in Mammoth Cave vestibule—part of trail construction improvements—was able to sample the camp refuse first identified by Nelson. Radiocarbon determinations on charcoal recovered from these deposits indicate that this camp refuse is at least 5380–5650 years old.<sup>1</sup>

It was during the Archaic Period occupation of Mammoth Cave vestibule that the first people began venturing into the deeper recesses of the cave. The two oldest radiocarbon dates from the interior of Mammoth Cave date between 4570 and 4910 years ago (one sample on torch charcoal from Audubon Ave. in Upper Mammoth and the other sample from a torch remnant found in Jessup Ave., a side branch of Ganter Ave. in Lower Mammoth). There are nearly identical early dates from Lee Cave in the Joppa Ridge portion of Mammoth Cave National Park, dating between 4470 and 4920 years ago. Lee Cave, although not connected to the Mammoth Cave system, was also explored very early, but apparently the prehistoric entrance collapsed sometime after

this initial exploration and the cave was not rediscovered until modern times when a group of cavers found a much smaller entrance (Freeman et al. 1973). The earliest date for cave exploration anywhere in eastern North America is from a cave in north-central Tennessee. This cave, which has some 274 human footprints preserved in the mud floor of a remote passage, has torch charcoal samples associated with this exploration dating between 5010 and 5660 years ago.

All of these early cave dates are associated only with exploration: a few fragments of torch charcoal, perhaps some stoke marks, and, in the case of the Tennessee cave, the remarkably preserved footprints of nine individuals: a caving party composed of males, females, and possibly one adolescent (Watson et al. 2005). By 4500 years ago, prehistoric Native Americans living in the mid-continental region of eastern North America, which includes Mammoth Cave, were quite adept at traveling far into very complex caves, carrying enough torch material to last several hours, perhaps up to a full day.

## 2.2 The Antiquarian Interest in Caves

As American settlers began filing land patents in Kentucky, many of them as compensation for military service during the Revolutionary War, caves were potentially valuable features of the land because they were known to be sources of niter. Niter, in this case, calcium nitrate, could be derived from cave sediments and converted to saltpeter or potassium nitrate, an essential component of gunpowder. With the advent of the second war with Great Britain, or the War of 1812, the price of saltpeter skyrocketed because the shipment of foreign supplies was blockaded by the British navy. Caves in Kentucky, Tennessee, and Virginia became important sources of domestic niter. In Kentucky, leading up to and during the War of 1812, the mining of niter went from a cottage industry to an industrial-scale business. Unprecedented amounts of niter dirt were dug from many caves and large rockshelters. And with this digging, new discoveries of the prehistoric past also became a sensation.

The trade in mummies—desiccated bodies of prehistoric Indians found in the dry cave fill that was also rich in nitrate—became a secondary reason for interest in these caves, one that would help launch new business interests following the War of 1812: tourism. Because very little was actually recorded about these discoveries, the location of most of the so-called mummies is poorly known or was intentionally obfuscated to claim ownership for exhibit purposes. (The single, best source that describes the various discoveries in the Mammoth Cave area is by Meloy (1977). Much of the information related below is from Meloy’s work.)

The first well-preserved body, that of a very young child, was apparently found in Short Cave in 1811, just a few miles

<sup>1</sup>Radiocarbon dates are usually reported as *radiocarbon years before present* with an associated counting error (for example, 4720 ± 60 rcybp). “Before present” is established as AD 1950, the year radiocarbon dating was first commonly available. To convert a radiocarbon determination to calendar years, it is necessary to calibrate the determination using a dendrochronology/radiocarbon calibration curve. Radiocarbon dates used here have been calibrated, increased by 64 years (the difference between AD 1950 and 2014, the current “present”), and rounded to the nearest 10 years to arrive at a date of “years ago.” For example, the radiocarbon date of 4720 ± 60 rcybp, the sample from Mammoth Cave vestibule, calibrates to 5320–5585 years BP. Then add 64 years to the minimum and maximum range (= 5384–5649) to arrive at 5380–5650 years ago, rounded to the nearest 10 years. Because decay of the radiocarbon isotope (<sup>14</sup>C) is a random process (hence the counting error), we can only say that the true date of a sample is estimated (with a 95% probability) to fall somewhere within the calibrated range.

from Mammoth Cave. However, these remains were destroyed by the miners. Upon learning of the discovery, Charles Wilkins, part owner in the mining operation at Mammoth Cave, offered a reward to the miners if they would preserve the next mummy they found. Indeed, a second mummy was found by the miners sometime between 1811 and 1813 in a small stone crypt. Wilkins collected this mummy and the artifacts that had been buried with it and took them to Mammoth Cave where they were placed in the cave and shown to visitors. The body, complete with short cut hair, long fingernails, and unblemished skin, was judged to be that of a tall female. More spectacularly, she had been buried with her wardrobe, which consisted of two deer skins and a woven textile of coarse fabric, a pair of woven shoes or slippers, a knapsack, and a small side bag, both also made of woven plant material. The two bags contained a variety of personal items, including a small woven cap, bird quills woven together, several hundred strings of small beads made from seeds, a string of fawn hoofs colored with red ocher, a large bird talon strung on a cord, a bear jaw strung on a cord, two rattlesnake skins, vegetable dyes, animal sinew, seven bone needles, a piece of deer skin with a hole for the thumb to be worn as protection for the hand, and two cane whistles. This mummy came to be popularly known as Fawn Hoof because of the necklace of deer hooves found with her.

After a short time on exhibit in Mammoth Cave, during which period several visitors wrote widely published descriptions of the find, a Mr. Nahum Ward of Marietta, Ohio, agreed to transport the mummy and its accoutrements to Peale's Museum in Philadelphia, in 1815. Being an entrepreneur, however, Mr. Ward took the mummy on a circuitous route, first to Lexington, Kentucky, then to Philadelphia (but by-passing Peale's Museum), and then on to Boston, stopping frequently and charging admission to see this amazing discovery. The mummy was finally deposited with the American Antiquarian Society in Worcester, Massachusetts, in 1817, but only after Wilkins and the Society threatened to press charges against Ward. Ward also published a very fanciful adventure story of his exploration into the many cave passages and *his* finding of the mummy. This description was picked up and published widely, including by international newspapers. Ward may have been a bit of a scoundrel, but he was responsible for generating more popular interest in Mammoth Cave than almost anyone else in his day.

At least two other mummies were found in Short Cave in 1814. One ended up at Scudder's Museum in New York, later purchased by P.T. Barnum, but was subsequently destroyed by fire in 1865. The second may have been sent to a museum in Cincinnati, but it was also reported to have been destroyed in a fire prior to 1844. One mummy was also purported to have been found by saltpeter miners in the Audubon Ave. area of Mammoth Cave in 1814. They

supposedly concealed the mummy by covering it with rocks with the intent of recovering it at some later time. For some reason this was never effected, but in 1840 the hotel manager at Mammoth Cave, having learned of this earlier discovery, relocated the remains. However, the body was so badly crushed by the rocks that it was of little value for display. It is not clear what happened to these remains. If this story is true, it was the only mummy actually found in Mammoth Cave by saltpeter miners.

Not far from Mammoth Cave, in the Flint Ridge portion of Mammoth Cave National Park, Salts Cave was also discovered to contain the desiccated remains of a prehistoric Indian. Although Salts Cave is a large, dry cave system, it was not mined for saltpeter, and these mummified remains were not found until 1875. Rather than being buried in the dry sediments, these remains, of a boy approximately nine years old, were found curled up on a rock ledge at a considerable distance from the entrance. Analysis of the remains indicated that he died about 2000 years ago, possibly from internal hemorrhaging as indicated by excess blood in his chest cavity. Hemorrhaging of this type can be caused by a blow to the chest or back (Robbins 1997: 144). It is easy to imagine that this young boy died after a fall in the cave. He was found in a side passage a short distance from the bottom of a steep-sided valley in Upper Salts, an area now known as Mummy Valley. Like the bodies found before him, he was traded among various cave owners and displayed to the public with many fanciful stories of his death. Represented to the public for many years as a young Indian girl or an Indian Princess, later examination of the body clearly indicated that this individual was a boy.

While desiccated human bodies were rare discoveries in the cave, but made for spectacular press, the environmental qualities of Mammoth and Salts Caves preserved many other types of archeological remains. Torch remains could be found in abundance strewn over the floor, some still bound together with strips of bark to form a torch bundle. In places, the cave walls and breakdown are blackened with hundreds of charcoal marks where burning torches had been stubbed into the surface. Soot covers large portions of cave passage from the countless prehistoric fires. Fragments of twined cordage and braided strips of bark and, occasionally, fragments of woven textiles and woven bags can also be found (Fig. 2.3). In particular, interesting are the woven slippers, masterfully made of plant fiber, some decorated with fringes or tassels, and having a drawstring to pull them tight around the ankle. Numerous worn-out examples of this footwear were cast aside by aboriginal cavers (Fig. 2.4). It was clear even to the earliest European-American explorers, however, that the cave had been used for more than just exploration. Long poles that had been hauled into the cave were found still wedged into piles of rock enabling access to high ledges or intersecting side passages. Rock cairns, apparently built





**Fig. 2.3** Examples of woven fabric made from twined plant fiber. Pending



**Fig. 2.4** An example of a woven slipper. Slipper is *upside down* with the heel to the *left*, which is worn through. The fiber tied around the *middle* was a last ditch effort to keep it on someone's foot. Scale in centimeters. Photograph by Charles Swedlund

for the same purpose, could be found along many passages. Digging sticks, their ends worn smooth from use; mussel shells, their edges ground down from scraping minerals off the cave walls (Fig. 2.5); large gourd bowls (Fig. 2.6) and, occasionally, wooden bowls were found throughout the passages visited by Indians. Gypsum crust, which normally occurs as thick sheets that exfoliate from the cave wall and as spectacular flower-like crystals (Fig. 2.7), has been battered, crushed, and scraped from the walls (Fig. 2.8) where the cave contains prehistoric archeological materials.



**Fig. 2.5** A mussel shell used to scrape minerals from the wall. Note edge damage from scraping. Scale in centimeters. Photograph by Charles Swedlund



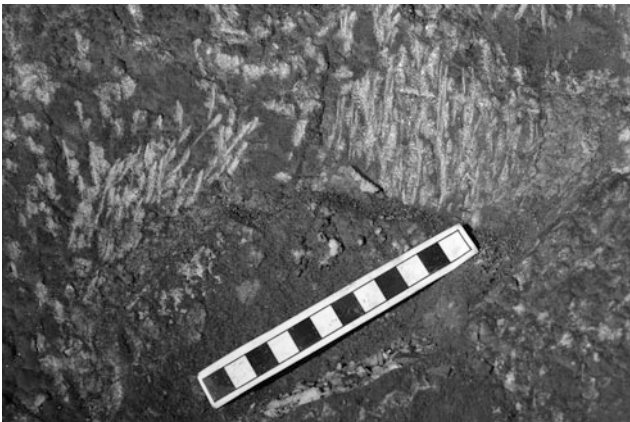
**Fig. 2.6** A complete gourd bowl. The bowl is made from the *bottom* part of a large bottle gourd. Photograph by Charles Swedlund

Although many people speculated about the possible uses for gypsum by the prehistoric Indians who mined it, it was at least quite obvious that they went to great lengths to obtain it.

Undoubtedly through the nineteenth and early twentieth centuries, many prehistoric finds were collected by cave visitors as curios and keepsakes. A few collections were made for scientific purposes and did end up in museum collections. Perhaps the two best-known collections are those made by Frederick W. Putnam, for the Peabody Museum of Natural History at Harvard University and Col. Bennett H. Young, a Civil War Confederate officer and prominent Louisville, Kentucky, lawyer. Young's private collection was eventually acquired by the Museum of the American Indian, Heye Foundation (now part of the National Museum of the American Indian, Smithsonian



**Fig. 2.7** Gypsum crust in its natural state. Photograph by Charles Swedlund



**Fig. 2.8** Gypsum crust that has been battered and scraped. The dark staining is from historic soot and dust. Scale in centimeters. Photograph by Charles Swedlund

Institution). More disturbing than the occasional collecting of artifacts over the years, however, are reports that early cave guides gathered prehistoric debris in the cave to build fires that would light up the large passages for the benefit of visitors.

### 2.3 Scientific Archeology

Not surprisingly, it was the discovery of another prehistoric mummified body that generated renewed interest in Mammoth Cave. In 1935, preparations were underway to acquire and donate the lands encompassing Mammoth Cave and other large caves in the region to the federal government as a National Park. In anticipation of eventual National Park status, work was already underway using Civilian Conservation Corps labor to enlarge and improve the trail system through portions of the cave. Two local men, Grover Campbell and Lyman Cutliff who had been hired to keep an

eye on the young CCC workers in the cave, were exploring a high ledge near the trail when they unexpectedly discovered the remains of another unfortunate aboriginal caver. This body lay partially crushed under a massive rock.

Because the trail construction was under federal management, the National Park Service took charge of the discovery. A Park Service archeologist by the name of Alonzo W. Pond was sent to investigate. Over the next several months, a scaffold was constructed and a system of pulleys and tethers put into place to lift the six-ton rock and remove the remains from underneath it. Pond documented the remains very thoroughly, but the recovery was also done for maximum publicity. Pond wrote a richly illustrated popular article that appeared in *Natural History* magazine (Pond 1937), and for the rest of his career the story of the discovery and removal of the Mammoth Cave mummy—illustrated with lantern slides—became one of his stock lectures. The Park, also wishing to cash in on the publicity, placed the remains of the prehistoric miner and his artifacts in a glass case to be exhibited in the cave. The remains are no longer on display, however, and at the request of Native American groups, the body remains at a secret location in the cave.

Material associated with the Mammoth Cave mummy was radiocarbon dated to 2380–2790 years ago. He was estimated to be approximately 45 years old at the time of death and would have stood about five feet, three inches tall (160 cm). He wore a woven plant-fiber blanket around his hips, knotted at the waist. He also had a small mussel shell on a cord around his neck. This was described as an amulet by Pond, but was probably just a convenient means of carrying his scraping tool. His torch lay near his body, along with a large gourd fragment. Archeologists surmise that he was on the ledge digging in the sediment for gypsum crystals when he either undermined or otherwise dislodged the large rock he was kneeling under so that it rolled over on him. He may have been trying to scramble out from under the rock as it moved. His right arm snapped above the elbow where he tried to brace himself against the weight; his left rib cage was crushed, and his skull was fractured. The soft sediment and other smaller rocks kept his body from being further damaged, but he would have died quickly from his injuries (Robbins 1997: 138).

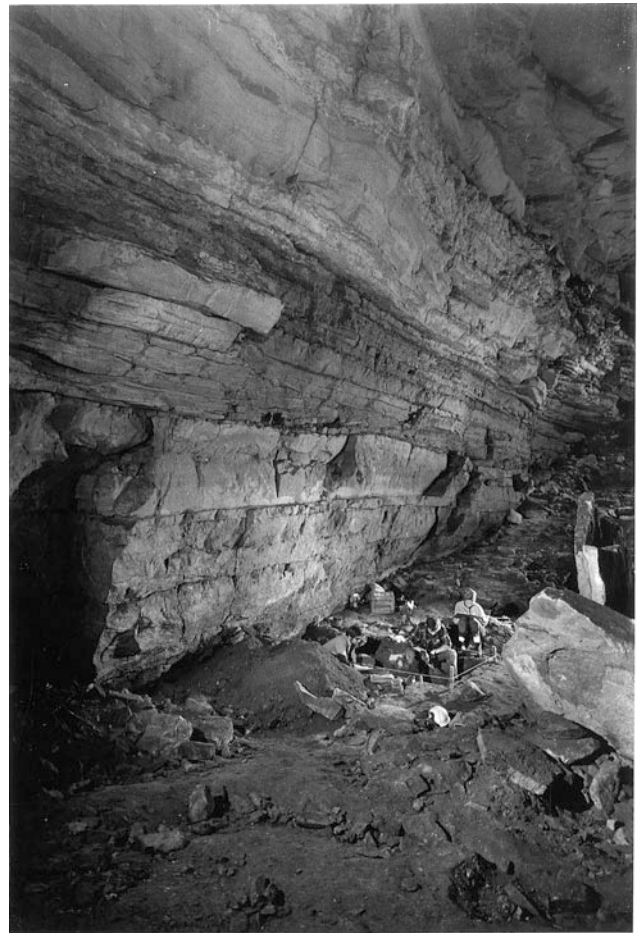
Unlike the human remains unearthed by saltpeter miners in Short Cave, which appear to have been intentional burials, the Mammoth Cave and Salts Cave mummies were accident victims. Clearly, prehistoric cave exploration and mining could be dangerous. By the mid-1950s, archeologists had collected a range of perishable material found in these caves, and thought that they were due to the mining of gypsum, but very little systematic documentation had been made of these cave sites nor had any specific analyses been performed on the range of ancient materials present within them.



In 1957, the Cave Research Foundation (CRF) was formed to promote the exploration and scientific study of caves and karst environments in the Mammoth Cave region. This multi-disciplinary organization had a difficult time finding an archeologist who was willing to take on the task of systematically documenting prehistoric human activity in Mammoth and other caves nearby. It seems that most archeologists are not too fond of working underground without sunshine or warm breezes. The work eventually fell to Patty Jo Watson, then a young Ph.D. in archeology whose primary fieldwork was in Southwest Asia (Iraq, Iran, and Turkey) but who was also a caver. Working primarily in Salts Cave, because the archeological situation there had not been so greatly affected by historic activities, as was the case in Mammoth Cave, she teamed up with other CRF scientists and archeological colleagues to build a long-term, interdisciplinary research program, known as the Cave Research Foundation Archeological Project. This project, while always relatively low key, has been continuously operating for more than 50 years (beginning in 1963, the first year of fieldwork). In addition to Watson's two major publications (1969, 1997), she and her colleagues and students have published dozens of scholarly articles and reports on many facets of Mammoth Cave archeology.

Watson conducted excavations in the vestibule of Salts Cave, where—as was the case in Mammoth Cave—there are significant ancient cultural deposits (Fig. 2.9). However, there are also important differences. Salts Cave entrance is small and descends steeply into the vestibule. Very little light enters the cave, and during heavy rains water pours through the entrance because it is at the bottom of a large sinkhole. Although debris in the midden consisted of the usual kinds of material found in domestic sites—animal bones, charred plant remains, and debris from making stone tools—it also contains a large amount of human bone, yet this was not a normal burial site. Approximately 2000 fragments of human bone were recovered intermixed in the deposits, many of them burned, some with cut marks, and even a few that had been fashioned into tools or artifacts. The 2000 or so bones represented at least 41 different individuals that ranged in age from fetal remains and infants to fully adult males and females (Robbins 1997). Although Salts Cave may have been used as a temporary camp from time to time, it was also an important mortuary facility where defleshing and cremation was part of the burial ritual. Salts Cave vestibule was occupied for a shorter period of time than was the entrance to Mammoth Cave. Radiocarbon dates from Salts Cave vestibule excavations span the time from 2520 to 4060 years ago, from Late Archaic to Early Woodland time periods.

Watson also systematically documented the range and intensity of prehistoric activity in Salts Cave. She sampled numerous kinds of material to understand the time depth



**Fig. 2.9** Salts Cave vestibule excavations in progress. Cave Research Foundation Archaeological Project. *Photograph* courtesy of the William S. Webb Museum of Anthropology, University of Kentucky

represented by these artifacts. The upper levels in both Mammoth and Salts Cave interiors, unlike most archeological situations, are completely dry. Sediments that would normally be laid down in stratified layers as a gage to identifying the relative ages of cave activity, have not been deposited in these upper levels since the Pleistocene. The surface we walk on today in the cave is the same surface that prehistoric Indians walked on in the past, making it difficult to know the age of any material without submitting it to radiocarbon dating. Watson did just that, submitting more than 40 samples of various kinds to obtain radiocarbon determinations on the full range of activities in both Mammoth and Salts Caves. The surprising part, with the exception of the two early dates for exploration of the cave noted earlier, is that all of the dates range between 2220 and 3450 years ago. The period of aboriginal mineral mining appears to have begun at the end of the Late Archaic Period and occurred most intensively during the Early Woodland Period. The Early Woodland Period, which archeologists typically date from 2200 to 3000 years ago, was an

important time of change among prehistoric societies in eastern North America.

## 2.4 The First Farmers

The origins of agriculture, when hunters and gatherers began to settle into more permanent communities and take up cultivation of several indigenous plants (and, in some parts of the world, animals as well) to supplement their diets, are considered the most fundamental reorganization of human society following the evolution of biologically modern humans. The creation of agricultural economies did not take place until the Holocene, first in western and eastern Asia and then slightly later in South and North America, but it was an independent process in only a few places in the world. Eastern North America was one such location, and Mammoth and Salts Caves contain the best evidence for this transition in the Americas.

The stable cave environment preserves organic material, as we have learned, in an exceptionally good state. Among the many prehistoric items left in the cave, one of the most numerous, other than torch material, is dried human excrement, or what archeologists call paleofeces. Literally thousands of these paleofeces can be found throughout dry portions of the cave. There is good reason why they are so numerous. Even though gypsum (calcium sulfate dihydrate) forms in many portions of the cave, other sulfate minerals also form under the right conditions. They are less common, but are abundant where found. Two of these minerals are mirabilite (sodium sulfate decahydrate) and epsomite (magnesium sulfate heptahydrate). Medicinally, both these minerals are very effective saline laxatives. Hence, archeologists think that another purpose for visiting these caves, in addition to mining gypsum, was to obtain these salts, which were consumed in the cave for their laxative effect.

Watson's colleague, Richard Yarnell, examined many of these paleofeces to determine dietary content. Fragments of nutshell indicated that hickory nuts were an important constituent of the diet, but more importantly, for the story of early agriculture, were the seed remains of several indigenous plants: sumpweed or marshelder (*Iva annua*), sunflower (*Helianthus annuus*), goosefoot or lambsquarters (*Chenopodium berlandieri*), and maygrass or Carolina canarygrass (*Phalaris caroliniana*). The hard seeds of these plants are abundant in the paleofeces, and at least three of them showed signs of early domestication. Domestication of plants bearing edible seeds is usually indicated by an increase in seed size beyond that present in naturally occurring stands. For example, as a wild annual, sunflower seed shells (achenes) are rarely longer than 7 mm. Achenes consistently larger than 7 mm indicate that the plant is undergoing cultivation resulting in morphological changes.

Later genetic changes induced by modern breeders have created the monstrous single-headed flower we grow today, but modern wild varieties of sunflower have several much smaller seed heads, as would also have been the case for ancient ancestors of the first domestic sunflowers.

The cave data are an important contribution to documenting the origins of agriculture in eastern North America. They show that this process was well underway by 3000 years ago, and that the seeds from domestic plants made up a substantial portion of the diet, not just an occasional or isolated occurrence in a few paleofeces. In addition to plants with edible seeds, Native American farmers were also growing bottle gourds (*Lagenaria siceraria*) and gourd-like squashes (*Cucurbitae pepo*) for their hard-shelled fruits that were used as containers by the ancient cavers. The seeds of these plants could be and were eaten, but the fleshy varieties of *C. pepo*, like pumpkin, zucchini, and scallop squashes, with which we are more familiar today, were developed later. The first domesticated squashes were more similar to the ornamental gourds (*C. pepo* var. *ovifera* and *C. pepo* var. *verrucosa*) common in modern markets in September and October.

## 2.5 Ritual Use of Caves

What compelled Early Woodland cave explorers to spend so much time and effort in these large, dry caves collecting minerals? The mineral salts have medicinal uses that may explain the desire to obtain them, but gypsum has no medicinal value or practical uses that archeologists have been able to identify. If ground and mixed with water, gypsum makes a good white paint or plaster (essentially, plaster of Paris), but gypsum residue has never been identified on any archeological remains from this time period (for example, as wall plaster or as paint on pottery or other artifacts). So what use did it have? The paleofeces are a key to answering this question.

In an ingenious study by Watson and her colleagues (Sobolik et al. 1996), they were able to extract residual steroids from the paleofecal specimens. The relative amounts of testosterone (T) and estradiol (E<sub>2</sub>) can be used to estimate the biological sex of the defecator. That is, males typically have much higher hormonal ratios of testosterone to estradiol than do females. Males and females may overlap in these ratios, but only males have extremely high quantities of T to E<sub>2</sub>. Twelve fecal specimens (six each from Mammoth and Salts Caves) were subject to this analysis. All twelve samples were determined to have high T: E<sub>2</sub> ratios in the range we would expect for mature males. Recall that both cave accident victims were also male: a middle-aged man and a young boy verging on adolescence. Mineral mining appears to have been an exclusively male activity.



Caves have special significance in many cultures. They can be foreboding, a perpetually dark underworld, and cave formations (speleothems—e.g., stalactites) can be exotic, fantastic creations not found in the everyday aboveground world. When you enter a cave, you descend into the unknown. When you emerge, you return to a world of light. One cross-cultural use of caves and cave-like structures is for secretive or exclusionary practices, including male initiation ceremonies: the rite of passage for young boys into adolescence and adulthood. I have suggested that Mammoth and Salts Caves were used to seclude young boys from the rest of the society and to initiate them into the fraternity of adult men (Crothers 2012). Medicinal salts used as laxatives in the cave, physically purged the initiate, a literal and symbolic act of cleansing, preparing him for the next stage of life. Typically, in initiation ceremonies, after a period of seclusion during which initiates learn ritual knowledge they will need as adults, they are reintroduced to society wearing new clothing, body decoration, or exhibiting bodily mutilation signifying their new status. The reintroduction ceremony may include performance of ritual dances or singing songs learned while in seclusion. Gypsum could have played a role as body paint or as some other forms of personal adornment used in such ceremonies. Fantastic crystal forms of gypsum may have had significance as amulets, or powdered gypsum may have been imbued with mystical power, an important substance carried throughout life and occasionally replenished when necessary. The important point is that gypsum, found only in certain cave contexts, identifies the person in possession of it as having obtained that status, as being a full adult member of society.

Finally, we need to explain why this interest in gypsum and cave ritual became so important during the Early Woodland Period. Recall that prehistoric people had been exploring deep into caves at least 4500 and possibly as early as 5600 years ago, a full 1000–2100 years before there is any interest in mining gypsum or collecting other sulfate minerals in any archeologically visible way. Also note that mineral mining was not exclusive to Mammoth and Salts Caves. Archeologists have identified at least five other caves in Kentucky and Tennessee that have evidence of gypsum mining. All the mining activity in these caves has been dated to the Early Woodland Period. It is not a coincidence that this mining—the ritual use of caves—occurs contemporaneously with the beginnings of intensive plant cultivation in eastern North America. Even though all cultures observe some rites of passage, male initiation ceremonies are more common, or more aggressively practiced, in agricultural societies. Agricultural subsistence requires a fundamental reorganization of society to be successful. It is a technological revolution (new tools and techniques to produce crops), an economic revolution (new forms of property rights that specify who owns the product of agricultural labor and perhaps more

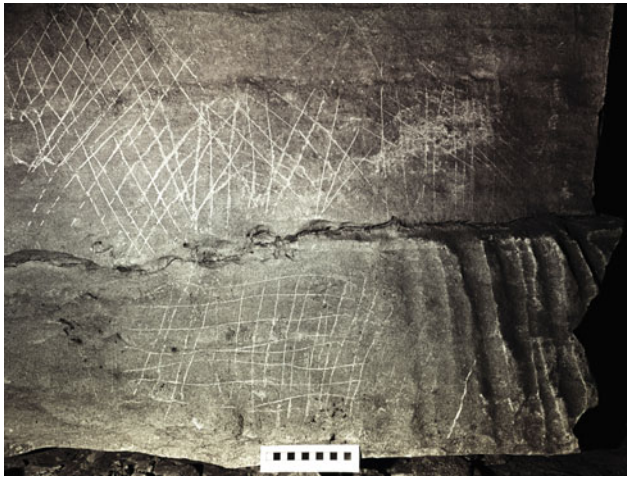
importantly, the surplus food produced), and a social revolution (there are those who labor and those who control that labor pool). Ceremonies, like initiation rites, strengthen social ties. They create communities of similarly aged cohorts—sodalities in anthropological terms—that are important for political and economic integration. Sodalities cross-cut kinship ties, the latter being the most fundamental form of social organization, to create non-kin groups spanning multiple villages or extended families. Sodalities often have specific purposes: defense, warfare, or simply to provide a larger labor pool for economic and social activities. Agriculture is an economic endeavor that requires specific communal property rights, defense of those rights, and sustained communal labor.

## 2.6 The End of Cave Mining

The intensive period of mineral mining appears to end rather abruptly around 2200 years ago, based on the available radiocarbon dates. Why the mining ended is not clear, but gypsum was not a scarce commodity in these caves. Perhaps one had to travel farther and work a little harder, but Mammoth and Salts Caves are enormous places and pristine gypsum can still be found in remote passages. Perhaps the mystery of the cave had run its course. The end of the mining, which interestingly enough corresponds with the end of the Early Woodland Period, is followed by an intensive period of mound building and earthwork construction throughout much of eastern North America and best known from the Hopewell Culture (1500–2200 years ago) in the middle Ohio River Valley. I suspect new forms of ritual, possibly centered at these impressive earthwork sites, began to eclipse caves as ritual places.

Caves continued to be used in other important ways, however, during and after the Early Woodland Period (Crothers 2009; Crothers et al. 2002). Perhaps the most widespread use was as mortuary sites. As discussed earlier, Salts Cave vestibule was used for special kinds of mortuary processing. In many areas of eastern North America, pit caves—caves with vertical openings to the surface—were also used as mortuary sites. Bodies were dropped into these shafts, often with personal artifacts like smoking pipes and shell beads (Crothers and Willey 2009). While a few of these pit cave sites are known from the Mammoth Cave area, it was an especially common use of caves in southwest Virginia during the Late Prehistoric Period (400–1000 years ago).

Another quite widespread activity in caves was drawing images on the walls and sometimes on the ceilings and floors. While prehistoric petroglyphs and pictographs can be found in Mammoth and Salts Caves, they are not common and seem to be isolated, individually inspired acts of expression (Fig. 2.10). The drawing of images, however—including



**Fig. 2.10** Petroglyph in Mammoth Cave. Cross-hatching like this is a common design. *Note* that the prehistoric torch marks are superimposed on the drawing. Scale in centimeters. *Photograph* by Charles Swedlund

geometric, animal, human, and fantastical creatures—was an exclusive activity in some caves. One of the best-known sites is called Mud Glyph Cave because the images were drawn into soft mud that coats many of the walls (Faulkner 1986). The intensive use of caves as locales for creating rock and mud art is almost exclusively a late prehistoric phenomenon (ca. 400–1000 years ago).

The prehistoric use of caves as mortuary sites and art galleries is not evident in Mammoth or Salts Caves. Archeologists do not know why, but apparently they were not deemed suitable for these purposes by those Native Americans who continued to live in the region. Perhaps the history of extensive mineral mining and stories of the ill-fated miners who lost their lives underground made Mammoth and Salts Caves places to avoid. Even though archeologists have learned much about the world's greatest prehistoric cave explorers, the caves themselves still hold many secrets.

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