Volume 33
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Contents

The Kansas Anthropologist

Journal of the Kansas Anthropological Association

KANSAS ANTHROPOLOGICAL ASSOCIATION

The Kansas Anthropological Association is the oldest amateur archeological organization in the state. Its membership is made up of individuals and institutions interested in the prehistoric and historic peoples of the area. The objectives and goals of the Association are the preservation and interpretation of archeological and ethnographic remains within the state; the scientific study, investigation, and interpretation of archeological remains and ethnographical materials; the publication and distribution of information concerning Kansas archeology and ethnology; and the development and promotion of a greater public interest and appreciation for the heritage of the state.

Types of memberships and dues:

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PUBLICATIONS

Each year members receive four issues of the *Kansas Anthropological Association Newsletter* (ISSN 1069-0360) and one journal, *The Kansas Anthropologist* (ISSN 1069-0379). They also receive four issues of *Kansas Preservation*, the newsletter of the Cultural Resources Division of the Kansas Historical Society. All members and interested individuals, professional or amateur, are invited to submit material to the editors for use in these publications. Abstracts are posted on the KAA web site at www.katp.org. Back issues of the journal or newsletter, if available, may be ordered from the Historian-Recorder at the address listed above. Prices will be furnished upon request.

INFORMATION FOR AUTHORS

Manuscripts are actively solicited for *The Kansas Anthropologist*. Articles should have a relationship to Kansas anthropology (archeology, ethnography, ethnohistory, cultural/social anthropology, physical anthropology, etc.). All manuscripts must be the original, unpublished work of the authors.

The varied readership of the journal should be kept in mind when preparing papers. **Jargon should be avoided**. The style authority is *American Antiquity* (see Volume 57, Number 4, 1992). Professionals are expected to submit their manuscripts in this form; others who are not familiar with the *American Antiquity* style guide will receive editorial assistance.

Illustrations are encouraged; at least two or three should be included if possible. **Digital photography with original resolution less than 300 dpi is not optimal for print publications.** High resolution digital images are acceptable, as are 35-mm black and white or color prints or slides. All illustrations should be designed to fit within 6 x 8.5-inch margins, including caption. If protected by copyright, securing written permission for use is the responsibility of the author.

If IBM-compatible computer technology is available, please submit papers on CD or as an e-mail attachment, **using as little internal formatting as possible**. **Each table and figure should be submitted as a separate file rather than embedded in the text.** A single hard copy also should be provided.

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Notes

MADE OF STONE: IMPACTS ON HISTORIC SITES IN REPUBLIC COUNTY, KANSAS

Jack L. Hofman
University of Kansas

Documentation of historic Euro-American sites in Republic County has highlighted a variety of ongoing factors that are contributing to the destruction of late nineteenth-century structures and sites. Such sites can teach about the daily life, economy, technology, and the culture of Euro-American settlers in a rural agrarian society. Many wooden buildings, constructed prior to 1900, have been lost due to abandonment and natural deterioration, as well as to efforts to clean up properties following land ownership changes. Stone structures are being destroyed by a combination of burning, razing, and dismantling for re-use of building stone. These efforts have been sparked by landowners' liability concerns and loss of family connection or interest in the heritage associated with structures. The potential for wood from local sources used in the construction to contribute to building a tree ring chronology for the area is one of many reasons why study and documentation of these early sites is important.

The archeological record of the ancient or recent past is always in the process of being changed, rearranged, or destroyed by natural and cultural factors (Asher 1962, 1968). Archeologists spend considerable time addressing the factors that influence or modify the archeological record in order to sort out the patterns in material evidence that result from past human activity from those which result from natural or non-human actions (Butzer 1982; Schiffer 1987). When changes in or impacts to sites are the result of human actions, these actions may add to the evidence to be gained about human behavior through archeological study (Schiffer 1983:678). However, some human actions are decidedly destructive and can have a devastating impact on the archeological record. Recent efforts to document historic archeological sites in the Republic County area have resulted in a renewed awareness of the rapid rate of site destruction and the variety of factors that are impacting sites, particularly historic sites, in the region.

The primary intention here is to bring attention to some ongoing factors that impact the historic archeological sites in Republic County and are likely to affect similar sites in other areas. Combinations of factors contribute to the destruction of sites and to an apparent increasing rate of site impacts and loss. First, sites do not weather and deteriorate at a steady and constant rate. Older sites, after decades of weathering, exposure, usage, or disuse, become susceptible to increasingly rapid deterioration unless they are adequately maintained. As structures age their function and worth often change, and these factors impact the amount of care and maintenance invested in them. In one Republic County example a log cabin that had served as a residence for one of the earliest Euro-American settlers fell into disuse, became a chicken coop, and then simply became a nuisance and so was destroyed. In other cases structures of "known" historic value change ownership, and after a generation or two the oral traditions about a site or structure and personal interest in its preservation may be lost. Such locations, when disconnected from their heritage, may be seen simply as obstacles to farming, as hazards, or even as liabilities (either as taxable structures or as human health or livestock hazards). Uninvited or unwanted curiosity seekers can result in crop damage, fence damage, loose livestock, or personal injuries. A few such events can tip the balance in favor of a landowner's decision either to demolish old structures or simply let them stand and degrade naturally.

A few examples of historic site destruction are provided here to highlight the importance of site documentation, including oral history or tradition pertaining to early historic sites, and the importance of public education concerning the historical and cultural significance of the historic archeological record. Sites that are now more than 100 years old are rapidly being impacted or destroyed, and this should serve as some incentive to record younger sites, those 50 years old or less, many of which remain relatively intact but almost certainly eventually will suffer a fate similar to that of the older historic sites. The rapid rate of technological and cultural changes in our society means that rural sites occupied in the 1950s and 1960s already represent an "unremembered past" for most modern Americans, and the oral traditions that can be associated with these relatively young sites are rapidly disappearing.

Sale of building materials from historic structures, notably wood and stone, is providing a new kind of impact on some historic sites. The sale of stone for landscape or secondary building use has created an incentive to demolish some stone buildings. Sale of stones from old structures can make monetary sense if that old structure is seen as nothing more than a nuisance or hazard. In such cases the owner may view the sale of old building stones as a way to make a profit or defray the costs of demolishing an unwanted structure. Given the labor and transport costs, however, the profit margin in such endeavors can be minimal. Reuse and recycling of building materials is a longstanding tradition in the Great Plains region and elsewhere. Early settlers tended to be rich in labor potential but short on building materials and manufactured items. In *Old Jules* Mari Sandoz (1935) depicts how quickly any abandoned resources were scavenged for continued or new uses by neighbors within homesteading communities.

Today efforts to reduce, reuse, and recycle are applauded, but such behavior can come at a cost to the old material record for the benefit of more modern concerns or needs. Building stone can be acquired from old structures more easily than from quarries, and usually at least one edge of each stone is already chiseled smooth. Sometimes stone from old structures is given to friends, family, or neighbors for use in landscaping, ornamental, or building projects.

In the Republic County area (Figure 1) the majority of native stone structures were built between about 1870 and 1910, with relatively few built using traditional methods (i.e., hand-chiseled stones fitted with lime mortar) after that date (Muilenburg and Swineford 1975). Very few rural stone houses built in that period remain as residences today. Not surprisingly, given the continued need for equipment and hay storage and livestock shelter, relatively more barns from that period remain in use today. The sale of building stone from old structures has at least some retail or commercial potential, as indicated by such stone recently seen for sale at a business in Scandia (Figure 2). As a result stone structures are now potential targets for destruction due to the value of native building stone. Figure 3 shows a yard retaining wall made of recycled Fencepost limestone.

Other factors contributing to the loss of historic structures include the generally declining rural population in much of the Great Plains, including western Kansas and Republic County. The current population is more centered in urban areas with fewer operators farming and managing increasingly large acreages. Rural depopulation is correlated with the consolidation of schools, fewer jobs, and the loss of nearby retail outlets and health providers, making rural living less feasible or less desirable for many.

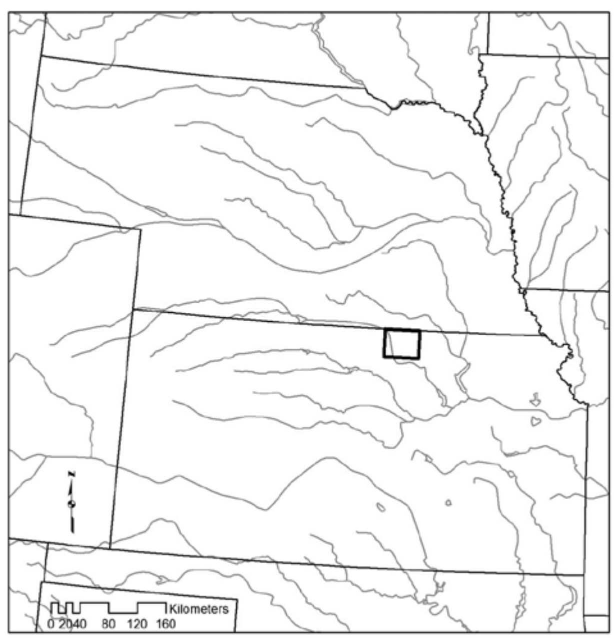

Figure 1. Location of Republic County, Kansas.

Figure 2. Recycled building stone from nineteenth-century structure, Scandia, Kansas.

Figure 3. Retaining wall built with recycled Postrock limestone from Republic County area, Hebron, Nebraska.

As a result abandoned farmsteads or, more accurately, unoccupied though often still functioning farmsteads, accent the rural landscape of Republic County and reflect a time, technology, and culture that was substantially different from that experienced by most Kansans today. These early historic sites, however, provide our most direct evidence of the technology, economy, and day-to-day life of early Euro-American settlers in Kansas. Loss or destruction of these sites is continuing to diminish the potential to learn about and understand the lives of these early settlers.

SELECTED EXAMPLES OF SITE DESTRUCTION, DETERIORATION, AND LOSS

Martin Farmstead (14RP322)

The Martin farmstead was endangered and eventually impacted by Highway 36 expansion; as a result systematic archeological investigations were conducted to help mitigate the impacts (Schoen 1994). One small stone cabin with a wooden addition on the east side was built about 1875 by James Klima. He built a number of other structures on the farm, including barns, sheds, a larger stone house, an arched-ceiling cave or root cellar, and a corn crib (Schoen 1994:7–12).

Originally from Bohemia, the Klimas received their claim (deed) to the land in 1879 and eventually sold the property in 1903. The western or Klima stone cabin apparently was not lived in after 1903 and presumably served for storage and other uses. Details of the farmstead's occupants and productivity were provided in Schoen's (1994) study.

After 1947 the farm was no longer used as a residence, and many of the structures fell into disrepair. Prior to the 1992 archeological investigations, several of the buildings were razed, including the wooden addition to the stone cabin, and the property was used primarily for grazing and feeding livestock. Many of the remaining structures were 50 m or more east and farther south of the original cabin. Being closer to the highway right of way and directly affected by the widening of Highway 36, this area received the primary archeological attention (Schoen 1994:43–46). The small Klima stone cabin and large bank barn or horse barn were north of the impact zone and were not studied in detail. In fact Schoen (1994:18–20) described the small cabin's exterior in detail but writes, "At the time of the investigations, the windows were covered with sheet metal and the plank door was padlocked. Therefore, the cabin's interior characteristics are unknown."

Today the only standing structures on 14RP322 are the small Klima cabin and the bank barn, so most of the farmstead's character is gone. Unfortunately, since 1992 much of the cabin has collapsed, with only the south wall, the southern portion of the east wall, and much of the west wall still standing; the northern wall has completely collapsed. The stone walls apparently collapsed some years ago, as the degree of weathering and deterioration of the cabin and its interior are severe. The current use of this partially covered and protected space by livestock is rapidly increasing the rate of deterioration. Some details of the cabin's interior and construction, which could not be observed by Schoen, are visible now. From the southwest corner the structure looks remarkably similar to its appearance 20 years ago, but there the similarity ends. The images in Figure 4 provide a comparison between the cabin's condition in 1992 and today. The fragile state of the stone cabin insures that it will not remain recognizable much longer. The large barn, because of its continued functional importance, has been maintained largely by roof repairs and is still in quite good condition, considering that it apparently was built before 1885.

The Martin farmstead provides an important and interesting example of why archeological and historical documentation are important. It also provides a sober reminder that most such research happens after the destructive fate of properties has been determined. Much could still be learned about this property, especially the earliest and western portions of the farmstead, including the small stone cabin and bank barn. The potential for first-person oral history pertaining to this property is slight, and most information will now be second hand at best. The importance of Schoen's (1994) research and documentation cannot be over emphasized. The prospect for renewed archeological investigations are very real and could provide details about this oldest portion of the site, which would complement the results of previous investigations and add to information about one of the earliest farmsteads in Republic County.

Brosh Cabin (14RP52)

Original log cabins in the Republic County area are increasingly rare. One good example is the log cabin at the Republic County Historical Museum in Belleville, which came from the Sherdal area in Union Township between Republic and Scandia. In contrast, relatively little is known about the Brosh

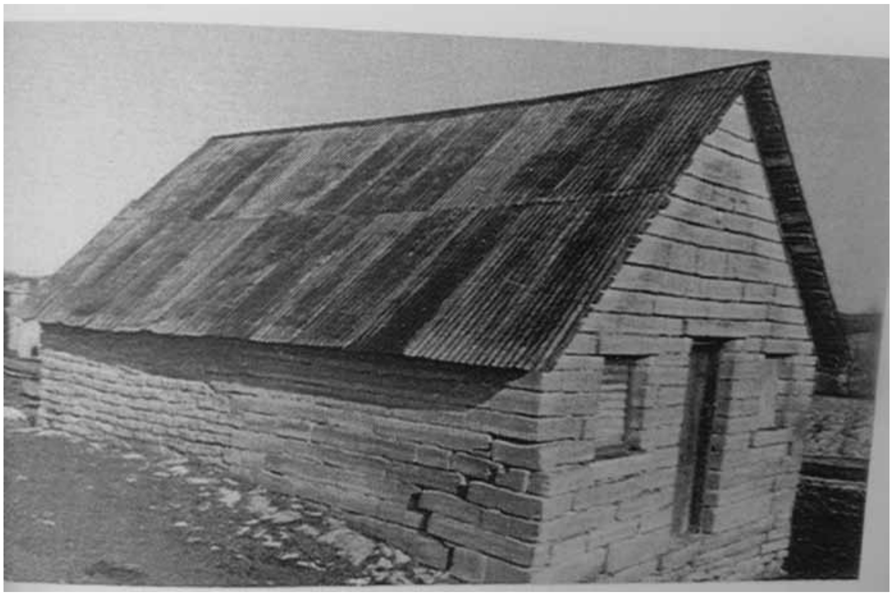

Figure 4a. Martin-Klima stone cabin about 1992 (from Schoen 1994).

Figure 4b. Martin-Klima stone cabin, view northeast, 2012.

Figure 4c. Martin-Klima stone cabin, view southwest, 2012.

cabin, located a few miles south of Munden. The Republic County Bicentennial Historical Committee (1976:34) recognized the rarity and importance of the cabin, recorded some notes and information about it, and even considered the feasibility of moving the cabin to be preserved as a museum display. Unfortunately, this did not happen, and the cabin was destroyed. Consequently, no photographic comparison between the 1975 picture (Figure 5) and today can be made.

Billy Jo Strnad owned the property until the mid-1980s. He recalls that the cabin had been modified to serve as a chicken coop, which probably added to its deterioration, but that it had a tin roof,

Figure 5. Brosh log cabin, 1975 (from Republic County Bicentennial Committee 1976).

which would certainly have enhanced its survival. After the property changed ownership, interest in preserving the cabin was lost, and the area has been farmed over since the mid-1980s.

In this case there was some awareness of the structure's significance, but resources and expertise were not available for a serious preservation plan to be enacted. Recent interest in trying to learn more about the cabin was stimulated by efforts to find and sample logs from early structures in the area that might be useful in creating a detailed tree ring chronology for the Republic County region.

Kiperta Farmstead (14RP20)

The Kiperta site is a good example of the loss of an important historic site that did not happen at a regular and steady rate. The site was first encountered in 2011 during a search for a reported prehistoric site. During the intervening year the potential of 14RP20 to provide preserved local wood used in construction, which might be useful in developing a tree ring chronology and record for the region, was lost. A site visit about a year later found that all three primary structures (barn, granary, and house) had burned. Figure 6 provides a comparison between the condition of the bank barn in 2011 and 2012. Considerable stone, construction rubble, and archeological evidence remained, but the architectural features were mostly lost. Although the site is situated along a wooded ridgeline, none of the adjacent trees were burned, indicating that this was not a general or accidental fire that burned the whole area. Rather the fires that consumed these structures were directed specifically at each one.

Burning of these buildings is a significant loss to the area's historical and archeological records, and this after many decades of mostly gradual decomposition. One lesson here is that recording and documentation, including photographs, should be done as soon as possible, because there is no assurance that a site will remain to be recorded later. The more basic problem, however, is that building maintenance is generally impractical, and typically there is little incentive to invest in preservation. There are, in fact, increasing incentives to destroy such structures, which can become hazards and liabilities to landowners. Much still could be learned about 14RP20 from photographs, oral histories, and the archeological record, even though the structures are gone.

Although the 1884 and 1903 plat maps for Fairview Township do not show a residence or other structure in this location, construction materials and artifacts, including cut square nails, which went out of use in the area about 1890, indicate that the structures probably were built by the time the 1884 plat was made. For sites like this that are far

Figure 6a. Kiperta barn, view west, 2011.

Figure 6b. Kiperta barn, view northwest, 2012.

removed from section roads and occur in heavily wooded areas, positions on early plat maps may represent little more than guesses or may not appear at all.

Vakar-Popelka Farmstead (14RP26)

The Vakar-Popelka farmstead is notable in part because of its distinctive barn, which is in relatively good condition considering its age. The barn was constructed using the timber frame method, with the framework made entirely from square-sawn beams, joined by mortis and tenon joints, and held by wooden pegs; nails or other metal fasteners were not used in the framing. There was no hay hood or hay fork, as seen on many later barns, and the only access to the loft from the outside was a narrow door above the main entry door to the south. All hay would have been pitched up to the loft from that access. The board and batten siding and lap-joined flooring of the loft were fastened with cut (square) nails. These features indicate a construction date prior to 1890.

Joseph Vakar's residence is shown at this location on the 1884 Fairview Township plat map (www.kansasmemory.org/item/224009/page/14). The residence is now gone, although a limestone basement and foundation remain. Figures 7 and 8 provide 2012 views of the barn and the limestone basement. This basement measures 10 feet (east-west) x 15 feet (north-south), and the walls were laid with limestone that is chiseled smooth on the interior surface. A few feet northeast of the house basement are the remains of a collapsed arched-

Figure 7. Vakar basement and barn, view west, 2012.

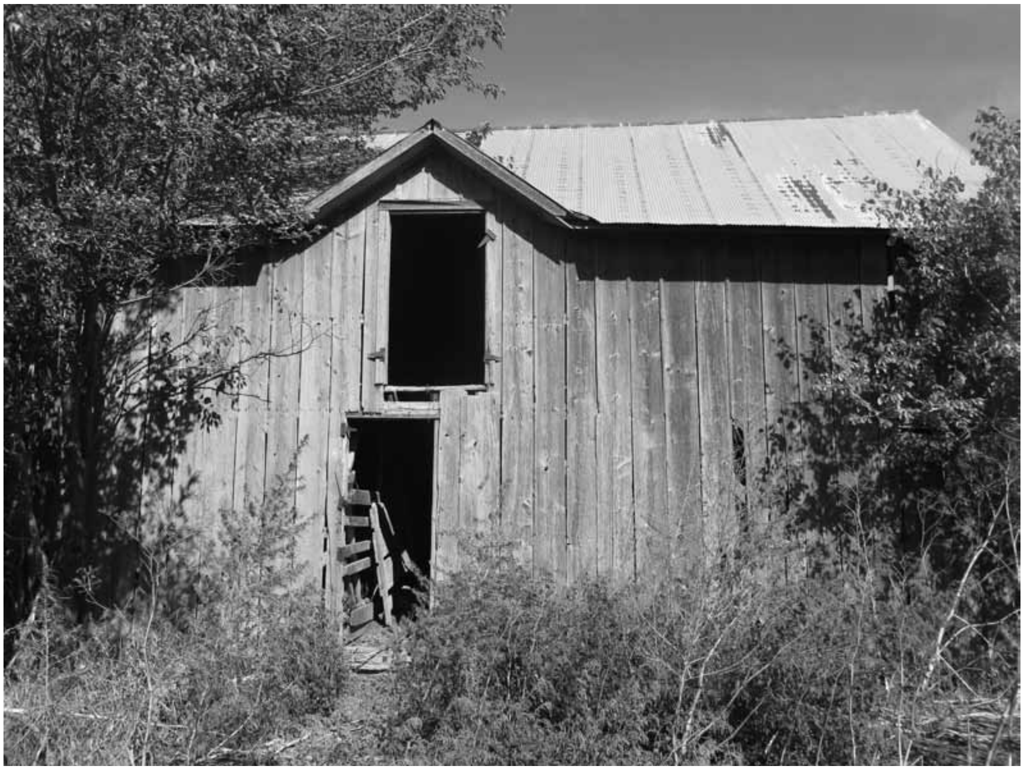

Figure 8a. Vakar barn exterior, view north. This loft door is the only exterior access to the loft.

Figure 8b. Vakar barn interior view of timber frame construction.

ceiling cave from which many stones appear to have been removed. A hand-dug well with limestone walls is located in the draw south of the house site. Any other features or structures have been lost.

The barn remains in use in part as a hunting blind or deer stand, a function that may enhance the desire to preserve it. The barn represents one of few still standing in the area built using the timber-framing technique. Its distinctive character and relatively good condition make this structure historically important in the region. At present the wood used in framing this barn has not been identified, but its beams have potential to add to the tree ring record for the region.

Myers Farmstead (14RP17)

The first log cabin in Republic County was constructed along Salt Creek on this property in 1861 by Conrad Myers and his brother Daniel, who settled property adjacent to the west (Smith 1976:15–16; Tolbert 1959). The cabin was reportedly on the line between the two properties (*Belleville Telescope*, 12 September 1889). The original cabin burned but was replaced, and a series of other structures were built by Conrad Myers and his descendants, including a large bank barn, sawmill, log shed, stone cave, and other structures. Although none of these remain standing today, the property is still owned by the Myers family. Therefore, in this case there is no loss of family tradition or lack of awareness of the property's historical significance.

The large barn's wooden super-structure was burned recently because it had become a hazard and was too costly to repair or dismantle. Only the limestone walls of the first level of this structure remain today. The barn measured 36 feet (north-south) and 28 feet (east-west). Very large limestone blocks, about 10 inches high, 16 inches thick, and some more than 3 feet long, were used in first-floor construction. Given available technology, this represented a significant engineering feat for the time.

The millhouse for the Myers' sawmill, which began operating in the mid-1860s, also had a well-finished limestone basement. Its super structure was recently dismantled, as was a 10 x 14-foot log shed. Fortunately, some wood from these structures was saved and is being evaluated to determine if it can contribute to the development of a tree ring chronology for the region. Figure 9 is a 2012 view of the barn, showing an example of the hand-hewn logs that were part of the log shed. The farmhouse was moved to a new location and continues to be used, but the stone cave and outbuildings from the house yard have been removed or filled in.

Site 14RP17 provides a good example of a location that has recognized historic importance, but for which the maintenance and curation of the

Figure 9a. Myers barn stone foundation, view northeast.

Figure 9b. Hand-hewn log from dismantled shed.

mostly unused structures was simply too costly and impractical. It also is a case in which an absentee landowner must make practical management decisions that involve consideration of multiple goals, limitations, and needs. Oral history, photographs, and archeological evidence can still provide considerable information about this Republic County farmstead.

Hrabe-Kieffer 2 Farmstead (14RP19)

The Hrabe-Kieffer 2 farmstead is located on a tributary of West Elk Creek near Cuba, Kansas, and has a number of distinctive features and structures. The stone house was one of a few in the area that had an arched-ceiling cave underneath it. This residence is shown in its present location on the 1884 plat map for Fairview Township. The structure was built in stages. First a four-room, two-story rectangular house, oriented north-south with a primary entrance on the east, was constructed. A well was located just southeast of the house. Steps leading down into the arched-ceiling cave, which was oriented north-south with a south entrance, were only a few feet east of the house's east door. The steps went down from west to east until they reached the level of the cave floor and then turned 90 degrees left (north) to enter the cave through an arched entryway. Subsequently, a two-story stone addition was built over the cave and joined the northern half of the original stone house. A vent was made from the cave's east wall up through the addition's east wall, because the addition's north wall foundation covered the original cave vent at its north end.

The exterior west wall of the southern portion of the original house is distinctive because the fencepost limestone used in construction still exhibits drill marks. Commonly drill marks were removed when chiseling and facing stones for house construction. Was this a preferred or desired "look," did it reflect cheaper or lower quality stones, or was it simply a time- or work-saving strategy by the stone mason? The northern walls, which faced the road, are now missing, so it is unknown if drill marks were present on that more exposed public wall.

Figure 10 provides views of the house and barn in 2012. When the structure was found and recorded, the north and west walls and the cave's ceiling stones were mostly gone. Rights to the rock had been sold to a person using or reselling it for landscape rock. This is an example of a situation where the landowner was not necessarily planning to destroy the structures but had no incentive or feasible means to preserve them.

Other structures at 14RP19 include a long and high retaining wall that was built on the creek bank between the house and a spring to the east. A big granary with a limestone first story was constructed into a bank south of the house. A large bank barn, erected southwest of the house, also had a limestone first floor that opened to the east. All these structures were built initially using square cut nails, which suggests pre-1890 construction, but subsequent repairs and replaced siding used wire nails. The partially dismantled stone house provided good views of the wall construction methods. Exposed walls illustrated the use of split wooden rails,

Figure 10a. Hrabe-Kieffer 2 stone house, view southeast.

Figure 10b. Hrabe-Kieffer 2 stone house, west wall exterior detail.

Figure 10c. Hrabe-Kieffer 2 barn, view west.

notched and pinned together in the corners to help hold the structure and walls true. Large hand-hewn wood interior supports also occurred in the walls to provide strength to the lintels above doors and windows. Some of the wood from this structure is being used to help develop a tree ring chronology for the area.

Fort Lookout (14RP326)

This early log structure was constructed by the U.S. Army in 1866 on the military road between Fort Riley, Kansas, and Fort Kearney, Nebraska (Republic County Historical Society Museum, Belleville; information also available online at larrypapenfuss.org/fortlookout). The two-story blockhouse was situated on the highest point of the high terrace about 1 mile south and west of the Republican River south of Warwick in northwestern Republic County. The Army abandoned Fort Lookout in 1868, and subsequently the local settlers utilized the structure for shelter or defense as needed. The site apparently deteriorated due to natural causes rather than being razed or intentionally burned. An article about the old fort was published in the *Superior Express* newspaper in 1908.

The shelter was still standing in the early twentieth century but was deteriorating from the ground up. One photograph shows the upper story after the logs from the lower level had rotted away. One log was saved and is now on exhibit at the Republic County Historical Society Museum in Belleville. It is not yet known whether the preserved piece of wood can be of use in efforts to construct a tree ring chronology for the area, but any identifiable and useable wood from Fort Lookout could add significantly to the tree ring record.

Site 14RP326 is now in a cultivated field, but the location of the structure remains known to and is marked by the landowners. The site is located only a few miles northwest of the Pawnee Indian Museum State Historic Site (Kansas Monument site; 14RP1). Other area archeological sites were reported by E. E. Blackman (Roper 2004), but no systematic archeological investigations have been made in the vicinity. As the structural remains are entirely gone, the research potential of this early and important feature in Republic County and regional history is now primarily in the domain of archeology.

Shimek House (14RP22)

This prominent house is located on the divide between the north and south branches of Mill Creek and has a number of distinctive elements in addition to being one of the larger stone houses in the county. The Shimek house provides a very good example of a structure that "should be saved," according to many who see it, but is simply weathering away due to the tremendous costs that would be required to maintain it and the lack of an immediate or practical reason to do so. This two-story house was built in 1903 for J. J. Shimek by stonemason Joe Baxa and carpenter Mr. Hulka, who had learned their crafts in Czechoslovakia (Kopsa 1976; Muilenburg and Swineford 1975:110). The quarry that supplied the stone is not known but presumably was in the vicinity. Quite a number of stone houses were built in the Cuba, Kansas community, and many were made with stone quarried from the same source.

The exterior of the house measured approximately 40 x 20 feet with main doors on the center of the south side and off-set to the west on the north because of an exterior basement stairwell. Postrock limestone was used in the construction with stones of relatively uniform size throughout. Stones were trimmed to be convex and rough on the exterior, which is distinct from many houses in the area that have exterior stones with chiseled flat or "smooth" surfaces. Window and door openings on the first floor and in the basement are arched, while the second-floor windows have rectangular stone lintels. The house appears to have been built over the southern arched-ceiling cave. The cave itself is extremely well constructed, with the faces of all stone chiseled smooth. What residential structure(s) may have existed prior to construction of the large stone house is unknown. The images in Figure 11 provide a comparison between the Shimek house in the 1970s and its condition in 2012.

The house had a full basement with two stone-arched ceiling caves in the west end, so it was in effect a three-story structure. There was a central stairway connecting all three levels and one central

Figure 11a. Shimek house, view north, circa 1975 (from Muilenburg and Swineford 1975).

Figure 11b. Shimek house, view northeast, 2012.

chimney. The arched ceiling of the northern cave was destroyed in the process of bringing plumbing into the northwest corner. Some of the interior walls, which are 2 feet thick, still exhibit remnants of hand-painted plaster.

This house was occupied as late as the mid-1970s, but all associated structures have since been razed, and the house now sits alone in a cultivated field (Figure 11). The types and locations of outbuildings could still be obtained through local informants. The house is largely intact, although vandalism is taking an increasing toll and the rate of natural weathering is accelerating due to a deteriorated roof and missing windows and doors. The structure provides an example of potential loss due to neglect rather than intentional demolition.

The history and current status of this remarkable structure serve to highlight the modern realities of rural living. Most families prefer more modern structures for their improved designs and features, such as central heat and air, insulation, modern plumbing and electricity, and less costly maintenance. Fewer families live in the rural landscape, and as a result demand for older structures as residences has decreased in recent decades, leaving homes like the Shimek house abandoned.

Minersville School, Cloud County District 72 (14Cd409)

This remarkable native stone schoolhouse is a distinctive feature of the old Minersville town site area, which is located along the Republic and Cloud county line. Notably, in 1880 Republic County had 18 stone schoolhouses of a total of 100 or 18 percent; adjoining Cloud County had 27 stone schoolhouses of 93 or 29 percent (Muilenburg and Swineford 1975:64). The Minersville school was organized in 1878, and the initial large room on the east was built by Jim Willis in the 1880s. Willis was a stonemason but not a local resident. After he was paid for his work on the completion of the school's large east room, he was never seen or heard from again. The mystery of his disappearance was linked by some to the 1934 discovery of a skeleton on the C. Ransom farm, located west of the school.

Following completion of the east room, later additions were made to the school, including an entry room with belfry on the west and a small room north of the entry used to store coal for the stove. The school continued in regular use through the spring of 1956; Ms. Gwen Whitney was its last teacher. Natural weathering, deterioration of the roof, and collapse of the southern and eastern walls has occurred since the 1970s. Figure 12 provides a comparison between the school in 1975 and 2012.

Figure 12a. (above, left) Minersville School (Cloud County Dist. 72), view northeast, circa 1975 (from Smith 1976)

Figure 12b. (above) Minersville School, view east, 2012.

Figure 12c. (left) Minersville School, view northwest, 2012.

SOME OBSERVATIONS

The deterioration and loss of the archeological and historical records cannot be stopped in Republic County or elsewhere. Optimistically, the tide of site destruction may be stemmed or slowed through efforts to inform the public, and particularly landowners, about the potential historical and research significance of sites, such as those mentioned here. However, to preserve without detailed study or investigation is a pale victory at best. It is important to have an engaged public who recognize the long-term benefits of historical and archeological studies of the early Euro-American sites in their area. Appreciation of the capacity that these sites hold for learning about daily life will come only if interested researchers, whether they are professional or avocational, demonstrate their potential. The record is endangered, and opportunities to learn from it are limited, with some sites becoming increasingly compromised or threatened.

A positive element to come from the variety of site destruction examples that the researchers have witnessed is that such destruction can reveal details about construction that would not otherwise be evident or recognizable. This was true with the Martin stone cabin, the Kiperta barn, the Hrabe-Kieffer 2 house, and others. Talking with landowners also provides an opportunity to express concern about the condition and historical importance of structures, and this is at least a small initial step toward potential preservation or further study.

Key factors in loss of early historic sites include weathering, neglect, burning, razing, sale of construction materials, liability issues, maintenance cost, tax burden, loss of historical connection or heritage, and concerns of absentee landowners. Importantly, education about the historical significance, preservation, and archeological research potential of these sites is also critical for enhancing preservation or thoughtful decision-making concerning these sites. Research goals for historic sites are varied but include fundamental concerns relating to issues such as daily life of early settlers, technologies, economic strategies, challenges of homesteading, relationship with the environment, seasons and weather extremes, reliance on wild and natural resources, reliance on cash crops, trade and exchange, changes over time, and development of community-based centers, such as schools and churches. Other issues that need to be explored include the impact on and interaction with Native American populations, impacts of railroads and rapidly changing farm-related technology, dynamics of culture contact between the distinct ethnic groups who settled in the area and how they contributed to the dynamic cultural convergence reflected by rural life in the region. The archeological record offers an opportunity to greatly enhance the historical and cultural documentation and awareness about this period of life in Kansas.

Early stone house and barn sites are tied technologically to other types of sites, which were once common on the Kansas landscape but now are poorly understood and have been inadequately documented and studied from anthropological, archeological, or technological perspectives. These include lime kilns and stone quarries. Lime kilns were the focus of practical and economic efforts in the early Euro-American settlement period. Vast quantities of lime were required in the construction of stone-walled houses and barns and therefore are significant as technological, economic, and probably social focal points in early communities.

Stone quarries were usually close to construction sites. Transporting stone was generally limited to short distances, thus many quarries were on the properties where the stone structures were built. Stone for the original house at the Smies farm on the Republic and Jewell County line was transported 5 miles from the quarry in 1869 (Muilenburg and Swineford 1975:109). Large stone blocks, such as those used in the Myers barn, would represent an engineering challenge even today. The technological system, which included quarrying, transporting, shaping, and building with native stone, is poorly documented for Republic County, but it represents many thousands of hours of labor and design and was a key element in social interactions as the region developed.

Stone houses and log cabins sometimes represent the core of houses that later are covered by more modern construction materials or hidden by structural additions. The burning or demolition of old homes occasionally reveals these old structural cores, but this is a costly way to learn. Figure

Figure 13. Republic County stone cabin, covered by later additions and re-exposed by fire.

Figure 14a & b. Recently burned stone houses in Republic County.

13 is an example of a native stone house that was covered with plaster and stucco facing and hidden by additions. Burning of the structure revealed the older stone cabin. If such structures are demolished before they are recorded, key elements of the record may be permanently lost.

Uninhabited structures that stood for decades appear to be at considerable risk. Many structures have burned in the very recent past; whether this pattern is simply accidental, driven by landowners' desire to be rid of potential liabilities, or other factors is unknown (Figure 14). Whether these losses are accidental or intentional, the message for preservation is the same. Opportunities for detailed documentation and research concerning these early structures are rapidly diminishing. Much is still to be learned about early Euro-American settlement in Kansas. It will never be any easier than it is today to do these studies or to answer some of the questions about early Euro-American Kansas life.

ACKNOWLEDGMENTS

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ARCHED-CEILING STONE CAVES: EARLY HISTORIC HORIZON MARKERS IN THE CENTRAL PLAINS

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Arched-ceiling stone caves or cellars are documented in the Republic County, Kansas, area to provide information about their construction, use, design, and age. Of 25 documented, most were built prior to 1910. By this time the rural population of Republic County was declining, and alternative construction methods and materials, notably cement, were coming into common use. The function of these structures was primarily for food storage prior to the advent of rural electrification, beginning in the late 1930s. Secondary uses were as temporary residences and shelter from severe weather. Construction of arched-ceiling caves was most common in areas with abundant native building stone, such as Fencepost limestone, and when stone masons were among the settling population.

Prior to the introduction of electrical service in rural Kansas, which began in the late 1930s, root cellars or caves were of key economic importance for storage of family and locally produced foods and home-canned goods. The terms "cellar" and "cave" are common synonyms for these structures with some regional and ethnic correlations with the specific usage. Based on an opportunistic linguistic survey, both terms are commonly used in the Republic County area of northern Kansas (Figure 1). During the late nineteenth and early twentieth centuries these structures were commonly made from native stone. The arched-ceiling caves made of native stone, which are the primary focus of this paper, represent a distinctive subset of a broad variety of caves and cellars found throughout the region. A good and well-illustrated example is provided in Schoen's (1994:Figures 15 and 16) study of the Martin Farmstead site in east-central Republic County.

Republic County was settled soon after Kansas statehood, with the first white settlers building residences in 1861 (Blackburn and Cardwell 1964; Savage 1901). This was followed by a period of rapid growth into the 1890s, when Republic County and several surrounding counties to the east and south reached peak population. Their populations have continued to decline since the 1890s (Cunfer 2005; Self 1978:82–89). "The 1920s and 1930s saw the beginning of an ongoing trend—the emptying of the rural Plains and the growth of urban centers" (Lavin et al. 2011:90).

During the late nineteenth century cash and dimension lumber were at a premium in the Republic County area, and this put a high demand on locally available construction materials. Early settlers of European descent included numerous stone masons and people with stone-working skills (Muilenburg and Swineford 1975:110–117). They had the knowledge of how to construct arched-ceiling stone caves and may have been interested in creating structures similar to those from their homelands. These caves were extremely durable, functionally important, and could be made relatively cheaply. Most early farmsteads had a cave or basement.

Early in the twentieth century improved roads, railroad transportation of bulk materials, and access to alternative construction materials, most notably easier-to-use cement or concrete and brick and tile, contributed to changes in how caves and cellars were constructed. Also, the number of residents in the area began to decline steadily after

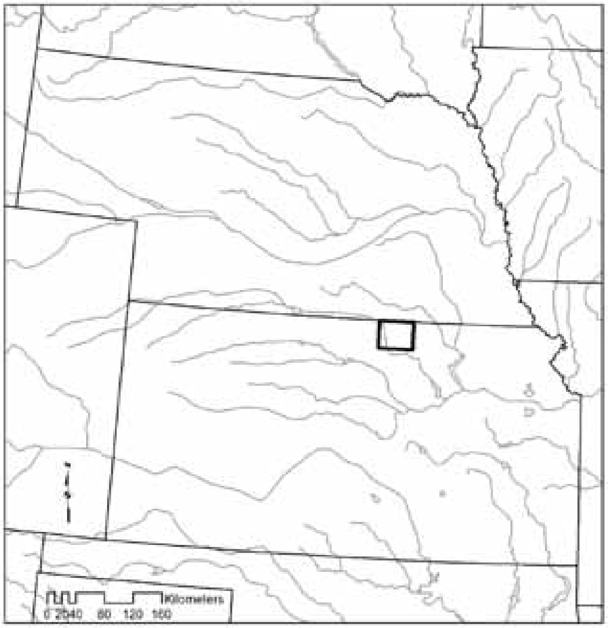

Figure 1. Map showing location of Republic County, Kansas, in the central Plains.

1900, lessening the demand for construction of additional caves. Because of these historical changes, Republic County has a relatively high frequency of arched-ceiling stone caves in relation to modern population density, and the caves are relatively good horizon markers for the early Euro-American settlement period in the region.

The great majority of these caves were built during the period when farms on the Great Plains were still horse-powered and prior to the introduction of electricity. In their consideration of historic agricultural-related resources of Kansas, Davis and Spencer (1992) divide these first decades of Kansas statehood into several periods of distinctive rapid development. Their "Golden Age: Farming in the Progressive Era, 1900–1920" saw the end of the period when arched-ceiling stone caves were built in Republic County. The fact that Davis and Spencer (1992:69) allocate only two sentences to storm and root cellars reflects the generally "unobserved" nature of cellars and caves in many architectural surveys and the under-studied condition of these important structures.

Many caves continued in use well into or through the twentieth century for storage of root crops, dairy products, meats, and canned goods or simply for general dry storage space (Gage 2012). Some continue to be used for limited storage and as storm shelters, although even this use is uncommon today because of more recently constructed concrete storm shelters situated within or adjacent to modern residences.

Arched-ceiling stone caves were often built very early during the homesteading period of site occupation, and sometimes were used as a temporary residence while the primary house was being built. Today, caves may be the primary remaining structural evidence of once busy farms, and even after decades of neglect, they can remain in remarkably good condition when other structures have decayed, burned, or been rebuilt, replaced, or razed. The caves provide a window into the economy, technology, settlement, and culture of early Euro-American life in Kansas. In addition, the stonework often is executed artistically, with the stone masons' skills expressed in a variety of details. Unfortunately, archeological investigation and historical documentation of stone caves in the region have been very limited. Arched-ceiling stone caves in good condition are increasingly rare and endangered, especially on no-longer-occupied farmsteads, where they are commonly viewed as a nuisance or liability and are sometimes filled in and covered over.

The use of vault ceilings was a key construction technique prior to use of poured concrete or concrete slabs and prior to availability of alternative ceiling support materials that sometimes included dimension lumber, wooden beams, or even metal, such as railroad rails. The use of native stone and arched ceilings continued into the twentieth century and may have had a modest resurgence during the depression era of the 1930s. Muilenburg and Swineford (1975:78–81) note a renewed interest in building structures with post rock limestone during that period. Although none of the documented arched-ceiling stone caves in the Republic County area were made this late, a native limestone chicken house was built in Republic County in 1934. Caves built with native stone walls and ceilings continued to be an economical construction option, but stoneworkers with the skills to build these structures became fewer during this period and alternative construction materials became widely available early in the twentieth century. While caves or cellars continued to be built well into the twentieth century, by the 1920s most were being constructed with a variety of manufactured materials including recycled stone, brick, tile, concrete blocks, and cement. The Teitjen and B. Krakow caves described below are examples of these more modern, if less "artistic," caves built with mixed materials. These two structures have concrete ceilings, which are arched rather than flat. This may reflect in part a stylistic continuation from the earlier construction type.

Most native stone caves documented from Republic County were made between the late 1860s and 1920, with the majority apparently constructed between 1870 and 1910. During this period most rural farmsteads had a cave or root cellar of some type. In the Republic County area, because of the availability of native shell rock limestone and some fencepost limestone, and because of the limited access to alternative materials and money during this early settlement period, most Republic County caves built prior to 1910 were made entirely or largely of native stone. A variety of roof or ceiling alternatives are represented in these structures. The intended purpose or function, cool but non-freezing storage, dictated that the roofs of caves needed to be well insulted and this was usually done with earth. It is common to see the mound of earth covering an arched-ceiling cave, bordered by or partially covered by rocks to help keep this earthen cover from eroding away (Figure 2). Framed and metal-covered roofs were sometimes also covered with dirt or sod to aid insulation. Such roofs were simply not as durable as the stone arched type and tend not to be well preserved.

Roofs of arched-ceiling stone caves sometimes were covered with cement on the outside and/or interior surfaces in order to reduce leakage. This became more common after 1890 when cement

Figure 2a. Stones to retain dirt on Kieffer 3 arched-ceiling cave, view northeast.

Figure 2b. Stones to retain dirt on Lojka-Tuma arched-ceiling cave, view east.

was more generally available (Self 1978:137–140) and rail transport facilitated distribution of and access to concrete mix. Interior walls were commonly covered with plaster and sometimes whitewashed or painted. A variety of materials were used to set the stones, including lime mortar of local manufacture, which was most common, raw lime, and black dirt. These materials were commonly pointed, sometimes at a later date, with concrete or plaster. In at least one documented case the cave's stones were set with concrete, which created a problem of wall cracking as the cave settled because the concrete set up very hard and did not allow the stones to shift. Covering the ceilings and walls with concrete or plaster and repointing the mortar presumably were done to reduce leakage and to enhance reflected light. Typically caves were lit with coal-oil lamps or candles. Niches built into the walls of some caves may have been intended as protected spaces for lamps and candles.

Houses that were built with basements, usually walled with limestone during the period of interest here, potentially would eliminate the need for a separate cave. Sometimes a cave would be built first and perhaps used as a dugout-type dwelling during construction of the larger above-ground house. As with some of the examples described below, stone vault caves occasionally occur underneath houses, suggesting that the houses were planned to be built over the previously existing caves. In some cases wooden framed rooms were built as additions to stone houses over previously constructed caves. This leaves a distinctly different construction and archeological signature than when a stone-walled structure is built over a stone cave with the cave's wall or walls serving as part of the foundation for the above-ground structure.

During the late 1930s and 1940s rural electrification lessened the need for caves and cellars, and their use began to change dramatically. Rural electric cooperatives began to develop about a year after President Franklin D. Roosevelt signed Executive Order No. 7037, which established the Rural Electrification Administration. In 1936 the U.S. Congress passed the Rural Electrification Act, and electrical service began to spread throughout rural Kansas (NRECA 2012). With alternative methods of food preservation and increased reliance on purchased foods, root cellars and caves commonly became referred to in some areas as storm shelters or "fraidy holes." This terminology, also found in Republic County, may reflect the decreasing reliance on caves for food storage but the continued importance of having protected space during periods of severe weather. Kansas is second only to Oklahoma in the frequency of tornadoes in proportion to land area per year (Self 1978:60–62). Severe thunderstorms, which typically approach from the southwest, may help account for the orientation of cave openings that are commonly to the east when they are not protected by an above-ground structure.

The documentation of arched-ceiling stone caves has been opportunistic and generally embedded in the study of other prehistoric and historic archeological evidence in the Republic County area. Of considerable concern is the continuing destruction of stone caves and associated sites for a variety of reasons, including safety, liability, tax burden, and the inconvenience of working or farming around such structures, especially when they are unused, serve no current function, and are located within cultivated fields. The engineering and construction of stone caves is largely a lost craft or skill that was once widely shared among stone masons and early settlers in the central Plains region and elsewhere. Stoneworkers and masons were well represented among the early settlers of the Republic County area (Muilenburg and Swineford 1975:110–117), but much of their work already has been lost. Documentation of existing stone caves by collecting systematic data (Appendix) is important to preserving a key element of the region's history and archeology. Although this is a limited and non-systematic survey of stone cave structures in the Republic County area, the available records provide a sample of the artistry, craftsmanship, and variation represented in these early historic structures. At present no caves in the region have been excavated using modern archeological methods with the goal of learning about their specific uses and functions prior to 1920. No craftsmen involved in the building of arched-ceiling stone caves are still living, and opportunities to interview people who used caves as part of their everyday lives are rapidly diminishing.

DESCRIPTIONS OF SELECTED ARCHED-CEILING STONE CAVES

All of the arched-ceiling stone caves described here are located in or near Republic County, and most are made from native limestone. Due to the abundance of trees in this locale, limestone was used primarily for building houses, barns, and bridges rather than for fence posts. This area represents the northeastern margin of the Fencepost limestone region (Muilenburg and Swineford 1975:91–98; Wing 1930:24–28). The post rock or Fencepost limestone is the uppermost unit of the Greenhorn limestone or similar limestone from lower in the Greenhorn formation, including shell rock limestone. These limestone layers occur in thin beds and overlie the Dakota sandstone. Outcroppings of Dakota sandstone are common in easternmost Republic County and Washington County to the east. All of these deposits are Cretaceous in age, and exposures and near-surface occurrences of Fencepost and shell rock limestone occur across the area and north into Nebraska along the Little Blue River in Thayer County (Figure 3). Many hillsides in the region are scarred by quarrying activity, associated with extraction of limestone from these beds for construction materials.

Most of the structures discussed here were built at the time when transportation was primarily by horse and wagon. Although the location of quarries used for specific structures is not known, most were located close to the building site, often on the same property and rarely more than a few miles distant.

Figure 3. Stratigraphic section of Greenhorn formation with alternating limestone and shale beds, River Road, Thayer County, Nebraska, view northeast.

Table 1 provides summary information and dimensions for the caves described here.

Martin-Klima Cave (14RP322)

The arched-ceiling cave at the Martin (Klima) farmstead (14RP322) in eastern Republic County was documented by Schoen (1994:35–38) and provides a rare example of a cave described in the archeological literature for the Central Plains region. Schoen described the Martin cave as follows.

> A storm or root cellar (or "cave") was located 16 feet north of the eastern cabin. It was as well made as the cabins. The exterior walls were about 15.5 feet long east to west and 12 feet wide north to south, and made of irregular slabs of limestone. The whole cellar was covered with a mound of earth about 1 foot thick. The interior walls were formed of coursed ashlar limestone blocks with tooled faces. The mortar was orange silty clay [probably lime mortar]. The interior measured 12.1 feet east to west and 8.6 feet north to south. The cellar's barrel-vault ceiling was of cut limestone blocks set end to end in a series of arches (Figures 12 and 13; Plate 10). Five arch rows were short rectangular pieces set at 90 degrees to the arches to act as "keystones," wedging the longer stones in place. Another 23 arches formed the rest of the ceiling. The center of the vault was 6.5 feet high. The floor was earthen.
>
> A niche was built into the north and south walls toward the east end (Figure 13). Large limestone blocks were set at the back of each niche. Four, one-inch diameter iron rods projected into the cellar

Table 1. Details about Arched-Ceiling Stone Caves in Republic County Area.

Site	Number	Length	Width	Height	Floor	Vent	Door	Niches	House Distance	Entry	Condition	Notes
Martin-Klima	14RP322	12.1 ft	8.6 ft	6.5 ft	earth	W end	E end	2	16 ft	E	unknown	Schoen 1994
Filipi-Kiperta	14RP20	12 ft 4 in	8 ft 2 in	6 ft 5 in	earth	W end	E end	3	8 ft	E	good	brick surface vent
Popelka-Shimek 1	14RP22	14 ft 8 in	9 ft	7 ft	concrete	W end	E end	1	NA	E	good	under house, pre 1903
Popelka-Shimek 2	14RP22	14 ft 8 in	6 ft 6 in	6 ft 10 in	rubble	W end	E end	?	NA	E	poor	under house, pre 1903
Tietjen	14RP23	11 ft 6in	7 ft 9 in	7 ft 3 in	earth, rubble	ceiling 2	S side	No	NA	S	poor	concrete ceiling
Jehlik	14RP21	10 ft 7 in	7 ft 10 in	10 ft	concrete	S end	N end	No	20 ft	N	good	deep, cement
Kieffer 1–1	14RP27	?	?	?	?	?	W end	?	5 ft	W	poor	concrete, rock
Kieffer 1–2	14RP27	11 ft	7 ft	?	?	?	E end	?	60 ft	E	poor	no concrete
Kieffer 2	14RP19	14 ft 6 in	9 ft	–	rubble	E wall	S end	1	NA	W	poor	under house, foyer
Kieffer 3	14RP29	11 ft 6 in?	8 ft 1 in	7 ft	earth	S end	N end	2	18 ft	N	good	lime mortar
Kieffer 4	14RP30	10 ft 7 in	7 ft 3 in	?	rubble	E end	W end	2	12 ft	W	good	tile surface vent
Kieffer 5	14RP32	10 ft 10 in	8 ft 5 in	?	earth, rubble	W end	E end	2	NA	E	good	enter from porch
Koukol	14RP41	12 ft	8 ft	6 ft 8 in	concrete?	W end	E end	No	12 ft	E	good	built 1919
Lojka-Tuma	14RP33	14 ft 3 in	7 ft 10 in	6 ft+	rubble	W end	E end	1	18 ft	N	poor	foyer
Lojka-Klima	14RP34	?	?	?	rubble	?	S end	?	NA	S	unknown	under house addition
Lojka-Svojgr	14RP35	10 ft	8 ft	6 ft 2 in	earth, rubble	W end	E end	2	4 ft	N	good	interlocked arch and wall
Krob	14RP31	12 ft	6 ft 7 in	?	rubble, silt	N end	S end	2	10 ft	S	good	filled with silt
Brown-Kusy	14RP42	13 ft	13 ft 6 in	6 ft 8 in	concrete	N end	S end	1	NA	S	good	enter from porch, 2 arches
Bredthauer-Swiercinsky	14RP327	12 ft	7 ft 3 in	?	rubble	?	E end	No	?	E	poor	frame roof collapsed
Linn MV9	14CD408	8 ft 8 in	6 ft 6 in	6 ft	rubble	W end	E end		12 ft	E	good	limestone slab ceiling
Henderson MV23	14CD422	10 ft ?	9 ft	?	rubble	?	E end	?	NA	E	poor	collapsed
Williams	14CD	14 ft	7 ft	?	rubble	?	E end	?	?	E	poor	collapsed
Hubbell	25TY	11 ft	8 ft	7 ft 2 in	rubble	S end	N end	N	NA	N	poor	fire box S end
Wagoner	25TY	15 ft 2 in	7 ft 10 in	6 ft 8 in	earth	W end	E end	N	18 ft	E	good	fire box W end
B. Krakow	25TY	11 ft 10 in	6 ft 6 in	6 ft 6 in	concrete	ceiling	E end	N	?	E	good	concrete mortar
Krakow-Anderson	25TY	11 ft 10 in	12 ft 3 in	6 ft 4 in	earth	ceiling	E end	N	20 ft	E	good	concrete mortar, well

from the north and south walls. Their purpose is unknown, but they may have been shelf supports. A large rectangular vent hole, located at the top of the west wall, had a wire mesh cover. The vent opened to the top of the cellar mound at the west end. A framed doorway was present at the center of the east wall. A large dressed limestone lintel was set over the doorway. The entrance was closed with a screen door. The cellar entryway was made of cut limestone blocks with tooled faces. It was 8.6 feet long and 2.5 feet wide. Seven limestone steps led down to the cellar.

The combination of description and illustrations (Figure 4) provided by Schoen make this cave perhaps the best documented example in the region and certainly for Republic County. It is unusual in that the arched-ceiling stones were set

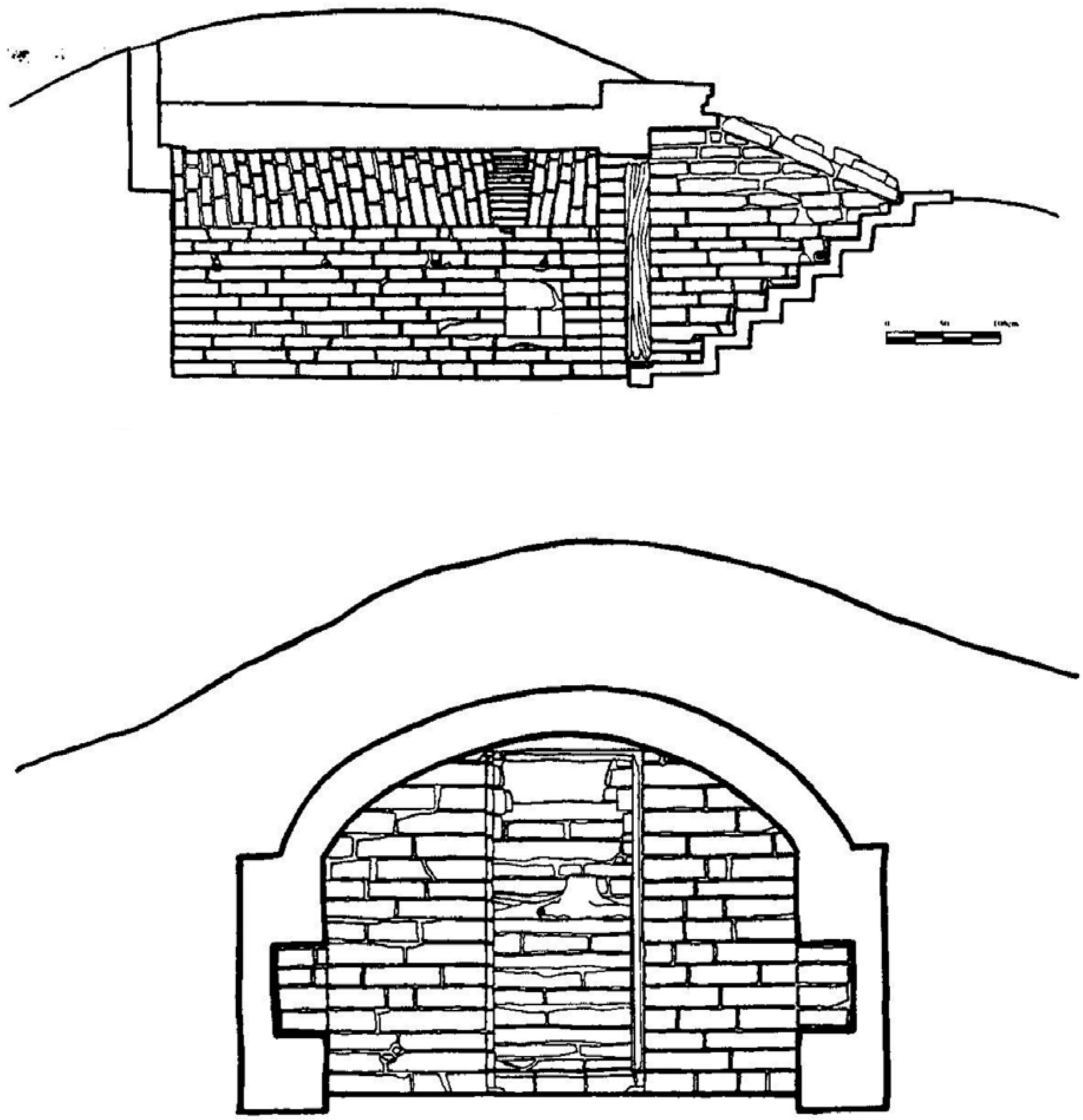

Figure 4. Drawings of stone work at Martin-Klima cave, from Schoen 1994:Figures 12 and 13. Drawings by Michael Irvin.

in two directions rather than just one, and it is one of only two caves recorded in the county in which this technique was used. In every other recorded case all the ceiling stones were laid either parallel with or perpendicular to the long axis of the cave. It is believed that this cave was destroyed during the expansion of Highway 36. A recent visit to the site in an attempt to relocate the cave indicated that it probably was located on the margin of the current highway right of way. A limestone vault described by Schoen (1994:38) at 14RP322 may represent a secondary or specialized cold storage area. Such shallow stone-lined storage spaces commonly were used prior to availability of electric refrigeration.

Filipi-Kiperta Cave (14RP20)

The Filipi-Kiperta cave is associated with an early historic farmstead that included a frame house with limestone foundation, bank barn with limestone walls on the first story, a granary with limestone foundation, outbuildings, and two wells. The site is situated on Mill Creek in eastern Republic County several miles north of the Martin-Klima site. All of the structures at 14RP20 now have been razed or burned with the exception of the cave, which remains intact. In 2012 a fire that destroyed the nearby house also burned the wooden shelves, door, and other perishable materials in the cave. It is located just a few feet north of the house with the doorway and steps to the east. The vent in the west end has a brick chimney extending above the surface (Figure 5a). The brick was set with concrete mortar and probably was built or rebuilt sometime after the original cave construction. This is a very well-constructed cave with uniform and well-dressed stones (Figure 6). There is no evidence of plaster, mortar or whitewash on the walls. The entrance has limestone walls and steps with limited concrete used on the top of the stair walls. The terrain in this location slopes to the east, and a

Figure 5. Surface vent types for arched-ceiling caves. (upper left) Brick chimney vent at Filipi-Kiperta cave, view west. (lower left) Pipe vents at Tietjen cave, view east. (upper right) Concrete chimney vent at Koukol cave, view southeast. (lower right) Limestone vent cover at Lojka-Svojgr cave.

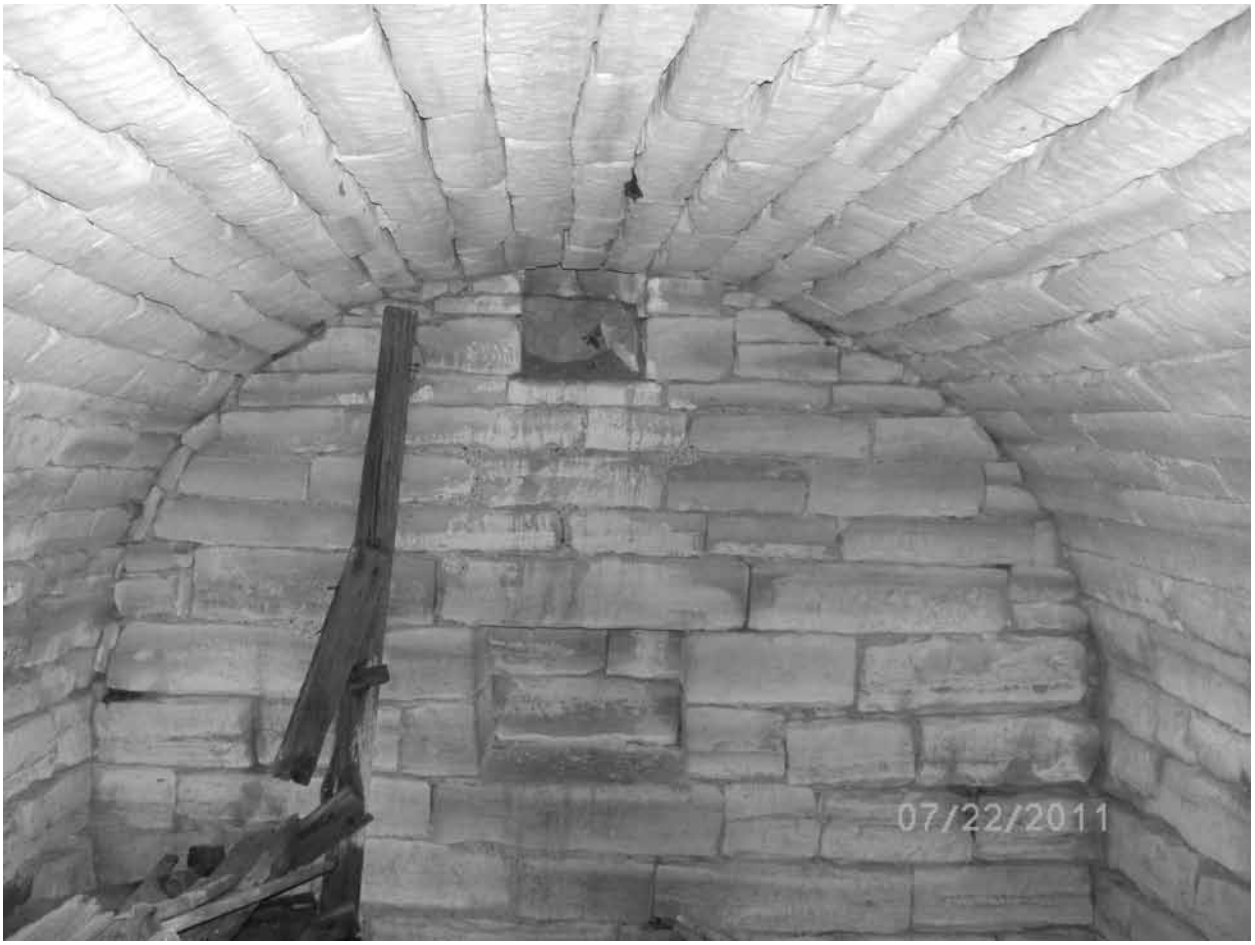

Figure 6. West end view of Filipi-Kiperta cave, showing niche, vent, and arch stones overlapping end wall.

prominent mound of earth marks the location of the cave with the brick vent chimney at the west end. A surface door sloped up to the west, and a concrete cap was added to the stone stairway walls to provide a smooth surface for this top door. At the base of the stairs was a 30-inch-wide framed door and a small window above the door with a stone arch above it (Figure 7). Prior to the fire a wooden door at the base of the stairs was tall enough to cover the window above the main doorway. The cave stones were set with lime mortar and were not resurfaced with concrete. The cave is just over 12 feet long, 8 feet 2 inches wide at the top of the vertical walls, and 6 feet 5 inches high in the center. The earthen floor is filled in with dirt and rubble.

Two niches occur on the east wall on either side of the door and next to the north and south walls (Figure 8). These small niches measure 18 inches wide by 15 inches high and 12 inches deep (northern niche) and 16 inches wide by 15 inches high and 10 inches deep. The west wall has a small vent at the top that is 12 inches wide and 10 inches high. A third and larger niche is centered in the west wall below the vent, and it measures 19.5 inches wide, 15 inches tall, and 12 inches deep. The evenly chiseled arch stones were laid parallel with the long axis of the cave and overlap and rest on the end walls (Figures 6 and 7). Freestanding wooden shelves were present along the south wall, but these burned during the 2012 fire.

Figure 7. East end view of Filipi-Kiperta cave, showing door, window above door, and remnant of shelving.

Figure 8. West end view of Filipi-Kiperta cave after fire, showing niche, ceiling, vent, and wall detail.

Popelka-Shimek Site (14RP22)

Shimek Cave 1

This is one of the best constructed arched-ceiling stone caves that the investigators have seen. It is underneath a large two-story stone house that was built in 1903, but it is not known whether the cave was built at the same time as the house or earlier. Also unknown is if Joe Baxa, the stone mason who built the house (Muilenburg and Swineford 1975:110), also built the cave. Measuring 14 feet 8 inches long, 9 feet wide (north to south), and 7 feet high, the cave is positioned in the southwestern corner of the basement and shares its western and southern walls with the house. The cave is oriented east-west with the entrance on the east. The east entrance wall is also a support wall for the structure above and is 21 inches thick. The wooden entry door on the east opens into the basement area outside the cave. The floor is a layer of cement. The west wall has a large chute-type vent with a four-pane window in the opening. The dimensions of the vent/window opening are 34 inches wide and 24 inches high. A single arch-shaped lintel stone is positioned above the vent. A niche, measuring 16 inches wide, 13 inches high, and 13 inches deep, was built into the west wall below and south of the vent (Figure 9). The ceiling is outfitted with six large metal hooks, evenly spaced with three on each side of the ceiling about halfway between the centerline and the sidewalls.

All of the stones in this cave are of standard appearance and form with a center brown streak as is common for Fencepost limestone. Most stones are 4 inches wide. The walls are vertical for 4 feet 2 inches and then capped with three additional rows of stones that are tapered inward to begin the arch (Figure 10). At a height of 5 feet 6 inches the per-

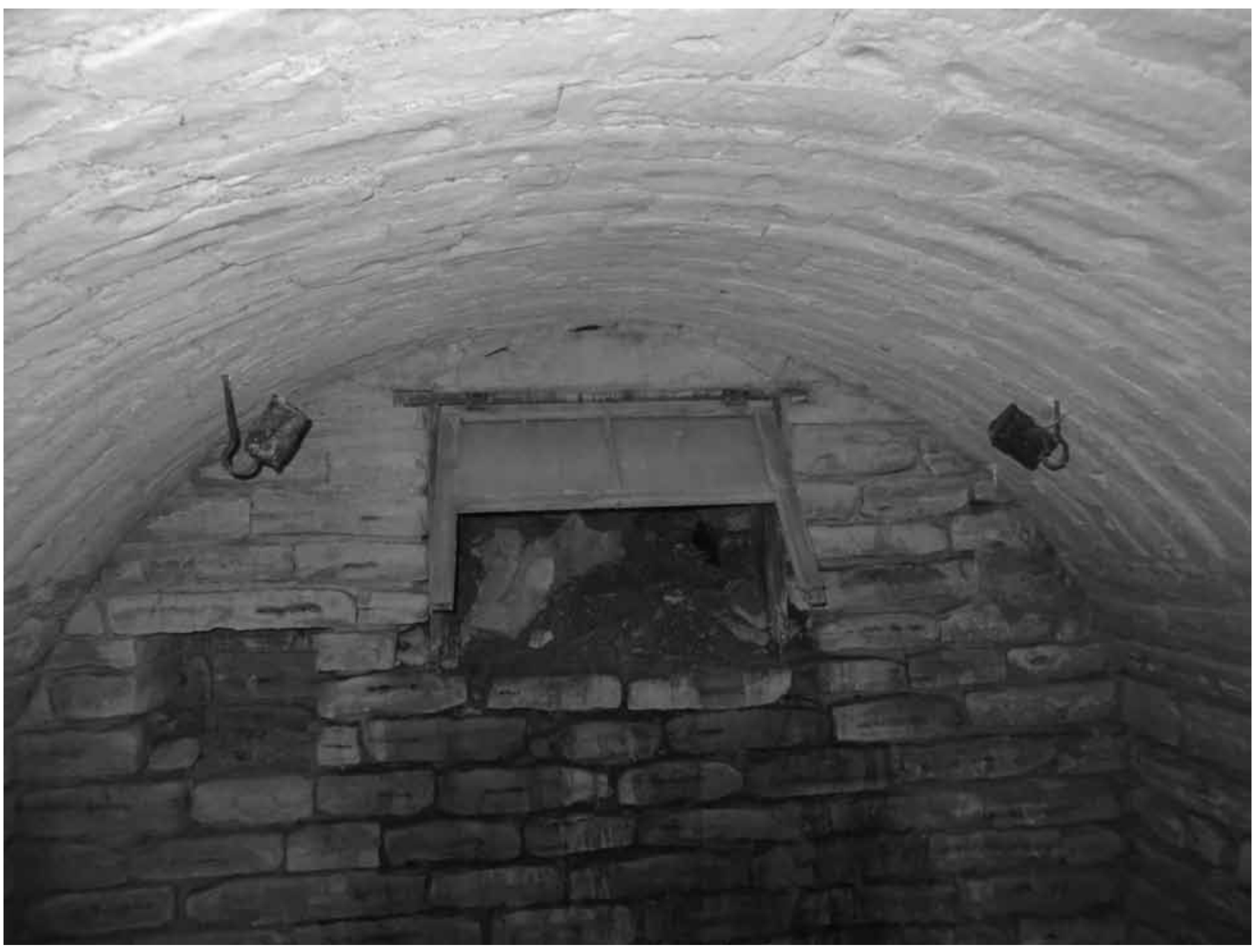

Figure 9. West end and ceiling view of Shimek cave 1, showing vent, niche, and hooks.

Figure 10. North wall view of Shimek cave 1, showing top wall stones tapered inward to begin arch.

pendicular arch ceiling stones begin. These are set perpendicular to the long axis of the cave and are tooled to have concave smooth exposed surfaces forming the arch. The arch stones butt up against the end walls. The interior surface of the cave is not whitewashed or plastered.

Shelving was installed with two types of supports. On the south wall flat metal bars were fitted between the stones and project out to support wooden shelves. The north wall was built with wooden blocks incorporated into the wall as a means of attaching shelves (Figure 11). Wooden blocks in the upper row are about 2 by 4 inches in size, and the lower row blocks are about 2 by 8 inches. No shelves are attached to the north wall at present.

Shimek Cave 2

A second arched-ceiling cave was built in the northwest corner of the basement below the Popelka-Shimek house. This cave is very similar in form to the larger and adjacent Cave 1. Cave 2 was built into the available remaining space and shares a wall with Cave 1; the south wall of Cave 2 is also the north wall of Cave 1. The precise thickness of the wall is undetermined. Cave 2 measures 14 feet 8 inches long (east to west) and 6 feet 6 inches wide (north-south). Its height could not be measured as all of the central arched-ceiling stones had been removed. The vertical walls on the north and south sides are 5 feet 6 inches high below the arch, and the topmost row of wall rocks were set at an in-

Figure 11. North wall view of Shimek cave 1, showing wooden blocks set in wall as shelf attachments.

Figure 12. Collapsed arch stones of Shimek cave 2, showing concave edge of stones set perpendicular to long axis of arch.

ward angle to begin the arch. The cave's ceiling was removed in the process of plumbing the house, but stones remaining on both sides of the arch base show that the arch stones were set perpendicular to the long axis of the cave, just as was done in Cave 1. The stones were chiseled concave on their exposed surfaces (Figure 12). The arched-ceiling stones butt up against the end walls as in Cave 1.

The floor could not be seen, as it is covered with rubble, including ceiling stones, earth, and debris. No niches were evident in the walls. A vent on the west wall was plugged with concrete, perhaps when the plumbing was added and the ceiling arch removed. The entry door on the east end, opening into the basement area, is very narrow, measuring only 21.5 inches wide, but it is 6 feet 10 inches high. The double-faced stone wall on the east end is 21 inches thick. The walls of this cave were covered with concrete mortar, much of which has broken away.

Tietjen Cave (14RP23)

The Tietjen cave represents a late construction that retained elements of earlier arch-vault ceiling caves. A date inscribed in the concrete on the adjacent well cover is Sept. 21, 1928. The cave was constructed in the west bank of a small tributary stream. The long axis is east-west, but the cave is unusual in that the entry is on a long side rather than a narrow end. The 28-inch-wide door opening is on the south wall near the east end and just 7 feet west and north of the well. A short (4 feet long) walled entryway extends to the south and is lined with limestone blocks. The cave is 11 feet 6 inches long, 7 feet 9 inches wide, and 7 feet 3 inches high. The floor is earthen, and collapsed wall and roof sections have covered most of the floor with rubble. The arch is 2 feet 2 inches high above the vertical walls, and the arch ends are constructed mostly of thin native limestone pieces, laid flat and set with concrete. Some bricks and irregular pieces of rock were used in the arch ends, the interiors of which were covered with concrete mortar. The walls are made primarily of Fencepost limestone, but the pieces are irregular in size and have roughly chiseled interior surfaces.

The ceiling is concrete with impressions of the board supports evident on the arch interior and parallel to the long axis (Figure 13). It is not clear whether a framework was built to support the board arch prior to pouring the concrete or if the boards were laid on mounded earth to make a smooth base for the concrete arch. In either case 4 inches of

Figure 13. Concrete arched ceiling of Tietjen cave with board impressions.

concrete without interior reinforcement was used to form the arched ceiling. Two metal ventilation pipes, about 2 inches in diameter, were set in the concrete ceiling toward the east and west ends (Figure 5b). A large portion of the arched concrete ceiling has broken and collapsed, leaving considerable rubble on the cave floor.

Hubbell Cave, Thayer County, Nebraska

The Hubbell cave is located on a few acres of steep rocky land that is within the boundary of Nebraska, but it is isolated from the remainder of the property by a creek, railroad grade, county (state line) road, and pasture fence. The cave was locally known as a squatter's residence, and this is a likely location for such because the Nebraska property owner would not be bothered by the isolated residence and the adjacent Kansas property owner would have no legal control. This is a well-made cave that was set into a steep north slope and so opens to the north. The only existing associated structure is a hand-dug well, 12 feet west and 10 feet north of the cave. This well is stone lined and 2 feet in diameter at the top, increasing in size toward the bottom, which is now dirt at 9 feet below the surface.

The cave measures 11 feet long and 8 feet wide and is 7 feet 2 inches high in the center. The cave entry door is 32 inches wide on the west side of the north wall. This wall is double coursed with dressed stones on the interior and exterior. The wall is 22 inches thick and set with lime mortar. The long axis of the cave is north-south, and the east and west walls are buttressed, 3–4 feet wide, on the northern ends where they extend out from the steep bank (Figure 14). The walls are 5 feet tall below the low arched ceiling, and the thick wall stones are dressed on their exposed interior surfaces by chiseling. The

Figure 14. South view of Hubbell cave, showing buttressed end of west wall and door opening.

lime mortar is coarse and contains pebbles. Considerable rubble and dirt cover most of the floor.

The walls were coated with plaster, which was whitewashed, and then a layer of cement mortar was added. No wall niches were recorded, but a wide vent is located in the center of the south wall. A fireplace or stove might have been located against the south wall, but debris and rubble from a partial ceiling collapse have covered this area (Figure 15). The central portion of the arched ceiling collapsed when large trees that had rooted were pushed over. The arched ceiling was made with undressed narrow stones that are only 2–3 inches thick; most are about 10 inches long. The exposed surfaces of these ceiling arch stones were broken to create relatively flat surfaces but were not chiseled. These stones were set parallel with the long axis of the cave, and 30–32 rows of stones are represented in the arched ceiling. Small stones were used between these ceiling stones to wedge or lock them together.

The wall corners are interlocked, but the arched ceiling butts up against the end walls. The wall stones are uniform and well dressed, mostly 4 to 6 inches thick and commonly about a foot long. The ceiling stones might have been collected from the adjacent slopes, but an early historic stone quarry, indicated on a 1884 plat map, was located within a half mile south of this cave, and the thicker dressed wall stones may have come from that source. This cave may represent a primary residence rather than a structure designed for storage or storm protection.

Jehlik Cave (14RP21)

The Jehlik cave is associated with and south of a stone house that was built on a west-facing bank or terrace and had a full limestone-walled basement.

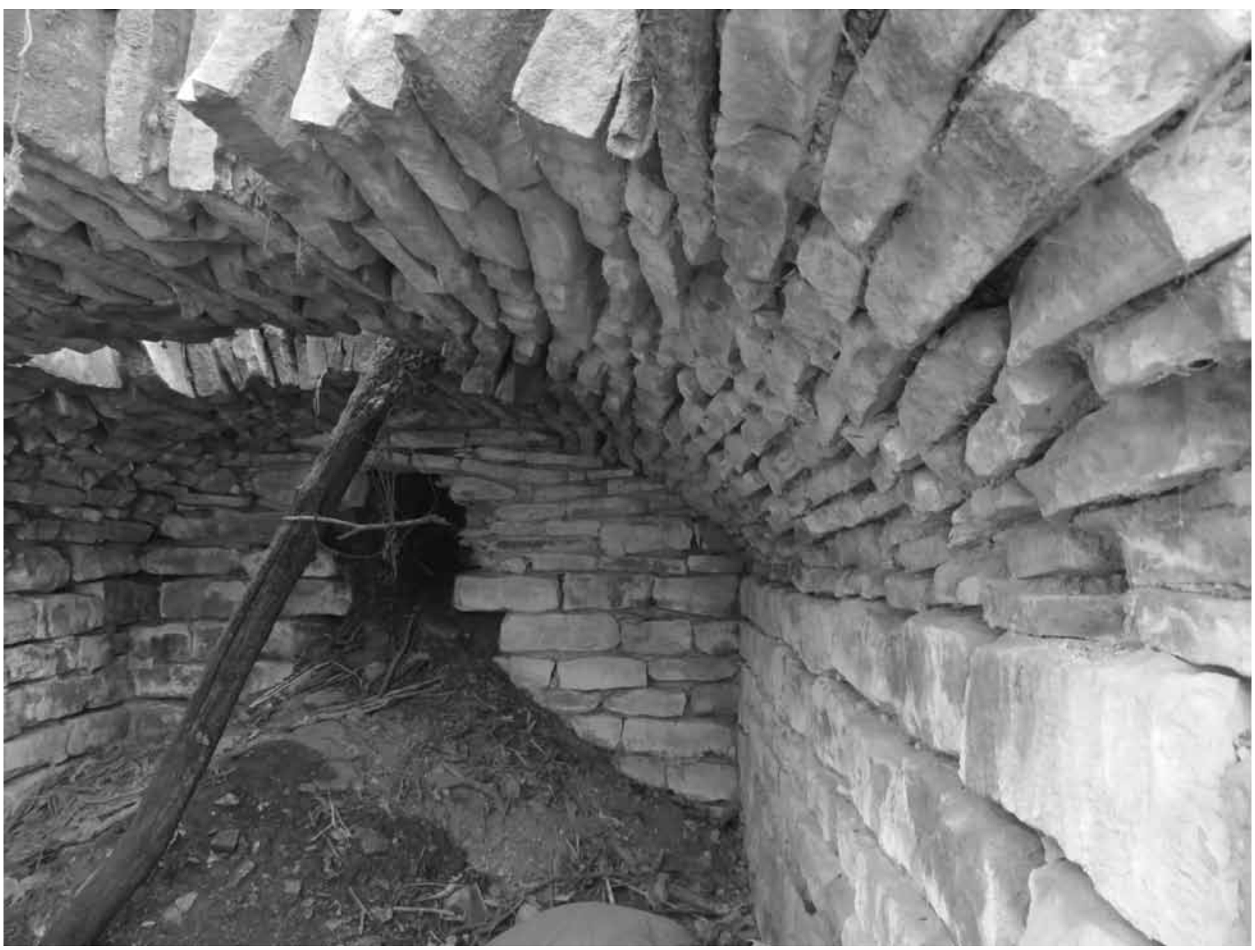

Figure 15. South wall view of Hubbell cave, showing vent, possible fireplace, and partially collapsed ceiling.

A frame addition is present on the east side of the house. A bank barn with limestone foundation and walls on the first level is located about 80 feet north of the house.

Square cut nails are present in the stone house. The frame addition has both cut and wire nails and lumber stamped "Harsh & Son Lumber," a lumber company in Byron, Nebraska, which was established in 1881 (Savage 1901) but was only in operation for a few years. Byron is located on the Kansas-Nebraska border just across the line from Harbine, Kansas, and was on the Chicago, Burlington, and Quincy Railroad or the Burlington and Missouri River Railroad, which passed within 8 miles north of the Jehlik farmstead. Presumably, the lumber was delivered as close as possible by way of the railroad.

Seemingly the cave was built about the time of the primary stone house, and the cut nails suggest probably prior to 1890 (Schoen 1994:101). On the 1884 plat map for Republic County, a house is marked in this position. However, concrete mortar was used as a cap on the stairwell stones and as a surface coating for the interior walls and ceiling. Concrete would have been available in the area only after 1890, so possibly the concrete mortar surface was added years after the cave was built (compare Schoen 1994:99).

The cave is located south of the house and opens to the north with a slope door that has long since decayed. This is a very deep cave with 15 concrete-covered steps leading down into the main chamber, which is 10 feet from floor to ceiling. This cave has the highest ceiling in the sample. A wooden door at the base of the stairs is 6 feet 6 inches high and 28 inches wide and has wire nails in the frame. The cave measures 10 feet 7 inches long (north-south) and 7 feet 10 inches wide. Near the top of the south or rear wall, a large vent with a wooden frame measures 26 inches high and 24 inches wide, and the back slopes up to the south (Figure 16). This is a chute-type vent and may have been used to aid delivering bulk materials into the cave. Another vent in the cave ceiling was made with a tile pipe about 8 inches in diameter. No niches were built into the walls. The walls are vertical for 6 feet to the point where the arch begins. The wall and ceiling surfaces were coated with concrete mortar that was whitewashed. In a few places, where small pieces of concrete coating have broken off, limestone is visible underneath. The depth of this cave and its ceiling height, as well as the limestone coating,

Figure 16. Ceiling and south wall view of Jehlik cave, showing chute-type vent and board impressions on ceiling.

make this cave distinctive. There are board impressions in the cement on the ceiling, indicating that boards were used to support the concrete as it dried. Whether that was at the time of the original construction or at a later date is uncertain.

Kieffer 1 Caves (14RP27)

There were two caves at this site, both now collapsed and filled with rubble. One, believed to be the most recently built, opened to the west and was located just 5 feet east of a porch on a two-story stone house. This cave had limestone walls, but concrete was used to cap the entry stairway walls and for construction of the top. The concrete ceiling had collapsed, prohibiting access. The cave is of interest because the west-facing entryway is unusual. This orientation apparently was chosen because of the close proximity to the house, which would have provided shade and protection from late afternoon sun. The west opening would have facilitated access from the house and porch. The extensive use of concrete in its construction indicates that this cave was built more recently than the one farther to the east.

The easternmost cave is completely collapsed, and few details are available except that it apparently opened to the east and was built entirely of native stone with no use of cement. Remnants of the arched ceiling can still be seen below the topmost rocks. Large flat slabs, pushed into the center of the collapsed structure, may have been among those used around the cave's earthen mound to retain the soil that covered the arched ceiling. Based on surface evidence, the size of this cave was estimated to have been 11 feet long (east-west) and 7 feet wide. The entry was about 60 feet east of the house, and this distance may have led to construction of the second cave closer to the house at a time when cement was more readily available. Collapse of these two caves may have occurred when heavy equipment was used in the area to construct a large concrete slab and steel grain storage bin near the stone house.

Kieffer 2 Cave (14RP19)

This cave is distinctive for several reasons. It was built underneath a stone house, as was the case for the Shimek caves, it has an ante-chamber or foyer at its entrance, and it has a distinctive vent. This cave was built underneath the east room of an L-shaped two-story house, with the east, south, and north walls of the cave serving as foundation for the stone house above. The cave opens to the south into a small 6-foot-square rock-walled foyer. Steps lead up to the west toward a porch, and doorways leading into both wings of the house are only a few steps away. The stairway is 39 inches wide with 5-inch-thick limestone steps. The east wall of the ante-chamber has a niche that measures 16 inches wide, 14 inches high, and 16 inches deep. The limestone rocks used in the walls are irregular, and some display drill holes from quarrying. This pattern also is seen on some of the exterior wall construction rocks in the southwest room of the stone house. Rocks on the exterior of the room above the cave do not display these drill holes and are consistently and evenly dressed by chiseling. The rocks in the foyer walls and in the southwest room of the stone house appear to include some quarry seconds.

The entry doorway to the main cave from the ante-chamber is arched (Figure 17), and the double-faced wall is 21 inches thick. This long and fairly wide cave measures 14 feet 6 inches long (north-south) and 9 feet wide. Too much rubble and stone are on the floor to calculate an accurate ceiling height. The low ceiling arch stones are set perpendicular to the long axis of the cave. Most of the ceiling collapsed when the upper portion of the house was razed, but a few rows of arch stones remain

Figure 17. South end view of Kieffer 2 cave, showing arch over entrance doorway below stone house.

Figure 18. North end view of Kieffer 2 cave, showing north wall vent and remaining arch stones with tooled concave edges.

in the northern end (Figure 18). A large chute-type vent, measuring 32 inches wide, is present in the northern wall. A second vent, built into the east wall, extends up through the double-coursed stone wall and exits about a foot above the surface, centered between the two east windows. This vent hole measures 6 by 9 inches. Details about the lower walls or floor of this cave could not be observed. The ceiling arch stones butt against the end walls, and interlocking stones, set with lime mortar, form the lower corners of the walls. Construction of the cave clearly seems to have been planned as the first step in construction of the house above.

Kieffer 3 Cave (14RP29)

This cave is associated with a stone house that has a frame addition on the west and a covered porch on the south. The cave is about 18 feet south of the porch or 22 feet south of the main house structure. The cave opens to the north and had a slope door at the surface. Although rubble at the base of the stairs makes the count uncertain, the 12 or 13 steps down to the main chamber are very well made. The steps measure 31–35 inches wide with 3–4-inch-thick cap stones on each step, which exhibit considerable tread wear. Each step rises 9–10 inches. The side wall stones along the stairwell are set onto the stair steps.

The entry down into this cave is distinctive for two reasons. There is a small niche on the east or left-hand side of the stairway wall near the base of the steps. This niche measures 22 inches wide, 28.5 inches high, and 12 inches deep. A wooden shelf is set into this niche at 15.5 inches from the bottom (Figure 19). Also of note is the arched covered ceiling of the lower stairway (Figure 20), which is the only one of this type that the investigators have seen. A narrow arch the width of the stairway was created so that one was not in danger of hitting his/her head when entering the main chamber. There does not appear to have been a second door at the base of the stairs at the main chamber entrance.

The main cave chamber measures 13 feet 3 inches long (north-south) and 8 feet 2 inches wide at the top of the vertical wall. The top of the ceiling arch is 7 feet above the floor, but a layer of silt on the floor may be as much as 6 inches thick. The stones used in the construction of this cave are very uniform in size and color and appear to be fence-post limestone. The stones are evenly and regularly chiseled, and the walls of this cave were never covered with whitewash or plaster. The ceiling's arch stones are set perpendicular to the long axis of the

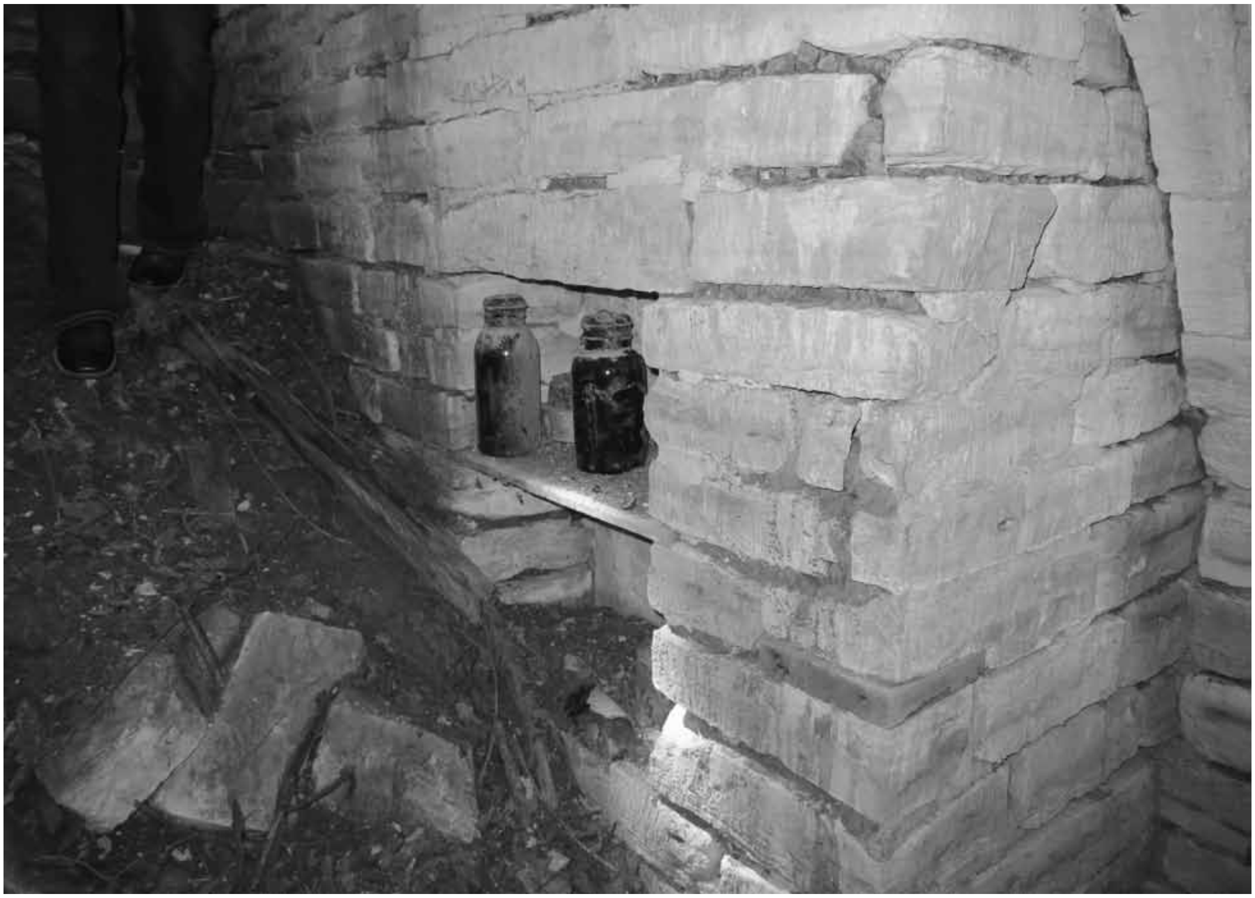

Figure 19. Northeast corner view of Kieffer 3 cave, showing stairway niche, northeast corner construction details, and canning jars with contents.

cave and are tooled to have a smoothly curving concave surface exposed. The vertical side walls are 46 inches high, and the top two courses of wall stones, each about 5 inches wide, taper inward to begin the arch (Figure 21a). The arch stones abut the end walls.

The south or rear wall has a large chute-type vent that is 2 feet 4 inches wide and 2 feet high (Figure 21b). This vent has a smooth sloping back that tapers up to the surface, where a large flat limestone rock was used to cover the opening. A second niche, measuring 22 inches wide, 25 inches high, and 15 inches deep, is located toward the entry door on the east wall. This large niche has large flat whitish limestone rock at its back, which would have been good for reflecting light.

The stone finishing and stone setting are very well done in all details. The work is very similar to that seen in Cave 1 at the Shimek site, located about 6 miles away. Stones were placed on the surface around the earth-covered mound above the cave to help keep the dirt from washing away (Figure 2a).

Kieffer 4 Cave (14RP30)

Kieffer 4 is associated with a two-story frame house that is located about 12 feet west of the cave entrance. The cave is unusual in this sample by having a west-opening entrance. West entrances are probably uncommon because the prevailing direction of storms is typically from the west and southwest. Because the cave is located just east of the house, the west opening was probably chosen for convenience of cave access and use. The cave is partially filled with stone and brick rubble from an old chimney and foundation, which obscures observation of the floor characteristics. The cave measures 10 feet east-west length, 7 feet 3 inches north-south width,

Figure 20. South view down stairway of Kieffer 3 cave, showing arched ceiling above stairs.

and the height could not be accurately determined due to the rubble covering the floor. The vertical wall height is 4 feet 2 inches minimum, and the center ceiling height is more than 5 feet above an unknown thickness of rubble.

The limestone blocks used in construction of the cave are of uniform size, most being 12–18 inches long and 4 inches thick. All stones are evenly chiseled on their exposed surfaces. The ceiling arch stones are set perpendicular to the long axis of the

Figure 21a. East wall detail of Kieffer 3 cave, showing tilted position of topmost wall stones to begin arch.

Figure 21b. South wall view of Kieffer 3 cave, showing tilted position of topmost wall stones to begin arch and chute-type vent.

cave, and the arch stones butt up against the end walls. The lower wall corners are interlocked in construction. The entry has six or seven steps that are nicely finished, but the lower portion is covered with rubble. The east wall has a small vent 10 inches wide and 7 inches high that extends to the east and is vented up with a round glazed tile pipe that is 7.5 inches in diameter. Two niches were built into the side walls of the cave near the west end. Both of these niches are 1 foot wide, 1 foot high, and 1 foot deep. The interior walls were plastered, but most of this has broken off. The stones were set with dark brown dirt and pointed with concrete. Concrete was also used on the top surfaces of the stairway to make a smooth fit for the sloped surface door.

Kieffer 5 Cave (14RP32)

This cave was associated with a frame house, of which only the stone foundation and cement porch floor remain. Other associated structures on this farmstead have been razed or removed, leaving the cave as the only intact structure. A windmill and pump are still present to the southeast of the house area. The cave opens to the east with steps up to the cement-covered porch area. The porch, which may or may not have been covered, was on the east side of the house, and the cave was just east of the southeast corner of the house. Artifacts at the site indicate an early twentieth-century occupation, but the date of cave construction is unknown. Concrete was used around the top stairway walls to provide a smooth surface for the door, which sloped up to the west. The stairway is 32 inches wide, but a considerable pile of rubble inhibited counting the number of steps leading down to the cave. The cave measures 10 feet 10 inches long (east-west) and 8 feet 5 inches wide. The current ceiling height is 5 feet 1 inch due to a considerable layer of dirt and rubble on the floor. The arched ceiling is made of 31 rows of stones, set perpendicular to the long axis of the cave. The arch extends 24 inches above the vertical walls of the cave, and the top row of wall stones is set at an angle to begin the arch. The arched ceiling abuts the end walls.

A long narrow vent was built into the top of the west wall and is chute-like in form but narrower than most chute-type vents. The vent measures 13 inches wide and 25 inches long and slopes up to the west. A large niche was built into the south wall, east of center, and measures 18 inches wide, 20 inches high, and 15 inches deep. A smaller niche is in the east wall south of the door and measures 14 inches wide and 10 inches deep. The height of this niche could not be measured due to a pile of rubble on the floor in that area. The entry door is centered on the east wall and is capped by a large stone lintel. The southern stairway wall bulges inward. The stones of this cave were set with black dirt and small raw limestone fragments. A metal rod was set in the north wall, and a rusted metal bar is present in the south wall. These were likely parts of shelf supports that have broken away. As with many caves, the old boards in the floor fill probably include the old shelving materials.

Wagoner Cave, Thayer County, Nebraska

The Wagoner cave is built into a terrace face on a tributary draw of the Big Blue River. It is located 18 feet north of a stone house that was built using cut nails, probably prior to 1890. The cave's long axis is northeast-southwest, extending into the terrace on the west and opening to the northeast. The cave measures 15 feet 2 inches long, 7 feet 10 inches wide, and 6 feet 8 inches high. The door is 38 inches wide, and the east wall is double faced with interior surface and exterior wall surface rocks being dressed by chiseling. The arched-stone ceiling is made with narrow shell rock limestone, set parallel with the long axis of the cave and dressed on the exposed interior surface. The arches abut the end walls of the cave, and the corner stones on the vertical walls are interlocked. The vertical side walls on the north and south are 2 feet 10 inches high above an earth- and rubble-filled floor and probably measured 3 feet originally.

The north wall has a narrow shelf where the arched ceiling stones begin. A small vent hole is present at the top of the west wall. A small rectangular fireplace box made of limestone is present against the west wall (Figure 22). This is the only cave recorded with a fireplace still intact, although the Hubbell Cave on Rose Creek also may have had a fireplace that is now partially collapsed and covered by rubble.

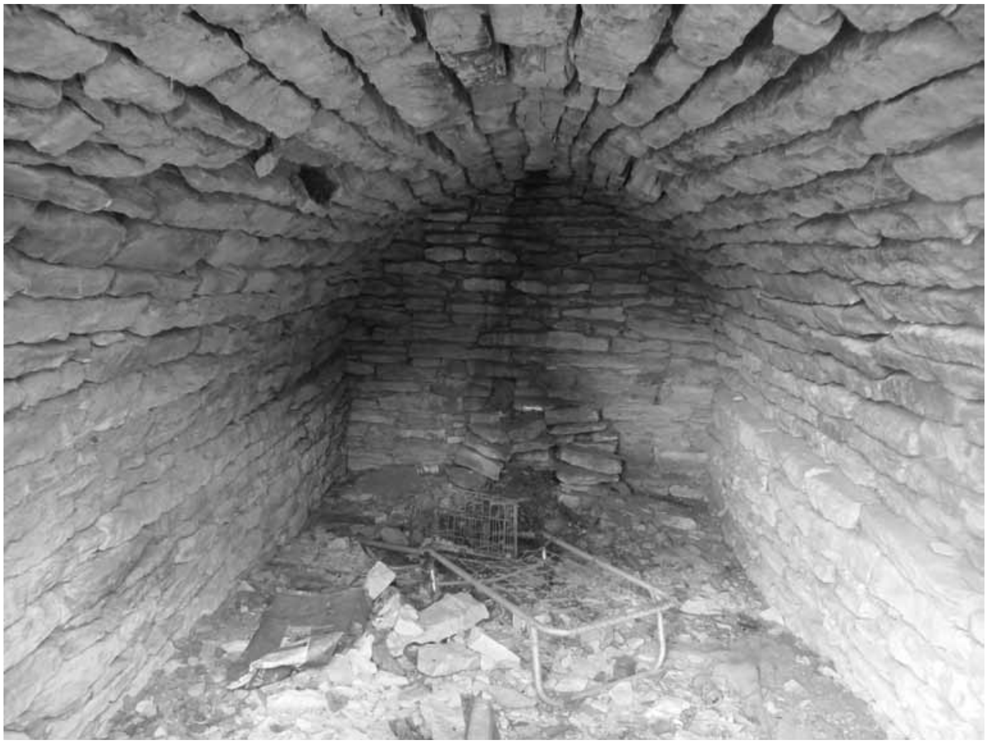

Figure 22a. West wall view of Wagner cave, showing ceiling construction and firebox against wall. Note narrow shelf on north (right) wall at base of arch.

Figure 22b. Detail view of Wagner cave firebox against west wall.

B. Krakow Cave, Thayer County, Nebraska

Bob Krakow's father and uncle built this cave in 1955. It is a good example of an economical mid-twentieth century cave built with concrete and mixed recycled stones in an area where older native limestone caves are relatively common. The cave is located northeast of the house and opens to the east with a steep stairway of seven steps. A variety of stones and blocks were used in wall construction, including fencepost limestone, concrete blocks, Dakota sandstone, and bricks. Stones were set with cement mortar, and a variety of items and materials were used as reinforcement for the concrete, including a metal double-tree (over the door) and a metal bed frame (part of the stairway wall). There are no niches built into the walls, but a water faucet is present in the north wall, reworked from the time when a water tank was located in the cave.

The floor and ceiling are concrete, and the ceiling has a slight V-shape rather than a rounded arch. Lengthwise impressions of boards are present on the ceiling interior, presumably from a form built to support the ceiling concrete when it was poured. The cave is 11 feet 10 inches long (east-west), 6 feet 6 inches wide, and 6 feet 6 inches high at the center. The doorway is 2 feet wide. The cave has electrical service and is currently used as a storm shelter and for potato storage.

Krakow-Anderson Cave, Thayer County, Nebraska

This very well made cave is the widest one recorded during this survey and also is distinctive in having a hand-dug well in its floor. Located about 20 feet north of a stone house, the cave was built on level ground and opens to the east. A tall mound of earth marks the cave's location (Figure 23). The cave measures 11 feet 10 inches long east-west and 12 feet 3 inches wide north-south across the low arch. Length was considered in relation to the opening in the east and to the long axis of the ceiling arch.

Figure 23. Southwest view of Krakow-Anderson cave, showing entrance and prominent earthen mound that marks location of arched-ceiling cave.

The well was dug in the center of the floor 4 feet 9 inches east of the west end wall. It is 11 to 12 inches in diameter and 5 feet 6 inches deep. Shallow wells were common on this terrace of the Little Blue River in early historic time. Another well was dug in the basement of a nearby house on this property. The cave entrance has seven steps up to the east, where there was a surface door (now missing) that sloped up to the west. A second door is present at the foot of the stairs on the east end of the main chamber. This door is vertical and has a wooden frame set against the stone opening to which the doorway hinged (Figure 24). The cave has a dirt floor. A ceiling vent in the form of a 5-inch-diameter metal pipe occurs over the well location and may previously have allowed a hand pump to be installed over the well. A small ceiling vent was placed at the top of the west wall. The arch ceiling stones were laid parallel with the long axis of the cave. The side walls below the arch measure 36 inches high. All stones are chiseled and dressed on their interior surfaces. The cave may have been whitewashed at some time, but little of the white wash remains.

Koukol Cave (14RP41)

The Koukol cave is the most recently built example of a native stone arched ceiling cave recorded during this survey. The date, 1919, is set in the concrete on the entrance above the stairway (Figure 25). Joe J. Koukol, the builder, also carved his name above the door at the foot of the stairs (Figure 26). This well-made and well-preserved cave opens to the east and was built 12 feet west of a frame house. The cave has nine steps, and the stairway width is 34 inches. It is 12 feet long and 8 feet wide with a center height of 6 feet 8 inches. The floor is

Figure 24. Interior view of Krakow-Anderson cave, showing door frame and hinged door at base of stairs.

Figure 25. 1919 date in cement above entrance of Koukol cave.

Figure 26. Joe J. Koukol name above stairway of Koukol cave.

earth or possibly concrete covered with a layer of dirt. The vertical side walls are 3 feet high before the arch begins. The arch stones are set perpendicular to the long axis of the cave. This cave has one of the highest arches recorded. All stones are well dressed by chiseling, and no paint or plaster was used on the interior surface. There are no niches, but four hooks are set in the ceiling for supporting meat, lanterns, or other items (Figure 27). A short wide vent is in the top of the west wall, and the surface of this vent is west of the cave and covered by a concrete chimney (Figure 5c).

Probably due to the late construction date, all the stones were set and pointed with concrete mortar. This mixture sets up harder than the rock, and the relatively softer limestone is prone to break or crack as the structure settles. This cave has a small crack about 2 feet long in the south wall, which continues through several stones and the concrete mortar. This is the only cave recorded during this survey that has cracked wall stones. The cave probably did not settle more than others that used lime mortar, but the concrete did not allow the stones to shift and adjust as the walls settled.

Lojka-Tuma Cave (14RP33)

This cave is associated with a stone and frame house located 18 feet to the north. It is set into a bank and opens to the east. It had one vertical door at the entrance and a small open rock-walled foyer east of the door (Figure 28). Steps down to this ante-chamber are from the north (toward the house). The 14RP33 feature is very similar to the one at the Kieffer 2 site, where the steps were from the west and the opening to the south. The Lojka-Tuma cave foyer may have a niche in the south wall, but old trees and rubble obscure much of this

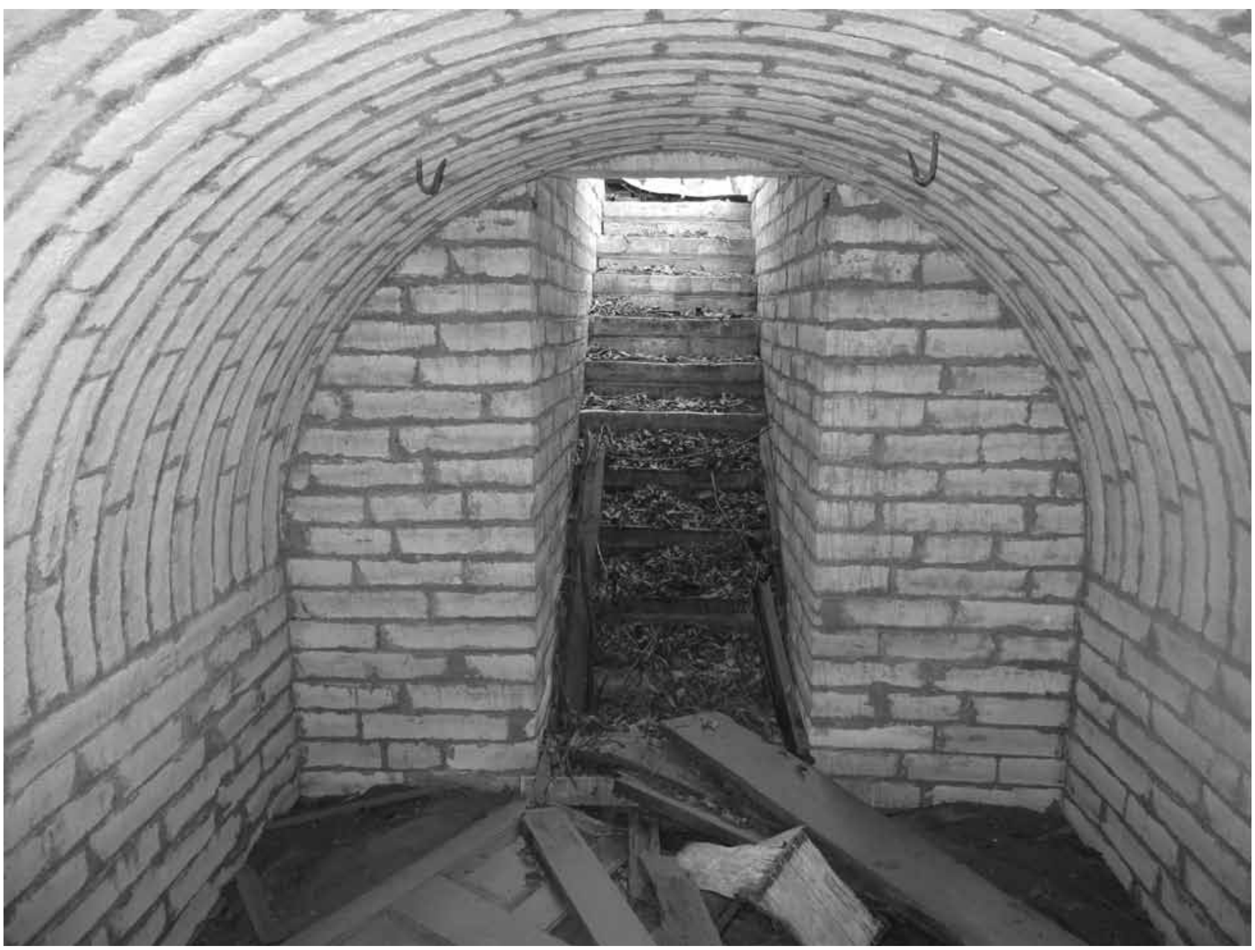

Figure 27. East interior view of Koukol cave, showing entrance, ceiling hooks, and high arch.

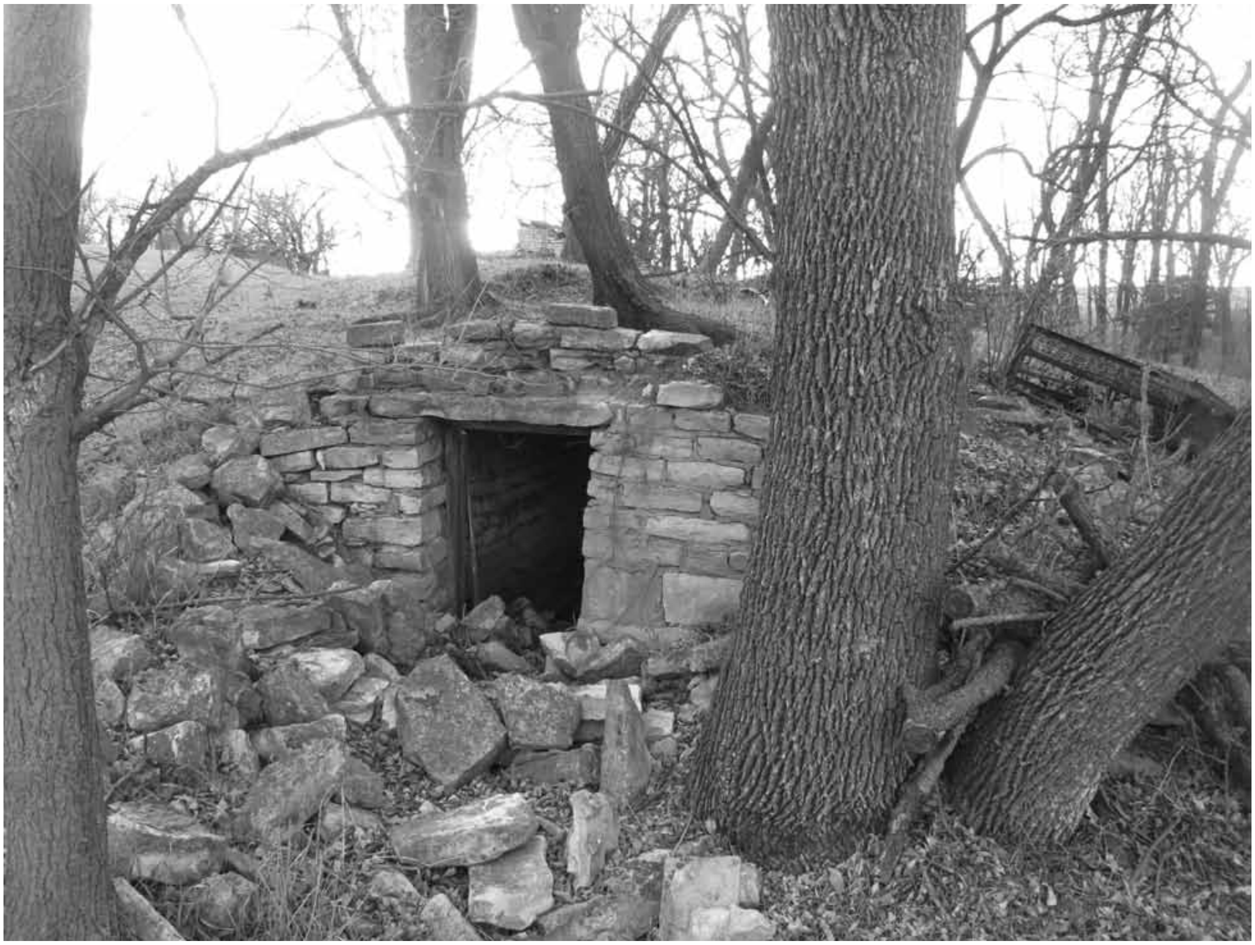

Figure 28. Southwest view of Lojka-Tuma cave entrance and foyer area.

wall. The cave measures 14 feet 3 inches long (east-west) and 7 feet 10 inches wide (north-south). The ceiling sags but presently measures 6 feet above the earth floor, which is partially filled with the rubble of the collapsing ceiling and other debris. The center of the north wall is bulging inward, making this part of the cave narrow, only 6 feet 6 inches wide. One niche was built into the north wall and measures 18 inches wide, 14 inches high, and 18 inches deep. A vent is present on the top of the west wall and measures 11 by 11 inches and is slightly off center to the north. Stones used in the cave's construction are relatively uniform, ranging 3–6 inches thick and up to 24 inches long. The east entrance doorway is 29 inches wide, and the east wall is 18 inches thick. The arched ceiling abuts the end walls, and the lower wall corners are interlocked. The cave is defined by a prominent mound of earth with large limestone slabs around the perimeter (Figure 2b). Large trees growing on the mound have contributed to the partial collapse of the arched ceiling, including 14 rows of arched stones on the east end (Figure 29). The ceiling arch is made with stones set perpendicular to the long axis of the cave. Stones are well dressed (chiseled) Fencepost limestone. The stones were set with lime mortar and black dirt and pointed or tucked with concrete. Whitewash and a layer of plaster or mortar were present on the interior walls and ceiling, but almost all of this has crumbled away or dissolved.

Lojka-Klima Cave (14RP34)

This cave could not be recorded in detail as its entrance has been filled by rock rubble from the collapse of the east wall of the adjacent stone house. The cave is of interest because a wooden frame addition to the stone house was constructed over the

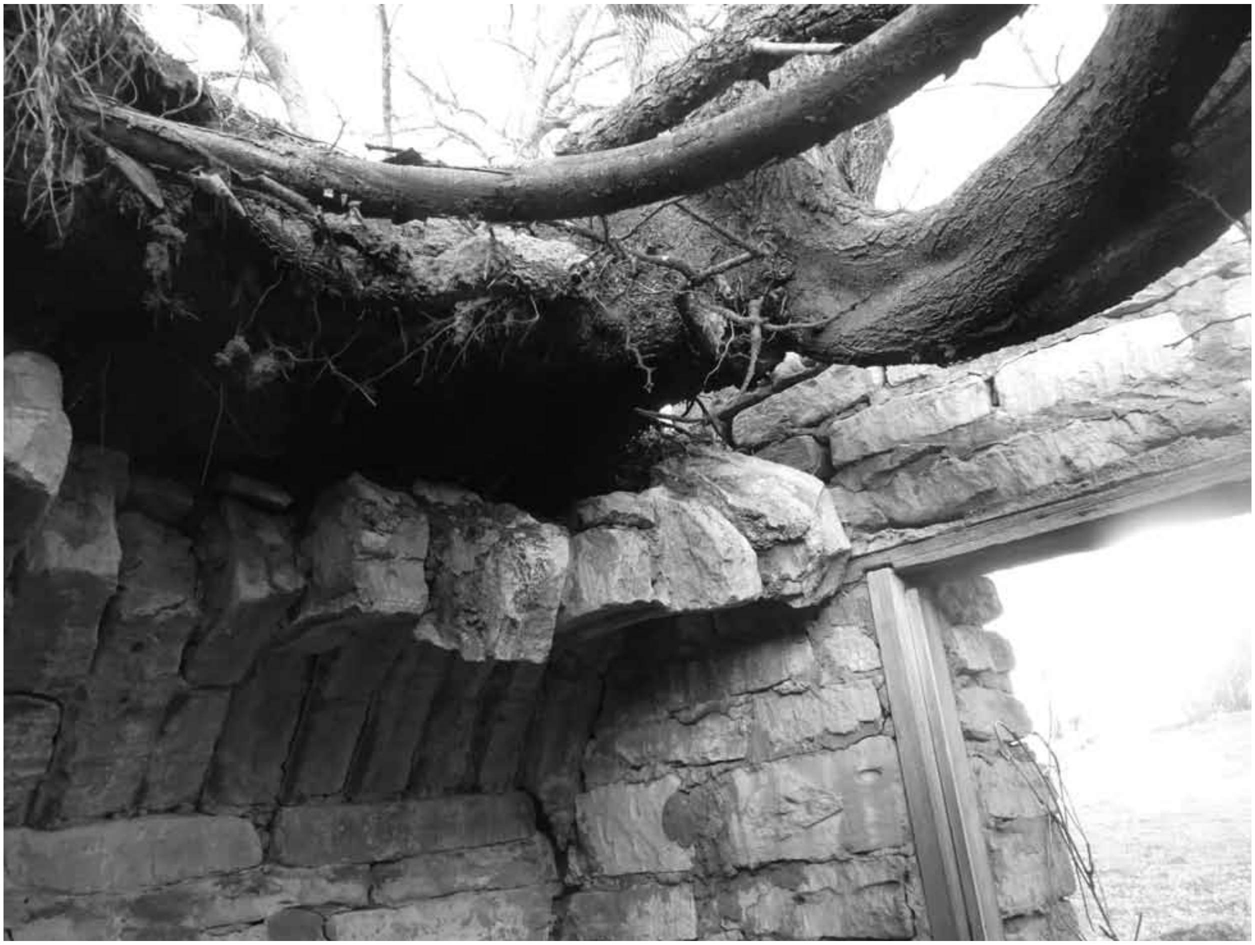

Figure 29. View of Lojka-Tuma cave, showing perpendicular arch stones and partially collapsed ceiling due to tree roots.

cave. The cave opened to the south and was just a few feet east of the original stone house. The house was constructed with black soil used to set the stones. The interior of the house was plastered, and the exterior was pointed with concrete mortar. Informants indicate that this was a very soundly constructed and well-functioning cave.

Lojka-Svojgr Cave (14RP35)

This is one of the more interesting caves documented because of its unique design. The cave opens to the north and is only 4 feet south of a stone house with a frame addition on the east end. Construction is believed to have been the late 1880s or early 1890s. The top of the cave stairway apparently had a door that sloped up to the south, where it rested on large limestone slabs that form a flat ceiling above the landing at the base of the stairs. At the bottom one turns to the right or west to enter the cave through its main entry door (Figure 30a and 30b). This door is off center and located on the south end of the east cave wall. Built into the south wall of the landing at the base of the stairway is a large niche that measures 23 inches wide, 32 inches high, and 12 inches deep. The flat landing area measures 31 inches square, and floor to ceiling height in the landing is 8 feet 2 inches. Both east and west walls of the stairway have windows. The east window is at ground level and measures about 1 foot square and extends through the almost 2-foot-thick wall. The west window connects the stairway with the main chamber of the cave and is about a foot lower than and north of the east window. It measures 11 inches square and extends through the 18-inch-thick east wall.

Figure 30a. Southwest view of Lojka-Svojgr cave, showing entrance with partial limestone cover.

Figure 30b. Lojka-Svojgr cave.Southwest view down stairway, showing landing, south wall niche, and small window and doorway on west (right).

The main cave chamber measures 10 feet long (east-west) and 8 feet wide with a ceiling height in the center of 6 feet 2 inches. This is a minimum height as the floor is covered with dirt and rubble. The ceiling arch stones are set perpendicular to the long axis of the cave. The arch is low, measuring less than 2 feet above the vertical walls. Two large iron hooks extend from the ceiling about equidistant from the center line and toward the western third of the cave. The main doorway is on the south end of the east wall and has a wooden door frame set into a stone opening that is 32 inches wide and 60 inches high. The door frame is made of 2 by 8-inch boards that contain square cut nails. The arched ceiling is somewhat bowed in with one row of rocks fallen loose. The ceiling abuts the end walls. Built into the top of the west wall is a narrow long chute-like vent (similar to that in the Kieffer 5 cave), which measures12 inches wide and 14 inches high, sloping to the west. The surface of the vent is bordered with limestone and capped with a large limestone slab (Figure 5d). A large niche in the north wall of the cave measures 26 inches wide, 32 inches high, and 12 inches deep.

The stones in this cave were set with dirt and limestone fragments. Areas of the cave, notably the entry stairway, were later pointed with concrete mortar. The stairway, set at 90 degrees to the long axis of the cave, and the windows in the stairway walls make this cave distinct from others. Also notably, two of the arch stones, on the bottom of the arch where it sits on the south, protrude down and interlock with the vertical wall stones rather than simply sitting on top of the finished wall (Figure 31). None of the other caves recorded showed this interlocking arch and wall rock pattern.

This cave fell into disuse after 1946 when the Svojgr family moved away. Almost 40 years later

Figure 31. South wall detail of Lojka-Svojgr cave, showing arch stone interlocked with top wall stones.

in about 1983, jars of canned cherries were still in the cave. Two informants, by all appearances reliable, claimed that the cherries were still good and a cherry pie was made with them—a remarkable testimonial to the effectiveness of the technology that combined canning and cave use for food storage.

Krob Cave (14RP31)

This cave is located about 10 feet east of a two-story stone house and opens to the south. Like many caves, this one had a slope door at the surface and a vertical door at the base of the stairs. Overall dimensions are 12 feet long and 6 feet 7 inches wide at the top of the vertical wall. The maximum height, which could not be measured due to the silt fill, is more than 4 feet 6 inches; the original height would have been at least 6 feet. Concrete was used to finish the top edges of the stair walls and the edges of the surface door opening. Wind-blown dust, combined with packrat nest material, fills the cave about half way to the ceiling, so details of the lower walls and floor are buried.

The south door to the main chamber is vertical and framed, measuring 24 inches inside the frame and 29 inches wide between the rock walls of the stairs. The wooden door is half open and its bottom half is buried. A 30-inch-wide vent in the center of the north end is of chute-like construction and could have served to dump or transfer potatoes, coal, or other materials into the cave for storage. An 8-inch metal stove pipe is present in the north vent and may represent either an extended ventilation pipe or perhaps evidence that a stove was used for a period. Stoves or fireplaces in caves are indicated in the Hubbell and Wagoner caves in Thayer County.

This cave is well built, and the stones evenly chiseled. The arched ceiling stones are laid parallel with the long axis of the cave. The ceiling's arch stones rest on top of the end walls, rather than abutting them as is more common. The lower corners of the walls below the arch are interlocked. Two niches were built into the east and west walls near the north end. These niches are half filled with silt, and their height could not be measured. They are 15 inches wide and 14 inches deep (east wall niche), and 15 inches wide and 18 inches deep (west wall niche). Two large wire nails were set in the ceiling to the east of center and these probably served as hooks to support meat or lanterns.

Brown-Kusy Cave (14RP42)

Caves and cellars were built in association with houses in towns, not only in the country. The Brown-Kusy cave is the only example included here that is not from a farmstead or rural setting; it is located within the community of Cuba, Kansas. This cave is of interest because it represents another instance of a cave built underneath a house. On inspection it proved to be distinctive in other ways as well. This cave, now more than 100 years old, is still in regular use, as is the B. Krakow cave described above. These two are unlike all the others, which are located on abandoned rural sites or are no longer in use. This cave probably was built in or prior to 1907, when the frame house over it was constructed. The cave's east wall serves as the east foundation wall for the house. The cave opens to the south with the original opening now enclosed by a room that was converted from the original porch area.

The building stones are all well finished and of consistent quality and appearance, similar to those used in constructing the Cuba store in that they exhibit a narrow brown streak near one edge. The stones may have been quarried approximately 1 mile south of Cuba, which was the stone source for the Cuba store.

The most distinctive aspect of this cave is that it was constructed with two arches, set perpendicular to each other. The first arch is narrow, 2 feet 6 inches wide, 6 inches high, and 10 feet 6 inches long, extending across the width of the south end or entry to the main chamber (Figure 32). This arch serves the purpose of allowing one to enter the main chamber from near the east wall without having to bend down and avoid the arch of the main chamber.

There are 11 steps down into the main chamber of the cave, and these steps exhibit considerable wear. The entry stairway is offset to the east edge of the cave, and the entry door enters the main chamber on the east end of the south wall. The door opens inward, and the narrow arched ceiling along the south end of the cave allows the door to open inward and enables a person to enter the main chamber easily without needing to dodge the

Figure 32. Southeast view toward entry door of Brown-Kusy cave, showing narrow entry arch.

main arch. The arch stones in this narrow arch are set perpendicular to the arch itself but parallel with the long axis of the main chamber. There are 31 rows of arch stones in this narrow entry arch. One row of arch stones, which serve as keystones and to separate (or connect) the narrow entry arch from the main arch, is set parallel with the long axis of the main chamber, but the 25 rows of stones in the large arch are set perpendicular to the chamber's long axis (Figure 33). Only this and the Martin-Klima cave (Schoen 1994) have arch stones oriented in two directions, both parallel and perpendicular to the cave's long axis. The arched ceiling abuts the north wall.

The main chamber, including both arches, is 13 feet long and 10 feet 6 inches wide. Ceiling height above a concrete floor is 6 feet 8 inches. A wide chute-type vent, measuring 2 feet 9 inches wide and about 3 feet high, was built into the north wall of the cave and slopes up to the north (Figure 34). A low stone border originally was built around the surface vent opening. On the south wall west of the entry door is a large niche, measuring 20 inches wide, 22 inches high and 13 inches deep. The doorway is framed and measures 3 feet wide and 6 feet 2 inches high outside the frame at the rock opening. Originally a vertical, inward-opening door was hinged to this frame. Without the narrow entry arched ceiling, this door could not have been fully opened.

Four metal hooks, set into each quadrant of the ceiling, are at approximately equal distances from the center. Set between the stones of both walls are four iron bars, projecting out with up-curved ends to serve as shelf supports. Free-standing shelves are also in use in this cave.

The vertical walls were coated with cement mortar. In about 1960 the north vent was reconfig-

Figure 33. Interior ceiling view of Brown-Kusy cave, showing arch stone orientations and metal bar shelf supports.

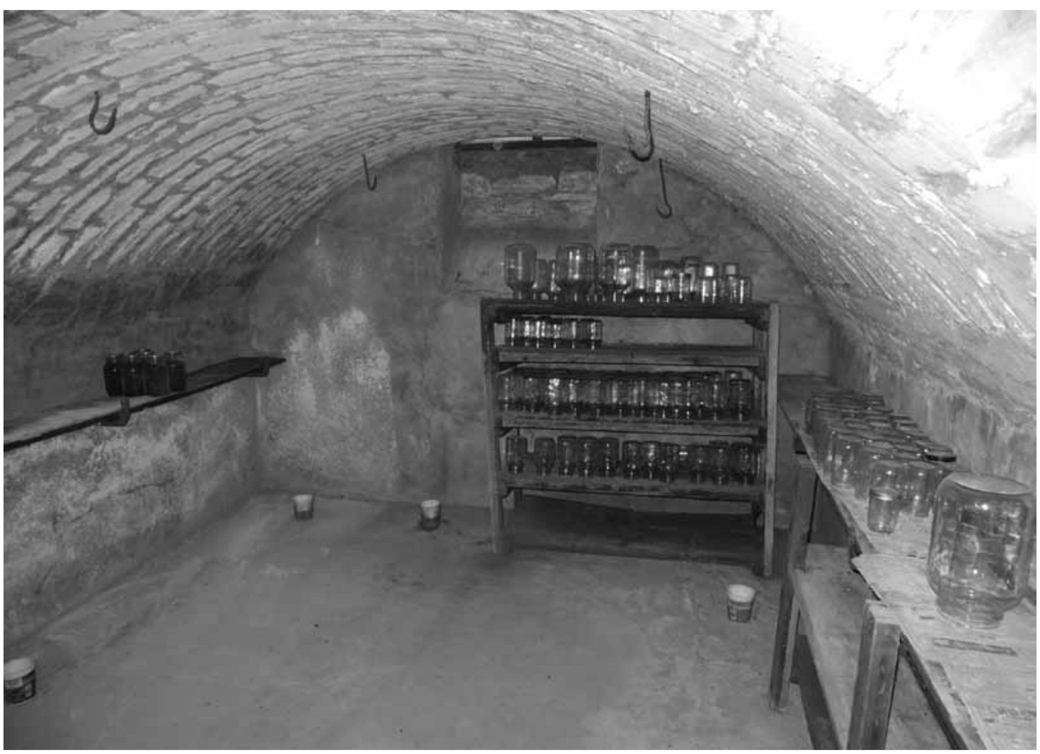

Figure 34. Ceiling and north wall views of Brown-Kusy cave, showing chute-type vent, metal bar shelf supports, and ceiling hooks.

ured to be more air and water tight, and the surface door was changed to allow it to lie flat on the porch room addition's floor. Otherwise, no modifications or repairs have been needed on this cave.

Bredthauer-Swiercinsky Cellar (14RP327)

This structure is more typical of those called cellars rather than caves. It is included here as an example of a cellar that was built with limestone walls and stairs but had a frame roof. The roof is collapsed now and reveals only some details of its original construction. Sheet metal covers the rafters that were set with the peak extending east-west along the long axis. Presumably, the framed and peaked roof of this structure would have been covered with soil for insulation.

The stairway extended up to the east, where it opened facing the frame house a few feet away. The cellar measures 12 feet long (east-west) and 7 feet 3 inches wide (north-south). The limestone walls are a minimum of 5 feet 6 inches high, but considerable rubble and dirt have filled in the floor and stairway areas. The interior wall stones are tooled, were set with lime mortar, and may have been coated with plaster. Fire has damaged some of the walls.

A construction date is unknown, but the dimension lumber and wire nails used in the roof suggest a date after 1890. The time of construction very likely overlaps with the period when arched stone ceilings were still being constructed. Availability of resources, design preferences, costs (including labor), and construction abilities of the maker could have been factors in deciding what kind of cellar or cave to construct.

Linn Site Cave (MV9; 14CL408)

This cave or cellar is located in northern Cloud County in the Minersville area and is in the approximate location where a dugout is indicated on an early sketch map (Aaron 2013b; Tolbert 1963). It is situated on a level terrace close to a deep draw that is a short distance to the north and is 12 feet north of a frame house that was set on a concrete foundation and basement. It is believed that the cave predates the house structure, potentially by decades.

The cave stones were set with lime mortar and later pointed with cement. The cave is distinctive in ceiling construction, composed of very large limestone slabs, about 4 by 8 feet in maximum length, and supported by a series of six sections of railroad rails. These rails are not large, measuring 4 inches wide at the base and 4 inches high, and probably are from coal mine rails used in the vicinity's coal mines. The entry stairway has six steps and enters the cave chamber at the south end of the east wall. There are no niches in the walls, and the ceiling stone slabs were arranged to allow a vent at the top of the west wall. The cave measures 8 feet 8 inches (east-west) and 6 feet 6 inches wide (north-south). Ceiling height is 6 feet, and the floor is covered with wood and other debris. The surface door, opening to the east, was sloped to the west, and the top of the stairway wall was capped with cement. There was also a vertical door at the foot of the stairs.

Other Caves

A few additional caves, not described above, are included in Table 1. These provide additional examples of entryway openings and occasionally other information, but many details are lacking usually because the caves have collapsed or detailed descriptions simply have not been recorded. Data on 26 caves are summarized here, including two with concrete ceilings, one with a framed roof, and one with a roof of limestone slabs.

In consideration of frequencies and percentages of features, only those cases for which there are relevant observations are included in the following discussion. For example, the number of caves with entry-direction information (n=26) is different from those with information on arch stone direction (n=17) or on the presence of niches (n=20). Percentages are calculated accordingly.

DISCUSSION OF SELECTED FEATURES

Although the current sample is small and the region investigated is limited, it is appropriate to consider some attributes of arched-ceiling stone caves in a more comparative and general manner. The patterns observed are preliminary, and some may be expected to change as more is learned about the details and variety of caves in the region. Here the attributes considered are facing direction, position in relation to landscape and other structures, door types, construction techniques, construction materials, interior finish, niches, vent types, shelving and storage units, floor type, size, and special features.

Door openings or facing direction of caves is determined by a variety of factors and should reflect a pattern that corresponds with all cellars and caves in the area, regardless of construction type. Because one primary role of caves was for year-round food storage, caves generally were situated close to houses and in proximity to doorways or porches where processing, preparation, or use of stored goods occurred. Also a recurrent configuration is for the cave entrance to be approximately in line with a doorway of the associated house, although this is much less consistent than simple proximity. Precise distance from houses was not measured for each of the documented caves, but the great majority of cave openings are less than 20 feet, and most are only a few steps away from a doorway or porch. The Martin-Klima cave, for example, was located 16 feet north of the associated house (Schoen 1994:35). Many of the recorded caves are within 12 feet of their houses; at 18 feet from the house, the Lojka-Tuma Cave is one of the more distant. This pattern makes the older cave at Kieffer 1 stand out, with its entrance located about 60 feet from the house. Likely, this cave was built independent of the large stone house, perhaps early in the settlement of this farmstead, and it may have served as a temporary habitation or perhaps was related to a structure that is no longer present.

The facing direction of cave openings apparently was determined by at least four factors: local topography and drainage, relationship to houses, need for cool storage, and severe weather patterns. When caves were built as part of a homestead, which was most commonly the case, their position in relationship to the house and doorways was important. Also, when the cave was built as part of a structure, such as underneath a room of an above-ground house, then the architecture, design, and floor plan of the house could determine the facing direction of the cave. When caves were built into slopes or banks, the direction of the slope generally controlled the facing direction. When options of slope direction were available, there seems to have been deliberate selection of facing direction—usually not to the west. Caves commonly were positioned upslope or "upstream" of structures, presumably due to consideration for drainage and the desire to keep the cave interiors and floors dry.

The need for cool storage of perishable foods and meat also influenced opening placements. Northern exposures receive the least radiant energy from the sun, especially during the winter. Other factors, such as topography and relationship to the house, being equal, northern openings would offer maximum protection from the sun, which might enhance preservation of some foods. However, in this sample of 26 caves and cellars, only four (15 percent) open to the north. If interior light were desired for using the cave as a living or work space, then orienting the opening to the east or south would be preferable to a northern opening. Western openings delivered more heat during the hottest portion of the day and were not favored if cool storage were a concern.

Use of caves and cellars as storm shelters undoubtedly influenced the placement of openings. In the Central Plains region the prevailing wind direction for most of the year is southerly, but most thunderstorms and severe weather come from the west and southwest (Flora 1948:256–260; Self 1978:51–59). Based on these considerations, the placement of cave openings to the north or east would provide maximum protection from severe weather and solar radiation at the same time. In fact, the 26 caves and cellars in the current documented sample primarily have eastern openings (n=15 or 58 percent), with five (19 percent) opening to the south and four opening to the north. Only two (8 percent) of Republic County caves open to the west; however, western-opening caves are documented elsewhere, such as in the Marshall County area. The western-opening caves in Republic County, Kieffer 1 and Kieffer 4, are situated east of the houses that they served. The houses and associated trees probably shielded the caves from intense late afternoon sun. The fairly common southern openings may suggest that light was as important in use of the caves as was protection from solar radiation.

In the majority of cases, the steps down into caves are in line with the structure's long axis and door. However, two examples have small open ante-chambers or foyers at the base of the stairs and in front of the doors. These foyers apparently were unroofed, and the stairs down are at 90-degree angles to the doors. These examples, Kieffer 2 and Lojka-Tuma, are distinctive in other ways. Kieffer 2 was built under a stone house, and, while the cave entrance is from the south, the steps down are from the west and lead to a protected east-facing porch area and two doors into the structure. At Lojka-Tuma the cave is built into a bank (terrace edge) and opens toward a draw on the east, while the steps down to the foyer are from the north in the direction of the house. In both cases the available level space in front of the caves was very limited, and this may have influenced their design. Both of these ante-chambers had small niches in their walls and would have provided workspace for activities associated with the caves. The Teitjen cave has a south-side entrance, even though the long axis of the structure is east-west. This cave may have served for a time as a residence, and the opening is adjacent to a well.

The Lojka-Svojgr cave is also of interest here because the stairway leads down from the north to a small covered landing. Once at the landing one must turn 90 degrees to the right (west) to enter the main chamber of the cave from the east. The purpose of this angle is not clear. There appears to be plenty of room east of the cave, so that the entrance could have been extended toward the east rather than turned to the north. The position of the cave close to the south side of the house and the stairway up to the north allow very easy access, and this may have been a determining factor in the design of the cave's entrance.

Doorway configuration was of three basic designs, only two of which are documented in this sample. The most common form is a sloped door at the ground surface at the top of the stairway. These doors usually are sloped with the high end toward the arched ceiling and the low end at the top of the stairs. Schoen's drawing (1994:Figure 12; Figure 4 herein) of the Martin-Klima cave is a good illustration of this pattern. The top of the stairway walls is commonly finished with concrete, sometimes added years after the cave was built. These sloped surfaces often had a wooden frame onto which the door was hinged. In many cases these door frames have rotted away, as in the cases of the Kieffer 4 and Kiperta caves. Today most caves are simply covered with whatever materials are readily at hand, if they are covered at all.

A second common doorway form was a vertical door set at the base of the stairway at the entrance to the main cave chamber. For these doors a wooden frame usually was constructed within the stone wall doorway, and the door was hinged to this frame (Figures 7 and 24). Sometimes two doors, a solid wooden door and a screen door, were used. The doorway commonly served as an air intake that, combined with a vent at the back of the cave, provided ventilation and enabled drying of the cave or contents. Some caves had a sloping door at the surface, which was always solid, and a secondary door, sometimes screened or vented, at the foot of the stairs. In one case, the Kiperta cave, a small window was placed above the vertical doorway at the foot of the stairs. Presumably, this was covered with screen to facilitate ventilation and to prevent access for flies or other pests. Ventilation obviously was important whether the purpose was for long-term storage of food stuffs or for human use, such as during severe weather. Candles or lamps, requiring oxygen, would have made airflow through the cave essential, so the primary cave doors did not need to be airtight, which probably was not an issue, given the available technology of the time. Use of screen doors and screen-covered vents would have been very important in caring for stored foods and controlling rodents and insect pests.

The third type of entry, not encountered in this initial sample, has a vertical door at the top of the stairs and sometimes a second vertical door at the base of the stairs in the cave entrance. This construction technique requires more labor and more materials in order to extend the stairway walls above ground and make the opening level with the ground surface. These entryways commonly are covered with soil, such as examples from Douglas County, Kansas (Figure 35), but also might be made as wood-framed extensions, sitting upon the stone walls of the stairways. The main advantage of this style is that it saves the bending and heavy lifting of the near-surface sloping cave door. (Sometimes a counter weight was used to aid in lifting the heavy doors when they were built close to the ground rather than vertical.) The need for additional construction materials and construction time

Figure 35. Northwest view of Coffman cave, showing vertical door at surface, Douglas County, Kansas.

are the obvious disadvantages to the vertical door at the surface type of entrance.

Vents were made in a variety of ways and were critical to a functional cave or cellar. Most commonly the vent was made in the top of the end wall opposite the cave's entry door. These vents were made either at an angle with the vent surface beyond the cave's end or vertical, so that the vent extended upward at or just outside the cave wall. The sloping or horizontally extended vent helped reduce moisture and light entering the cave. The vents vary considerably in size, perhaps due in part to the size of the rocks used in wall construction, and are generally rectangular from about 6 inches to more than 3 feet in width.

The wide vents that occur in several caves typically are sloped with a smooth stone surface and are considered chute-like vents, which may have functioned as portals to efficiently transfer bulky commodities, such as potatoes or coal, into the cave (Figures 9, 16, and 34). Stone covers or screens could then be used to keep out unwanted pests. Potatoes were a common crop and typically were stored in caves and cellars for prolonged use. Coal commonly was used for heating and cooking during the late nineteenth and early twentieth centuries. Prior to railroad transportation, coal was derived primarily from mines in the Minersville vicinity on the southern edge of Republic County and in northern Cloud County and from a few other area mines, such as west of Agenda (Fitzgerald 1982; Schoewe 1952; Smith 1976; Tolbert 1963). Dakota formation coal, widely used in the region, was lignite of relatively low quality. It was necessary to keep the coal dry for it to hold its form and burn well. Caves could have provided a dry storage space through the winter months. Limited testing below the chute-like vents would enable evaluation of this possibility. Similar chutes, noted in stone basements of some houses in the region, presumably were for transfer of coal and other bulk materials. Railroads introduced higher quality coal and would have provided easier access for some residents, probably contributing to the decline in demand for Minersville lignite coal after the 1890s.

Other vents occur as ceiling holes in some caves. These may be slightly later in time, as they are associated with concrete usage in at least three instances. Metal or tile pipe usually serves as the vent; when these materials were not available, the more traditional vent in the stone end wall presumably would have been used. The surface expression of vents is also varied, including metal and ceramic pipes, rock-lined crypts that may have stone covers, or short chimneys made of stone, brick, or concrete (Figure 5).

A final vent type was documented at Kieffer 2. This cave was built under a stone house, and three of the cave walls served as footings or basement walls for the house. The cave vent is on the east cave wall and is a 9- by 6-inch opening that continues up the center of the stone wall and exits above ground on the east side of the house. This cave also has a chute vent in its north wall. A similar vent, also is positioned in the center of the eastern wall, is present in the basement of the Popelka-Shimek house (14RP22).

Cave size is relatively consistent, and Figure 36 shows the variation in length and width measurements. These caves range from 10 feet to just over 15 feet long and from 6 1/2 feet to more than 12 feet wide, but most are no more than 9 feet wide. The only notable outlier in this distribution is the Anderson-Krakow cave, which is significantly wider than the others. Being the only cave with an inside well, it may have served as a residence for a period of time. Arched ceilings between 6 feet 6 inches and 9 feet wide clearly represent the common size range, probably related to a manageable span for arched-ceiling construction and adequate storage space for a family. Ceiling heights are commonly 6–7 feet at the center, when complete measurements could be made. This allowed adequate clearance, the potential for supporting materials

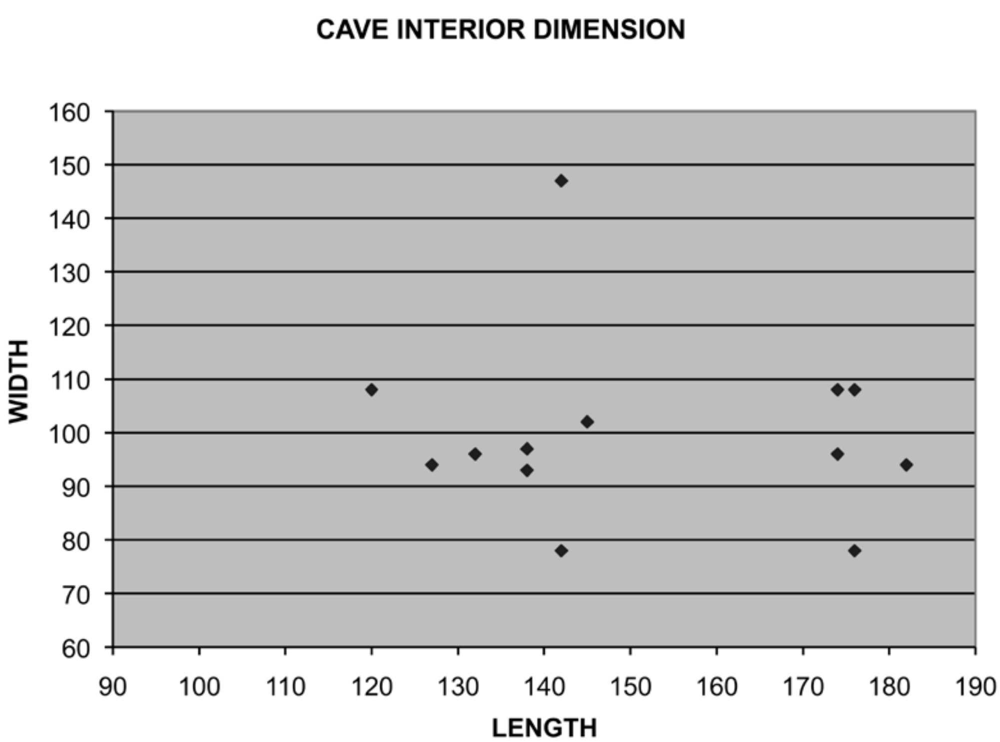

Figure 36. Plot of interior cave dimensions, length by width, for Republic County area sample.

from the ceilings, and better ventilation. The highest ceiling was in the Jehlik cave with a height of 10 feet.

Stones used in construction of arched-ceiling caves were predominantly Fencepost limestone or related, but stratigraphically lower, units within the Greenhorn limestone (Muilenburg and Swineford 1975; Wing 1930). The ceilings of the Hubbell and Wagoner caves and the arched ends of the Teijten cave were made with thinner pieces of limestone that occur in units below the Fencepost layer. Stones in many of the caves in this region have abundant bivalve shell fossils and probably represent the shellrock bed of the Greenhorn limestone. Some caves, notably those of late construction, contain a variety of materials, including Dakota sandstone, bricks, and concrete blocks. The stones in these later caves are typically set with concrete.

Stone surface treatment is also variable. Exposed exterior cave walls that are set into banks and have

Figure 37a. Double-faced walls with rubble cores. Southeast view of Hubbell cave north wall.

Figure 37b. Double-faced walls with rubble cores. East wall view of Wagner cave, showing double face.

partially exposed fronts with vertical doors, such as Hubbell, Wagoner, and Lojka-Tuma, are double-faced with rubble cores (Figure 37). The majority of exposed interior stone surfaces in this study are chiseled to form flat or even surfaces. Substantial variation is evident in the evenness or care with which the surfaces are chiseled, and different types and widths of tools clearly are represented. Presumably, only the exposed surfaces and joining ends of most stones were chiseled flat. The care invested in finishing the exposed stone surfaces may be related to whether the wall and ceiling surfaces were intended to be covered with a layer of plaster or mortar. Also, some stones may represent "seconds" or lower quality building stones that initially were shaped at the quarry. Rough or untooled surfaces occur in a few caves. The ceiling of the Hubbell cave is made of thin limestone slabs that are broken to form squared and relatively straight edges.

The ceiling stones in which the arch stones are set perpendicular to the long axis of the cave are typically curved (concave) on their exposed surfaces (Figures 12 and 18). This gentle curve was usually consistent for all stones in each arch, and the circumference was set based on the size of the arch. These arch stones are typically less than 2 feet long. A form or guide would have been used to chisel these curved edges, so they would all have the same arch or degree of arc. Even in a collapsed structure or with relocated stones, these perpendicular arch stones are distinguishable by their concave tooled edges.

When the ceiling arch was formed by stones set parallel with the long axis of the cave, the exposed surfaces were chiseled or broken to form straight, rather than concave, faces, and these surfaces were kept even and level from one end of the ceiling to the other. The narrow width of most stone, usually less than 6 inches, allowed the stones' edges to be set at slight angles to the adjacent stones in order to form the arch. Smaller stones commonly were set between the primary stones to help wedge them and hold them in place. In this ceiling type the sides of the arch would be built up first to meet in the middle, with the center row(s) being set last.

Stones commonly were set with lime mortar, made in kilns used to burn limestone rock for an extended period until it crumbled into powder (Muilenburg and Swineford 1975:61–63). The Smith Kiln near Fairbury, Nebraska, is a good example of a commercial lime kiln from this era (Henkel 1981), but many smaller kilns were also in operation throughout the region; thus lime mortar for use in stone building construction was relatively accessible. The locations of kilns were sometimes indicated on early plat maps. The 1884 plat maps for Farmington, Grant, Jefferson, and Richland townships show no lime kilns in the area around Cuba, but they are indicated on contemporaneous plat maps elsewhere in Republic County. Several such kilns are known in the Minersville area in southern Republic County (Aaron 2013a). The lime mortar is usually pink or pale red in color and may have a variety of impurities or inclusions, such as limestone fragments, sand, or gravel.

Some caves and structures have stones that were set with dirt rather than mortar. A number of structures and caves in the area southwest of Cuba were made in this way. Stone structures at the Lojka-Tuma and Lojka-Klima sites were set with black dirt. Presumably, this is simply because no lime mortar was available. Use of soil for setting the stones required that the surfaces between the stones be covered or pointed soon after construction. This was done with plaster or concrete in most cases. After 1890 and especially after 1900, it became more common to set stones with cement mortar; Koukol cave, for example, built in 1919. It was also common to apply concrete mortar as pointing material or as wall coating on walls that originally were set with soil or lime mortar.

Many caves were left with chiseled stone surfaces exposed on the interior walls and ceiling. This may have been more common during the early homesteading period, and cave walls could be covered with plaster or mortar at a later date. A number of the recorded caves exhibit multiple layers of treatment, sometimes including whitewash, plaster, or mortar and a subsequent layer or layers of whitewash or paint. Plastered or mortar-covered walls would have provided an extra barrier against moisture, but over time they crack and crumble. Sometimes whitewash or paint was applied directly to the limestone surfaces, probably to increase reflected light in the cave, as in the Anderson-Krakow and Lojka-Tuma caves.

Niches were built into slightly more than half of the caves where the walls could be observed and this information recorded (11 of 20 or 55 percent). The number, location, and size of the niches are highly variable. In several instances the niches were paired on either side of the doorway or on opposing walls. Typically the niches were set about 2 feet above the floor, usually about 1 foot deep, and always set into the vertical walls rather than the lower part of the ceiling arches. Niche use probably was highly variable, but they would have served as convenient storage spaces for items that were used repeatedly, such as candles, matches, paring knives, and lamp oil. Some of the larger niches could have served as protected spaces to set lamps, but this would have reduced the effective light. One informant indicated that the larger niches were used for beer kegs in the Cuba vicinity. Smaller niches could have been used for candles and helped keep the open flame away from clothing or other flammable items. Occasionally niches were built into the stairway walls or foyer areas outside the main cave chamber; examples include the Kieffer 2, Kieffer 3, and Lojka-Svojgr caves.

Storage of goods within the caves was a primary function, and a variety of strategies were used to enhance the care or organization of materials. Canned goods, primarily home-canned vegetables, fruits, and meats in jars, very commonly were stored in caves, so that they did not freeze and were not exposed to sunlight. Decades-old canned goods still occasionally are encountered in these caves (Figure 19). Shelving was used for storing canned goods, and shelves were made in a variety of ways. Free-standing shelves were built using boards supported by lumber frames or stones. Shelf supports also were made by inserting or setting metal bars into the cave walls during construction (Figure 38). In some cases wooden blocks or short pieces of lumber were set into the walls to facilitate attach-

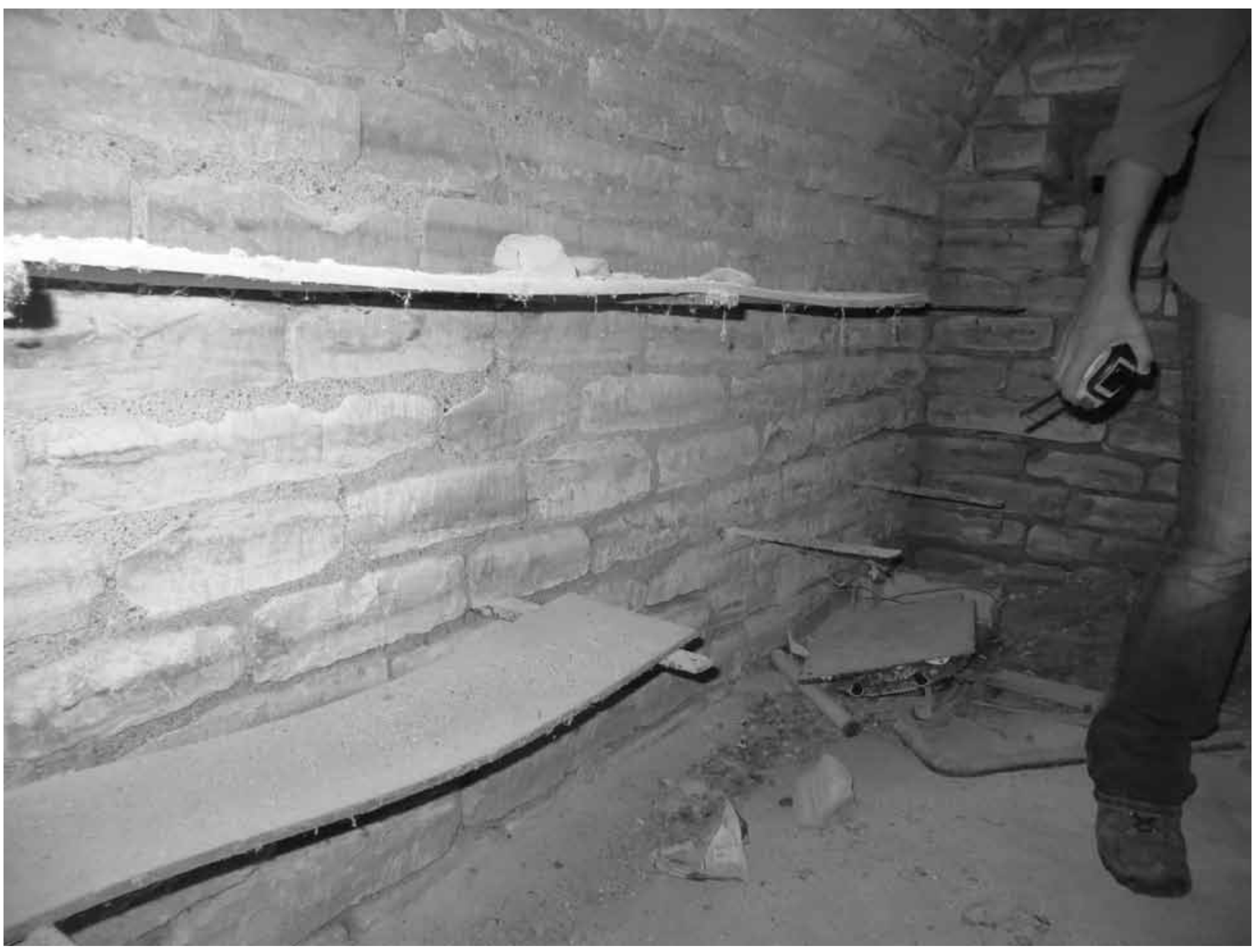

Figure 38. South wall view of Shimek cave 1, showing metal bars built into wall as shelf supports.

ing shelves or shelf supports to the stone (Figure 11). Bins or ventilated containers, made with slats or wire sides, were used for bulk goods, such as potatoes. It was necessary to turn potatoes occasionally so those in the inner portion of the bins would not spoil.

Other storage was provided by hooks set into the ceilings of caves (Figures 9, 27, and 34). These hooks could serve to hang meat while it was curing, to store smoked or cured meat, or for other materials that needed to remain dry or out of reach of rodents. Hooks also provided a means to support lanterns or other light sources when working or living in the caves.

Cave floors were typically packed earth, although a layer of concrete or plaster was sometimes added. Most caves documented in this study had floors covered with silt and rubble and could not be adequately studied without some excavation. This would be a good question to investigate with future work. Likely, some of the floors interpreted here as earthen are actually limestone or prepared floors currently covered with dirt and rubble.

Patterns of stone use in cave construction are of interest. Variations in the way the arch stones are set, how they connect with the end walls, and how they are set on the side walls are distinctive but of unknown significance. These divergences might reflect distinct traditions, differences in the stones or mortar used, or other factors. Presumably, each stonemason would have his own preferred method of making arched ceilings. With very few exceptions, such as Joe Koukol, the builders are unknown. Because most of these arched-ceiling caves were built prior to 1900, it is unlikely that the actual builders can be determined with confidence. However, it may be possible to distinguish individual makers or at least traditions or "schools" of masons, based on distinctive individualistic features, such as the patterns of stone use, design, and finishing.

One obvious difference in stone use and arch construction is the orientation of the ceiling stones. The long-axis direction of ceiling stones in relation to the long axis of the ceiling arch was recorded for 17 caves. Of these, 11 caves (65 percent) had arch stones set perpendicular to the cave's long axis, and 6 were laid parallel to the long axis of the arches. In the Martin-Klima cave the majority of ceiling stones were set perpendicular to the long axis of the arch, with only a few rows set parallel (Schoen 1994:36–37). The only other documented cave where ceiling stones were set in both directions is the Brown-Kusy cave. This cave is truly remarkable in having two distinct conjoined arches. The primary arch is made with stones laid perpendicular to the long axis of the arch, with the exception of one row where the two arches meet. With the perpendicular method the stones would have been fitted and set one arch at a time. In this type construction an arch form, probably made of wood, could have been used to support each arch as it was built.

Caves with ceiling stones set parallel with the long axis would have been constructed one row of stones at a time, building from both sides of the cave to the center. This probably would require that the entire arched ceiling be supported, as discussed below. Caves with parallel-set stones include those in which very narrow 2- to 3-inch-wide stones were used in the ceiling. These simply may have been too narrow to set using the perpendicular arch method. Also, it may be noteworthy that three of the five caves with stones set parallel are built into banks or on a slope. This practice may have facilitated building the arch form of earth prior to constructing the stone arch ceiling.

In the recorded sample articulation of arched ceilings with end walls was handled using two different methods. The most common was to simply butt the end of the arched ceiling against the end walls of the cave (Figures 9 and 19). In a few cases, when the arch stones were set parallel with the long axis of the cave, the arched-ceiling stones were set overlapping one or both end walls (Figures 6 and 39); the Kiperta and Krob caves are examples. The cave corners, where walls intersected below the arch, were interlocked in all recorded cases. As the walls were built up in each corner, stones were set with their long axes extending in alternating directions into the adjoining walls.

The bases or footings for the arches were formed by the side walls of the cave, and the arches were initiated in two different ways. In most cases the side walls were built up vertically with wall stones laid parallel with the long axis of the cave. The arch was then built up from this level top surface of the side walls. Buttressing of the lower walls presumably was not necessary because they

Figure 39. Northwest view of Krob cave, showing arch stones overlapping end wall, small side wall niche, and chute-type vent.

were fully supported by the earth on their exteriors. In several cases, however, when the arch stones were set perpendicular to a cave's long axis, the top wall stones were used to begin the arch by setting them at an angle to the vertical wall (Figures 10 and 20). These topmost wall stones on each wall (usually two courses) then served as the beginning of the arch but were laid in the same direction as the other wall stones, perpendicular to the ceiling arch stones. This reduced the number of arch stones that needed to be chiseled concave on their exposed surfaces and expedited completion of the arched ceilings.

The manner in which the arches were supported during construction is also of particular interest. This challenge could be resolved in multiple ways, but it must be kept in mind that dimension lumber or flexible support materials would have been in high demand and short supply during the early homesteading period. During a tour of French wine caves in the Solutre-Pouilly region of southern France in 1997, Jean Combier explained the construction method for the large arched-ceiling caves at the Chenas winery. These expansive structures, reminiscent of below-ground quanset huts, were built by first digging the wall trenches and using the dirt from these trenches to build the central earthen arch in the form and size desired for the cave's ceiling. This arch would be level or even end to end and formed to the spring or degree of curvature desired for the ceiling arch. Then the arched ceiling was built with stones being laid on the ground, using this earthen form as the support and guide. Once the stone arch was completed the earth fill on the inside was excavated to leave the arch free standing and the cave ready for use. The earth from inside the cave was used on the exterior to cover and insulate the cave.

During the early homesteading era, when resources were limited and framing materials presumably scarce, it is likely that earthen forms were used and that the construction method may have been similar to European wine cellars. Trenches would have been dug wide enough to enable workmen to set foundations for the walls and then to set the wall stones, with tooled faces inward against the earthen form of the cave. Earth fill and rubble could have been replaced against the outsides of walls as they were constructed.

The lentil or archway above the entry door and the vent in the rear wall would have been constructed prior to building the arch itself. Once the arch was completed, the fill from within the cave would be removed and used as insulation on top of the cave ceiling. The floor would be leveled and packed or perhaps covered as the last step in preparing the cave for use.

Alternatively, once framing materials for making an arch form from wood were readily available, the cave space may have been fully excavated, a frame built, and then the walls and arch constructed over the wooden frame. This method would clearly be much less efficient than an earthen form to support the arch during construction.

The method for constructing arch-shaped ceilings of concrete is less clear. The Teitjen cave ceiling, for example, was made of concrete, poured about 4 inches thick. The interior exposed surface of this concrete arch has clear impressions of boards that were part of the form to support the arch when the concrete was poured. It is not clear, however, how these boards themselves were supported. Certainly it is possible that the boards supporting the concrete arch were supported by a timber framework. It is also possible, however, that the boards were simply laid on the earthen form of the arch being constructed. This might be done in order that the finished interior exposed ceiling surface of the arch would be smooth. The ceiling would be irregular and pitted if concrete was poured onto a bare earthen form. The arched form would give the non-reinforced concrete greater strength.

The Jehlik cave ceiling is very tall (10 feet) and has clear impressions of boards in concrete (Figure 16), but stones are present above this cemented layer. When this concrete surface was made is uncertain, and it may have been added as a new ceiling surface after the cave was built. It is also possible that this concrete was poured on boards during the construction of the stone arched ceiling. This ceiling does appear to have been poured at one time rather than in sections, as might be the case if the concrete was added to the ceiling after it was constructed and the boards were used to support the concrete as it cured. Clearly the advent of cement use resulted in some modifications of traditional arched-ceiling construction methods.

RETROSPECT AND PROSPECT

The study of arched-ceiling stone caves in the Republic County area is a work in progress, and this paper reflects the early phase of documentation and initial study. Since this paper was first drafted more than a year ago, the authors have continued to record additional caves in the region and elsewhere in Kansas. The study has become richer and more diverse with additional sites and case histories. More than 50 caves have been documented in various levels of detail, with a long list of additional sites yet to be recorded. The patterns noted in this initial study hold true, though the counts and percentages of specific attributes have changed slightly. For example, two additional caves with openings to the west have been documented, but without exception the houses are situated immediately west of the openings to provide protection and immediate access.

Evaluation of construction methods has begun with archeological testing of an arched-ceiling stone cave that had a collapsed ceiling. This site, 14RP37, northeast of Cuba, Kansas, was tested during the 2013 University of Kansas archeological field school. The work confirmed that construction of the stone arched ceiling, at least in this case, used the earthen-form construction method, similar to that employed in building European wine cellars. A perimeter trench was excavated first, and the arched-ceiling form was built from the earth removed from the trench. The trench was more than 5 feet wide and about 3 feet below the cave's floor level. The width enabled the stone mason to work effectively, and the deep footer trench, filled with lime rubble, provided a sound foundation for the walls and weight of the ceiling. Additional caves with collapsed ceilings have been identified for testing to evaluate the details and variations in construction methods.

The damage and destruction of these sites continues at a rapid pace. The authors talked with several people during the past year who have filled in old cellars because they were a nuisance. These structures are quite durable when left unattended but do not last long once they become targets for demolition or removal.

The recording has become more systematic, and the authors have learned to look for elements that simply were not considered when the study began. In some cases photographs allowed augmentation of construction details that were not recorded in field notes. This is a normal process and likely will continue; as more is learned about these structures and their variations, more questions arise, and investigators consider new and different features.

The authors are not aware of any living individuals who built or participated in building these structures. Therefore, oral histories associated with specific features and sites must be recorded now along with archeological documentation. Historic site surveys typically consider only the aboveground structures, and the range of uses of caves is often assumed rather than evaluated. When a few such caves were recorded in Ellis County during the 2013 Kansas Archeology Training Program field school, a story was told that two children had been born in one of them. While it was known that the structures sometimes were used as residences, at least on a temporary basis, the cool conditions in summer and the ease of warming them in winter may have made them suitable for other activities, especially when other spaces were limited, crowded, or uncomfortably hot. A year ago investigators would not have known to ask how often caves and cellars were used for birthing.

Recording the contents of caves and cellars has not been a focus of this phase of the study, with only non-systematic photography and brief notes taken. Systematic photo-documentation of the floors, shelves, and niches is needed to gain information about the use and abandonment of the structures. Likewise, excavation of floors is important for gathering data about the diversity of functions that these caves served and their time frame of use. Like evaluating the methods of construction, this is an obvious area where the combined use of archeological and historical methods could enrich understanding of the past.

An area of considerable interest pertains to possibly identifying individual stone masons or groups of masons and potentially recognizing distinctive methods and traditions employed by different ethnic groups. Republic County was settled by Czechs, Germans, Swedes, and others, each occupying a relatively discrete area within the county. Documentation of distinct cultural traditions might allow comparisons with variations represented in their respective European homelands. Perhaps a European vacation with a purpose is in order. There is just no telling where descending the steps of an arched-ceiling stone cave will lead.

ACKNOWLEDGMENTS

This paper was made possible by the interest and generous support of many individuals, including Geri Coffman, Todd Filipi, Eddie and Barbara Popelka, Frank Popelka, Robert Popelka, Joel Popelka, Marvin Parrack, Jerome Kieffer, Annette Bredthauer, John and Janelle Swiercinsky, Mike Henry, Tony Strnad, Tana Trost, Conrad Trost, Justin Trost, Ruth Wagner, Bob Krakow, Glen and Barbara Lojka, Elmer Brown, Joe Chizek, John Krob, Marilyn Koukol, Bret Trecek, Steven Kuhlmann, Randy Bartling, Stan Krohn, Jacob Myers, Leland Bray, Darlene Lewis, Joe Odette, Kent Morgan, Wayne Pachta, Quentin Smith, Harold Dowell, David Heyka, Larry Hadachek, and Delbert Hoffman. We very likely have omitted mention of some, but we hope that the interest and pride which the people of Republic, Thayer, and Cloud counties have in their heritage is reflected here. Support for this work was provided in part by a University of Kansas General Research Fund grant, award #2301664.

APPENDIX: INVENTORY FORM

STONE ARCHED-VAULT CEILING CAVE INVENTORY FORM

Location: County: State: ¼ ¼ ¼ Sec. T R

Owner/contact:

Location/access description:

Informant:

Setting:

Dimensions (inside): length width height

Floor type:

Vent description/location:

Details of wall and ceiling construction:

Entry steps and walls:

Door type and location (top slope or foot of stairs, frame):

Niches and shelves:

Stone type:

Mortar type:

Direction of door: Direction of house:

Associated structures:

Cave condition:

Contents:

Construction date:

Builder:

Photographs:

Notes and comments:

Form completed by: Date:

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CORRECTION

Please note a correction for Brad Logan's article, "The Phil Site (14JW48) and the Central Plains Tradition at Lovewell Reservoir, Jewell County, Kansas," which appeared in *The Kansas Anthropologist* 23:32–115. Below are the correct Figures 23 (page 63) and 24 (page 64).

Figure 23. Distribution of bifaces/fragments per excavation unit across the house block, entryway excluded.

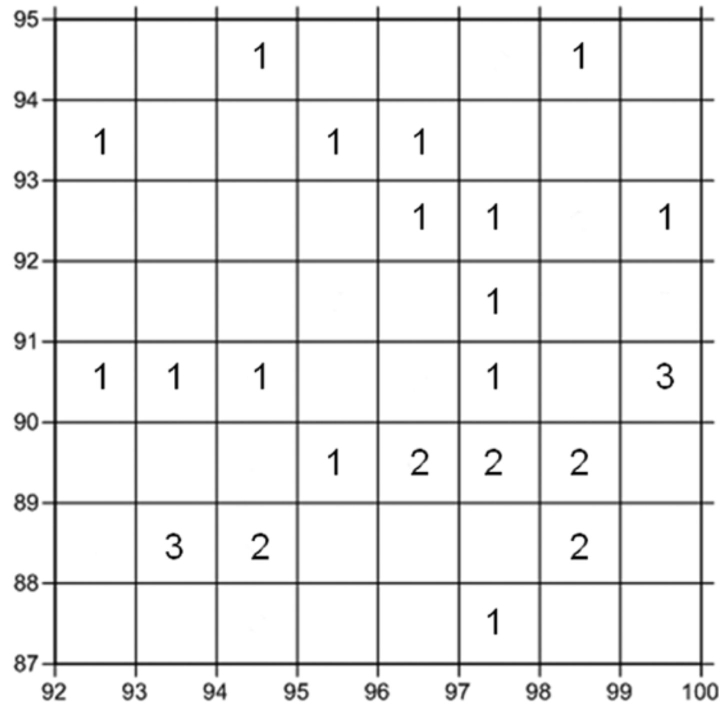
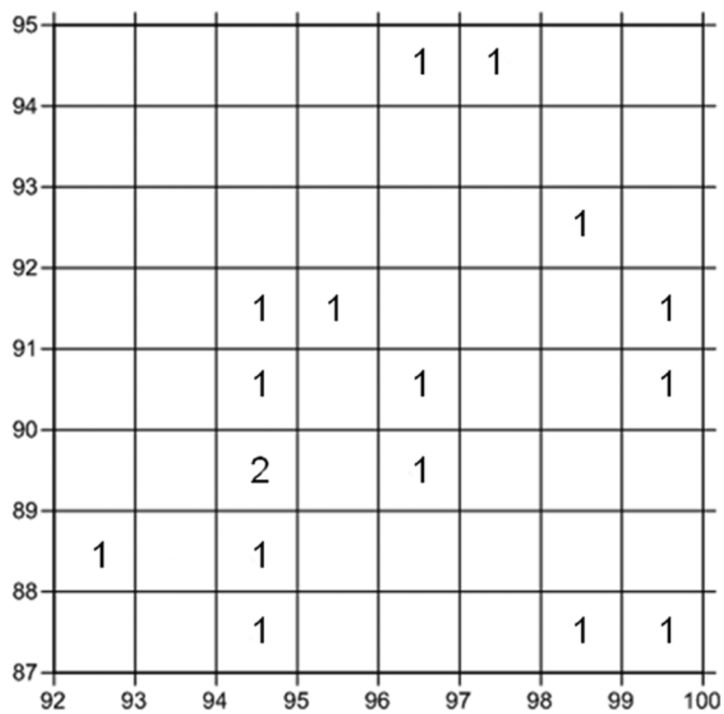


Figure 24. Distribution of scrapers in the house block and extramural units, entryway excluded.



MAKING SENSE OF THE NUTTER SITE (14CD480): A CAUTIONARY TALE

Rose Marie Wallen
Lindsborg, Kansas

The Nutter site (14CD480), a Middle Ceramic-age earthlodge of the Central Plains tradition, was excavated by amateurs in 1969–1970. No report was written, although a portion of the collection and some sketchy field notes found their way to the Kansas State Historical Society. More than 40 years after the excavation, KAA member Rose Marie Wallen undertook writing a report on the Nutter site, using the small collection and field notes. It was not a simple task because another layer of archeology—the excavation itself—had been added.

In 2008 Kansas Historical Society (KSHS) Laboratory Archeologist Chris Garst recommended to the Kansas Anthropological Association (KAA) Certification Committee that requirement 5C of the Advanced Laboratory Technician category, demonstrating proficiency in recording weights and measurements of artifacts, be changed, as it was redundant to a Basic Laboratory Technician requirement. In its place was the choice of two activities to accomplish in prior consultation with the KSHS Lab Archeologist: 1. Undertake a research project to further knowledge of a particular artifact class, method of conservation, etc., or 2. Write a short article for publication in the *KAA Newsletter, Kansas Preservation*, etc., on a small collection or artifact type. The KAA board approved this and other changes in November 2008.

Garst advised me that the KSHS lab had a small collection that had been languishing unanalyzed for years, and she suggested I might undertake writing a report about it in part to fulfill requirement 5C. I accepted the challenge, photocopied the sheaf of field notes from the files, and checked out three boxes of artifacts from 14CD480. I made initial analysis of the artifacts in the spring of 2010, but making sense of the field notes was a major stumbling block. I took the KAA Certification Seminar on Report Writing in February 2011 and confessed to the group that this was my goal, but like many other amateur archeologists in KAA, I was having trouble "putting pen to paper." Apparently this had been a problem for the original investigator as well, and the information contained in the field notes had become no easier to sift through after 40 years. While the site report contained all the appropriate information, the excavation notes needed a lot of fleshing out. It was a tough job, more like a puzzle than a simple summary of findings.

This report is a cautionary tale for all who collect or take part in archeological investigations. Record your findings immediately and clearly, not only for yourself, but for those to come. Memory fades, methods change, and posterity cannot read minds. Your field efforts may be wasted and information totally lost if you do not keep intelligible records and share them appropriately.

THE NUTTER SITE: 14CD480

The excavation of 14CD480 took place in 1969 and 1970, five years before the first Kansas Archeology Training Program (KATP) field school. The site lies on a hilltop near Elm Creek, southwest of Ames in Cloud County, Kansas. In about 1964 a terrace was constructed on this hillside on land belonging to Maurice Nutter. During construction, remains of an earthlodge were uncovered by the grader. Soil discoloration was evident in an estimated 30-foot diameter area. Nutter and others collected artifacts, and Laurence Smith of Miltonvale was said to have kept most of the pottery. Duane Kusy of Clifton heard of the site and submitted a KAA site report in June 1969. Kusy wrote, "I knew my wife & me could pick up some very valuable experience without destroying anything, because I feel at the present time that most of this house was destroyed when the terrace was being made." Kusy and his wife Fern then undertook an excavation of the site on weekends with the help of a few friends. It is evident that most of the diagnostic artifacts remained in the hands of private collectors or were placed in repositories elsewhere. Although the KSHS collection contains 353 catalog numbers (as opposed to an item count), primarily pottery sherds, most of these artifacts are unremarkable. Sketches in the site report indicate that some diagnostic projectile points and interesting pottery had been among the finds. Chipped stone tools from the site included knives, scrapers, and utilized flakes, mostly made of dark gray Permian chert found in the Flint Hills. Kusy's notes indicate that Nutter had collected a number of small, side-notched projectile points, drills, and a yellow sandstone "pipe," as well as pottery sherds, thumb scrapers, abraiders, and knives. These are not included in the KSHS collection. One can hope that the private collectors kept records of their artifacts' provenience and that one day these might rejoin the rest of the collection at the KSHS.

The artifacts collected and the excavation results show that 14CD480 was an earth dwelling of the Middle Ceramic period, affiliated with the Smoky Hill phase of the Central Plains tradition. Only one cultural component is evident at the site. According to Virginia Wulfkuhle's 1999 site report revision, the area of the site had been about 405 m^2, but it is now destroyed by excavation and subsequent farming.

ARTIFACT ANALYSIS

As part of my investigation, I reviewed the artifacts previously catalogued by the KSHS lab volunteers, verified the information, and compiled it in Excel files. While this quantifies the artifacts that the Kusy team excavated, probably an equal amount was retained by others. Table 1 records the artifacts by type and weight. Appendix A organizes all of the non-ceramic artifact data.

Pottery sherds from 14CD480 have wall thicknesses ranging from 2 to 14.5 mm. The major portion of the collection is thick walled: only 58 of the 265 specimens are 5 mm or less. The temper is grit and sometimes sand. The decoration is mostly cord roughened or smoothed cord roughened. Ten rim sherds have incised lips, seven have pinched nodes on the collar, and one has a cross-hatched collar. The most interesting specimen is a large rim-collar-body sherd, clearly demonstrating the pot's globular form. The body is cord roughened, and the lip of the flared collar is incised (Figure 1). While much of the pottery is coarse, the seven pieces with pinched nodes are quite crude in composition and are the thickest examples, ranging from 10 to 14.5 mm. They are black with white grit showing on the surface (Figures 2 and 3). The majority of samples in the collection are reddish brown on the exterior surface and do not reveal the temper except in cross section. The ceramic artifacts are detailed in Appendix B.

Table 1. Nutter Site Artifacts by Type and Weight.

Artifact Type	Weight in Grams
pottery sherds	2104.6
ground stone tools	1320.3
chipped stone tools	140.2
tool-making debris	29.1
culturally modified bone	26
faunal remains (bone and burned bone)	167.6
floral remains (charcoal)	146.9
floral remains (ash)	37.8
burned earth	116.9
daub	389.8
rock	465.4

Except for a quartzite celt section, all the ground stone tools are brown sandstone: seven abraders or arrow shaft smoothers (Figure 4) and six grinding stone fragments. Grinding stones are associated with seed gathering as well as cultivation of grain and have been found in the Early Ceramic period Plains Woodland sites, as well as Late Ceramic period sites (O'Brien 1984).

Chipped stone tools are represented by 18 specimens: five modified flakes, three utilized flakes, one end scraper, one projectile point base, one projectile point tip, two knife bases, one knife midsection, one knife tip, one unidentified tool section, and two unifacial tools (Figure 5). Materials include three examples of Smoky Hill jasper (n=3), heat treated chert (n=1), and gray or dark gray chert (n=14). All tool-making debris is gray chert, except for one ex-

Figure 1. Rim-collar-body sherd.

Figure 2. Crude rim sherds with pinched nodes.

Figure 3. Node-pinching technique.

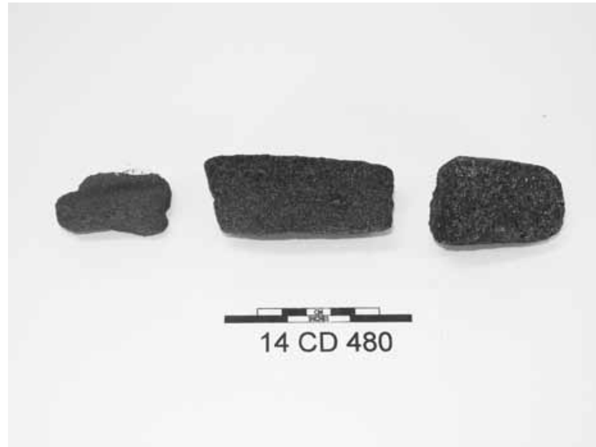


Figure 4. Three abrader fragments.

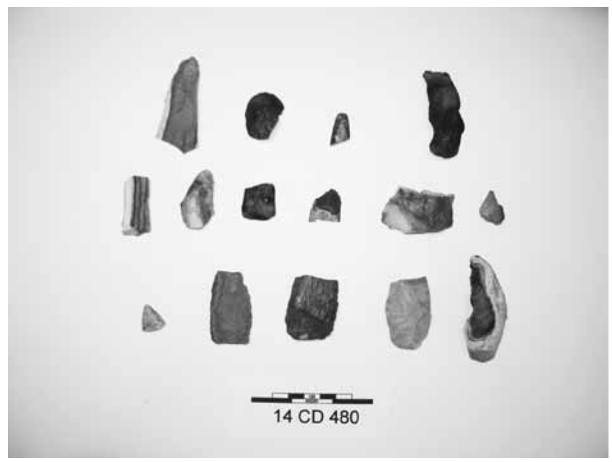


Figure 5. Chipped stone tools.

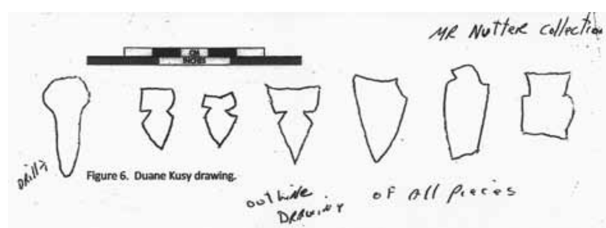


Figure 6. Kusy drawing of tools in Nutter collection.

ample of brown quartzite. No diagnostic tools exist in the 14CD480 collection at KSHS, but sketches in Kusy's site report show that Nutter collected side-notched triangular points, indicating Middle Ceramic period affiliation (Figure 6). Of what material the Nutter points were made is unknown, but the rest of the chipped stone tools were fashioned from locally available materials. Permian chert outcroppings occur in the Flint Hills about 30 miles to the east. Smoky Hill jasper is found in Cretaceous limestone and chalk of the Niobrara formation, the nearest outcrop of which is about 60 miles to the west (Stein 2006). These stones might also have been found in local gravel deposits.

The collection contains four examples of culturally modified bone. Three, including an antler tip, are burned. The fourth specimen is a 16.6-cm long bone awl in three refitted pieces (Figure 7). This, along with the end scraper, demonstrates the use of hides by the 14CD480 occupants.

Faunal remains are bone, burned bone, and shell. The bone has not been identified as to species, but there are joints, portions of long bones, and a rib. It is probable that these came from bison and deer.

Specimens that originated from plant sources are charcoal and ash. A significant amount of charcoal was collected and represents burned posts from the house structure. Ash, as well as burned earth, was collected from the hearth area. Charred grass also was collected and was used by Roper and Adair (2011) for radiocarbon dating analysis.

A large amount of daub is present in the collection, demonstrating that the wattle-and-daub house had burned (Figure 8). On record F-50 of his field notes, Kusy wrote, "This house must have burned down shortly after this house was built on account of the little material that was left in the pit. 2 piece of pottery, 1 piece of [illegible word] bone and 1 good sized flat rock along with daub and burned soil and straw- & 1 piece of flint -& burned timber."

Figure 7. Bone awl.

Figure 8. Daub.

The artifacts in the KSHS and the Nutter collections support the conclusion that this site dates to the Middle Ceramic period (A.D. 1000–1500) of the Kansas cultural sequence. Small triangular side-notched points, globular pots, rectangular earthlodges, and reliance on seed gathering and horticulture, as well as use of large animals for subsistence, are diagnostic for this period (Roper 2006). The radiocarbon dates obtained by Roper and Adair (2011) in the previously mentioned analysis confirm this conclusion: AD 1281–1330 or 1338–1397.

An examination of the excavation field notes further supports this conclusion, drawn from the artifacts. The lodge floor was found 25 inches below datum in the west, grading to 38 inches below datum in the east. The interior of the lodge was about 35 feet long north-to-south. Two small storage pits were found and excavated. Pit 1 in the northeast quadrant was 37 inches deep and 30 by 32 inches across. Pit 2 in the southwest quadrant was 46 inches deep, bell shaped, and 28 by 36 inches across. Storage pits were used to store surplus food supplies by horticultural groups across Kansas. These appeared when cultivation of corn became common in the late Early Ceramic period. Near the center of the house floor, evidence of the central hearth was found: a 35 inch circle of burned earth, 4 inches deep. This was surrounded by four large (12–14-inches in diameter) postholes, indicating the location of the main supports for the lodge roof. They were each about 12 feet from the center of the hearth. An additional 58 smaller postholes (4 to 13 inches in diameter) were also found, which determined the location of three of the outer walls of the rectangular lodge. Although the house was partially destroyed by terrace-making activity before excavation, it was possible to construct a floor plan (Figure 9). Presumably the entryway was on the east side, but the grader destroyed its traces.

While the amateur investigators may have done a fair job of excavating a threatened site, they were less successful in their recordkeeping. The copies of record sheets and notes found in the KSHS files can best be described as sketchy. Inconsistencies in or misunderstandings of terminology made statements difficult to interpret; sentence fragments and pages and figures not labeled contributed to confusion. Most troubling was that three measurement datums were mentioned, but only one was given a location, and ironically it was mislabeled. The notes clearly stated that it had been established in "the SE corner of x-24," but it turned out to be in the southwest corner of excavation unit 24 and was then later moved 11.2 inches away into x-14. Once the correct datum 1 was discovered, the other two datums could be deduced by back measurement from features that were accurately measured on the grid. The information was that datums 2 and 3 were each 22 feet from datum 1. Quite a bit of sleuthing and geometry were required to discover their exact locations. This was necessary to reconstruct the posthole plan, using measurements in the notes from the three datums. A plan view of the site must have been drawn at one time, but it is not in the KSHS site file. Eventually, success was achieved, and the result is the earthlodge footprint in Figure 9.

Cautionary tales do not usually end happily, but I am glad to say that it was finally possible to create a report for the Nutter site. I do want to advise

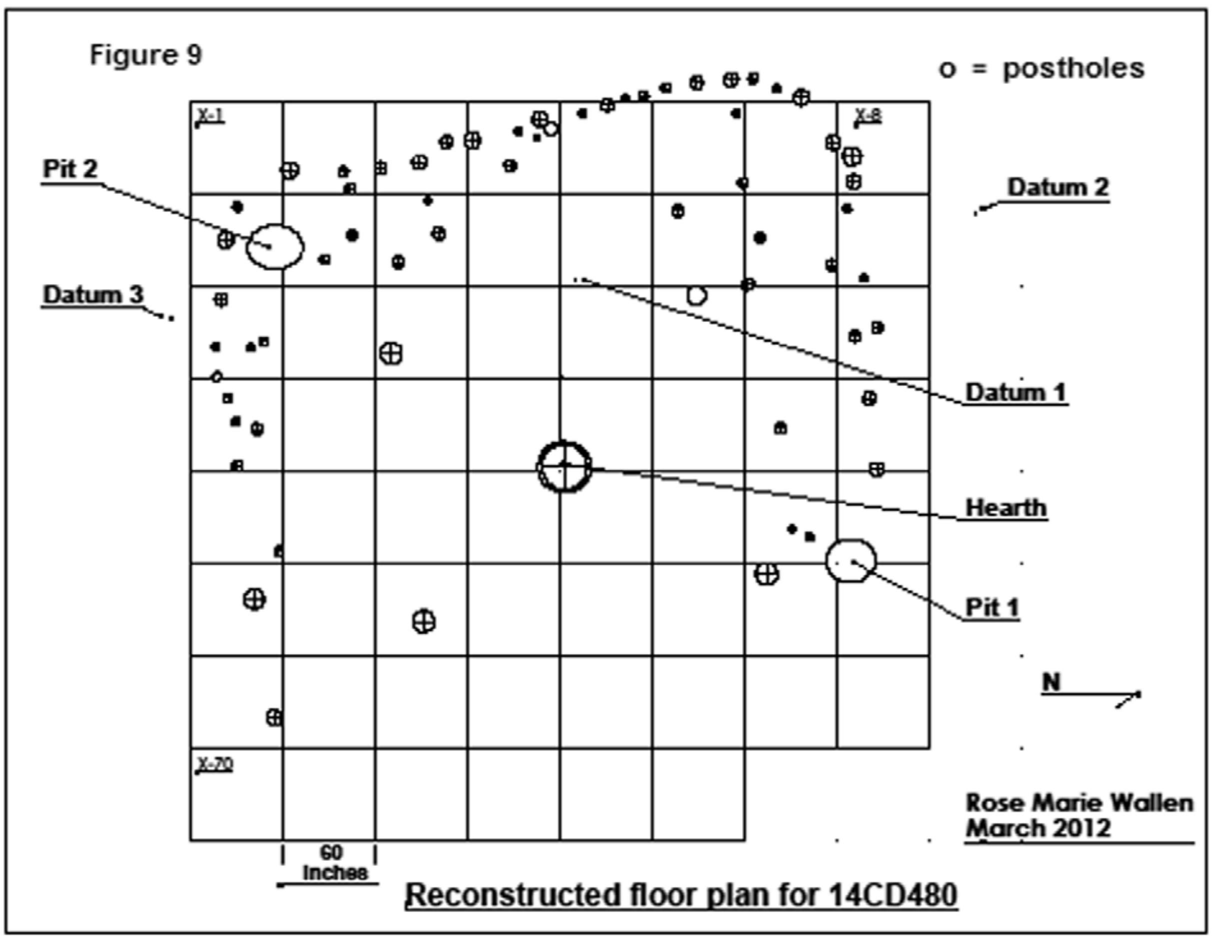


Figure 9. Reconstructed floor plan of excavated house.

all present and future investigators to please make clear and concise notes, keep them organized, and take time to write a report of the conclusions sooner rather than later. Future researchers, and maybe even your grandchildren, will thank you.

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APPENDIX A: NON-CERAMIC ARTIFACTS

Code	Provenience-Specimen (count)	Weight in g	Max. Width in mm	Max. Length in mm	Max. Thickness in mm	Description	Material	Comments
Ground stone tool								
(GST)	1-1	25	28	53	11	abraider	sandstone	
GST	5-1	93	32	76	28	abraider	sandstone	
GST	13-2	50.2	36	48	21	celt	quartzite	fragment
GST	19-1	69.4	39	44	21	abraider	sandstone	
GST	19-2	22	26	28	22	abraider	sandstone	
GST	34-1	82.9	34	54	30	abraider	sandstone	
GST	47-1	26.3	27	48	18	abraider	sandstone	
GST	61-1	18.4	29	36	21	abraider	sandstone	
GST	65-3	70.2	36	43	40	grinding stone	sandstone	fragment
GST	65-4	106.2	57	87	25	grinding stone	sandstone	fragment
GST	65-5	175.3	59	87	25	grinding stone	sandstone	fragment
GST	65-6	153.8	58	76	28	grinding stone	sandstone	fragment
GST	67-1	381.8	89	110	25	grinding stone	sandstone	fragment
GST	67-2	45.8	42	46	17	grinding stone	sandstone	fragment
Subtotal		1320.3						
Culturally transported rock								
(CTR)	41-0	30.6	21	46	26	rock	sandstone with iron	
CTR	61-0 (6)	15.4	various	various	various	rock	sandstone	
CTR	69-0 (2)	50.5	various	various	various	rock	sandstone, caliche	
Culturally modified rock								
(CMR)	70-0 (2)	230	various	various	various	rock	sandstone	burned
CTR	74-0 (3)	138.9	various	various	various	rock	sandstone	
Subtotal		465.4						

Appendix A. (continued)

Code	Provenience-Specimen (count)	Weight in g	Max. Width in mm	Max. Length in mm	Max. Thickness in mm	Description	Material	Comments
Chipped stone tool								
(CST)	12-1	8.1	29	67	4	modified flake	chert, gray	
CST	15-2	8.4	24	33	10	scraper	chert, dark gray	
CST	21-1	6.9	23	60	4.5	knife	chert, dark gray	utilized flake
CST	32-1	1.2	12	23	3.5	uniface knife	chert, gray	tip
CST	41-3	25	13.5	21	6	tool	chert, gray	section
CST	46-3	6.8	22	39	7	uniface	chert, gray	
CST	46-4	6.2	18	38	6	uniface blade	chert, gray	
CST	47-2	11.9	38	44	7	uniface	chert, gray	
CST	52-1	3.2	21	23	4.5	prijectile point	jasper, brown	base
CST	52-2	1.4	19	24	4	modified flake	chert, gray	
CST	56-1	1.3	15	30	3	uniface	chert, pink	heat treated
CST	65-2	14.2	46	25	8	modified flake	chert, gray	
CST	69-1	1.5	16	21	5.5	modified flake	chert, gray	
CST	69-2	1	15	16	4	knife	chert, gray	point
CST	74-2	9.5	26.5	45	5.5	knife	jasper, Smoky Hill	mid section
CST	74-3	13.1	30	40	7	knife	jasper, Smoky Hill	base
CST	74-4	11.9	29	46	8	knife	chert, gray	base
CST	74-5	18.6	31	67	11	modified flake	chert, dark gray with cortex	
Subtotal		150.2						
Debitage								
(DEB)	33-0	4.4	34	35	4.5	debitage	chert, dark gray	
DEB	40-0	7.5	30	37	6	debitage	quartzite, brown	
DEB	43-0 (2)	9.5	19	24	7	debitage	chert, gray/brown	
DEB	43-0 (2)		13	26	12	debitage	chert, gray/brown	
DEB	45-0 (5)	2					chert, various colors	all small
DEB	48-0	1	18	18	3	debitage	chert, gray	
DEB	49	3.3	13	36	8.5	debitage	chert, gray	
DEB	74-0	1.4	21	30	2	debitage	chert, gray	
Subtotal		29.1						
Culturally modified bone								
(CMB)	13-1	6.2					burned bone	flat
CMB	55-1	0.3				antler	burned bone	tip
CMB	60-1	16.6		126		awl	bone	3 pieces refitted
CMB	65-1	2.9					burned bone	flat
Subtotal		26						
Faunal remains								
(FAU)	8-0	1.7					burned bone	
FAU	11-0	4					bone	
FAU	13-0 (4)	26.8					burned bone	
FAU	13-0 (2)	3.3					bone	

Appendix A. (continued)

Code	Provenience-Specimen (count)	Weight in g	Max. Width in mm	Max. Length in mm	Max. Thickness in mm	Description	Material	Comments
FAU	21-0 (3)	3					bone	refitted
FAU	26-0 (4)	35.1					burned bone	4 pieces, crumbling
FAU	33-0 (1)	6.6				joint	burned bone	
FAU	39-0 (1)	9.3					burned bone	
FAU	45-0(3)	0.3				rib	burned bone	
FAU	55-0 (1)	0.8					burned bone	
FAU	65-0 (7)	1.7					bone	7 small pieces
FAU	67-0 (2)	7.3					bone	long bone
FAU	73-0 (1)	9.3					bone	long bone
FAU	74-0	5.3					bone	possible squirrel skull
FAU	74-0	11.1					burned bone	
FAU	33-0	29.5					shell	half
FAU	65-0	12.5					shell	2 halves
Subtotal		167.6						
Floral remains								
(FLO)	8-0	1				sticks	charcoal	
FLO	9-0	28.4					charcoal	
FLO	9-0	30.5					charcoal	
FLO	15-0	0.7					charcoal	
FLO	19-0	3.3					charcoal	
FLO	67-0	81				post	charcoal	
FLO	67-0	2				sticks	charcoal	
Subtotal		146.9						
FLO	43-0	9.6					ash	
FLO	61-0	28.2					ash	
Subtotal		37.8						
Burned earth								
(BDE)	8-0	43.3					burned earth	
BDE	45-0	1.8					burned earth	
BDE	61-0	61.6					burned earth	
BDE	13-0 (2)	6.3					burned earth	
BDE	13-0 (2)						burned earth	
BDE	21-0 (10)	3.9					burned earth	
BDE	21-0 (1)	3.8					daub	
BDE	41-0 (2)	16.7					daub	
BDE	61-0 (3)	22.8					daub	
BDE	69-0 (3)	15.2					daub	
BDE	71-0 (1)	17.4					daub	
BDE	74-0 (24)	313.9					daub	
Subtotal		506.7						

APPENDIX B: CERAMIC ARTIFACTS

Provenience-Specimen (count)	Weight in g	Wall Thickness Maximum in mm	Wall Thickness Minimum in mm	Description	Surface Treatment	Temper	Comments
4-1	207.3	10	6	rim sherd	cord roughened, incised lip	sand	
6-0	10.2	8	8	body sherd	cord roughened	sand	
8-0 (4)	62.1	11	11	body sherd	cord roughened	sand	
8-0 (4)		7	7	body sherd	cord roughened	grit	
8-0 (4)		7	3	body sherd	cord roughened	grit	
8-0 (4)		4	2.5	body sherd	cord roughened	sand and grit	
11-0	9.7	7	4	body sherd	cord roughened	grit	
13-0 (1)	6	5.5	3	body sherd	smooth	sand and grit	
15-1	8	10	4	rim sherd	cross-hatched collar	sand	
15-0	6.7	6	5	rim sherd	cord roughened	sand	
16-1	20.1	8.5	5	rim sherd	incised lip	grit	
19-0 (3)	41.7	7	7	body sherd	cord roughened	sand and grit	
19-0 (3)		6.5	6.5	body sherd	cord roughened	sand and grit	
19-0 (3)		6	3	body sherd	cord roughened	grit	
20-0 (2)	13.9	6	5	body sherd	smooth	grit	
20-0 (2)		3.5	3	body sherd	cord roughened	grit	
21-0 (10)	39.9	4	3	body sherd	cord roughened	grit	
21-0 (10)		7	4.5	body sherd	cord roughened	grit	four refitted
21-0 (10)		3.5	3	body sherd	cord roughened	grit	
21-0 (10)		3	3	body sherd	cord roughened	grit	
21-0 (10)		3.5	3	body sherd	cord roughened	grit	
21-0 (10)		3.5	3	body sherd	cord roughened	grit	
21-0 (10)		3.5	2.5	body sherd	cord roughened	grit	
24-1	7	5	2.5	rim sherd	incised lip	grit	
26-0 (28)	105.6	9	7	body sherd	smooth	grit	
26-0 (28)		7	5	body sherd	smooth	grit	
26-0 (28)		6	6	body sherd	cord roughened	grit	
26-0 (28)		7	7	body sherd	cord roughened	grit	
26-0 (28)		4	3	body sherd	cord roughened	grit	
26-0 (28)		5	4	body sherd	cord roughened	grit	
26-0 (28)		4	3.5	body sherd	cord roughened	grit	
26-0 (28)		3.5	3.5	body sherd	cord roughened	grit	
26-0 (28)		4.5	4.5	body sherd	cord roughened	sand	
26-0 (28)		5	4	body sherd	cord roughened	grit	
26-0 (28)		3.5	3.5	body sherd	cord roughened	grit	
26-0 (28)		5.5	3.5	body sherd	cord roughened	sand and grit	
26-0 (28)		5.5	4	body sherd	cord roughened	grit	
26-0 (28)		5	4.5	body sherd	cord roughened	grit	
26-0 (28)		4	3	body sherd	cord roughened	grit	
26-0 (28)		3.5	3	body sherd	cord roughened	grit	
26-0 (28)		4.5	3.5	body sherd	cord roughened	grit	
26-0 (28)		5	3.5	body sherd	cord roughened	grit	

Appendix B. (continued)

Provenience-Specimen (count)	Weight in g	Wall Thickness Maximum in mm	Wall Thickness Minimum in mm	Description	Surface Treatment	Temper	Comments
26-0 (28)		5	4	body sherd	cord roughened	grit	
26-0 (28)		4.5	3.5	body sherd	cord roughened	grit	
26-0 (28)		4	3	body sherd	cord roughened	grit	
26-0 (28)		5	4	body sherd	cord roughened	sand	
26-0 (28)		3	2	body sherd	cord roughened	sand	
26-0 (28)		3.5	3	body sherd	cord roughened	grit	
26-0 (28)		3.5	3	body sherd	cord roughened	grit	
26-0 (28)		7	6	body sherd	cord roughened	grit	
26-0 (28)		6	4	body sherd	cord roughened	grit	
26-0 (28)		2	1	body sherd	cord roughened	grit	spalled fragment
26-1	20.2	14	6	rim sherd	5 pinched nodes, rolled lip	sand	
26-2	14	12	4	rim sherd	7 pinched nodes, rolled lip	sand	
26-3	6	8	5	rim sherd	2 pinched nodes, rolled lip	sand	
26-4	3	8	4	rim sherd	rolled lip	sand	
26-5	4.4	8	5	rim sherd	3 nodes	sand	
26-6	2.1	4.5	3.5	body sherd	cord roughened		
33-1	17.4	9	5	rim sherd	incised lip	grit	
33-2	2.6	9	3	rim sherd	incised neck	sand	
33-3	2.7	4.5	3	rim sherd	cord roughened, incised lip	grit	
33-0 (42)	283.9	12	9	body sherd	cord roughened	grit	
33-0 (42)		10	9	body sherd	cord roughened	grit	
33-0 (42)		5	4.5	body sherd	cord roughened	sand	
33-0 (42)		5	3.5	body sherd	cord roughened	grit	
33-0 (42)		9	8	body sherd	cord roughened	grit	
33-0 (42)		8.5	6.5	body sherd	cord roughened	sand and grit	
33-0 (42)		9	5	body sherd	cord roughened	grit	
33-0 (42)		5	5	body sherd	cord roughened	sand and grit	
33-0 (42)		5	4.5	body sherd	cord roughened	grit	
33-0 (42)		8	7	body sherd	cord roughened	sand	
33-0 (42)		6	5.5	body sherd	cord roughened	grit	
33-0 (42)		10	8	body sherd	cord roughened	sand	
33-0 (42)		7	4	body sherd	cord roughened	grit	
33-0 (42)		10	5.5	body sherd	cord roughened	grit	
33-0 (42)		10	9	body sherd	cord roughened	grit	
33-0 (42)		8	6	body sherd	cord roughened	grit	
33-0 (42)		8	6	body sherd	cord roughened	grit	
33-0 (42)		8	5	body sherd	cord roughened	grit	
33-0 (42)		9	6	body sherd	cord roughened	sand	
33-0 (42)		8	6	body sherd	smooth	grit	
33-0 (42)		8	7	body sherd	cord roughened	grit	
33-0 (42)		8	7	body sherd	cord roughened	grit	
33-0 (42)		6	4	body sherd	cord roughened	grit	spalled

Appendix B. (continued)

Provenience-Specimen (count)	Weight in g	Wall Thickness Maximum in mm	Wall Thickness Minimum in mm	Description	Surface Treatment	Temper	Comments
33-0 (42)		8	7	body sherd	cord roughened	grit	
33-0 (42)		9	4.5	body sherd	cord roughened	grit	spalled
33-0 (42)		9	4.5	body sherd	cord roughened	grit	spalled
33-0 (42)		8	6	body sherd	cord roughened	grit	
33-0 (42)		10	10	body sherd	cord roughened	grit	
33-0 (42)		7.5	7.5	body sherd	cord roughened	grit	
33-0 (42)		8	7	body sherd	cord roughened	grit	
33-0 (42)		8	6	body sherd	cord roughened	sand	
33-0 (42)		8	6	body sherd	cord roughened	grit	
33-0 (42)		8.5	7	body sherd	smooth	grit	spalled
33-0 (42)		8.5	7	body sherd	cord roughened	grit	
33-0 (42)		8	6.5	body sherd	cord roughened	grit	
33-0 (42)		4.5	4	body sherd	smooth	grit	
33-0 (42)		5.5	4.5	body sherd	cord roughened	grit	
33-0 (42)		6.5	6	body sherd	cord roughened	grit	
33-0 (42)		5.5	4.5	body sherd	cord roughened	grit	
33-0 (42)		6	4.5	body sherd	cord roughened	grit	
33-0 (42)		6	4.5	body sherd	cord roughened	grit	
33-0 (42)		5	3	body sherd	cord roughened	grit	
34-0 (16)	100.2	13	8	body sherd	smoothed cord roughened	grit	
34-0 (16)		11	7.5	body sherd	cord roughened	grit	
34-0 (16)		10	10	body sherd	cord roughened	grit	spalled
34-0 (16)		11	9	body sherd	cord roughened	grit	
34-0 (16)		9	8	body sherd	cord roughened	sand and grit	
34-0 (16)		9	5.5	body sherd	cord roughened	grit	
34-0 (16)		6	5	body sherd	smooth	grit	
34-0 (16)		5.5	4.5	body sherd	smooth	grit	
34-0 (16)		5.5	4	body sherd	smooth	grit	
34-0 (16)		11	10	body sherd	smooth	grit	
34-0 (16)		9	7	body sherd	smoothed cord roughened	grit	
34-0 (16)		8	6	body sherd	smooth	grit	
34-0 (16)		7.5	6.5	body sherd	cord roughened	sand and grit	
34-0 (16)		10.5	9	body sherd	smooth	grit	
34-0 (16)		9	3	body sherd	smooth	grit	spalled
34-0 (16)		5	3	body sherd	smooth	grit	
37-0	20	8	4.5	body sherd	smoothed cord roughened	sand and grit	
40-0 (3)	23.8	7	5.5	body sherd	cord roughened	grit	
40-0 (3)		9.5	9	body sherd	smooth	grit	
40-0 (3)		3.5	3	body sherd	cord roughened	sand and grit	
40-1	1.7	4.5	3.5	rim sherd	trailed	grit	
41-0 (9)	49.6	10	7	body sherd	smooth	grit	
41-0 (9)		6	5.5	body sherd	smooth	grit	
41-0 (9)		5	4.5	body sherd	cord roughened	grit	

Appendix B. (continued)

Provenience-Specimen (count)	Weight in g	Wall Thickness Maximum in mm	Wall Thickness Minimum in mm	Description	Surface Treatment	Temper	Comments
41-0 (9)		8	6	body sherd	smooth	grit	neck
41-0 (9)		6	4	body sherd	smoothed cord roughened	grit	spalled
41-0 (9)		7	5	body sherd	smooth	grit	
41-0 (9)		6.5	6	body sherd	smooth	grit	
41-0 (9)		12.5	10	body sherd	smooth	grit	neck
41-0 (9)		9	8	body sherd	smoothed cord roughened	sand and grit	
41-1	14.6	8.5	7	rim sherd	cord roughened	grit	direct rim, beveled in lip
41-2	7.6	8	4	rim sherd	cord roughened	grit	flared, round lip
43-0 (34)	289	10	5	body sherd	smooth	grit	
43-0 (34)		9	5.5	body sherd	smoothed cord roughened	grit	
43-0 (34)		7	4.5	body sherd	smoothed cord roughened	grit	
43-0 (34)		12	7	body sherd	smooth	grit	mud impression?
43-0 (34)		9	7	body sherd	smoothed cord roughened	grit	
43-0 (34)		8	5	body sherd	smoothed cord roughened	sand	
43-0 (34)		9	8	body sherd	smooth	grit	
43-0 (34)		10	8	body sherd	smooth	grit	
43-0 (34)		8	6	body sherd	smoothed cord roughened	grit	
43-0 (34)		9	6	body sherd	smooth	grit	mud impression?
43-0 (34)		10	7	body sherd	smooth	grit	mud impression?
43-0 (34)		10	5	body sherd	smooth	grit	neck
43-0 (34)		11	9	body sherd	smooth	sand and grit	
43-0 (34)		10	8	body sherd	smooth	grit	
43-0 (34)		7	5	body sherd	smooth	grit	
43-0 (34)		8	5	body sherd	smoothed cord roughened	grit	
43-0 (34)		9	8.5	body sherd	smoothed cord roughened	grit	
43-0 (34)		5	2.5	body sherd	smoothed cord roughened	grit	
43-0 (34)		8	6	body sherd	smoothed cord roughened	grit	
43-0 (34)		7.5	7	body sherd	smoothed cord roughened	grit	
43-0 (34)		9.5	9	body sherd	smooth	grit	
43-0 (34)		10	10	body sherd	smooth	grit	
43-0 (34)		10.5	7.5	body sherd	cord roughened	sand and grit	shoulder-neck
43-0 (34)		4.5	4	body sherd	cord roughened	sand	
43-0 (34)		8	7	body sherd	smooth	grit	
43-0 (34)		9	9	body sherd	smooth	grit	
43-0 (34)		7	7	body sherd	smoothed cord roughened	grit	
43-0 (34)		8	7.5	body sherd	smooth	grit	
43-0 (34)		4.5	3.5	body sherd	smooth	grit	
43-0 (34)		7	6	body sherd	smooth	grit	

Appendix B. (continued)

Provenience-Specimen (count)	Weight in g	Wall Thickness Maximum in mm	Wall Thickness Minimum in mm	Description	Surface Treatment	Temper	Comments
43-0 (34)		10	9.5	body sherd	smooth	grit	
43-0 (34)		7	6	body sherd	smooth	grit	
43-0 (34)		6	5.5	body sherd	smooth	grit	
43-0 (34)		11	11	body sherd	smooth	grit	spalled
43-1	11.4	10	6	rim sherd	cord roughened, nodes	sand	pinched nodes on lip
45-0 (30)	181.7	10	7.5	body sherd	cord roughened	grit	
45-0 (30)		9	7.5	body sherd	smoothed cord roughened	grit	
45-0 (30)		11	9	body sherd	smoothed cord roughened	grit	
45-0 (30)		10	6	body sherd	cord roughened	grit	
45-0 (30)		8	7	body sherd	smoothed cord roughened	grit	
45-0 (30)		8.5	5	body sherd	smooth	grit	
45-0 (30)		9	8	body sherd	smooth	grit	
45-0 (30)		10	8	body sherd	smoothed cord roughened	grit	
45-0 (30)		7.5	7.5	body sherd	cord roughened	grit	
45-0 (30)		7.5	6	body sherd	smoothed cord roughened	grit	
45-0 (30)		7	6	body sherd	smooth	grit	
45-0 (30)		7.5	7	body sherd	cord roughened	grit	
45-0 (30)		9	6	body sherd	smooth	grit	
45-0 (30)		7.5	7	body sherd	smoothed cord roughened	grit	
45-0 (30)		6.5	5.5	body sherd	smooth	grit	
45-0 (30)		8.5	7.5	body sherd	smoothed cord roughened	grit	
45-0 (30)		9	8	body sherd	smooth	grit	
45-0 (30)		6	6	body sherd	cord roughened	sand and grit	spalled
45-0 (30)		9.5	8.5	body sherd	smooth	grit	
45-0 (30)		10	10	body sherd	cord roughened	grit	spalled
45-0 (30)		7.5	7.5	body sherd	cord roughened	grit	
45-0 (30)		10	9	body sherd	smoothed cord roughened	grit	
45-0 (30)		9.5	8.5	body sherd	cord roughened	grit	
45-0 (30)		8	7	body sherd	smoothed cord roughened	grit	
45-0 (30)		8	7.5	body sherd	smoothed cord roughened	grit	
45-0 (30)		8.5	8.5	body sherd	smoothed cord roughened	grit	spalled
45-0 (30)		6.5	6	body sherd	smoothed cord roughened	grit	
45-0 (30)		7.5	7	body sherd	smoothed cord roughened	grit	
45-0 (30)		6.5	6.5	body sherd	smoothed cord roughened	grit	spalled
45-0 (30)		5	5	body sherd	smoothed cord roughened	grit	spalled
46-0 (3)	43.8	8.5	7.5	body sherd	smooth	grit	
46-0 (3)		12	9	body sherd	smooth	grit	
46-0 (3)		9	8.5	body sherd	smoothed cord roughened	grit	
46-1	35.8	11	7	rim sherd	nodes	grit	4-5 pinched nodes on lip
46-2	6.1	8	4.5	rim sherd	smoothed cord roughened, incised	sand and grit	incised lines, curved lip

Appendix B. (continued)

Provenience-Specimen (count)	Weight in g	Wall Thickness Maximum in mm	Wall Thickness Minimum in mm	Description	Surface Treatment	Temper	Comments
48-0 (10)	78.3	6.5	4	body sherd	smoothed cord roughened	grit	
48-0 (10)		11	9.5	body sherd	smooth	grit	
48-0 (10)		9	8	body sherd	smooth	grit	
48-0 (10)		6	4.5	body sherd	smooth	sand and grit	
48-0 (10)		4	4	body sherd	smoothed cord roughened	grit and shell	
48-0 (10)		7	6	body sherd	smoothed cord roughened	grit	
48-0 (10)		8	8	body sherd	smooth	grit	spalled
48-0 (10)		6	4.5	body sherd	cord roughened	grit	
48-0 (10)		4	3	body sherd	cord roughened	sand and grit	
48-0 (10)		4	3.5	body sherd	smoothed cord roughened	grit+	
48-1	4	7.5	5	rim sherd	smoothe cord roughened, incised	sand and grit	incised lip
49-0 (7)	30.2	6.5	5	body sherd	smoothed cord roughened	grit	
49-0 (7)		7	5	body sherd	smooth	grit	
49-0 (7)		9	8	body sherd	smooth	grit	
49-0 (7)		9	8	body sherd	smoothed cord roughened	grit	
49-0 (7)		6.5	6	body sherd	cord roughened	grit	
49-0 (7)		5	3.5	body sherd	smooth	grit	
49-0 (7)		5	4	body sherd	smooth	sand and grit	
50-0 (12)	55.7	6	4	body sherd	smooth	grit	
50-0 (12)		6	4.5	body sherd	smooth	grit	
50-0 (12)		6	5.5	body sherd	smoothed cord roughened	grit	
50-0 (12)		9	8.5	body sherd	smoothed cord roughened	grit	
50-0 (12)		8	7	body sherd	cord roughened	grit	
50-0 (12)		6	5.5	body sherd	smooth	sand	
50-0 (12)		7	6	body sherd	smooth	grit	
50-0 (12)		7	5	body sherd	smoothed cord roughened	sand	
50-0 (12)		10.5	10	body sherd	smoothed cord roughened	grit	
50-0 (12)		10	9.5	body sherd	smoothed cord roughened	sand and grit	
50-0 (12)		6	4.5	body sherd	smooth	sand and grit	
50-0 (12)		6.5	4.5	body sherd	smooth	grit	
52-0 (11)	86	7	5	body sherd	smooth	sand and grit	
52-0 (11)		7.5	6	body sherd	smooth	sand	
52-0 (11)		6	4	body sherd	cord roughened	grit	
52-0 (11)		11.5	10	body sherd	smoothed cord roughened	grit	
52-0 (11)		5	4.5	body sherd	smooth	grit	
52-0 (11)		6	4.5	body sherd	smooth	grit	
52-0 (11)		7.5	6.5	body sherd	smooth	grit	
52-0 (11)		8	6	body sherd	smooth	grit	
52-0 (11)		8	7	body sherd	cord roughened	sand	
52-0 (11)		8	6	body sherd	smoothed cord roughened	grit	
52-0 (11)		7	6	body sherd	smooth	grit	
55-0 (4)	21.1	8.5	7.5	body sherd	smooth	grit	

Appendix B. (continued)

Provenience-Specimen (count)	Weight in g	Wall Thickness Maximum in mm	Wall Thickness Minimum in mm	Description	Surface Treatment	Temper	Comments
55-0 (4)		8.5	7.5	body sherd	smoothed cord roughened	sand	
55-0 (4)		7.5	6.5	body sherd	smoothed cord roughened	grit	
55-0 (4)		4	3	body sherd	smoothed cord roughened	grit	
56-0	8.2	7	4	body sherd	smoothed cord roughened	grit	
57-1	53.8	11	4	rim sherd	smooth	grit	incised lip
61-0	0.9	4	4	body sherd	smooth	grit	
67-0 (3)	11.9	10	8	body sherd	smooth	grit	
67-0 (3)		6	4.5	body sherd	smoothed cord roughened	grit	
67-0 (3)		5.5	5	body sherd	smoothed cord roughened	sand	
69-0 (6)	39.1	4	3	body sherd	smoothed cord roughened	grit	
69-0 (6)		9	6	body sherd	smoothed cord roughened	grit	
69-0 (6)		3	2	body sherd	smoothed cord roughened	sand	
69-0 (6)		5	4	body sherd	smooth	sand	
69-0 (6)		4.5	4.5	body sherd	smoothed cord roughened	grit	
69-0 (6)		4	2.5	body sherd	smoothed cord roughened	grit	
72-1	4.3	14.5	6	rim sherd	nodes	grit	2 nodes, round lip
74-1	30.2	14	6	rim sherd	nodes	grit	8 nodes, round lip
74-0 (1)	1.1	11	9	rim sherd	incised	grit	incised lip
Total weight	2104.6						

NOTES

ARCHEOLOGICAL INVESTIGATIONS OF 14MO403: REPORT OF THE 2006 KANSAS ARCHEOLOGY TRAINING PROGRAM FIELD SCHOOL

James L. Dougherty
Wichita, Kansas

In June 2006 the Kansas Archeology Training Program field school was held at 14MO403 in far eastern Morris County, Kansas. As a field school, the event was a resounding success; analytically the paucity of archeological features certainly was disappointing. The excavated findings of the field school, coupled with surface-collected artifacts in the Stauffer Collection at Wichita State University and those from another small private surface-collected assemblage, suggest Archaic and Woodland occupations of unknown frequencies and durations at this site. Collectively, the recovered archeological record and the geomorphological setting of the site suggest its most consistent use throughout prehistory was a fall and or winter camping place for the on-site production of chipped stone tools, primarily from gravels collected from the gravel bars of adjacent Rock Creek. Its setting in an ecotone undoubtedly added to its attractiveness for foraging and collecting in the surrounding areas.

SITE DESCRIPTION

Site 14MO403 occupies a low terrace in a cultivated field on the left (east) bank of the narrow (approximately 1-km wide) and relatively flat valley containing Rock Creek, a fifth-order stream at a point just below the mouth of Bluff Creek (Figure 1). It is in the upper Neosho River drainage, approximately 6 river miles (9.8 km) above where Rock Creek empties into the Neosho River. It occupies an ecological niche at the extreme western edge of Osage Cuestas physiographic region, within 2 miles of the eastern border of the Flint Hills Uplands. The site is essentially flat ground with an intra-site relief of just over 2 m (Figure 2). Geoarchaeologist Rolfe Mandel provides a geomorphological and stratigraphic analysis of the site as an appendix to this report.

In 2001 Brendy Stauffer Allison reported this site to the Kansas Historical Society (KSHS). Subsequently, the Stauffer family donated an extensive site surface collection to Wichita State University in 2002. Excepting debitage, the Stauffer Collection, combined with a somewhat smaller private collection, amount to almost twice the number of chipped stone tools than were found by the 2006 KATP limited site excavations. This report reflects elements of those two surface collections, as well as the 2006 KATP collection. Based on this author's knowledge of surface collections from the site, collector interviews, personal observations of intermittent and varying densities of site surface lithic scatters, and six 1 by 1-m test pits, the site limits are inferred to be a contiguous area of up to 10 acres (4.05 hectares) in extent.

Site 14MO403 was known to have Archaic and Ceramic components prior to any investigations by the Kansas Archeology Training Program. It is situated within a region containing other sites with similar single or mixed components. Within a 10-km radius of the site, 18 other sites with single or multiple Archaic, Early Ceramic, or Middle Ceramic components have been registered with the KSHS.

Soils in the immediate site area are of the Mason-Tully-Reading association (specifically, Mason). These silt loam soils, as the site typifies, slope from 0 to 1 percent and are occasionally flood (Barker 1974). Gale Lee, who has farmed this site for many years, reported that on a typical year the site, all or in part, flooded once or twice.

The geology units found in Morris County outcroppings are either Permian (230–280 mya) limestone or Quaternary (0–1 mya) loess and fluvial

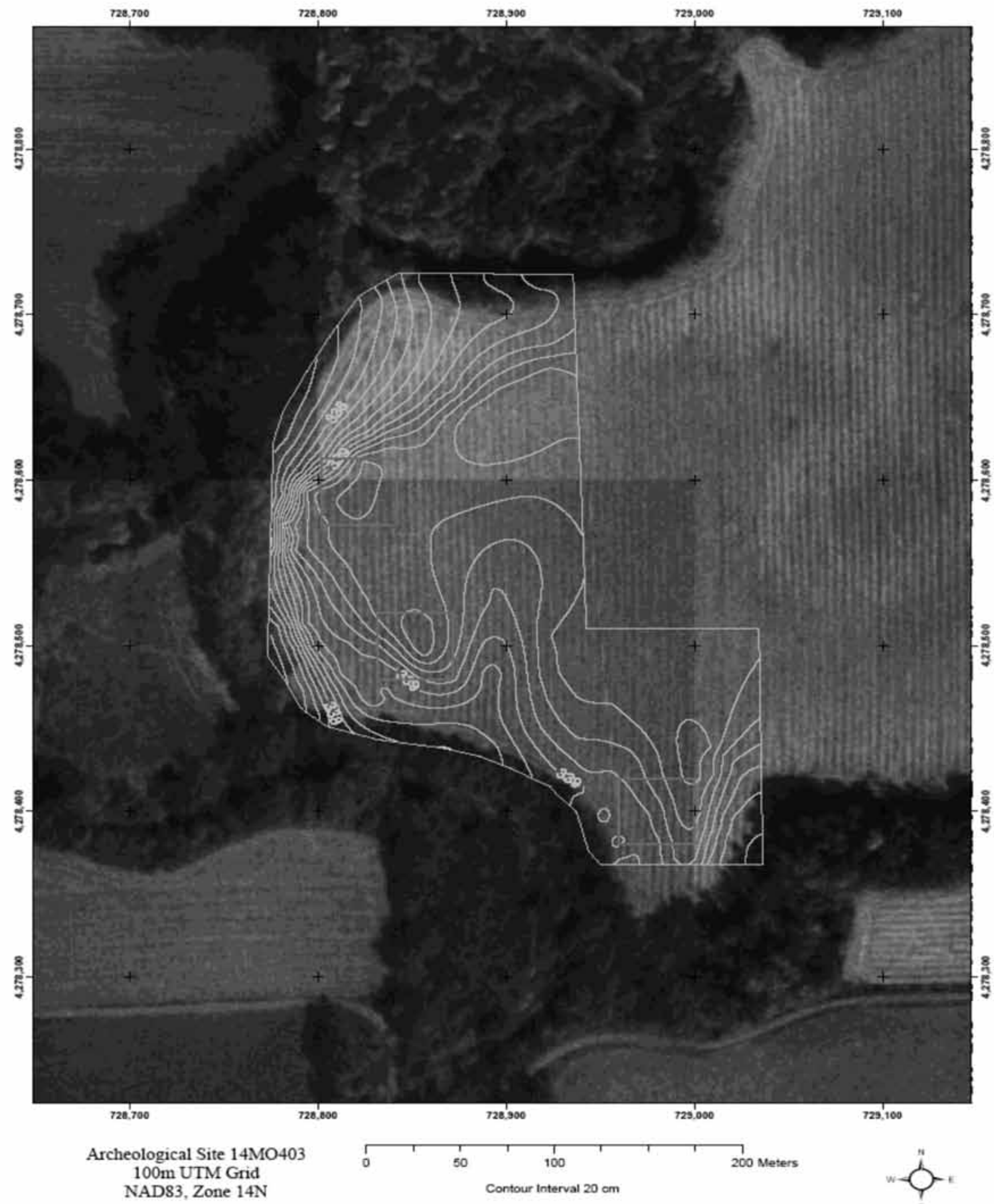

Figure 1. Excavation areas with topography.

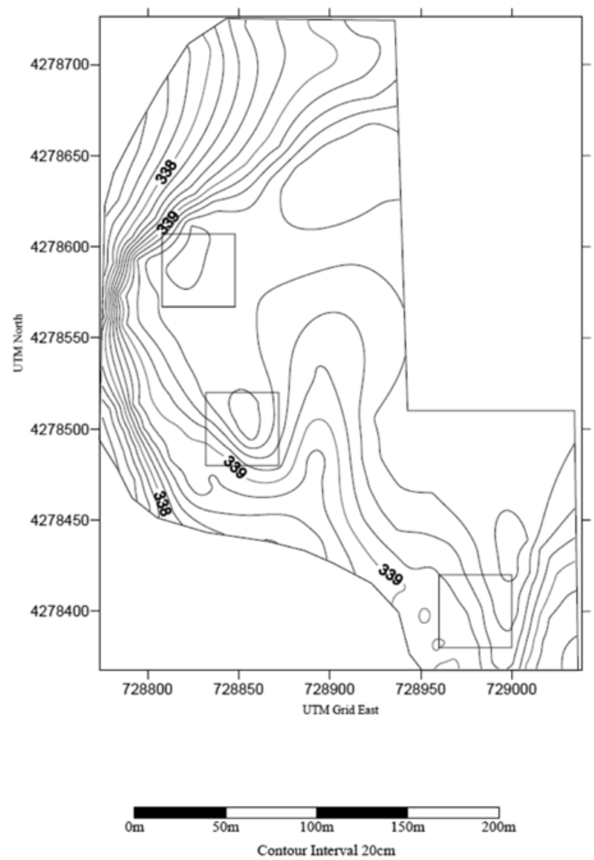

Figure 2. Site topography.

deposits. These fluvial chert gravels may contain some Tertiary (1–63 mya) deposits. Beginning 8 miles to the east in Lyon County, Pennsylvanian (280–310 mya) limestone outcrops but does not feature chert elements (Mudge 1958).

In the immediate site area tool stone sources were cherts exposed in Quaternary- and Tertiary-aged gravel lenses, exposed in Rock Creek and nearby Bluff Creek cutbanks and gravel bars. Within the general site area other Permian-age sources of tool stone exist. Approximately 1.75 miles (2.82 km) to the west, Wreford limestone (Chase group) outcrops. About 4 miles (6.44 km) to the northwest, Florence limestone outcrops. Just over 1 mile (1.61 km) to the east in Lyon County, the Permian-age Cottonwood limestone of the Beattie limestone outcrops with its scattered chert nodules.

The gallery forests on both sides of Rock Creek no doubt expanded and contracted in width throughout prehistory. Prior to 1857 the site was part of the Osage Indian Reservation, but Government Land Office records shed little light on how the site area looked prior to modern agricultural disturbances. Morris County land title records suggest that the area has been intermittently cultivated for the past 120 years. During that time it is estimated that the site has eroded as much as 50 cm (Rolfe Mandel, personal communication 2006). The remaining in situ archeological record has a shallow deposition.

RESEARCH DESIGN ELABORATION

The research design adopted for this project was greatly influenced by discussions with collector/informant Richard L. "Dick" Stauffer, who is since deceased. On two different occasions, while visiting the site together, Stauffer pointed out to the author areas where he had observed and subsequently collected surface artifact concentrations. These observations, limited conversations with one other collector of the site, and the author's personal site surface observations, suggested three portions of the site for subsurface investigation.

On November 13, 2004, a party of 10 archeological volunteers dug six 1-m^2 test units, focusing on two of the three surface artifact concentrations. Five of the six test pits were positive below the plow zone, but above 60 cm below present ground surface. One diagnostic Archaic point, as well as 4 pottery sherds, 2 cores, 196 flakes, and 21 calcined pieces of unidentifiable bone, were found, but **no** features.

Based on the above test results and some awareness of the pragmatics of geophysical testing, the author selected three 40 by 40-m portions of the site for remote sensing. Steve De Vore of the Midwest Archeological Center, National Park Service, was contracted to employ four geophysical survey techniques on the three designated blocks: magnetic gradient, conductivity, resistance, and ground penetrating radar (GPR). Professor Emeritus John Weymouth of the University of Nebraska, acclaimed pioneer in the application of geophysics to archeology, generously volunteered to provide his interpretation of portions of De Vore's data. Geophysical testing was conducted November 7–10, 2005.

Weymouth analyzed two of De Vore's four survey data sets: magnetic gradient and resistance. In reference to the magnetic gradient data set, he detected two anomalies that could be of archeological interest in the southwest grid (Area 062), one in the southeast grid (Area 063), and none in the northwest grid (Area 061). In the resistance survey data, he (Weymouth 2006) identified two anomalies of possible interest in the northwest grid, one in the southwest grid, and none in the southeast grid.

De Vore (2006) analyzed the conductivity and the GPR data sets and related them to Weymouth's analysis of the other two geophysical tests. From the conductivity survey data he noted three anomalies in the southwest grid that could be either archeological features or "natural phenomena," one in the northwest grid, and none in the southeast grid. He pointed out that all of these conductivity anomalies were less defined than the complementary resistance anomalies. From the GPR survey data set he detected three anomalies in the southwest grid, six in the northwest, and two in the southeast. However, De Vore (2006:15) emphasized, "These GPR anomalous areas do not appear to represent strong amplitude signals that might represent cultural features but differ enough from the surrounding area to suggest additional investigations are warranted."

Thus, traditional and geophysical testing led investigators to reason that the potential for intact features qualified 14MO403 as the location for the 2006 KATP field school and potential eligibility for the National Register of Historic Places. In essence the primary strategy for the field school investigations was to conduct excavations to "ground-truth" the geophysical findings of Weymouth and DeVore. Figure 3 shows an aerial view of the excavation areas, designated A061, A062, and A063.

EXCAVATIONS

Over a 16-day period in June 2006, 180 KATP volunteers excavated 188 m^2 of 14MO403. Because the site proved to be rather shallow in artifact deposition, almost all of the excavations were no more than 40 cm in depth (Figure 4). The standard excavation unit was 2 m^2. The plow zone was excavated as a 20-cm level, and all subsequent levels were 10

Figure 3. Designated investigation areas, from left to right: A061, A062, and A063.

Figure 4. Excavations in A061, June 2006.

cm. One square meter provenience was maintained for all of the excavation areas. The matrix from all but the southwest square meter of each 2 by 2-m unit was dry-screened through ¼-inch mesh. Matrix from each southwest quadrant was water-screened through 1/8-inch mesh, with typically 10-liter samples from each level of the southwest quadrant being water-screened through 1/16-inch (window screen) mesh. Most of the matrix to be water screened was processed at the site with water pumped from adjacent Rock Creek (Figure 5). The soil flotation station was located at the field lab in Council Grove (Figure 6). Less than 1,000 liters of matrix had to be transported from the site for subsequent flotation or water-screening. All fill from the three limestone features was floated. In retrospect the extensive and systematic water-screening component of the field school project proved to be unproductively elaborate. Very little data was recovered at a tremendous cost of labor.

It was anticipated that excavations would uncover diagnostic features, especially in A061 and A062, but these expectations were not met. Unequivocal evidence of in situ hearths, house floors, storage pits, or post-molds was not found. Exposed just below the plow zone in A061 were three concentrations of burned rounded limestone pieces, assumed to be remains cleaned out from one or more hearths (Figures 7 and 8). These concentrations were not believed to be in primary context in that no burned earth was found in concert with them. Some of the matrix beside and below these features was processed by soil flotation, but the samples may have minimal potential for paleoethnobotanical analysis because the concentrations probably were exposed to one or more flood events and were no longer in situ.

CHIPPED STONE TOOL ANALYSIS

More than 1,000 whole and incomplete chipped stone tools and in excess of 15,000 pieces of debitage combined from the field school excavations, the WSU Stauffer Collection, and the other private

Figure 5. Water screening station adjacent to site.

Figure 6. Soil flotation station at Council Grove High School.

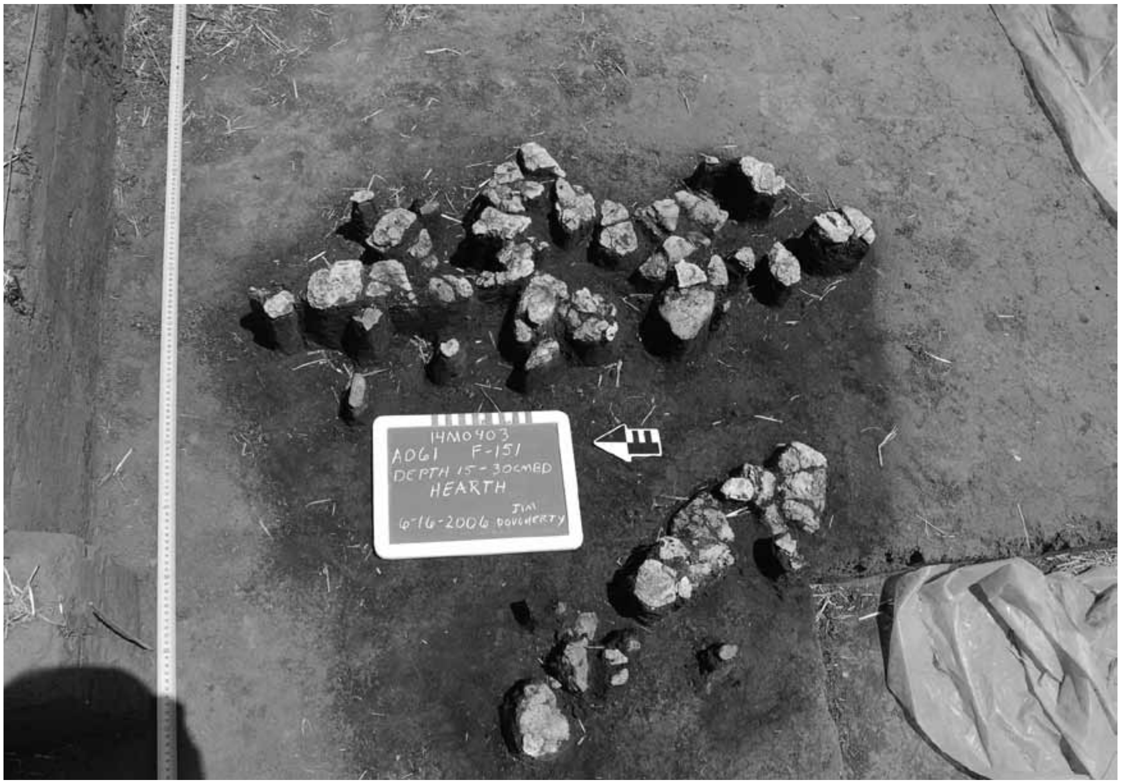

Figure 7. Inferred hearth clean-out of burned limestone, F151 in A061.

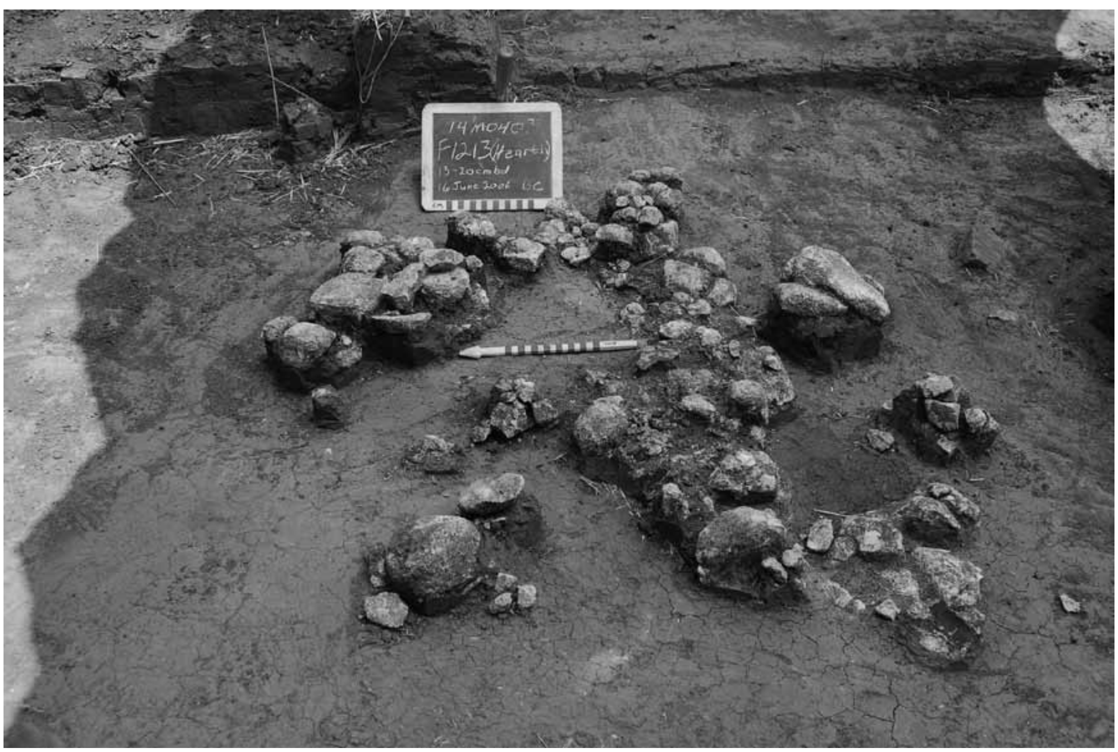

Figure 8. Another hearth clean-out, F1213 in A061.

collection comprise the most readily analyzable portion of the recovered archeological record.

Morphological analysis of the projectile points from the two previously mentioned collections and the KATP excavations suggest an Archaic through Middle Woodland periodic utilization of 14MO403. The most likely source of much, if not most, of the tool stone is Rock Creek, as it is contiguous to the northern and western borders of the site. Blackmar and Hofman (2006:59) note, "Most Archaic sites … have chipped-stone assemblages dominated by local lithic materials …."

The 670 chipped stone tools from the Stauffer Collection and the other small private collection are depicted in Figure 9. Seventy-one (11 percent) are Late Archaic projectile points, represented by stemmed points (Figure 10). A combined total of 83 (12 percent) are Early and Middle Woodland, the latter represented by Snyders points (Figure 11). Preforms and unfinished bifaces represent 27 percent of the collections. Knives (21 whole and fragments combined) of a Munkers Creek morphology represent 3 percent of the chipped stone tools. As is the case with many amateur-collected surface assemblages, no utilized flakes are in the collections. Approximately 23 percent of the formal tools are scrapers, varying in weight from 20 to 130 g (Figures 12–14).

Excluding any consideration of utilized/retouched flakes, 369 chipped stone tools (whole and fragments combined) were found during the KATP excavations. Interestingly, 47 percent are non-projectile point tool fragments. Approximately 16

Figure 10. Selected dart points from surface collections.

Figure 11. More selected dart points from surface collections.

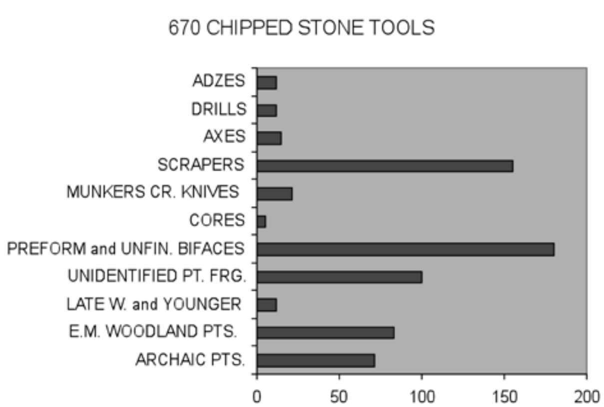

Figure 9. Graph of chipped stone tool assemblage from surface collections.

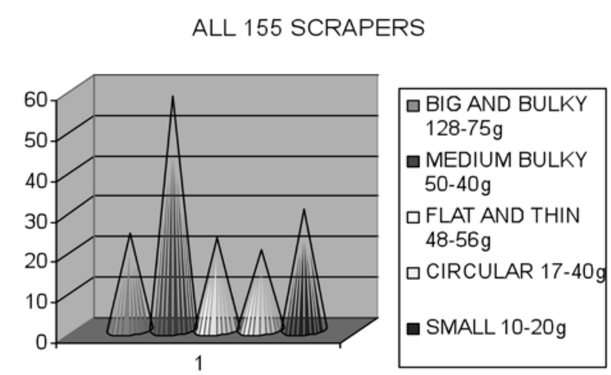

Figure 12. Graph of scrapers from surface collections.

Figure 13. Large scrapers from surface collections.

Figure 14. Middle Woodland scrapers from surface collections.

percent are preforms and broken or whole bifaces (finished and unfinished and not included in the 47 percent tool fragments just mentioned). Scrapers of all sizes (n=47) comprise 13 percent of the chipped stone findings. Points (whole [n=15] and fragments [n=14]) make up 8 percent of the excavated assemblage. Knives of a Munkers Creek morphology (whole n=6; fragments n=15) comprise 6 percent of the excavated material. Nine cores were discovered.

A profusion of primary, secondary, and tertiary flakes (more than 15,000) was unearthed. Water screening and flotation allowed for the discovery of hundreds of micro-flakes. No detailed analysis of retouched and utilized flakes was carried out. Likewise, no attempt was made at systematic debitage analysis. Nothing in a cursory review of the flake assemblage contradicts the operating assumption that the primary activity at the site, regardless of which archeological cultural caused the

Figure 15. Possible Munkers Creek knives from surface collections.

occupational event, was chipped stone tool production. Chert nodules were reduced, bifaces were successfully crafted or discarded, flakes were created and used/not used, modified, or further reduced into tools. The extent to which any one cultural group or occupational event emphasized any particular level of reduction/manufacture is, pragmatically, an unanswerable question. Variance had to exist but is not discernible by current methods. As previously noted, the site is a shallow, eroded palimpsest of Middle Archaic through Middle Woodland occupational events. When adapted for geoarcheological description, the term palimpsest refers to evidence of multiple distinct occupations on the same surface.

One fascinating question brought into focus by the KATP work is the enigmatic presence of numerous (42 whole and fragments) knives of a Munkers Creek morphology (Figure 15) on the 14MO403 surface, tested to be less than 3,800 years old (see Mandel's appendix). The Munkers Creek complex has been dated at the William Young type site at around 6200 BP (Banks and Wigand 2005). Mandel proffers three possible explanations for this enigma. A fourth possible hypothesis is that cultural groups much more recent than the Munkers Creek people manufactured knives of similar morphology.

CERAMIC ANALYSIS

Tables 1, 2, and 3 provide data on the ceramic assemblage of 249 pottery sherds from 14MO403. These data reflect finds from the 2006 KATP excavations and from two private surface collections.

Table 1. Description and Metrics for All 11* Rim Sherds.

Sherd Number	1	2	3	4	5	6
Temper	Grog	Grog	Grog	Grog	Grog	Grog
Size: Height x Length	33x28 mm	24.7x34 mm	20x33 mm	34x35 mm	73x86 mm	44.3 x 40 mm
Thickness	8,0 mm	8.1 mm	8.7 mm	9.02 mm	11.0 mm	9.29 mm
Weight	9.2 g	9.0 g	7.2 g	14.8 g	87.4 g	20.6 g
Decorations	B**, SVI	B, SVI	CS	OCWSI	B, SVI, ZDS	B, SVI
Mohs Exterior Surface Hardness	3 - 3.5	2.5	3 - 3.5	2.5	3 - 3.5	2.5
Estimated Mouth Diameter	Unknowable	35 cm	35–40 cm	Unknowable	35 cm	25 cm
Lip Shape	BI	BI	BI	R	BI	BI
Rim Shape	Straight	Straight	Straight	Straight	Straight	Straight
Dry Munsell Color						
Interior Surface	10YR/3/2	10YR/3/2	10YR/5/4	10YR/6/4	10YR/5/3	10YR/7/3
Exterior Surface	10YR/4/2	10YR/4/4	10YR/3/1	10YR/6/4	10YR/4/1	10YR/4/1
Core	2.5Y/2.5/1	2.5Y/2.5/1	Gley1/2.5/N	5Y/2.5/1	Gley1/2.5/N	10YR/4/1
Provenience	Surface	Surface	Surface	Surface	Surface	Surface

Information Category Sherd Number	7	8	KATP 9	KATP 10	11
Temper	Grog	Grog/Sand	Grog	Grog/Sand	Sand
Size: Height x Length	40.5x35.3 mm	54.4x51.2 mm	18.4x18.9 mm	14.4x9.5 mm	20.2x28
Thickness	9.2 mm	8.8 mm	7.9 mm	7.82 mm	10.06 mm
Weight	15.8 g	35.4 g	3.6 g	2 g	8 g
Decorations	PNL,ZP,TL	CS,DS,ZDS,TL,B	PNL	Too Small	DS
Mohs Exterior Surface Hardness	3.5	6	4.5	2.5	6
Estimated Mouth Diameter	40 cm	40 cm	Unknowable	Unknowable	25 cm
Lip Shape	BI	FL	FL	BI	BI
Rim Shape	Straight	Straight	Straight	Unknowable	Straight
Dry Munsell Color					
Interior Surface	10YR/6/4	10YR/4/2	10YR/6/4	10YR/6/4	5Y/4/1
Exterior Surface	10YR/7/4	10YR/5/3	10YR/6/4	10YR/6/2	5Y/3/1
Core	10YR/5/1	Gley 1/2.5/N	10YR/6/1	Gley1/2.5/N	Gley1/2.5/N
Provenience	Surface	Surface	N30E20SW1/4, 0-10DBMS	N28E20NE1/4, 0-10DBMS	Surface

*Nine from two private surface collections, two from KATP excavations

B = bossed; BI= beveled inward; CS = comb stamped; DBMS= depth below modern surface; DS= dentate stamped; FL= flat lip; OCWSI= oblique cord wrapped stick impression; PLN= plain notched lip; R= rounded; S= stamped; SVI= stamped vertical impression; TL= trailed lines; ZDS= zoned dentate stamping; ZP= zoned punctates

** Punched Boss / Hole Diameters: Sherd #1 = 4 mm; Sherd #2 = 6.25 mm; Sherd #5 = 9.54 mm; Sherd #6 = 6.26 mm; Sherd #8 = 6.62 mm

Table 2. Body Sherd and Sherdlett* Summary, Quantity and Weight by Surface Treatment per Temper Type.

	Total Sherds By Temper	Quantity Plain Sherds	Weights Plain Sherds	Quantity Decoraded Sherds	Weights Decoraded Sherds	Quantity Cord-Marked Sherds	Weights Cord-Marked Sherds	Sherdletts Qty / Weights
Temper								
Grog and Grit	50	41	259.6 g	7	101.2 g	2	19.1 g	82 / 62.5 g
Grog	41	19	178.1 g	13	106.9 g	9	113.7 g	9 / 8.7 g
Grog and Sand	23	16	164.2 g	3	80.6 g	4	42.5 g	0
Grit	10	7	72.7 g	3	40.7 g	0	0	16 / 20.2 g
Sand	6	5	64.9 g	1	6. g	0	0	0
Grog and Limestone	5	1	13 g	0	0	4	53 g	0
Limestone	6	3	42.1 g	1	8.3 g	2	41.3 g	0
Grog and Bone	1	1	14.8	0	0	0	0	0
Pamona Ware	1	0	0	0	0	1	10.5 g	0
Totals	143	93	809.4 g	28	343.7 g	22	280.1 g	107 / 91.4 g

* Sherdlett is used here to reference a ceramic piece that is missing either a discernible outside or inside surface, or both.

Table 3. Percentages of Total Sherds and Sherdletts per Temper by Weight and Count.

Temper	Plain Sherds	Decoraded Sherds	Cord-Marked Sherds	Sherdletts
	By Weight By Count	By Weight By Count	By Weight By Count	By Weight By Count
Grog and Grit	32 % 44 %	29 % 25 %	7 % 9 %	68 % 77 %
Grog	22 % 20 %	31 % 46 %	41 % 41 %	10 % 8 %
Grog and Sand	20 % 17 %	24 % 10 %	15 % 18 %	0 % 0 %
Grit	9 % 9 %	12 % 11 %	0 % 0 %	22 % 15 %
Sand	8 % 5 %	2 % 4 %	0 % 0 %	0 % 0%
Grog and Limestone	2 % 1 %	0 % 0 %	18 % 18 %	0 % 0 %
Limestone	5 % 3 %	2 % 4 %	15 % 9 %	0 % 0 %
Grog and Bone	2 % 1 %	0 % 0 %	0 % 0 %	0 % 0 %
Pamona Ware	0 % 0 %	0 % 0 %	4 % 5 %	0 % 0 %
Totals	100 % 100 %	100 % 100 %	100 % 100 %	100 % 100 %

All of these ceramics are surface or plow-zone finds from the portion of the site designated as 062. The mean weight of the 9 rim sherds found by the collectors is 23 grams. The mean of the two rim sherds recovered by the KATP excavations is 2.9 grams. Perhaps this very big difference in average size can best be explained by the simple fact that larger objects are easier to see. Likewise, the median weight of the sherds from the KATP excavations is 3.9 grams; the median from the private collections is 10.4 grams. One inference that partially explains these discrepancies is that the site is heavily collected.

Each of the 11 rim sherds appears to be from a different vessel. The average thickness of the rim sherds is 8.89 mm (Figure 16), well within a typical thickness range for Middle Woodland grog-tempered cooking pots (Fowler 1955). Based on the decorative styles found on these sherds, per se, it can be argued that two of the three Kansas City Hopewell phases, as delineated by Johnson (2003) and Logan (2006), are represented. The three different phases are Trowbridge (approximately A.D. 1 to 250); Kansas City (approximately A.D. 250 to 400); and Edwardsville (approximately A.D. 400 to 600). Rim sherds 1–6 and sherd 8 (Figures 17 and

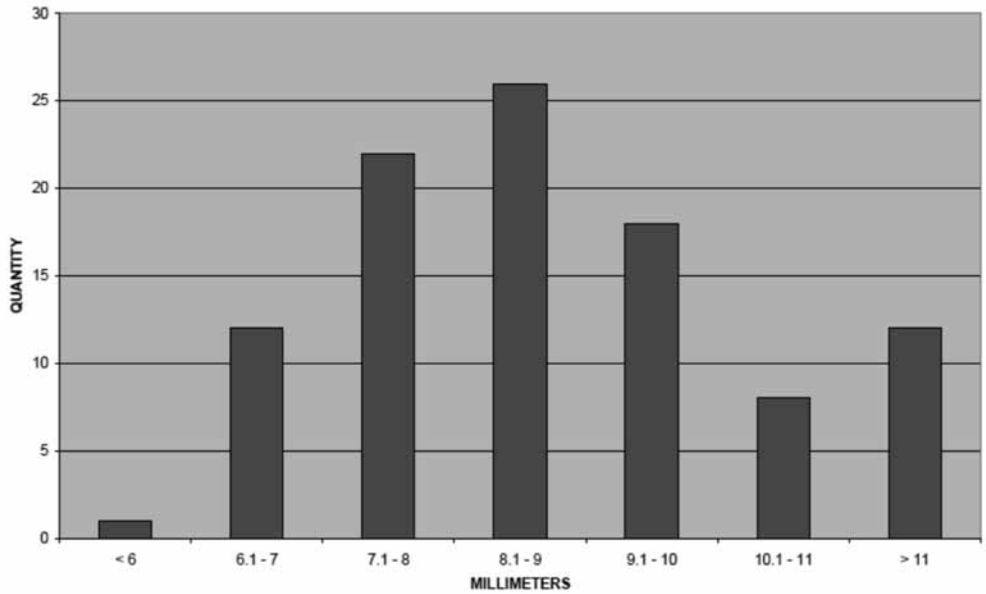

Figure 16. Graph of thicknesses of 100 body-sherds from the Stauffer Collection.

18) exhibit elements of the Trowbridge phase decorative style. Rim sherds 7 and 9 (Figure 19) have the decorative style of the Edwardsville phase. Rim sherds 10 and 11 (Figure 19) are considered stylistically indeterminate.

The Kansas City phase, the middle phase, does not appear to be represented. Here, the author assumes the same phase chronology as was found in the Kansas City Hopewell area. Therefore, any of at least four different scenarios can explain this absence of data: 1. The Middle Woodland people did not use this site between A.D 250 and 400; 2. The sherds that Hopewellian people left on the site are yet to be located; 3. They were just more careful with their ceramics and did not break them; 4. They or later peoples using the site collected their broken pottery for grog or from some other motivation.

Figure 18. Rim sherd 5.

Figure 17. Rim sherds 1–4.

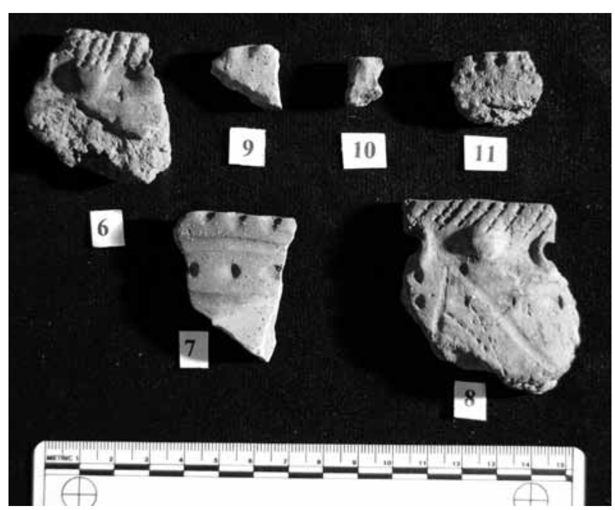

Figure 19. Rim sherds 6–11.

OTHER ARTIFACTS

Four fragments of ground stone were found. None of the unearthed 330 small pieces of bone is identifiable as to species. Only one mussel shell was found.

CONCLUSION

Surface collections from 14MO403 produced artifacts indicating Middle and Late Archaic components, as well as Middle and Late Woodland components, suggesting site occupations from ca. 3500 B.C. through A.D. 600. However, extensive excavation failed to recover similar artifact assemblages. As noted in the report of geomorphological investigations at the site, further investigation of the landform structure may reveal a complicated history that could accommodate multiple cultural occupations. More radiocarbon assays would also be useful.

ACKNOWLEDGMENTS

The list of individuals who made this project possible is too long to acknowledge separately. However, I would be remiss in not singling out a few "angels" for their singular contributions. Each of the following provided exceptional utility to the project: Marty Shawver, Roy Schmidt, Dean Rath, Dr. David Hughes, Dr. Don Blakeslee, Bob Blasing, Virginia Wulfkuhle, Don Stuteville (property owner), Gale Lee, Ed Suanek, Clint Thomas, and last but not least, the late Dick Stauffer and family. Collectively, the staff of the Kansas Historical Society and the wonderful volunteers of the Kansas Anthropological Association performed their roles to perfection. Finally, without the facilities provided, pro bono, by the Council Grove School District, this project may never have happened.

APPENDIX: GEOMORPHOLOGY AND STRATIGRAPHY OF SITE 14MO403

By Rolfe D. Mandel

Site 14MO403 is located on the valley floor of Rock Creek, a fifth-order tributary of the Neosho River. The valley floor at 14MO403 is about 1 km wide and consists of four late-Quaternary landform sediment assemblages: the modern floodplain (T-0), a low terrace (T-1), a high terrace (T-2), and alluvial/colluvial fans. The site is associated with the T-1 terrace, a broad relatively flat surface that is 2–3 m higher than the adjacent T-0 surface.

In March 2009 a backhoe trench was excavated at 14MO403 in order to closely examine the surface soil and determine whether buried cultural deposits are present (Figure 20). The trench was about 6 m long and excavated to a depth of 2.30 m. In addition, a trailer-mounted Giddings hydraulic soil probe was used to collect an intact 7.2 m-long core. The core had a diameter of 6.35 cm and was used to assess the stratigraphy of the T-1 fill at 14MO403 and to recover material for radiocarbon dating. After being measured and briefly described in the field, the core was transported to the Kansas Geological Survey for detailed analysis.

The backhoe trench at 14MO403 exposed a surface soil with a well-expressed A-AB-Bt-Btk-BC profile (Table 4). The A horizon (Ap + A) is 35 cm thick and consists of very dark gray (10YR 3/1, dry) silt loam. The underlying argillic horizon (Bt + Btk) is 1.43 m thick and consists of dark grayish brown (10YR 4/2, dry) and yellowish brown (10YR 5/4, dry) silty clay loam and brown (10YR 4/3, dry) silty clay. There are common prominent to distinct clay films (argillans) on ped faces, and films and threads of calcium carbonate (stage I carbonate morphology) begin in the Btk1 horizon (1.32–1.64 m below surface) and continue into the Btk2 horizon (1.64–1.89 m below surface). The BC horizon, which comprises the lower 41 cm of the soil profile exposed in the trench, consists of yellowish brown (10YR 5/4, dry) silt loam. A few flecks of charcoal were recorded at a depth of 1.25 m below the T-1 surface, but no artifacts or cultural features were associated with the charcoal. In fact, the entire soil profile was culturally sterile.

The lithology of the T-1 fill exposed in the trench is consistent with the lithology of the Gunder Member of the DeForest Formation. The Gunder Member consists of strongly to moderately oxidized, dominantly silty and loamy alluvium lacking a loess cover. Some parts of this member may be reduced and/or coarse grained. In the unglaciated area of eastern Kansas, Gunder Member deposits occur in valleys of all sizes and unconformably overlie loess, bedrock, or coarse-grained and often organic-rich older alluvium (Mandel and Bettis 2003). Younger members of the formation are separated from the Gunder Member by a fluvial erosion surface or a hiatus marked by a buried soil. Surface soils developed in the Gunder Member typically are thick Mollisols with brown (10YR 4/3–5/3, dry) to yellowish brown (10YR 5/4–5/6, dry) Bw, Bt, Bk, and/or Btk horizons. Buried soils occur within the Gunder Member, but they are not widely traceable or useful as regional pedostratigraphic units. The

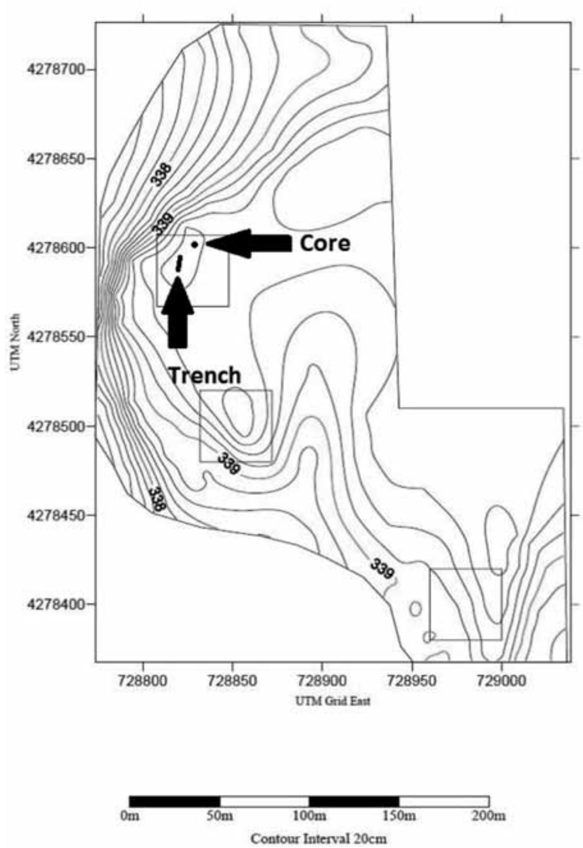

Figure 20. Location of backhoe trench and core at 14MO403, March 2009.

Gunder Member ranges in age from about 10,500 ^{14}C yr. B.P. at its base to about 2,000 ^{14}C yr B.P. at its surface (Bettis 1990, 1995; Mandel and Bettis 1992).

The core (Table 5) revealed a surface soil similar to the one observed in the backhoe trench. Below a depth of 3.50 m the yellowish brown silt loam comprising the BC horizon quickly grades into grayish brown (10YR 5/2, dry) silt loam that has been slightly modified by soil development (CB horizon). The T-1 fill consists of stratified fine-grained alluvium (silty clay loam and silty clay) from 4.35 to 7.20 m below surface (C horizons), and the Gunder Member alluvium is reduced (gleyed matrix color [dark gray, 5Y 4/1, dry]) below a depth of 5.80 m. There was no evidence of buried soils in the upper 7.20 m of the T-1 fill.

Charcoal fragments recovered at a depth of 6.60–6.65 m in the core yielded an AMS radiocarbon age of 3835±20 yrs B.P. (ISGS-A1344). Based on this age, the upper 6.65 m of the T-1 fill rapidly aggraded after ca. 3800 ^{14}C yr B.P. The develop-

Table 4. Description of Soil Profile Exposed in the Backhoe Trench at 14MO403.

Landform: T-1 terrace
Slope: 1%
Drainage class: Well drained

Depth (cm)	Soil Horizon	Description
0–20	Ap	Very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; friable; common very fine roots; abrupt smooth boundary.
20–35	A	Very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; friable; common fine and very fine roots; common worm casts and open worm burrows; gradual smooth boundary.
35–46	AB	Dark gray (10YR 4/1) light silty clay loam, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure parting to moderate medium and fine granular structure; hard, friable; common fine and very fine roots; common worm casts and open worm burrows; gradual smooth boundary.
46–74	Bt1	Dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine prismatic structure parting to moderate fine subangular blocky; hard, firm; common prominent continuous dark gray (10YR 4/1) clay films on ped faces; common fine and very fine roots; few worm casts and open worm burrows; common fine and very fine pores; gradual smooth boundary.
74–132	Bt2	Brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; interior of peds are yellowish brown (10YR 5/4), dark yellowish brown (10YR 4/4) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; very hard, very firm; common prominent nearly continuous dark grayish brown (10YR 4/2) clay films on ped faces; few fine and very fine roots; few flecks of charcoal at 125 cm below surface; few worm casts and open worm burrows; common fine and very fine pores; gradual smooth boundary.
132–164	Btk1	Yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; moderate fine prismatic structure parting to moderate fine subangular blocky; hard, firm; common distinct discontinuous dark grayish brown (10YR 4/2) clay films on ped faces; common films and threads of calcium carbonate; few fine roots; few worm casts and open worm burrows; common fine and many very fine pores; gradual smooth boundary.
164–189	Btk2	Yellowish brown (10YR 5/4) light silty clay loam, dark yellowish brown (10YR 4/4) moist; moderate fine prismatic structure parting to moderate fine subangular blocky; hard, firm; few distinct discontinuous dark grayish brown (10YR 4/2) clay films on ped faces; common films and threads of calcium carbonate; few fine roots; few worm casts and open worm burrows; common fine and many very fine pores; gradual smooth boundary.
189–230+	BC	Yellowish brown (10YR 5/4) silt loam, dark yellowish brown (10YR 4/4) moist; very weak fine subangular blocky structure; hard, friable; few faint irregular (disturbed) laminae of pale brown (10YR 6/3) and very pale brown (10YR 7/3) silt loam; few fine roots; few worm casts and open worm burrows; many very fine pores.

Table 5. Description of the Core Collected at 14MO403.

Landform: T-1 terrace
Slope: 1%
Drainage class: Well drained
Remarks: Charcoal fragments collected at a depth of 660–665 cm yielded an AMS radiocarbon age of 3835±20 yr. B.P.

Depth (cm)	Soil Horizon	Description
0–20	Ap	Gray (10YR 5/1) sily loam, dark gray (10YR 4/1) moist; weak fine granular structure; very friable; many fine and very fine roots; commom very fine pores; abrupt boundary.
20–40	A	Dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; friable; common fine, very fine and medium roots; gradual boundary.
40–75	Bt1	Yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium to fine prismatic structure; slightly hard, friable; common discontinuous dark gray (10YR 4/1) clay films on ped faces and in macropores; common fine and very fine roots; gradual boundary.
75–125	Bt2	Yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium prismatic structure parting to moderate fine and very fine subangular blocky; hard, friable; many distinct continuous dark gray (10YR 4/1) clay films on ped faces; common fine and very fine roots; abrupt boundary.
125–175	Bt3	Yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; weak fine to very fine subangular blocky structure; hard, friable; common distinct continuous dark gray (10YR 4/1) clay films on ped faces; very few very fine and fine roots; gradual boundary.
175–220	Bt4	Yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; weak fine to very fine subangular blocky; friable; few discontinuous dark gray (10YR 4/1) clay films along root channels; very few very fine and fine roots; gradual boundary.
220–350	BC	Yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky straucture; friable, slightly plastic; gradual boundary.
350–435	CBb	Yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; very weak fine subangular blocky structure; hard, friable, slightly plastic; gradual boundary.
435–580	C	Laminated brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist, interbedded with light yellowish brown (10YR 6/4, dry) silt loam; hard, friable; abrupt boundary.
580–640	Cg1	Dark gray (5Y 4/1) silty clay loam, very dark gray (5Y 3/1) moist; massive; firm; slightly plastic, abrupt boundary.
640–690	Cg2	Dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; massive; very firm; many lenses of fine and medium subrounded and well-rounded pebbles; abrupt boundary.
690–720+	Cg3	Dark gray (5Y 4/1) silty clay loam, very dark gray (5Y 3/1) moist; massive; firm; common prominent reddish brown (5YR 4/4, dry) mottles and soft masses of iron oxide, massive; firm.

ment of a thick argillic horizon (Bt + Btk) in the surface soil required at least 2,000 years of landscape stability and concomitant pedogenesis; hence, aggradation probably slowed by ca. 2500 ^{14}C yr B.P., allowing commencement of soil development soon after that time.

The radiocarbon age of 3835±20 yrs B.P. determined on charcoal collected 6.60–6.65 m below the T-1 surface is relevant to the reported discovery of Munkers Creek artifacts on the T-1 surface at 14MO403. Charcoal collected from Munkers Creek cultural deposits at the William Young site (14MO304), the type locality for the Munkers Creek technological complex (Blackmar and Hofman 2006), yielded radiocarbon ages of 5255 ± 40 yrs B.P. (ISGS-A0508) and 6200 ± 160 yrs B.P. (Banks and Wigand 2005). Given the antiquity of Munkers Creek artifacts, how can they occur on a terrace surface that is less than 3800 years old? One explanation is that people who occupied 14MO403 after ca. 3800 ^{14}C yr B.P. procured the Munkers Creek artifacts. Also, it is possible that middle Holocene alluvium containing Munkers Creek cultural deposits is laterally inset against the late Holocene alluvium observed in the core and backhoe trench. Another explanation is that the charcoal sample that yielded the date of 3835 ± 20 yrs B.P. was not in situ. The sample was very small (about 3 mm in diameter), so it may have been translocated downward through bioturbation or other soil/sediment-mixing processes. Resolution of this problem requires additional subsurface exploration (primarily deep coring) and additional radiocarbon dating at 14MO403.

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Notes

THE EASTEP SITE (14MY388): A LATE ARCHAIC/WOODLAND PERIOD SITE IN SOUTHEAST KANSAS

John Tomasic, Edwin J. Miller, Mark Volmut, and Andrew R. Wyatt
Kansas Historical Society

In 2011 the Kansas Historical Society completed a series of excavations at the Eastep site (14MY388), a multicomponent archeological site containing stratified cultural deposits dating to the Late Archaic and Woodland periods (2000 B.C. –A.D. 1000). Geographic Information Systems (GIS) mapping technologies and techniques have provided critical information regarding the spatial distribution of artifacts and features at the site. Specialized research has provided significant insight regarding the lifeways of the site's former occupants. Overall, this research has generated valuable data that contributes to the understanding of the nature of human adaptation during the Late Archaic/Early Woodland transition in the region.

INTRODUCTION AND PROJECT BACKGROUND

The Eastep site (14MY388), located in Montgomery County, Kansas, was recorded by State Archeologist Tom Witty and avocational archeologist Ernie Carr in 1975. At the time the site was reported as a surface component on a low terrace along the southern bank of the Verdigris River. Artifacts consisted of chipped stone debitage and tools, including bifacial blades, a beveled knife fragment, projectile point fragments, and end scrapers, as well as quantities of burned and fire-cracked rock. While it is apparent from this abbreviated list that diagnostic artifacts likely were associated with 14MY388, no data concerning the specific types of points found were available in the site records.

In recent years severe flooding and river bank erosion along this portion of the Verdigris River prompted officials from the Natural Resources Conservation Service (NRCS) to develop plans for a river bank stabilization project. As required by federal law, the NRCS requested a survey of the Eastep site to determine if the proposed project would adversely impact the site. Kansas Historical Society (KSHS) archeologist Tod Bevitt revisited and visually inspected the area in 2008. Close examination of the river's cutbank revealed a series of exposed, intact features more than 1 m below the ground surface. This survey demonstrated that 14MY388 was a well-stratified, multicomponent site with intact cultural features, which qualified the site for placement on the National Register of Historic Places (Bevitt 2008). Unfortunately, the cutbank location of the features meant that significant portions of the site would be destroyed by the upcoming river bank stabilization project. Given the importance of the archeological site and the unavoidable adverse effects of the conservation project, in 2009 the NRCS requested that the KSHS conduct salvage excavations of the endangered features.

A team of KSHS archeologists under the direction of the primary author conducted salvage excavations of several exposed features over a two-week period from September 21 to October 2, 2009 (Tomasic 2010a). These salvage excavations demonstrated that the number of features exposed in the river's cutbank was much higher and the overall extent of the site was larger than previously thought. Notably, the information obtained from these excavations demonstrated that the site was occupied during the Late Archaic and Woodland periods (2000 B.C.–A.D. 1000). During this 3,000-year period a series of profound changes in human adaptation occurred, including an increased reliance upon domesticated plant cultivation, the adoption of ceramics, the adoption of the bow and arrow, and a general shift from a mobile to sedentary lifestyle.

Based on the scientific importance of the Eastep site and the imminent destruction of a major portion of it, the KSHS conducted additional investigations in May and June 2010. This second phase of research involved 1) mapping of established site datums using a differential Global Positioning System (GPS) receiver, 2) a geophysical survey of the surface component, and 3) additional salvage excavations by enlisting the help of the Kansas Anthropological Association (KAA) as part of the 2010 Kansas Archeology Training Program (KATP) field school (Tomasic 2010b, 2012). The final phase of field research, which took place in October 2011, consisted of monitoring earthmoving activities during the implementation of the river bank stabilization project. The monitoring portion of the project resulted in identification of additional buried prehistoric features and associated artifacts throughout the project area.

ENVIRONMENTAL SETTING

In physiographic terms the project area is located within the Osage Cuestas division of the Osage Plains section of the Central Lowland province of the Interior Plains division of North America (Schoewe 1949:283–286). The bedrock of the region consists of interbedded limestone, shale, and sandstone formations of Pennsylvanian age. Exposure and differential erosion of the unequally resistant, westward-sloping strata at the ground surface has created a series of low parallel ridges. These "cuestas" have steep, rugged, east-facing escarpments that front on broad, gently inclined, westward-sloping vales. Thus, the topography consists of long, low rolling hills and wide shallow valleys. In general the escarpments exhibit an irregular northeast-southwest trend. However, the major stream courses flow to the east and southeast, transverse to the direction of the escarpments and against the westward dip of the rock formations.

The prehistoric vegetation of the Osage Cuestas was open prairie, penetrated by thin ribbons of riverine forest. Kuchler (1974) listed the Cuestas as part of the tall grass bluestem prairies, described more specifically as an area with extensive interspersion of forest and prairie. Soil survey data and early historical accounts indicate that wooded areas were confined to the floodplains and valley edges of the major stream courses and their tributaries. The timber consisted of medium tall to tall broadleaf deciduous forests, often with dense undergrowth and many lianas (woody vines). Oak, black walnut, hickory, hackberry, cottonwood, willow, and elm were common along with a variety of smaller species, such as persimmon, papaw, elderberry, serviceberry, chokecherry, and wild grape. Forestation apparently was not pervasive even in bottomland locations; however, many of the common streamcourse soils have characteristics indicating that they developed under a native vegetation of both tall grasses and hardwood trees. In any case the forest belts and nearby prairies of the Osage Plains provided shelter and food for plentiful mammalian fauna, including bison, elk, deer, antelope, and bear, while the streams yielded an abundance of edible fish and shellfish. Wild turkey, prairie chicken, ruffed grouse, and quail were also available, and ducks and geese were present on a seasonal basis (Wedel 1959:14).

The natural ecology of the region has been greatly altered by modern land-use practices. Today, most of the lands in this part of the state are used for agricultural purposes, primarily the pasturing of livestock and the cultivation of crops, such as wheat, corn, milo, and soybeans.

CULTURAL-HISTORICAL SETTING

Archeological research in this region of Kansas has yielded evidence of prehistoric human occupation, dating from around 11,000 years ago and extending up to the modern era, and certainly has the potential for yielding more such evidence. Sites in the region usually represent habitation areas or small workshops and more rarely occur as villages or burials. While the full extent of the area's archeological resources has yet to be determined, it is clear that the region contains materials deriving from all of the major cultural periods thus far identified in Kansas: Paleoindian period (11,500–6,000 B.C.), Archaic period (6,000–500 B.C.), Woodland period (500 B.C.–A.D. 1000), Late Prehistoric period (A.D. 1000–1500), and Protohistoric and Historic period (A.D. 1500-present).

This report follows Brad Logan (2006) and Lauren Ritterbush (2006) in abandoning the use of John Champe's widely used Early (A.D. 1–1000), Middle (A.D. 1000–1500), and Late Ceramic (A.D. 1500–1800) classification system. Champe (1946) used the presence of ceramics as a primary means of differentiating between the Late Archaic and the subsequent Ceramic periods. While his alternative to classification systems developed for the eastern United States remains useful to many Central Plains archeologists, it is of limited utility in the investigation of 14MY388 for two reasons. First, Champe developed his system prior to the recognition of Early Woodland period (500 B.C.–A.D. 1) sites in Kansas (Johnson 1992) and cannot easily accommodate the presence of Woodland adaptations prior to A.D. 1. Second, Champe's system was designed "as a means of distinguishing ceramic-bearing sites of the Great Plains from their Midwestern counterparts" (Hoard and Banks 2006:7). Continued use of a classification system designed specifically for the Great Plains can hinder efforts to compare the Eastep site artifact assemblage with assemblages from contemporary sites in the midwestern and eastern United States.

As with all cultural period classifications, the cultural periods employed in this report are broad and somewhat artificial categories, and there is some temporal overlap between periods. As might be expected, more is known about the most recent inhabitants than is known about the earliest (Brown and Simmons 1987; Hoard and Banks 2006; Lees 1989; Thies 1987; Wedel 1959). The following discussion provides a brief overview of the Archaic and Woodland periods and associated cultural phases in southeastern Kansas.

Archaic Period (6000–500 B.C.)

By at least 6000 B.C. mammoth, giant bison, and the many of the megafaunal species that were exploited by Paleoindian groups became extinct as a result of a variety of factors, including climate change and other natural processes (Fagan 2005:95–96). During the Archaic period in Kansas, communities of large mammal species similar to modern species were present, and Archaic-period subsistence was characterized by broad spectrum hunting and gathering. For heuristic purposes the Archaic period can be subdivided into the Early, Middle, and Late Archaic, although these are largely artificial divisions (Blackmar and Hofman 2006).

During the Late Archaic period (2000–500 B.C.) the number of archeological sites in southeastern Kansas and northeastern Oklahoma increased dramatically compared to the preceding Middle Archaic. In southeastern Kansas some of the best evidence of Late Archaic lifeways comes from the Snyder site (14BU9), a stratified, multicomponent site excavated by the University of Kansas from 1968 to 1971 at El Dorado Reservoir (Grosser 1973). Based on projectile point variation and radiocarbon dating, Roger Grosser (1973) defined four archeological phases for the region: Chelsea phase (2800–2000 B.C.), El Dorado phase (2000–1400 B.C.), Walnut phase (1200 B.C.–A.D. 1) and Butler phase (A.D. 200–800). Of particular importance to research at the Eastep site are the Walnut and Butler phases.

Walnut Phase (1200 B.C.–A.D. 1)

Following its identification by Grosser (1973) at the Snyder site, the Walnut phase was identified at a few other localities, including the Coffey site (14PO1) in the northern Flint Hills (Schmits 1978). Walnut phase projectile points are triangular, corner-notched forms that have been noted for their similarity to projectile points from the Lawrence site (34NW6) in northeastern Oklahoma (discussed below) (Grosser 1973:233). Traditionally, Walnut phase sites were assigned to the Late Archaic, rather than the Early Woodland, despite the fact that "the material culture remains and adaptation type appear to be very similar to that identified for the prairie-bordered Early Woodland complex" (Adair 1996:107). Recent research suggests that the Walnut phase perhaps should be considered as Early Woodland phase (Adair 1996; Johnson 1992; Logan 2006; Logan and Beck 1996:58).

Lawrence Phase (800 B.C.–A.D. 1)

Across the border in northeastern Oklahoma, several Late Archaic sites have been identified as belonging to the Lawrence phase (Wyckoff 1984:146–150). At the Lawrence site, located on the Verdigris River less than 50 km south of the Eastep site, excavations discovered a series of burned rock features, accompanied by a wide variety of chipped stone artifacts. Interestingly, the assemblage included few contracting-stemmed points, with the majority of points being corner-notched forms similar to the

Middle Archaic Caudill complex, suggesting continuity in lithic manufacturing traditions between the Late Archaic Lawrence site and the earlier Middle Archaic cultures of northeastern Oklahoma (Wyckoff 1984:147). The Lawrence site also contained a diverse faunal assemblage that included relatively large quantities of deer remains, nearly 20 percent of the overall assemblage (Baldwin 1969:83–84). Radiocarbon dates from the Lawrence site suggest that the site was intensively occupied around 700 B.C., and evidence from other Lawrence phase sites in northeastern Oklahoma suggests that the Lawrence phase lasted roughly 800 years, from 800 B.C. to A.D. 1 (Wyckoff 1984:147).

During the Lawrence phase, sites show increasing evidence of regional and long-distance trade. At the Lawrence site approximately 25 percent of recovered chert artifacts were identified to source as Mississippian cherts from 80 km to the east in the Ozark region of Missouri, and 8 percent of chert artifacts were from Kay County, Oklahoma, sources, approximately 130 km west. Evidence of long-distance trade came from an obsidian flake recovered at the Lawrence site. Several obsidian sources have been identified in the western United States, with northeastern New Mexico being the nearest source of obsidian for the Lawrence site inhabitants (Baldwin 1969:81–82).

Woodland Period (500 B.C.- A.D. 1000)

During the Woodland period, a series of cultural innovations occurred in eastern Kansas, including larger populations, increasing sedentism, increasing reliance upon domesticated plant cultivation, and technological innovations including the widespread use of ceramic vessels, changes in lithic technology, and the adoption of the bow and arrow. These innovations are generally thought to be a result of interactions between Central Plains populations and groups in the eastern woodlands of North America (Logan and Beck 1996:55). These interactions may have entailed exchanges of ideas and/or technologies either directly through demographic shifts from the east or indirectly through cultural diffusion (Logan 2006). Following Alfred Johnson (2001), the Woodland period is subdivided into three periods: Early Woodland (500 B.C.–A.D. 1), Middle Woodland (A.D. 1–500), and Late Woodland (A.D. 500–1000).

Early Woodland (500 B.C.–A.D. 1)

Traditionally, the Early Woodland has been defined as a cultural stage that witnessed the development of ceramics, horticulture, and burial mounds (Griffin 1952). Although this definition remains useful in some respects in the eastern United States, it is of little utility in Kansas or Missouri, where a wealth of archeological data demonstrates that all of these cultural traits are now known to predate the Early Woodland period at a number of sites (Adair 2006; Martin 1997:4–6; Reid 1983).

Rather than define Early Woodland based on an outdated understanding of the development of these cultural traits, in this report Woodland is defined following Terrell Martin's (1997:24) definition of Early Woodland in Missouri as a period of time between roughly 600 B.C. and A.D. 1 containing artifacts diagnostic of the Marion and Black Sand Cultures of Illinois. Following Brad Logan and Margaret Beck (1996:57), Early Woodland sites in Kansas can be characterized as "small groups of hunter-gatherers that are transitional from Archaic to later Woodland adaptations with regard to settlement-subsistence patterns and characterized by more utilization of a ceramic technology, though use of pottery is not well-developed."

Compared to the relatively high number of Kansas sites dating to the Late Archaic, Middle Woodland, and Late Woodland, Early Woodland sites are quite rare in Kansas. In northeastern Kansas, sites in Brown and Johnson counties have been identified as having early Woodland components (Johnson 1992; Logan and Hedden 1990), and as discussed below, the Walnut phase of the Flint Hills has been considered by some to represent an Early Woodland occupation (Adair 1996:106; Johnson 1992). The paucity of Early Woodland sites in Kansas could indicate that populations were relatively low, or that many Archaic peoples' lifeways did not change radically until the subsequent Middle Woodland period.

According to Martin (1997:92), the evidence for Early Woodland in Missouri is just as elusive. He provided additional possible explanations for this phenomenon, suggesting that it may be due to the relatively short (500-year) duration of the Early Woodland period, or it could be a result of the burial or destruction of most Early Woodland sites through alluvial processes. It also has been suggested that previous archeological interpretations have misidentified Early Woodland sites because they have relied too heavily on pottery as the primary means of discriminating between the Late Archaic and the Early Woodland period (Martin 1997:4). Specifically, Martin (1997:92) and Michael O'Brien and Raymond Wood (1998:186) have suggested that the similarity between Early and Middle Woodland ceramics in Missouri may have caused some pottery-bearing Early Woodland sites that lack radiocarbon dates to be misidentified as Middle Woodland sites.

In Kansas a similar reliance upon pottery as the primary means of discriminating between the Late Archaic and the Early Woodland periods probably has led to the misidentification of Early Woodland sites. Johnson (1992) demonstrated that Early Woodland sites in Kansas can be identified not only by pottery, but also by lithic technologies. According to Johnson (1992:133), since pottery is relatively rare, even at Early Woodland sites in Missouri, its absence at Early Woodland sites in Kansas could be a result of sampling bias, or pottery simply may never have been part of the original assemblage at some Early Woodland sites in Kansas.

Dickson Cluster Contracting Stemmed points (Justice 1987:189) are diagnostic of the Early Woodland in the lower Illinois Valley, and according to Johnson (1992), the presence of Dickson Cluster points at roughly contemporaneous sites in Kansas can be indicative of an Early Woodland presence. In addition, Johnson suggested that corner-notched projectile points found at Walnut phase sites in Kansas that are contemporary with Early Woodland sites in Missouri and Illinois also can be indicative of an Early Woodland presence in Kansas. Unlike contracting-stemmed points, corner-notched points are not thought to have an eastern origin, but their presence at Walnut phase sites in Kansas and Early Woodland sites in northwestern Missouri suggests that this point type may be common in Early Woodland assemblages in Kansas (Adair 1996:106; Johnson 1992).

Although projectile point types can be useful in identifying Early Woodland sites in Kansas, caution must be exercised when dealing with Dickson Cluster contracting stemmed points (Justice 1987:189). Dickson Cluster points are considered diagnostic of the Early Woodland period in the midwestern United States (Justice 1987:189; Martin 1997:17), yet contracting-stemmed points remain in use in Kansas for centuries longer, through the Middle and Late Woodland periods. Based on the frequency of Dickson Cluster points at Middle and Late Woodland sites in southeastern Kansas, these points have been considered to be diagnostic of the Middle/Late Woodland Cuesta phase (Witty 1982:214).

A final factor that may contribute to the misidentification of Early Woodland sites in Kansas may be the continued use of Champe's (1946) classification system of ceramic cultures among Kansas archeologists. Created prior to the recognition of an Early Woodland presence in Kansas (Johnson 1992), Champe's classification system uses the presence of ceramics as a primary means of differentiating between the Late Archaic (2000 B.C.-A.D. 1) and the subsequent Early Ceramic (A.D. 1–1000) period, and this classification scheme leaves no room for an Early Woodland (500 B.C.–A.D. 1) presence in the state. This reliance upon Champe's outdated classification system, combined with the persistence of Dickson Cluster points through the Woodland period, has created an unfortunate situation in which an Early Woodland site in Kansas could contain both pottery and contracting-stemmed points, but without radiocarbon dates the site almost certainly would be placed in the subsequent Early Ceramic period, rather than the Early Woodland period.

Middle And Late Woodland (A.D. 1–1000)

During the Middle and Late Woodland periods more than a dozen archeological cultures are defined in Kansas and adjacent states, and most of these archeological cultures share certain lithic and ceramic attributes with Illinois Hopewell cultures (Logan 2006:79). Logan (2006) and others (Johnson 2001; Logan and Beck 1996) have suggested that the distinctions between many of these archeological cultures are unwarranted. In fact, Logan

(2006:84) stated that most of these archeological cultures "have more in common than they do in difference." Following Logan (2006), the Butler and Greenwood phases of the southern Flint Hills are viewed as virtually indistinguishable from one another and are discussed collectively in this report. In addition, the Cooper phase of northeastern Oklahoma and the Cuesta phase of southeastern Kansas are also viewed as essentially identical and are discussed collectively in this report.

Cuesta/Cooper Phases (A.D. 1–1000)

The Cuesta and Cooper phases of northeastern Oklahoma and southeastern Kansas witnessed the widespread adoption of pottery and the construction of large, permanent structures with storage facilities. Subsistence was based on hunting and gathering and limited horticulture (Johnson 2001:164). In terms of projectile point types, both Cooper and Cuesta phase sites contain a mixture of probable dart and arrow point types, including Dickson Cluster points, Snyders points, and Scallorn arrow points, suggesting that Cuesta and Cooper phase peoples used both the atlatl and bow and arrow.

The Cuesta/Cooper phase traditionally is considered a Middle Woodland development (Logan 2006), based on shared ceramic attributes between Cuesta/Cooper phase sites and Kansas City Hopewell sites (Johnson 2001:164). Although the original radiocarbon dates obtained at Cuesta phase sites in southeastern Kansas indicated a Late Woodland assignment for the Cooper/Cuesta phase (Marshall 1972:92–93; Witty 1999), these dates generally are considered unreliable (Logan and Beck 1996:65–66). As a result, the similarities between Cuesta/Cooper phase ceramics and Middle Woodland Kansas City Hopewell ceramics has led most scholars to assign the Cuesta/Cooper phases to the Middle Woodland, despite the Late Woodland radiocarbon dates.

Recently, samples excavated several decades ago from the Infinity site (14MY305; Marshall 1972), a Cooper/Cuesta phase site in southeastern Kansas, were subjected to accelerator mass spectrometry (AMS) radiocarbon dating, and these dates place the Cuesta phase firmly within the Late Woodland period and possibly even later (Cole and Neel 2010). If these radiocarbon dates are valid, the shared attributes of Middle Woodland Kansas City Hopewell ceramics and Late Woodland Cooper/Cuesta phase ceramics may indicate the persistence of Middle Woodland ceramic technologies for several centuries in this region. Ongoing research by Holly Smith (2002) at Cuesta/Cooper phase sites should help to clarify this issue.

Butler Phase (A.D. 200–800) And Greenwood Phase (A.D. 600–1000)

As previously mentioned, the Greenwood phase of the Flint Hills and western Osage Cuestas (Reynolds 1984; Witty 1982), and the Butler phase of the southern Flint Hills are treated collectively in this report. Much of the knowledge of Butler/Greenwood phase sites comes from excavations at the Snyder site (14BU9) at El Dorado Lake in Butler County (Grosser 1973), Curry site (14GR301) in Greenwood County (Calabrese 1967:42–129), Two Dog site (14MO301) at Council Grove Lake in Morris County (Witty 1982:37–71), and Cow Killer site (14OS347) at Melvern Lake in Osage County (Reynolds 1984).

Butler/Greenwood phase sites frequently contain both corner-notched Snyders points and Dickson contracting-stemmed points, as well as small corner-notched Scallorn points, suggesting the use of both the atlatl and the bow and arrow (Logan 2006:87). Ceramics recovered from Butler/Greenwood phase contexts include limestone-tempered and cord-marked pottery similar to other Hopewellian era occupations in southeastern Kansas and northeastern Oklahoma, especially Cuesta/Cooper phase ceramics (Logan 2006:82). Based on post mold patterns found at the Curry, Two Dog, and Cow Killer sites, oval or round houses constructed at least partially with clay daub over thatched grass can be inferred (Reynolds 1984:28). Storage pits are present both inside and outside Butler/Greenwood phase structures, but hearths have not been recovered (Adair 1988:33).

METHODS

KSHS research objectives were to recover as much information as possible from the portions of the Eastep site in danger of destruction by the river bank stabilization project and at the same time conduct problem-oriented scientific research that would address key issues in Central Plains prehistory. Overall, the hope was to generate data that would contribute to a better understanding of regional adaptations in the Central Plains during the Late Archaic and Woodland periods (2000 B.C.–A.D. 1000), including types of activities conducted, the degree of sedentism, seasonality of occupation, and the nature of subsistence practices.

Description of Areas Investigated

The overall extent of 14MY388 is more than an acre, and the 2009–2011 excavations and monitoring at the Eastep site focused on two relatively small areas of the site, designated Area 101 and Area 102 (hereafter referred to as A101 and A102) (Figure 1). A101 is located along the southern bank of the Verdigris River and contains a series of exposed features and associated artifacts actively

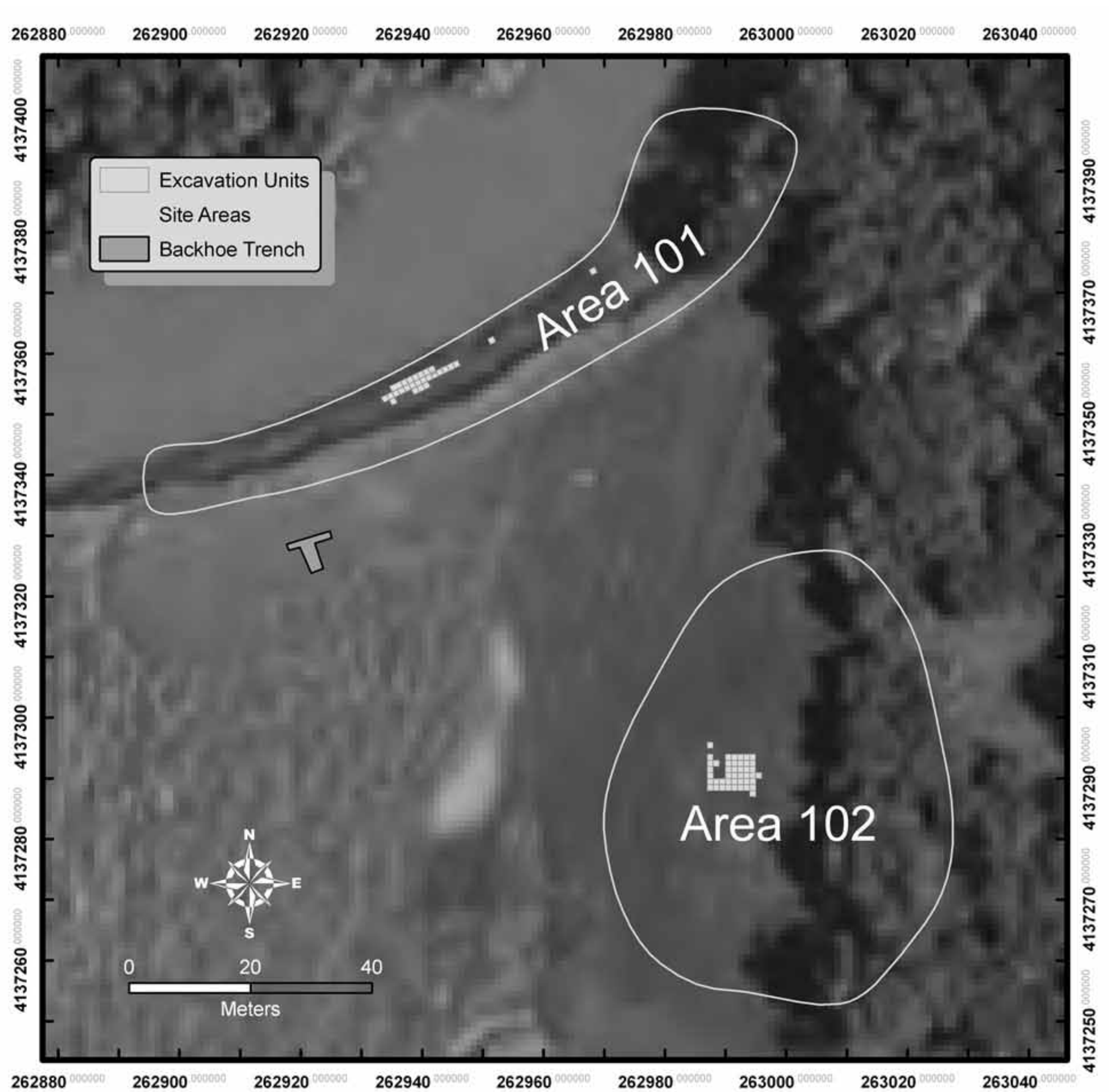

Figure 1. 2008 aerial image of the Eastep site with the locations of A101 and A102 indicated. UTM coordinate grid reference points are indicated along the border.

eroding from the cutbank of the T-1 terrace. Although most of the cutbank was too steep to conduct excavations in 2010, a significant portion of the cutbank was relatively flat and approximately 4 m wide, making this area well suited for a series of excavation units. A102 is located approximately 100 m south-southeast of A101 and contains a dense concentration of artifacts on its surface, including ceramic, lithic, and bone artifacts. A102 sits above the T-1 terrace on a bedrock footslope at the base of the valley wall.

Key differences exist between the location, extent, and condition of cultural deposits in A101 and A102. First, A101 contains relatively undisturbed features and associated artifacts buried beneath several meters of alluvium and exposed in the river's cutbank. These cultural deposits were in constant threat of destruction due to river erosion and certainly would be destroyed by the planned river bank stabilization project. As a result A101 excavations primarily were aimed at salvaging as much information as possible before this portion of the site was destroyed. Unlike A101, A102 is located atop a bedrock footslope more than 100 m south of the river bank, well outside the site area actively being eroded by the Verdigris River and well outside the boundaries of the river bank stabilization project. A102 contains a high density of artifacts atop the plowed surface of the landform, but the degree to which intact cultural deposits were present beneath the plow zone was unknown prior to the 2010 research.

Based on the major contextual differences between A101 and A102, a research design was created that would take into account the particular conditions in each area. In both areas standard excavation techniques were supplemented with some of the latest analytical and excavation techniques. By using a combination of traditional and innovative methods, the hope was to obtain as much information as possible from the site and to obtain data that could address key issues in Central Plains archeology.

Creation of the Site Map and GIS Database

One of the primary objectives of the Eastep site research was creation of an accurate site map, using real-world coordinates. Traditionally, archeological site maps created by KSHS archeologists were based on arbitrary coordinates, such as N500, E500, rather than Universal Transverse Mercator (UTM) coordinates. Excavation units and topographic features were recorded with a theodolite or a total station, using an arbitrary grid aligned to magnetic north (Witty 1999:32). In the past the only method of obtaining precise UTM coordinates for a site was to locate the nearest known point, such as a United States Geological Survey (USGS) or National Geodetic Survey (NGS) survey benchmark, and to carry the coordinates to the site by surveying a transect from the previously established survey benchmark.

In recent years the wide availability and low cost of hand-held GPS receivers has made it possible to obtain UTM coordinates at any location on the landscape, and these coordinates are usually accurate to within 3 m. In general the level of precision required to establish a site's map datums is much higher than today's hand-held GPS receivers can provide, so most archeological site maps continue to employ arbitrary coordinate systems. However, extremely precise UTM coordinates can be obtained with the aid of so-called differential GPS receivers, which receive signals from both satellites and from fixed ground-based stations and are able to reduce the margin of error inherent in hand-held GPS devices to sub-centimeter vertical and horizontal error. As a result the UTM coordinates of a site's datums can be established rather quickly and with extremely high precision, and excavation units can then be surveyed and mapped using real-world UTM coordinates.

With the rapid development of GPS-based technologies, major advances have been made in the types of software used to manage spatial data. In particular most archeological site maps can now be integrated in a computer database known as a Geographical Information System or GIS. Once the real-world UTM coordinates of an archeological site have been established, these coordinates can be used in a GIS database to organize endless forms of spatial data—satellite imagery, topographic maps, survey data, and artifact locations—and to display these datasets as layers in a map. It is possible to create a wide variety of maps and to visualize data in ways that were previously impossible using traditional paper maps.

During the 2009 excavations two map datums were established at the Eastep site, and these datums were used for all subsequent mapping. Due to the lack of an available USGS benchmark with precise real-world coordinates, the site was surveyed using the conventional method of establishing arbitrary coordinates of N500, E500 and orienting the survey grid to magnetic north. Prior to the 2010 excavations, the NRCS generously provided assistance by sending an engineering technician, armed with a differential GPS receiver, to record the locations of the previously established map datums in UTM coordinates with sub-centimeter accuracy. Based on these precise UTM coordinates, the 2010 investigations were surveyed and mapped with a total station. Furthermore, a series of tools in ArcGIS, a popular GIS spatial database design program, were used to transform the 2009 survey points from an arbitrary coordinate system to real-world UTM coordinates. As a result, all previously mapped points were rectified into real-world coordinates using ArcGIS software's Spatial Adjustment tool and seamlessly integrated into the project GIS database.

Unit Numbering System

Despite the obvious advantages of establishing unit locations using real-world coordinates, one major disadvantage to the field archeologist is the number of UTM coordinate digits that label a unit. Traditionally KSHS-sponsored excavations have employed a unit numbering system based on the site's arbitrary coordinate system with each unit named by the three-digit northing and three-digit easting of the unit's southwestern corner point. This traditional system proved efficient in the past, being an intuitive method that minimized confusion during excavations, as well as during laboratory analysis. For example, a unit labeled N105, E105 in the traditional system would be N4137264.2203, E2622921.6006 in UTM coordinates, creating an excessive string of digits and increasing the potential for a variety of transcription and other recording errors.

To avoid labeling each unit with long strings of UTM coordinates, in 2010 a system was devised that employed only the final three whole numbers of the easting and northing of the UTM coordinates, omitting the decimal numbers. Thus, a unit with southwestern corner UTM coordinates of N4137264.2203 E2622921.6006 was labeled N264, E921 in the field. This method combined the convenience and utility of the traditional labeling method with the accuracy of real-world UTM coordinates.

Artifact Recovery and Sampling Strategy

The 2009 excavations at the Eastep site targeted cultural deposits exposed along the river bank in A101, and artifact recovery methods were aimed primarily at salvaging as much information as possible from the site before its imminent destruction. During 2010 excavations both A101 and A102 were intensively excavated, and recovery methods were improved upon with the goal of obtaining representative samples of artifacts and ecofacts. This more rigorous sampling strategy was designed based on the particular nature of the cultural deposits in each area. At all times the excavations proceeded following the previously agreed upon Phase IV data recovery plan, detailed in the Memorandum of Agreement between the NRCS and the Kansas State Historic Preservation Officer (SHPO) regarding the Eastep River Bank Stabilization Project.

A101 is characterized by a series of intact features exposed in the river cutbank within a matrix of firm, clay-rich alluvium. During 2009 excavations all features exposed in A101 were in constant danger of destruction due to river erosion. Consequently, the salvage of exposed features took priority over a desire for representative excavation sampling. Rather than process all of the clay-rich alluvium through ¼-inch hardware cloth, the decision was made to hand sort the excavated material and to collect samples of feature fill for laboratory flotation. Soil samples were taken from excavated features, and sample sizes were selected rather arbitrarily, with most samples consisting of a 3.8-liter (1-gallon) plastic bag of soil removed from each exposed feature, regardless of overall feature size. Admittedly, hand sorting of excavated material and the relatively small size of most flotation samples were less than ideal. However, the data generated from the salvage excavations and flotation samples provided critical baseline information regarding the types of artifacts used and plants and animals exploited by the site's former inhabitants.

The 2010 excavations in A101 employed a combination of recovery techniques. As in 2009, the excavations were primarily a salvage endeavor because of the immediate threat of river erosion and the long-term threat of destruction by the proposed river bank stabilization project. Based on the salvage nature of the excavations and the clay-rich alluvium, dry screening of excavated soil was not considered a viable option. However, a sampling strategy was designed and implemented that employed a combination of water screening, flotation, and hand sorting of excavated fill to generate a representative sample of cultural material from exposed features.

The artifact recovery methods employed in A102 differed in several respects from those in A101 along the river bank. First of all, A102 was not considered a salvage excavation; its location atop a bedrock footslope above the T-1 terrace and beyond the limits of the river bank stabilization project minimized the immediate danger of destruction to this portion of the site. Second, although A101 contains deeply buried deposits that are relatively undisturbed by subsequent processes, the cultural deposits in A102 are relatively shallow, and a major portion of these deposits has been impacted by more than a century of modern plowing, suggesting that intact features would be encountered only beneath the plow zone. Finally, unlike the A101 clay-rich alluvium, the silty clay and clay loam soils in A102 made dry screening an effective artifact recovery option. Based on these circumstances particular to A102, most excavated soil was dry screened through ¼-inch mesh, and as discussed below, the remainder of the excavated soil was either processed by water screening or flotation.

Prior to 2010 excavations in A101 and A102, in order to ensure that a representative artifact sample would be obtained from water-screening and flotation samples, fractions of excavated material were established for each type of sample, based on a variety of statistical considerations (Drennan 1996). To determine an adequate sample sizes for water screening and flotation, volume estimates of excavated material were obtained. Because the volume of excavated loose soil is greater than that of compacted soil and can vary depending on the type of sediments, soil data tables available from Renton Technical College (http://www.rtc.edu/cce/) were employed to estimate the volume of excavated soil. Based on this data, a calculation was made of the amount of excavated soil that would be needed to obtain representative flotation and water screening samples from each excavation unit.

In A101, 3 percent of sediment from general excavations was processed through flotation, and 10 percent was processed through waterscreening. From the southwest corner of each unit level in A101, a 3.8-liter (1-gallon) flotation sample was taken. In addition, a ¾-full sandbag (14 x 26 inches) was taken from throughout the unit level. The remainder of the excavated soil was hand sorted. This sampling strategy resulted in the desired 3 percent flotation sample and 10 percent water-screening sample from each general excavation level. When features were encountered, the sampling fraction was raised to at least 50 percent for water-screening samples and increased to 10 percent for flotation samples.

In A102, because the initial two levels (20 cm) of each excavation unit were located within the modern plow zone, systematic water-screening and flotation samples were not taken. One hundred percent of the excavated material in this 20-cm-deep plow zone was dry screened. In the levels thought to be located beneath the plow zone, the majority of excavated material was dry screened, and water-screening and flotation samples were systematically taken, based on the same sampling fractions and measurement techniques employed in A101, resulting in 10 percent water-screening samples and 3 percent flotation samples. Like the A101 excavations, the sampling fraction for A102 excavated features was increased to at least 50 percent for water-screening samples and 10 percent for flotation samples.

Georeferencing of Photographs and Drawings

Plan photographs and drawings have been standard procedure in archeological excavation for decades. With the advent of GIS-based technologies, it is now possible to integrate the visual records of individual excavation units into a GIS and create a mosaic as layers in a map. This integrating process is called georeferencing, a technique that is named for its ability to reference an image to a geographic location. Photo georeferencing has been employed with success outside the Central Plains as a tool for identifying and examining hearth-related activity areas in archeological sites (Craig et al. 2006).

With the eventual goal of georeferencing excavation plan photographs and drawings, photography and drawing standards were established prior to the start of the 2009 fieldwork at the Eastep site and followed throughout the course of excavations. Plan drawings were made and plan photographs were taken at the completion of each unit level. At a minimum all formal tools, ceramic sherds, and radiocarbon samples were drawn and labeled on unit level plan drawings. Following the end of fieldwork, plan drawings were scanned and photographs were cropped and adjusted in preparation for georeferencing. Using the georeferencing tool in the spatial database program ArcGIS, photographs and drawings were integrated into the GIS. Composite plans of individual units were generated that have greatly aided the interpretation of artifact and feature distribution across excavation units. Because the artifact and feature locations in the georeferenced plan drawings and photographs were tied to geographic coordinates, precise horizontal piece plotting was achieved in the laboratory, saving countless hours of costly field time in the process.

2009 EXCAVATIONS IN AREA 101

Features

As a first step during the 2009 research at the Eastep site, an intensive survey of the entire cutbank was conducted to record all visible cultural features. The number of recorded features along the cutbank shelf more than doubled as a result of this survey (Figure 2). Overall, 28 features were identified during the 2009 excavations, and these are described in detail in the preliminary excavation report (Tomasic 2010a). Most contained a variety of cultural material, including bone, shell, charcoal, burned earth, fire-cracked rock, and lithic artifacts. In most cases clear feature boundaries were not discernible, and their locations were recorded with a hand-held GPS receiver. In some cases the feature

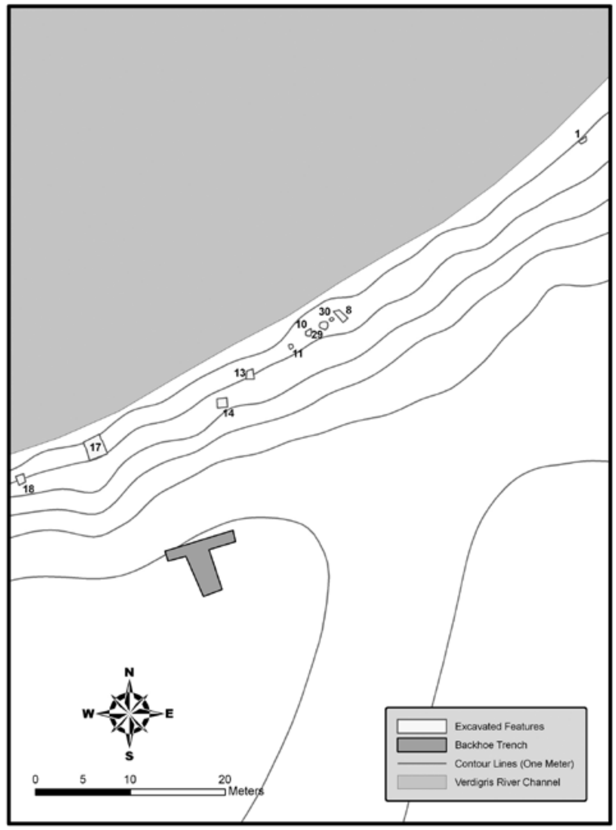

Figure 2. Map of A101 showing the locations of mapped features present on the cutbank shelf during the 2009 excavations.

locations were mapped with a total station, but admittedly, the mapped extents were somewhat arbitrary.

Several of the highest priority features were selected for excavation, and initially excavation units were placed within them. Excavations were aimed at defining feature boundaries and manually excavating entire features. These excavations revealed that many features extended beyond what had been visible on the surface and mapped. In order to examine cultural material beyond the mapped extent, the excavation strategy was modified from targeting visible surface features to focusing on a series of adjacent 1 by 1-m excavation units, encompassing several features (Figure 3). These 2009 units were neither oriented to the cardinal directions, nor were they established using a total station based on UTM coordinates. Rather these units were established relative to the orientation of the river bank, and the units were given arbitrary labels based on their locations. Approximately 14 m² were ex-

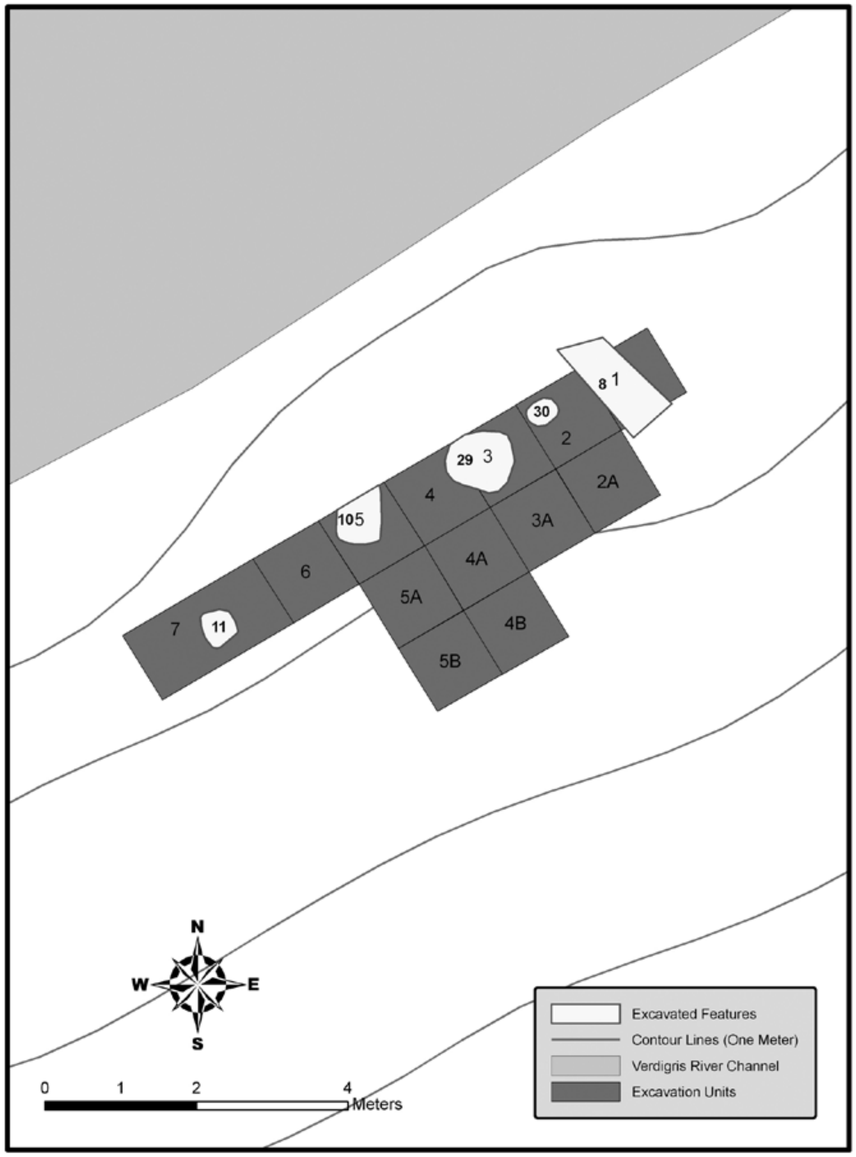

Figure 3. Map of the 2009 excavation units and excavated features in A101.

cavated in this manner. The method proved to be highly effective for excavating the remaining portions of recorded features, and it resulted in discovery of additional features not visible on the surface, helping to clarify the spatial relationship between the exposed features.

Excavations revealed that the vast majority of cultural material was concentrated within a narrow lens, extending through all of the units at approximately 15–25 cm below the surface of the river bank shelf. The artifacts recovered from the excavations included a variety of formal lithic tools, lithic debitage, faunal remains, shell, charcoal, burned earth, and large quantities of burned limestone and sandstone. Each excavated feature is described in detail in the order of its location from east to west along the exposed cutbank.

F8 consisted of a 40 by 50-cm concentration of lithic artifacts, including a complete biface, biface fragments, and multiple flakes. During excavation charcoal, burned earth, sandstone, and bone were found in association with the lithic artifacts. No clearly discernible edges could be identified, so the mapped boundaries of the feature are arbitrary. Most artifacts appeared in a relatively narrow lens between 15 and 25 cm below the surface of the river bank shelf. The feature was excavated to 30 cm, and an Oakfield probe was used to determine if cultural materials continued below that depth. No cultural materials were discovered in the probing, which extended another 30 cm beneath the feature.

F30 was discovered during excavation of Units 3 and 4. It is interpreted as a hearth, based on a well-defined concentration of burned earth and charcoal approximately 75 cm in diameter within a 10-cm-thick lens about 20–30 cm below the surface of the cutbank shelf. At 20 cm below ground surface, the feature was bisected, and the southern portion of the feature was excavated to 40 cm below the surface of the cutbank shelf.

Discovered during excavation, F29 contained burned earth, charcoal, and bone, with a dense concentration of artifacts occurring in the 20–24 cm depth range. The burned earth concentration was clearly defined at a depth of 25 cm. The feature was then bisected, and the southern portion was excavated to 43 cm below the surface of the exposed cutbank. The feature is interpreted as a hearth.

F10 with a surface expression of 10 by70 cm contained a large concentration of charcoal. Its boundaries were arbitrarily established approximately 20–40 cm from the concentration of charcoal evident on the surface of the river bank shelf. It extended 10 cm below the shelf surface.

F11 contained bone, a relatively large concentration of charcoal, and fire-cracked sandstone, with a surface expression of 45 by 40 cm. It was excavated to a depth of 10 cm below ground surface, but, due to the absence of clearly discernible edges, the remainder of the feature was excavated as part of Unit 7.

F50 was the westernmost feature investigated. Located west of the river bank shelf, it was approximately 2 m below the modern land surface, roughly the same stratigraphic level as the excavated features along the river bank shelf. An approximate 1-gallon flotation sample was removed from F50 in 2009; eventual analysis of carbonized macrobotanical remains resulted in the identification of one gourd rind fragment (*Cucurbita* spp.), probably a wild variety based on rind thickness, as well as two nut shell endocarp fragments, tentatively identified as hickory or walnut shells (Juglandaceae family). In addition, the feature fill contained one seed from the wild buckwheat family (Polygonaceae), possibly knotweed. The recovery of gourd rind, knotweed, and nut shell fragments provides significant evidence for the exploitation and/or cultivation of these plant species during the Late Archaic and Woodland periods.

Area 101 Spatial Analysis of Artifacts and Features

The georeferencing of excavation drawings and photographs generated a wealth of information that greatly aided the interpretation of artifact distribution. The precise locations of all diagnostic artifacts and associated features exposed by the A101 excavations were piece plotted in the GIS developed for the Eastep site excavations (Figure 4).

A critical factor in interpreting the spatial patterning of A101 artifacts is the degree to which these deposits were affected by bioturbation, argilliturbation, and other site formation processes (Schiffer 1976) that followed the abandonment and subsequent burial of the site. As discussed by Rolfe Mandel (this volume; Tomasic 2012), geomorphological research indicated that the cultural deposits atop the river bank shelf are located within a buried soil that developed relatively rapidly as a result of alluvial sedimentation in a low-energy floodplain environment. Therefore, exposed features probably were buried quickly by alluvium, minimizing the effects of cultural and some natural formation processes, such as flood scouring and bioturbation that might have occurred following the abandonment of the site. However, the presence of numerous slickensides in the clay rich alluvium indicates that argilliturbation potentially could have contributed to the vertical displacement of artifacts.

The A101 excavation and mapping data is wholly consistent with Mandel's interpretations regarding the minimal effects of bioturbation and flood scouring on artifacts and features. For example, the absence of krotovina supports Mandel's suggestion that these cultural deposits were buried relatively rapidly by alluvium with minimal soil

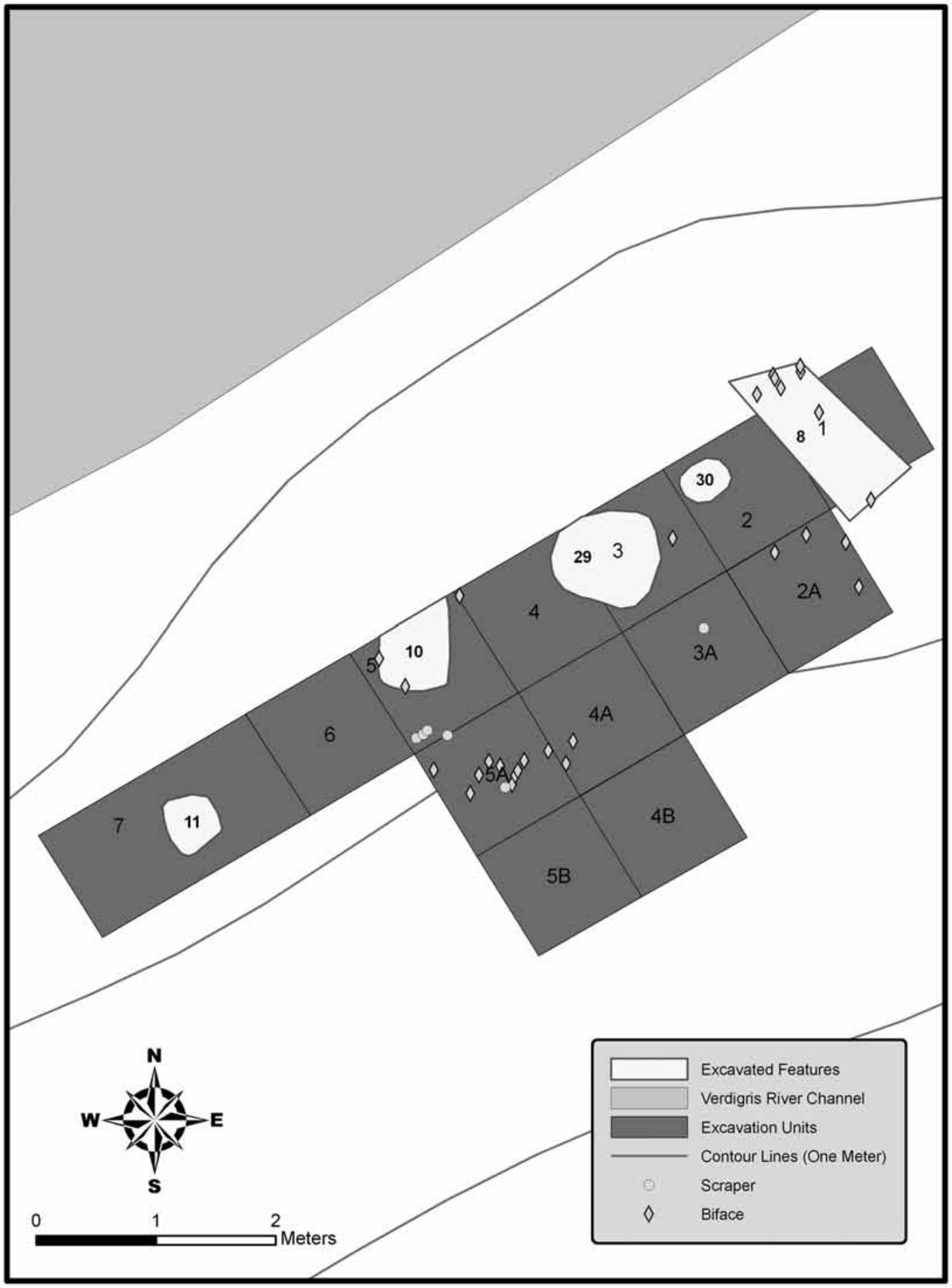

Figure 4. Map of the 2009 excavations in A101 with the locations of piece-plotted bifaces and scrapers indicated.

mixing by plants and animals. Numerous artifact classes of varied sizes in direct association with hearth features indicate that the effects of ancient or modern flood scouring on artifact distribution probably were slight. Furthermore, vertical displacement of artifacts due to argilliturbation was minimal; virtually all excavated artifacts were encountered within a narrow (10-cm) stratigraphic lens and in direct association with features, such as hearths and burned rock concentrations. In addition, several biface and point fragments recovered in the excavations were refitted later (Figure 5). Although some of the pieces were displaced laterally more than 1 m, vertical displacement was less than 2 cm. Collectively the absence of archeological evidence of disturbances, such as bioturbation, argil-

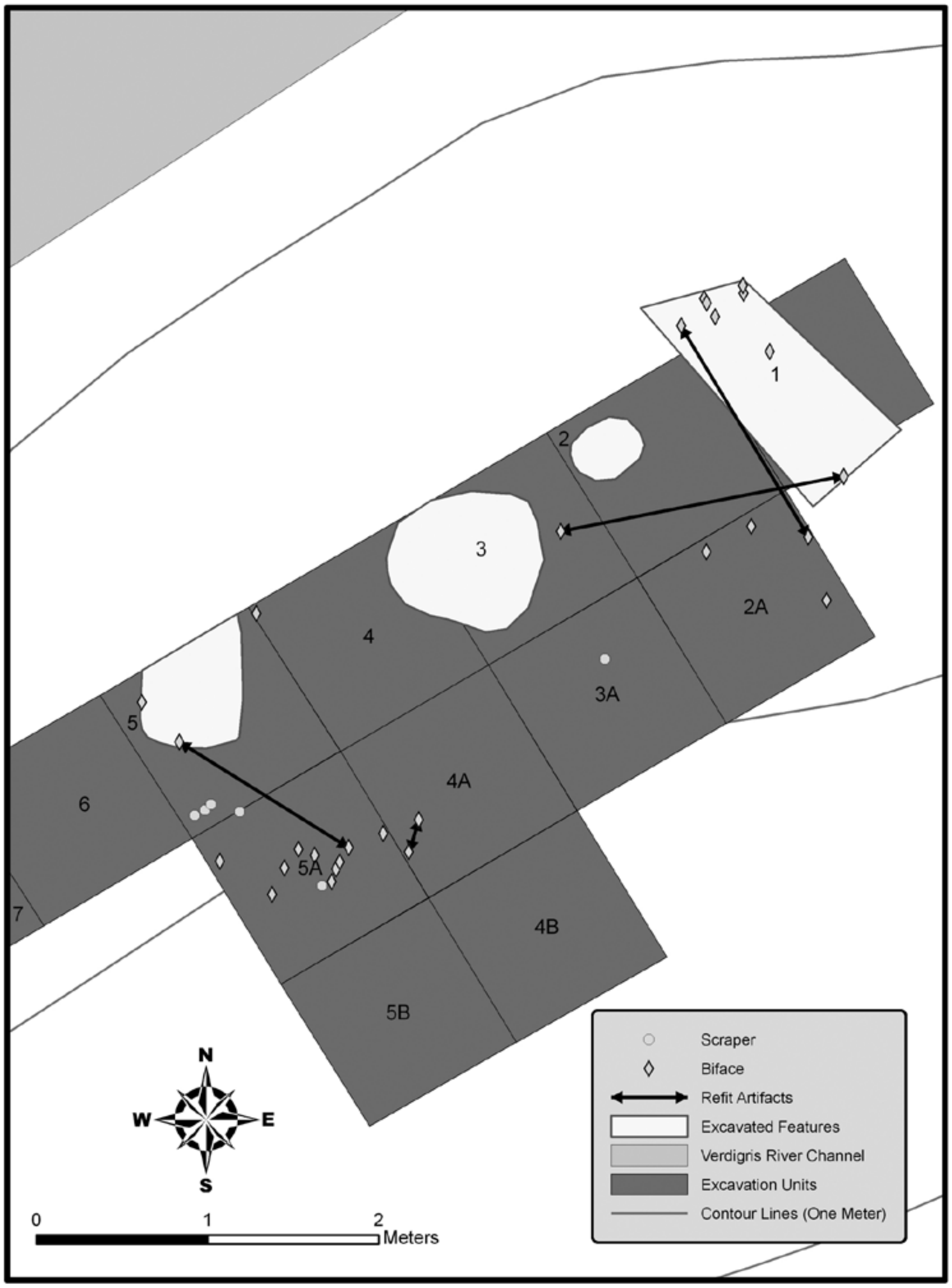

Figure 5. Map of the 2009 excavations in A101 with the locations of refitted bifaces indicated.

liturbation, or flood scouring, suggests that natural site formation processes may have had little effect on artifact distribution in A101.

Perhaps the most beneficial aspect of georeferenced photographs and drawings is the ability to create a composite image of excavation photographs and to visualize the distribution of artifacts in ways that were impossible previously (Figure 6). Excavation drawings recorded the locations of diagnostic artifacts and identifiable features, and information from these drawings was used to piece plot the artifacts and features in the GIS. In addi-

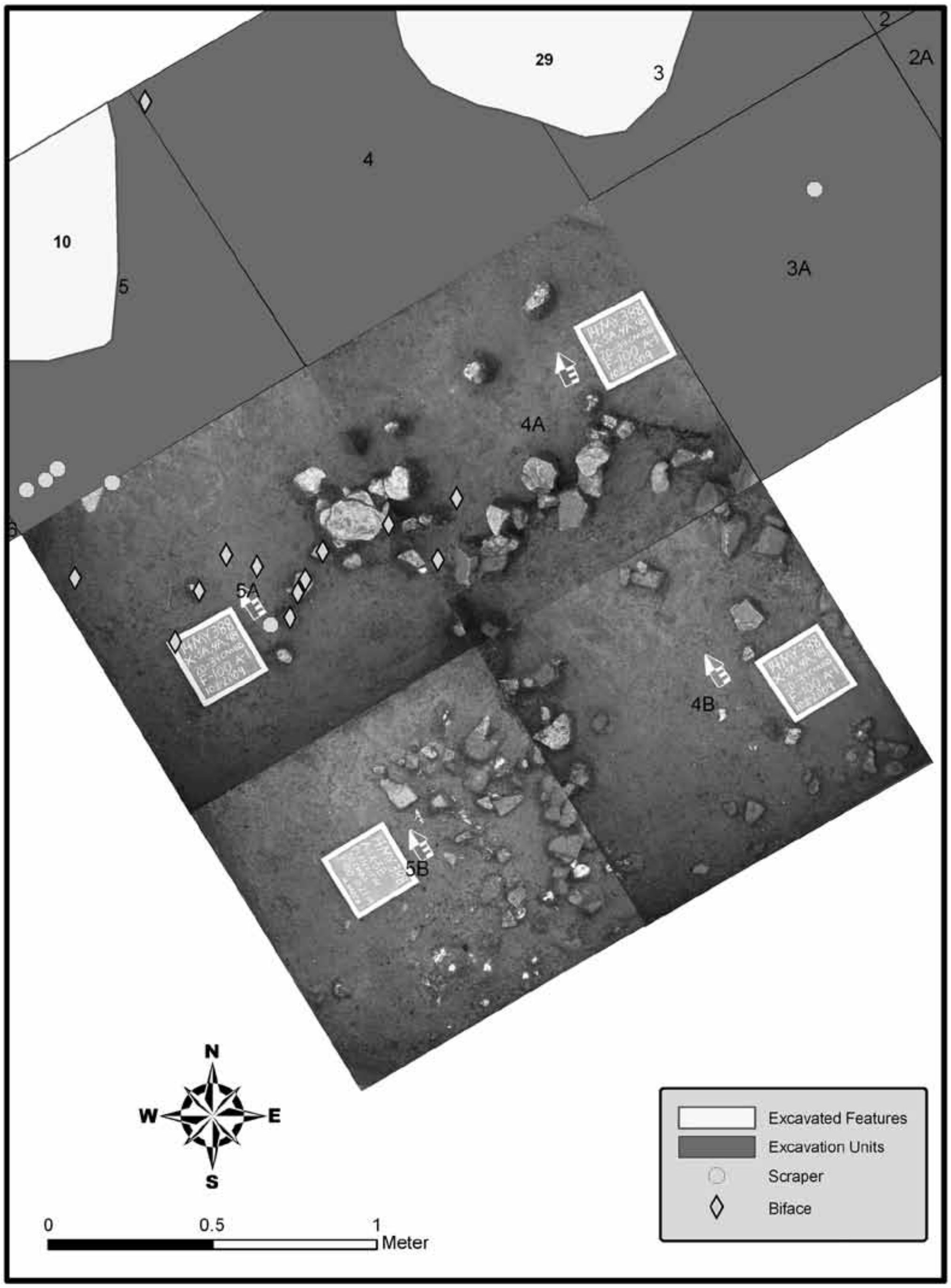

Figure 6. Georeferenced excavation photographs showing the relationship between burned rock concentrations and formal tools in A101.

tion, large pieces of burned rock, bone, and charcoal, identified as features, were included in unit level plan drawings. However, artifacts that were not considered diagnostic or were not identified as part of a feature were not noted on plan drawings. Fortunately, because georeferenced photographs of each individual excavation unit level were created, the distribution of piece-plotted diagnostic artifacts and features relative to a variety of non-diagnostic artifacts distributed throughout the excavations were captured.

During excavation burned rock concentrations were identified occasionally, but no feature numbers were assigned due to their sparse and rather amorphous nature. However, the georeferencing of excavation photographs and creation of a composite image of individual excavation units, illustrated in Figure 6, revealed a pattern in the burned rock distribution that was not evident during excavation. Clearly, the sparse burned rock scatters were part of a larger concentration that extended across excavation units 4A, 4B, 5A, and 5B. This overall pattern is even more interesting when visualized relative to all piece-plotted diagnostic artifacts and features: a line of piece-plotted scrapers and bifaces extended along the same general east-west line as the north edge of the burned rock concentration. Clearly a variety of artifact classes were part of a larger artifact distribution pattern in A101, and this overall pattern would not have been recognized without the use of georeferenced photographs.

2009 Trackhoe Trenching

In order to better estimate the degree to which buried cultural deposits might be present beyond the shelf of the cutbank and to provide the geomorphologist with a vertical soil profile in A101, a trackhoe was used during the 2009 excavations to create a trench approximately 15 m south of the river bank (Figure 7). This T-shaped trench was excavated to a depth of more than 3 m below ground surface, well below the level of the cultural deposits exposed on the cutbank shelf. It exposed multiple soil horizons that are described in detail by Mandel (this volume).

The trench also exposed concentrations of burned earth and charcoal, as well as a crudely flaked projectile point. Therefore, buried cultural materials were clearly present at least 15 m beyond the exposed river bank in this portion of the site.

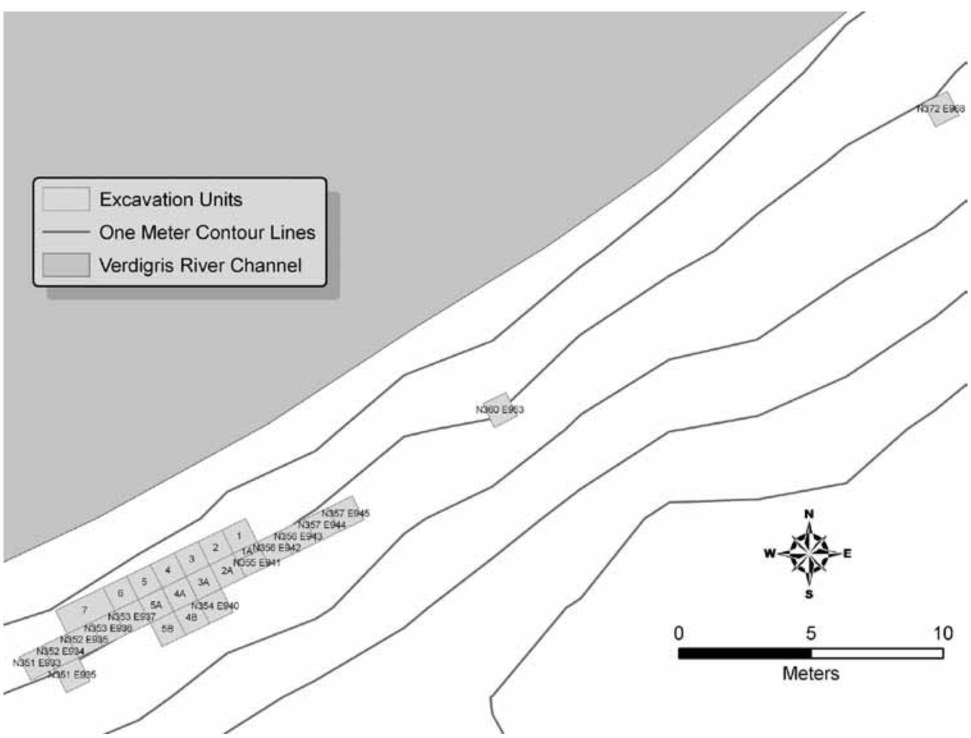

Figure 7. Map of A101 showing the locations of excavation units and the 2009 backhoe trench. UTM coordinate grid reference points are indicated along the border.

2010 Excavations

During the 2010 research at the Eastep site, an additional 14 m² in units were placed adjacent to the 2009 excavations and relative to additional features not previously investigated (Figure 8). These units were not oriented to the cardinal directions in order to follow the previously established grid and to continue excavation of features exposed in 2009. However, the unit locations were recorded in UTM coordinates, and the coordinates of the southwest corners were used to label the units, matching the coordinate system employed in A102.

Somewhat surprisingly, the 2010 excavations in A101 did not discover any additional features or diagnostic artifacts. Originally the plan was to excavate at least 30 m² along the shelf of the river bank, but efforts were severely limited due to fluctuating river levels. The Verdigris River inundated A101 for the majority of the 2010 KATP field school, and some of the potentially most productive areas, including locales adjacent to artifacts and features exposed in the 2009 excavations, were never excavated. With the exception of the recovery of additional paleoethnobotanical and radiocarbon samples, the 2010 excavations in A101 did not contribute significantly to understanding of past activities in this part of the site.

2011 Monitoring

Earth-moving and construction activities, associated with the river bank stabilization project, began in September 2011 and continued through October 2011. To assess the degree to which buried features and associated artifacts were affected by construction, KSHS archeologist Tricia Waggoner directed a program of monitoring over a three-day period in early October. Exposed features were mapped in UTM coordinates, using the total station, and soil samples were collected for future processing and analysis.

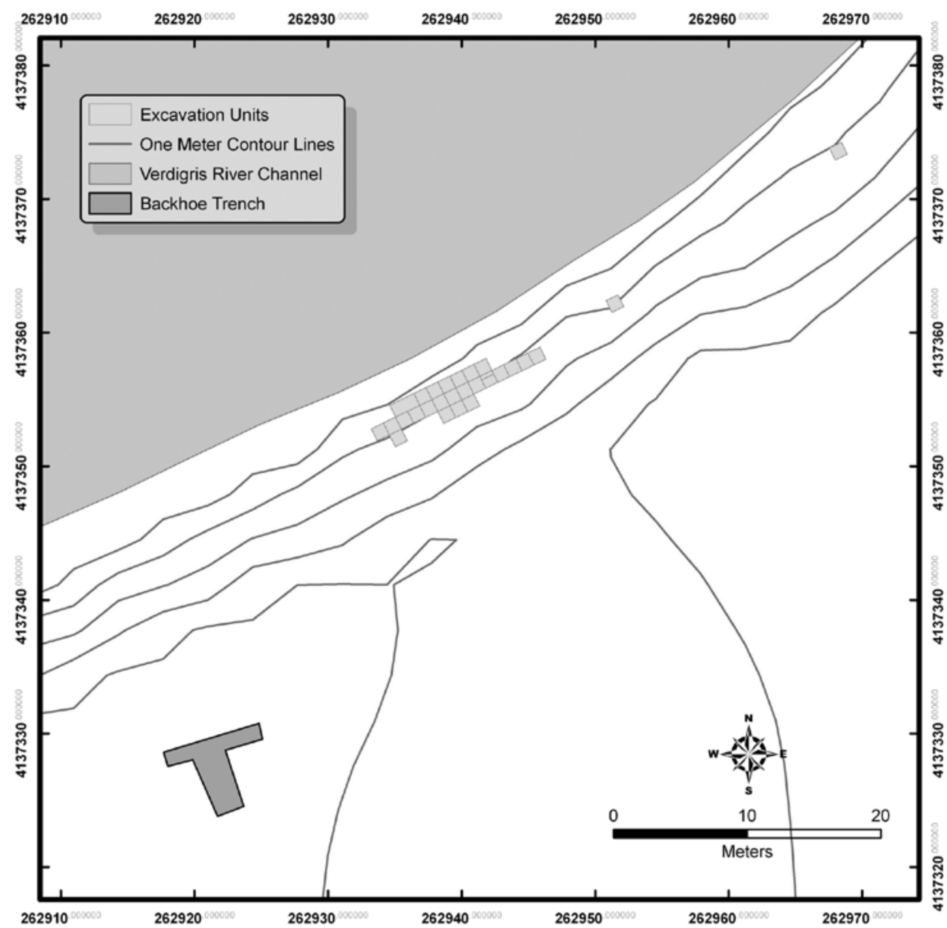

Figure 8. Map of A101 showing the locations of all 2009–2010 excavation units.

The location of some features several meters inland supported the evidence from the trackhoe trenching that buried features are not limited to those exposed along the river bank. Furthermore, it is evident that cultural deposits extend at least 100 m farther to the west than previously thought (Figure 9), as several features were identified along the river bank west of the previously investigated areas. Importantly, many of these features were found at a higher stratigraphic level than those along the cutbank shelf, and it appears that these features are located in the same stratigraphic level from which Bevitt (2008) recovered Middle/Late Woodland Cuesta phase pottery. Although the precise dating of these newly identified features remains unclear, they may provide meaningful evidence regarding Middle Woodland, Late Woodland, and possibly later occupations in A101.

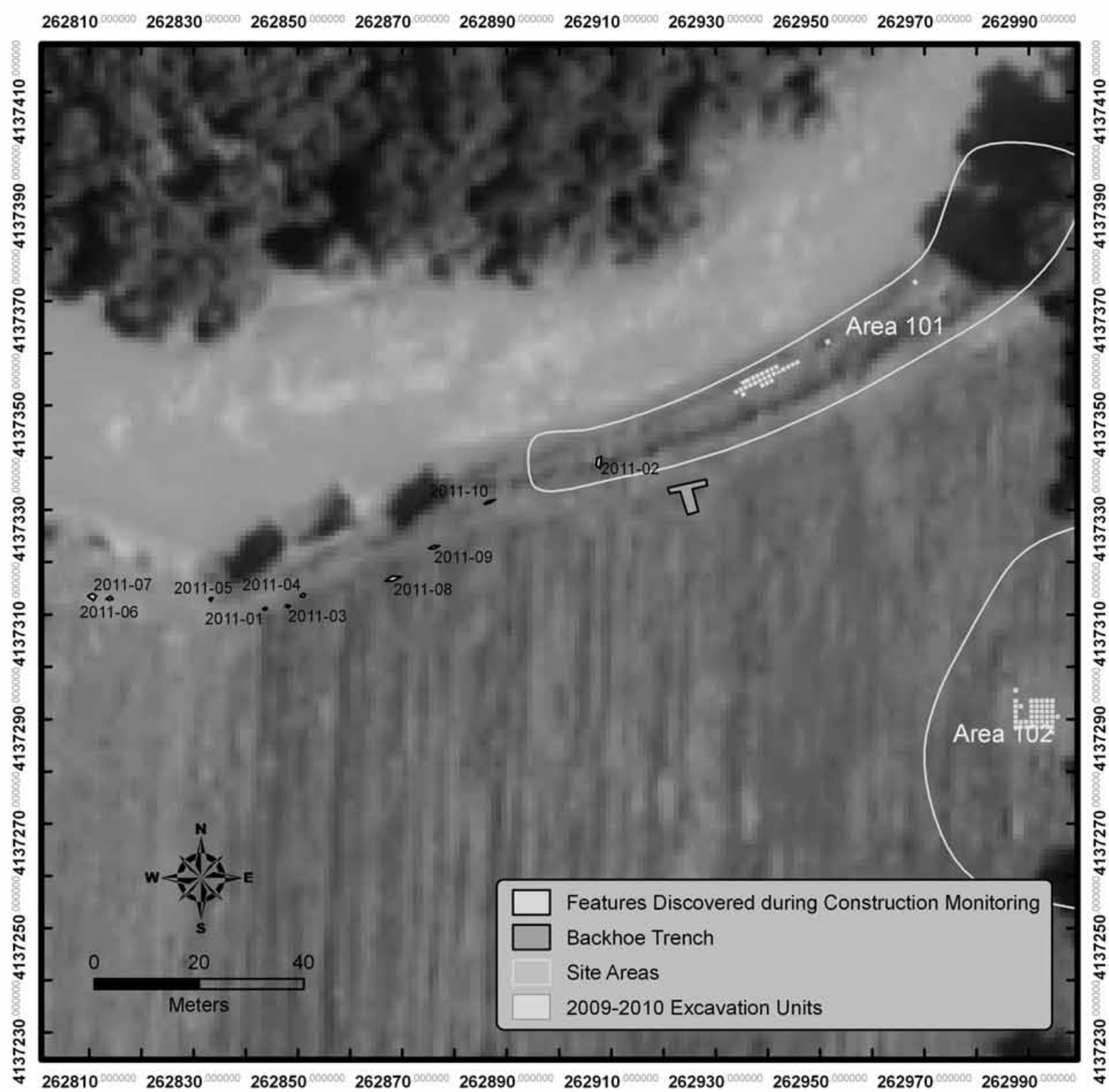

Figure 9. Aerial image (2010) showing the locations of features discovered during 2011 construction monitoring in relation to previous excavations, backhoe trenching, and site area boundaries. UTM coordinate grid reference points are indicated along the border.

GEOPHYSICAL SURVEY OF THE EASTEP SITE

During the fall 2009 an intensive pedestrian survey indicated that A102 contained dense artifact concentrations on the surface, yet the degree to which intact features existed beneath the plow zone remained unclear. Although excavation units could have been placed randomly across the terrace surface, hoping to locate buried features based on surface artifact concentrations, a more appropriate option was to conduct a geophysical survey. This procedure uses magnetic and electrical subsurface sensing techniques to identify electrical and magnetic anomalies, many of which could be buried features. Thanks to financial support from the Kansas Anthropological Association's John Reynolds Memorial Research Fund, Geoff Jones of Archaeo-Physics LLC (www.archaeophysics.com) was contracted to conduct a geophysical survey. Archaeo-Physics had conducted a geophysical survey prior to the 2004 KATP field school at 14MP407, identifying several Central Plains tradition structures and associated features, some of which were excavated with excellent results (Maki 2006).

The geophysical survey took place in May 2010, prior to the KATP field school, in an attempt to identify intact features that could be targeted for excavation. The geophysical investigation included a magnetic field gradient survey over an approximately 3800-m^2 area and an electrical resistance survey over 1,500-m^2. The magnetic field gradient survey identified dozens of magnetic anomalies beneath the plow zone in A102 (Figure 10). This dense concentration of anomalies was selected for a more intensive electrical resistance survey, which identified a number of high resistivity locales that correlated with magnetic highs, suggesting that the anomalies identified during the magnetic field gradient survey were not caused by bedrock morphology or other natural phenomena (Figure 11). The results of the geophysical survey suggested that many of the anomalies probably are large concentrations of burned rock or soil associated with a prehistoric hearth or pit features (Jones 2010).

Following the geophysical survey, five of the anomalies were selected for testing to determine if they were prehistoric thermal features. A total of six auger tests were excavated to a depth of up to 1 m below ground surface. Five of the auger tests were placed within the confines of geophysical anomalies, and one was placed in a non-anomaly area to better evaluate the validity of the geophysical survey results. The auger testing revealed large quantities of burned sandstone in all five geophysical anomalies, and the single auger test in the non-anomaly area was largely devoid of artifacts, including burned sandstone. The auger testing confirmed that most of the anomalies were likely prehistoric features containing large quantities of burned sandstone.

Based on the combined results of the geophysical survey and the auger testing, a grid of 44 1-m^2 excavation units was placed within an approximately 8 m^2 zone encompassing several of the most promising magnetic anomalies (Figure 12).

AREA 102 SITE FORMATION PROCESSES

In A102 the precise mapping of individual artifacts, the georeferencing of excavation drawings and photographs, and the recording of weights of artifact classes generated information that can be used to better understand the nature of the occupation at the Eastep site. The precise locations of all diagnostic artifacts and associated features exposed in the A102 excavations were plotted in the GIS database.

The site formation processes affecting A102 involve a combination of natural and cultural formation processes. Unlike the deeply buried alluvial deposits in A101, the cultural deposits in A102 are located within a thin layer of colluvium, overlying weathered shale. The location of these cultural deposits in the colluvial mantle with minimal aggradation suggests that site formation processes have probably substantially impacted the site. Sites located within the A-horizon of soils are much more susceptible to the effects of bioturbation (Logan and Hill 2000), as well as post-abandonment scavenging (Schiffer 1976). Furthermore, repeated occupation of this portion of the site, combined with the lack of stratigraphic control, has created a palimpsest (something reused or altered but still bearing visible traces of its earlier form) of human activities that complicates the spatial analysis of features and artifacts in A102. Finally, A102 has

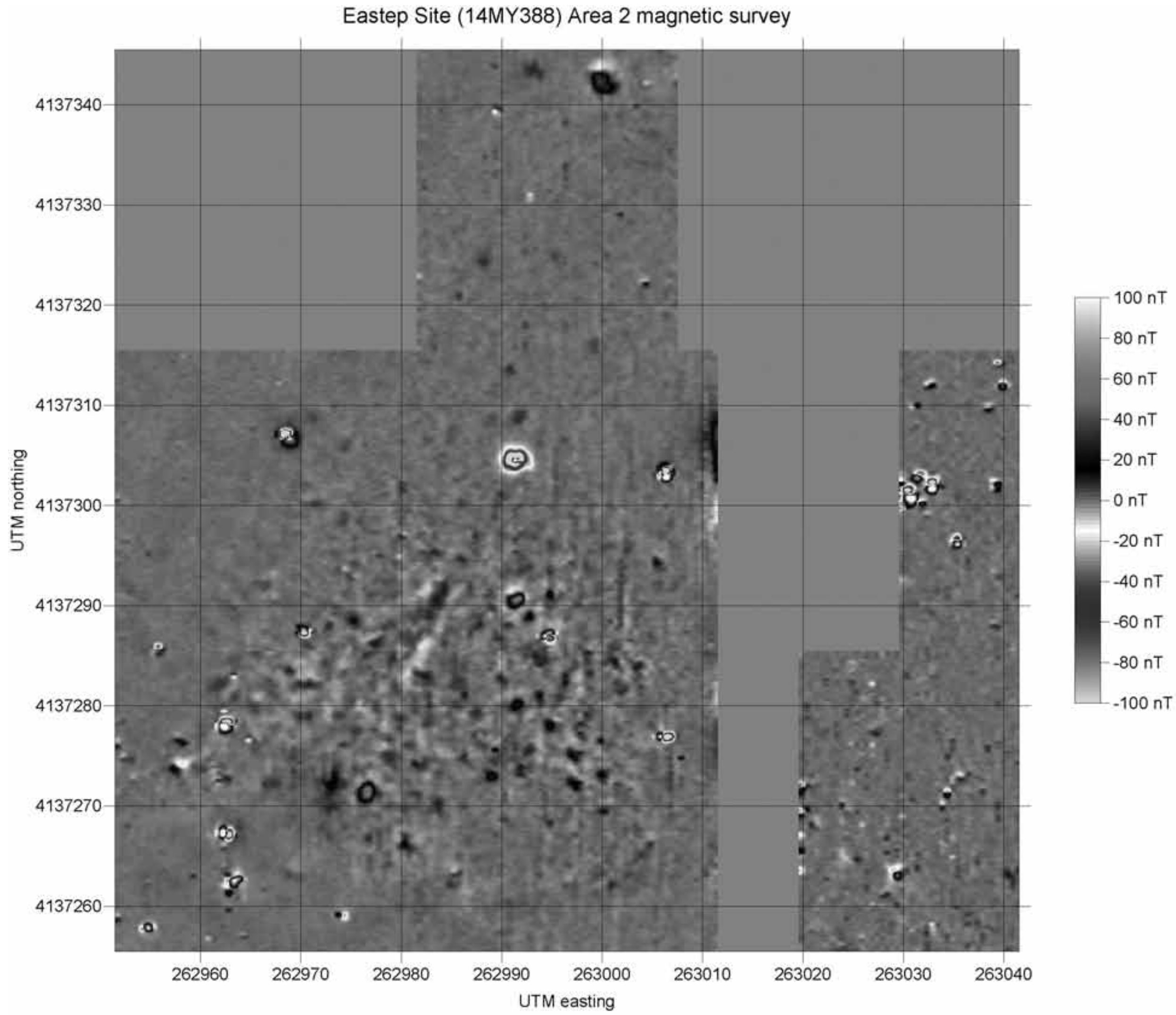

Figure 10. Results of the magnetic gradiometer survey of A102. The western survey block is located in plowed portions of the site, and the eastern block is located in unplowed portions. The two areas are divided by a barbed wire fence and hedge row.

been repeatedly plowed during the twentieth century, and recent tree planting efforts throughout A102 resulted in a series of trenches, 20 cm wide and 40 cm deep, cut across the site at 4-m intervals and oriented in a north-south direction. Although certainly less than ideal, these trenches are clearly delineated both in the excavations and in the geophysical survey of the site, showing that most of the excavations have not been impacted by the trenching operations (Figures 13 and 14).

Despite the severe impact of formation processes in A102, several lines of evidence suggest that contextual information may be preserved and the spatial patterns of artifacts may yield evidence regarding the prehistoric occupation in A102. Although A102 probably represents a palimpsest of occupation, spatial patterns can be evident in the distribution of artifact classes, despite centuries of cultural and natural formation processes (Logan and Hill 2000). Although A102 has been subjected to plowing, research by Roper (1976) suggested that the lateral displacement of artifacts due to plowing is often minimal in midwestern sites. As a result, the surface distribution of artifacts in plowed portions of A102 can be indicative of the subsurface distribution of artifacts in unplowed contexts.

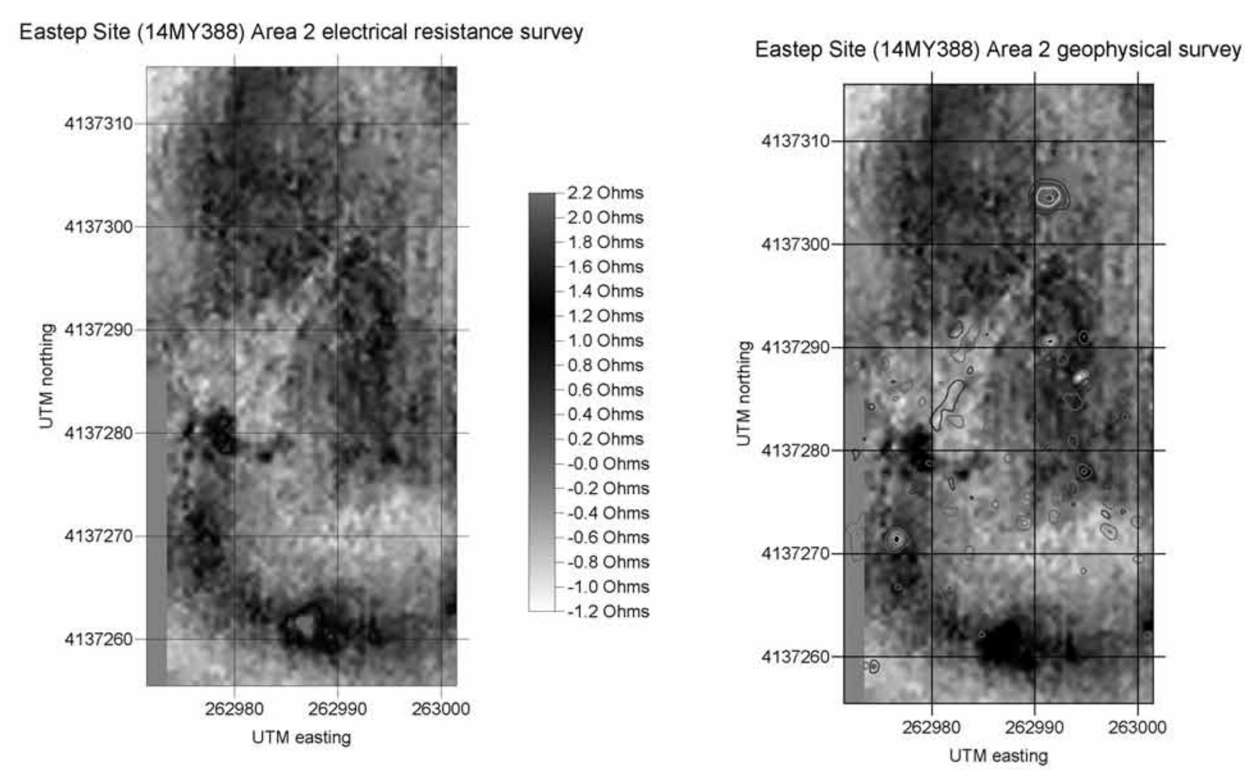

Figure 11. Results of the A102 electrical resistance survey, showing electrical anomalies (left) and the electrical anomalies in relation to magnetic anomalies (right).

EXCAVATIONS IN AREA 102

A102 excavations recovered a wide variety of artifacts from the Late Archaic and Woodland period occupations of this portion of the site, including chipped stone tools, ground stone tools, and bone, shell, and ceramic artifacts. In addition, these excavations confirmed the identification of two of the most promising geophysical anomalies as largely intact burned rock features located beneath the plow zone. Meticulous excavation and spatial documentation of these burned rock features and associated artifacts, combined with subsequent laboratory analysis, provided a wealth of information that greatly aided efforts to provide functional interpretations of the burned rock features. Both F2201 and F2204 and their associated artifacts are examined in detail below.

Feature 2204

This feature was initially identified during the geophysical survey as a bright red anomaly more than 1 m in diameter, and a positive auger test (auger test 2) confirmed the presence of large quantities of burned sandstone in the location of the geophysical anomaly (Figure 15). One primary objective of the A102 excavations was the controlled excavation of this probable feature. Because the horizontal extent of the anomaly was clearly larger than the standard 1-m² excavation unit, portions of the anomaly were excavated in four 1-m² units. An unusually large feature was exposed, which consisted of a concentration of burned rock approximately 1 m in diameter and located in precisely the same location as the geophysical anomaly and positive auger test.

As previously discussed, plan photographs were taken at the completion of each unit level, and all of the excavation photographs were georeferenced and integrated into the project's GIS database. The technique of georeferencing proved invaluable in the study of F2204 because it allowed generation of a photographic mosaic, composed of individual excavation unit photographs. As F2204 was exposed in multiple individual units excavated independently of one another, this georeferenced

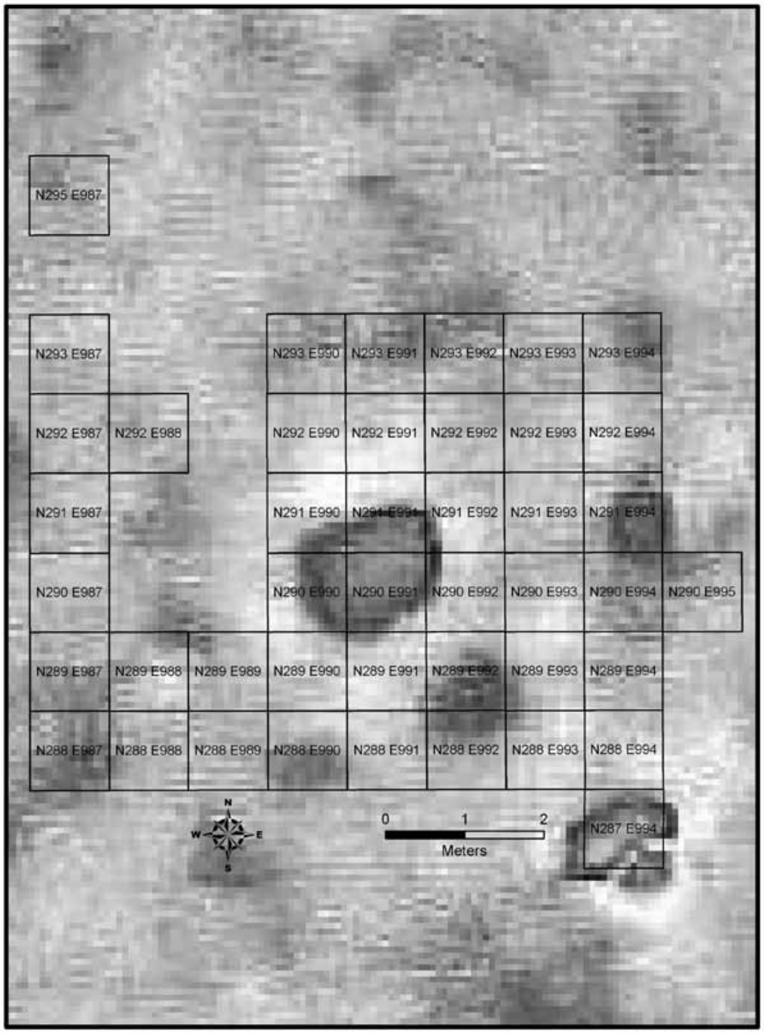

Figure 12. Grid of excavation units within A102, showing the location of magnetic anomalies identified during the geophysical survey.

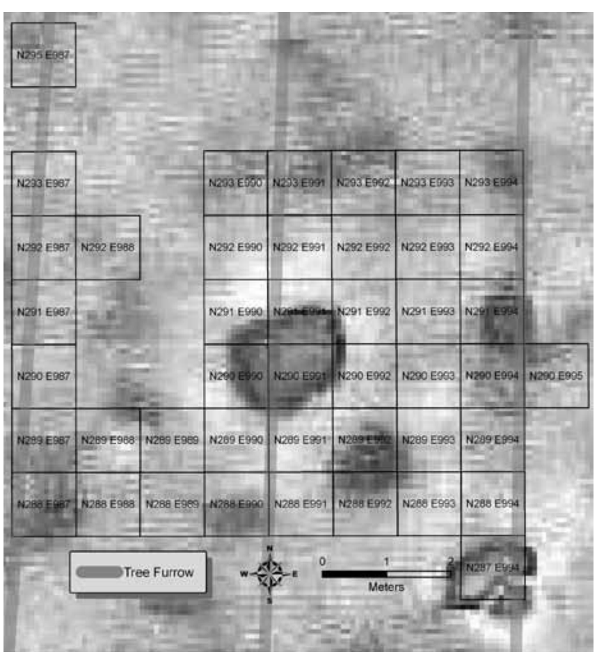

Figure 13. Locations of tree planting trenches in relation to geophysical anomalies in A102.

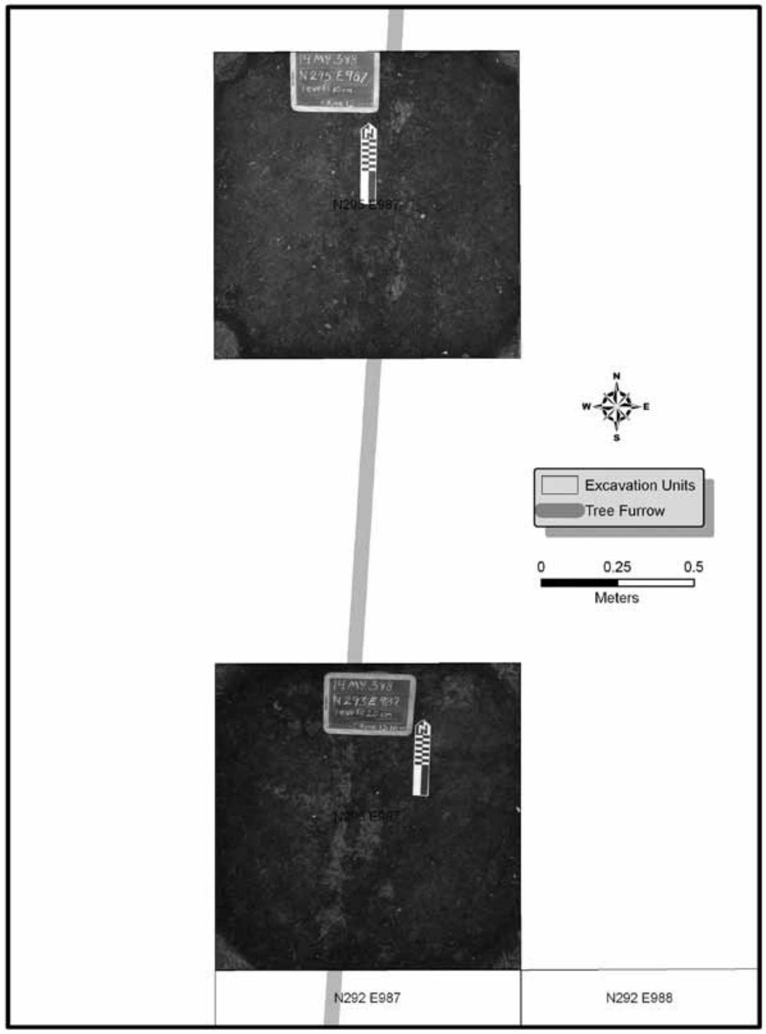

Figure 14. Georeferenced excavation photographs of excavations in trenched portion of the excavations. Heavily mottled soil along the path of one trench is evident in both photographs.

photographic mosaic revealed the horizontal extent of the entire feature in ways that were impossible during the actual excavation. Furthermore, as the georeferenced photographic mosaic is integrated into the GIS database along with the results of the geophysical survey, comparison of the two datasets clearly demonstrates the visual and spatial correspondence between the central, bright-red anomaly identified during the geophysical survey and large pile of burned sandstone identified as F2204.

Considered from a regional perspective, F2204 is actually a relatively common type of archeological feature in southeastern Kansas and northeastern Oklahoma. These features, which are referred to in the archeological literature as burned rock features (Thies and Witty 1992), burned rock complexes (Williams 1988), and rock concentrations (Baldwin 1969), date primarily to the Late Archaic, and their original function is not altogether clear (Blackmar and Hofman 2006:69–71; Thies and Witty 1992). There is general agreement that these features probably were used originally as earth ovens for food processing (Adair 2006:252), but it is unclear what types of food were prepared. It has been suggested that these oven features were used in the processing bulbs and other root crops (Thoms 1989, 2008), high-fat foods and root crops (Wandsnider 1997), acorns, using heat to leach acid from the nuts and make them suitable for human consumption (Williams 1988).

During the excavation of F2204, several samples of carbonized material were collected in the hope of submitting samples for radiocarbon dating. Following the completion of fieldwork, a sample of carbonized material was submitted to the Illinois State Geological Survey (ISGS) for AMS radiocar-

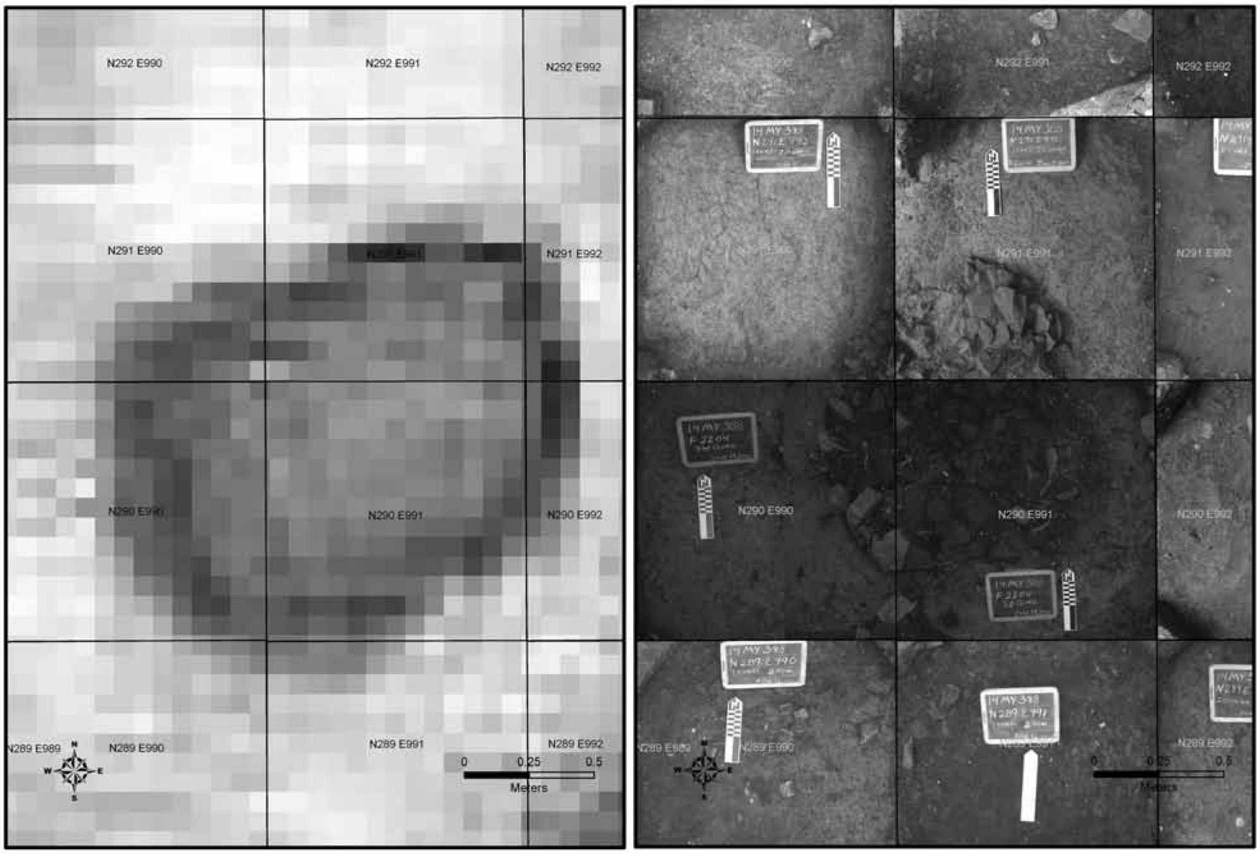

Figure 15. Geophysical anomaly relative to excavation units and burned rock feature (F2204) discovered during excavations in the same location.

bon dating. As discussed in the radiocarbon dating section of this report, this sample generated a date of 3190 ± 20 B.P., with a 2 Sigma calibrated range of 1499–1424 B.C. Based on the AMS dating of material from this feature, F2204 dates firmly in the Late Archaic rather than the subsequent Woodland period.

Faunal materials from F2204 were analyzed by Mark Volmut. Although most F2204 faunal remains could be identified only as large mammal or small mammal, faunal remains identifiable to species were predominately deer. The presence of mammalian remains, including deer, is consistent with the interpretation of F2204 as a cooking locale used for food preparation.

In an attempt to clarify the functions of F2204 and to generate data that might contribute to a better understanding of burned rock features in the region, two samples of burned rock from the feature were collected and submitted to PaleoResearch, Inc. to be tested for organic residue using Fourier Transform Infrared Spectroscopy (FTIR). FTIR measures the wavelengths of infrared radiation in a sample, and based on the wavelengths of infrared radiation, FTIR can indicate the presence of particular organic compounds, based on known wavelengths of laboratory samples. In the case of burned rock, fats, lipids, and other organic compounds, which might have been deposited on the burned rocks during the cooking process, can be identified using FTIR analysis.

The FTIR analysis of the two samples from F2204 yielded mixed results. There was no clear evidence of processing root crops (Thoms 1989) or acorns (Williams 1988), and although there is organic residue indicative of meat processing, more parsimonious explanations have been suggested. Specifically, on the first sample "peaks representing various amino acids suggests either cooking meat in this feature or possibly natural decomposition of faunal remains within the feature" (Logan 2010:12). On the second sample, "Recovery of peaks representing the amino acid lysine might reflect cooking meat in the feature represented by this burned rock complex. Alternatively, they might be present as a result of decomposition of faunal remains in this area" (Logan 2010:12). The FTIR signatures for cooked meat are consistent with Volmut's identification of predominantly large and small mammal faunal remains, including deer. However, the possibility that the FTIR signatures indicate natural decomposition of faunal remains rather than cooked meat cannot be ruled out entirely.

FTIR and faunal analysis of materials from F2204 have clarified to a degree understanding of the possible functions of this burned rock feature as a cooking locale. In addition, the spatial analysis of artifacts throughout the A102 excavations has contributed to understanding of the possible cooking functions of this feature. In particular, the distribution of mussel shell throughout the excavation units suggests that F2204 might have been used to process mussels.

Mussel Shell Analysis

Mussel shells are commonly encountered at archeological sites throughout the Central Plains. It is generally accepted that freshwater mussels served as a source of animal protein that was exploited only occasionally, despite the high visibility of mussel shells in archeological sites (Blakeslee 2000:7; Wedel 1986:126–127). Most likely, mussels were prepared by heating the entire mussel over hot coals in a similar manner to modern clambakes. After the mussels were cooked, the edible portions of the mussel were removed and consumed and the mussel shells discarded (Blakeslee 2000:7).

As discussed in Appendix A of this report and elsewhere (Tomasic 2012), Edwin Miller's analysis of the Eastep site's mussel shell assemblage revealed valuable information regarding the seasonality of harvest of freshwater mussels. Based on an examination of growth bands, Miller suggested that most mussels were harvested during the late summer or early autumn. Today, these remain the preferred seasons for harvesting mussels, as water levels are generally low and water temperatures are at their warmest. In addition, Miller determined that most mussel shells in the Eastep assemblage were significantly smaller compared to many of the mussels currently found in the Verdigris River. Among the explanations proposed by Miller, smaller mussels may have been selectively harvested by the Eastep site inhabitants, perhaps because smaller mussels are much more palatable than larger mussels, or perhaps in order to leave the larger mussels as parental stock.

Spatial Analysis of Mussel Shell Distribution

In order to evaluate their spatial distribution in the A102 excavations, all excavated mussel shells were weighed by excavation unit level in the laboratory. An estimate of mussel shell density across the excavation units was calculated in terms of weight (in grams) of mussel shell per m^3 of excavated soil. To visually illustrate the patterns of mussel shell distribution, this information was integrated into the GIS database and a choropleth map was generated based on the density of mussel shell in the A102 excavations.

The choropleth map in Figure 16 illustrates the distribution of mussel shells in the excavation units, revealing two significant visual patterns. First, the excavations encompassing F2204 contain relatively few mussel shells compared to many other excavation units. Second, the excavations containing the highest quantities of mussel shell appear to be located along the edges of the A102 excavations in a ring-like fashion surrounding F2204.

Based on this near-absence of mussel shells in F2204 and the abundance of mussel shells surrounding F2204, it appears that the distribution of mussel shells relative to F2204 might be best explained by considering Lewis Binford's (1978) ethnoarchaeological research. By studying refuse disposal patterns among modern hunter-gatherers at short-term campsites, Binford developed a model for interpreting prehistoric hunter-gatherers' refuse disposal patterns, based on an expectation of what refuse disposed of in this manner would look like in an archeological context. In terms of artifact distribution relative to outside hearths, Binford (1978:345) identified "drop zones" where small pieces of refuse would be discarded by individuals seated around a central hearth, and "toss zones"

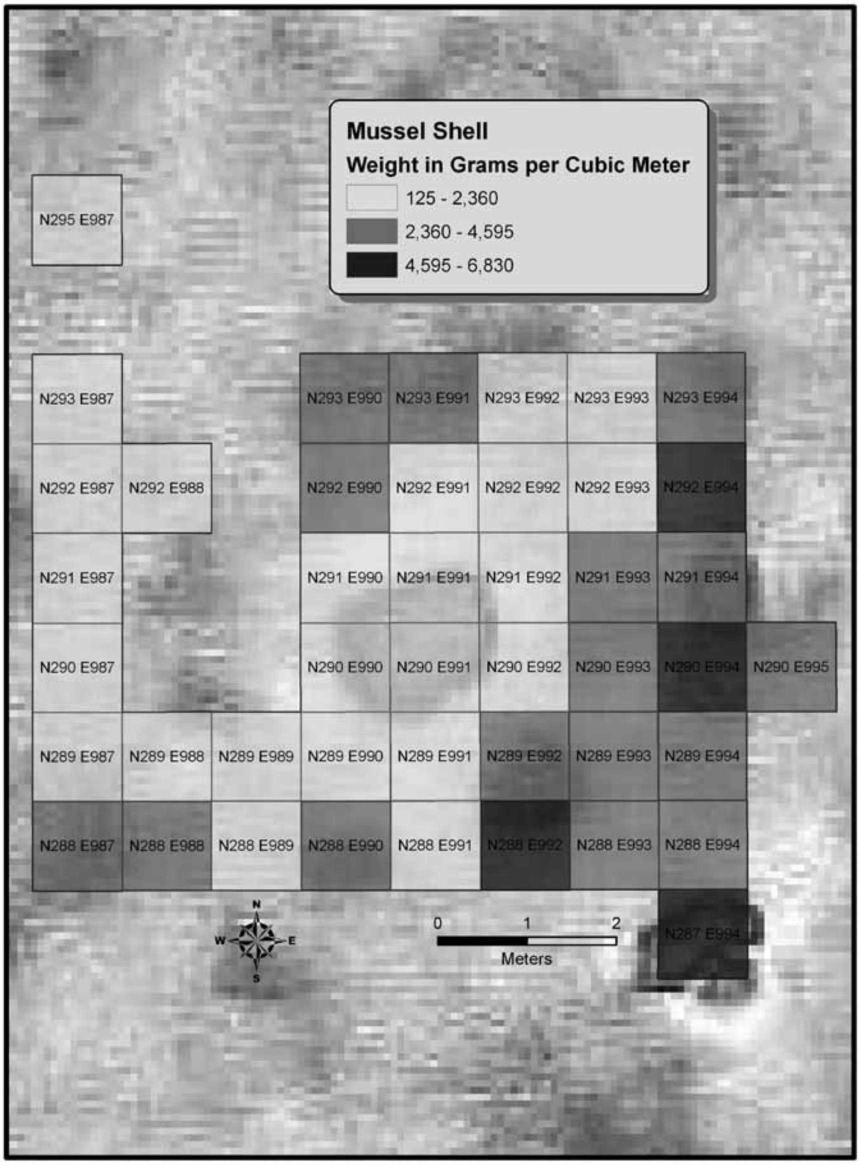

Figure 16. Choropleth map of A102, showing mussel shell weight relative to geophysical anomalies.

where the same individuals would discard larger pieces of refuse, such as empty containers, in a concentric ring at a distance from the hearth.

Based on the distribution of mussel shells relative to F2204, a hypothesis was proposed that F2204 may have been used to heat mussels in a manner similar to modern clambakes (Blakeslee 2000:7). Presumably, if the mussel shells were discarded in refuse piles in a ring-like manner surrounding F2204, Binford's outside hearth model would explain both the near-absence of mussel shells in F2204 as well as the concentrations of mussel shells at a distance from F2204. Descriptive statistical techniques (described below) were used to evaluate the degree to which Binford's outside hearth model corresponds to the distribution of mussel shell relative to F2204.

Based on Roper's (1994) application of Binford's idealized refuse zone and toss zone boundaries at a prehistoric site in Iowa, two concentric rings were established relative to F2204. Based on the zone in which the majority of each unit was located, the excavation units were lumped into one of two proximity classes: "hearth zone" or "toss zone" (Figure 17). To evaluate whether distribution differences in the proximity classes were due to sampling vagaries, the SPSS statistical program was used to run an independent samples T-test of mussel shell

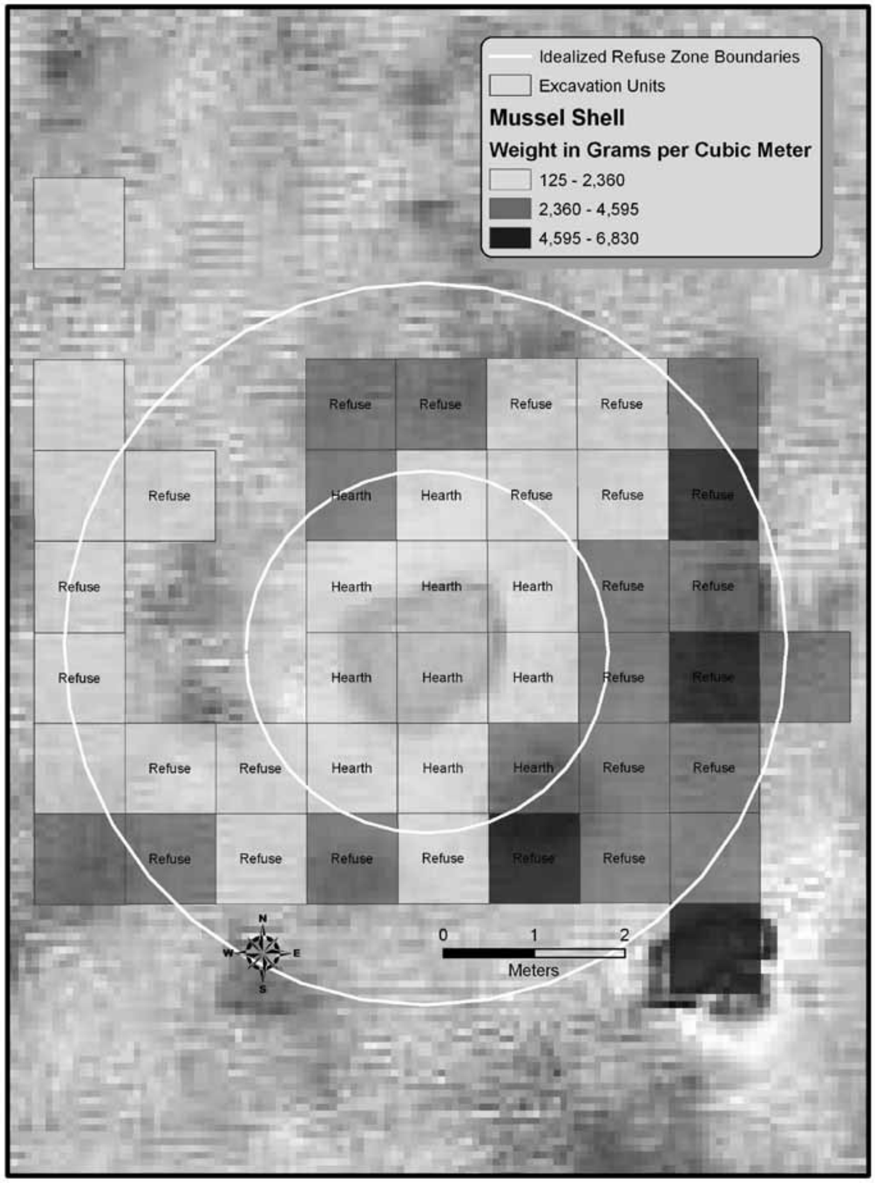

Figure 17. Idealized refuse zone boundaries, based on the expectations of Binford's (1978) outside hearth model.

weight by proximity class, with equal variances assumed. T-test results were t = –2.179, p = .037, suggesting a greater than 95 percent chance that observed patterns in mussel shell weight distribution in proximity classes were not due to sampling quirks. This pattern is visually illustrated through the use of error bars in Figure 18. Based on the results of these descriptive statistical tests, it appears that mussel shell is not randomly distributed. These results lend support to the hypotheses that mussel shell distribution is reflective of Binford's outside hearth model and that F2204 may have been used to process mussels.

Although the mussel shell distribution surrounding F2204 may best be explained by comparison with Binford's toss zones, it is unclear whether mussel shell distribution was affected by repeated use of this feature (Leach et al. 2005), as well as by reoccupation and activities associated with other site features. Charcoal in the adjacent pit feature (F2201) has been radiocarbon dated to 1955 ± 20 B.P., and charcoal from the central burned rock feature (F2204) has been radiocarbon dated to 3190 ± 20 B.P. Given the later date of the pit feature (F2201), this represents an occupational episode distinct from that responsible for the central burned

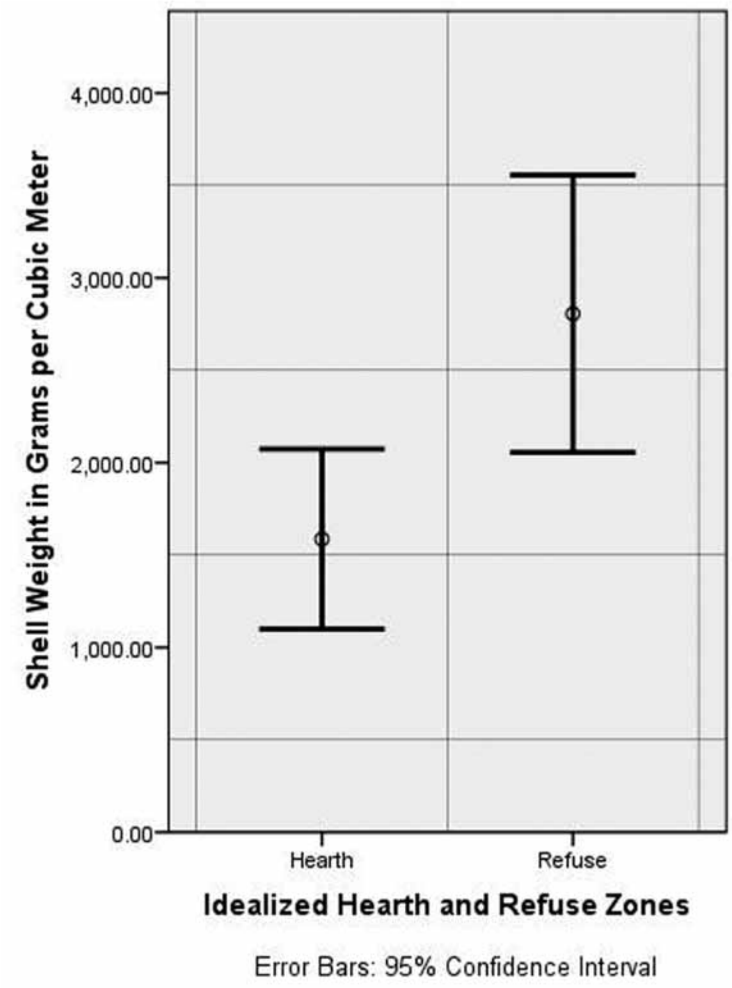

Figure 18. Error bars with 95 percent confidence intervals for mean shell weight in hearth and refuse zones.

rock feature. Thus, the degree to which subsequent occupations affected mussel shell distribution surrounding F2204 remains unclear.

Feature 2201

F2201 is a large and unusually deep pit feature, filled with hundreds of pounds of burned rock. This feature was initially detected during the geophysical survey as a dark gray anomaly, approximately 1 m in diameter and located approximately 2 m southeast of F2204.

As with F2204, plan photographs of F2201 were taken at the completion of each unit level, and all of the excavation photographs were georeferenced and integrated into the project's GIS database. The technique of georeferencing proved invaluable in the study of F2201 because it facilitated the layering of excavation photographs to examine the precise relationships between each of the excavation levels, which would have been impossible using traditional techniques. As the excavation photographs in Figure 19 illustrate, excavations in the vicinity of this anomaly initially exposed F2201 as a circular concentration of dark soil, lined with flat stone slabs. As the excavations proceeded, a layer of large stone slabs was encountered at 48 cm and continued downward nearly 1 m.

Following the completion of fieldwork, a sample of carbonized material was submitted to the ISGS for AMS radiocarbon dating. As discussed in the radiocarbon dating section, this sample generated a date of 1955 ± 20 B.P., with a 2 Sigma calibrated range of 18–14 B.C., A.D. 0–86, A.D. 106–118. Based on the AMS analysis of feature material, F2201 dates to the Early/Middle Woodland period.

F2201 is a somewhat unusual type of feature in

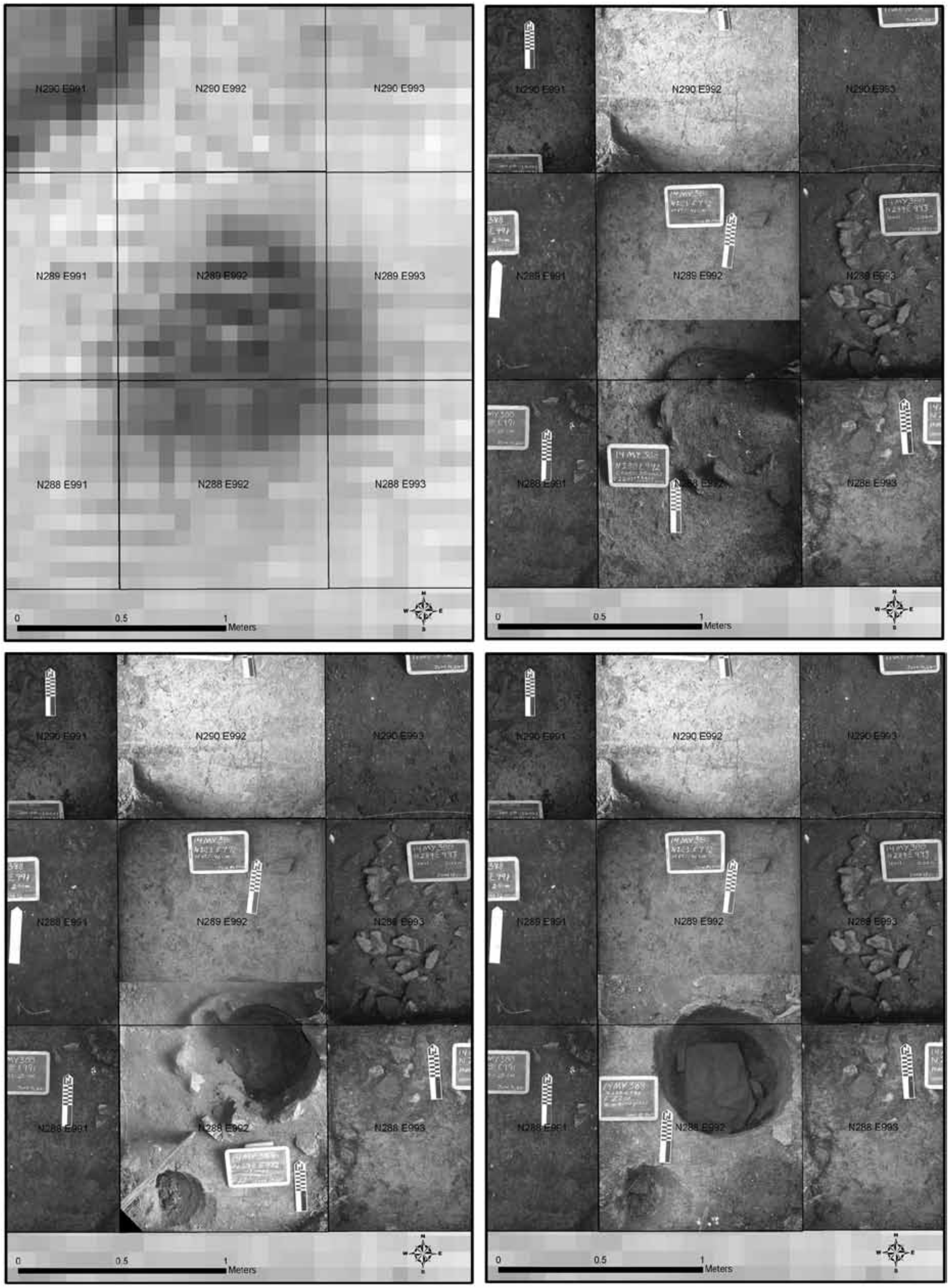

Figure 19. Geophysical anomaly targeted for excavation (upper left) compared to georeferenced excavation photographs of F2201 at 30 cm (upper right), 48 cm (lower left), and 76 cm (lower right).

southeastern Kansas during the Late Archaic and Woodland periods. However, pit features containing large quantities of burned rock are quite common at Archaic period sites in the northern plains. George Frison (1983:89–90) suggested that these features were used primarily for food preparation but also may have served as heat sources for small short-term structures. "The apparent procedure for using these features was first to build a fire in the bottom, and, after a substantial bed of coals was formed, stones were then placed on the coals. More than one sequence of fire and stones may occur in some of the deeper pits, and there is evidence in many cases also of cleaning out the pits for repeats of the same process" (Frison 1983:81).

In an attempt to clarify the functions of F2201, two samples of burned rock were collected and submitted to PaleoResearch, Inc. to be tested for organic residue using FTIR. Analysis of the first sample yielded functional group peaks representing cooked wild onion (*Allium tricoccum*). In addition, a general shape match with cooked wild onion bulbs included the portion of the spectrum between 1200 and 700 and 600–500 wave numbers" (Logan 2010:11). The second sample yielded no functional group peaks, but a general shape match for cooked *Allium* bulbs was identified. Thus, it appears that "wild onion, and perhaps other unidentifiable plants were cooked in the pit using heated rocks" (Logan 2010:11–12). The chemical signature of cooked wild onion is consistent with Frison's (1983) interpretation of similar pit features as cooking locales. Furthermore, the evidence fits well with Thies' (1990:104) discovery of charred onion bulbs in Archaic period burned rock features at the Stigenwalt site (14LT351).

As discussed in Appendix B and elsewhere (Tomasic 2012), Mark Volmut identified several species, including deer, turtle, eastern cottontail, bird, fish, and a variety of additional species in smaller quantities. The presence of faunal remains in F2201 is consistent with its interpretation as a cooking receptacle, and the presence of multiple species suggests that the feature may have been used repeatedly for food preparation.

As discussed in Appendix C and elsewhere (Tomasic 2012), a flotation sample yielded a thin gourd rind (*Cucurbita* spp*.)*. In addition, several nut shell endocarp fragments, tentatively identified as hickory or walnut shells (Juglandaceae family), were recovered. The associated AMS radiocarbon dating of F2201 (1955 ± 20), combined with the recovery of gourd and nut shell fragments, provides evidence of nut exploitation and gourd cultivation during the Early/Middle Woodland transition and use of F2201 as a cooking locale.

2010 ARCHEOLOGICAL SITE SURVEY

In addition to the excavations at the Eastep site, considerable information was generated as a result of a pedestrian survey of more than 100 acres of land around 14MY388. The 2010 survey was directed by Vita Tucker with the assistance of Kent Sallee. During the survey the locations of artifacts were recorded with a hand-held GPS receiver, artifacts were collected, and the artifact distribution was plotted in the project GIS. The artifact locations were used to expand the Eastep site boundaries substantially to the east and south.

Although the pedestrian survey was aimed primarily at identifying evidence of prehistoric occupation, it also generated information regarding Historic period activities. Three lead musket balls were discovered approximately 250 m southwest of 14MY388 in an area largely devoid of prehistoric artifacts. The interpretation of their presence in this portion of the survey area was greatly aided by data obtained from the nineteenth-century General Land Office (GLO) map. This map was scanned, georeferenced in the project GIS, and overlaid as a transparency atop the modern USGS topographic map of the survey area (Figure 20). Close examination of the georeferenced map overlay revealed that the three musket balls were found along the nineteenth-century course of the Verdigris River. Although lead musket balls may not be diagnostic of the nineteenth century (Cleve Mulder, personal communication 2010), their apparent age is evidenced by thick oxidized patina, suggesting that these artifacts most likely were associated with activities along this stretch of the Verdigris River in the 1800s.

RADIOCARBON DATING

Seven samples were submitted to the ISGS for AMS radiocarbon age determination: five charcoal

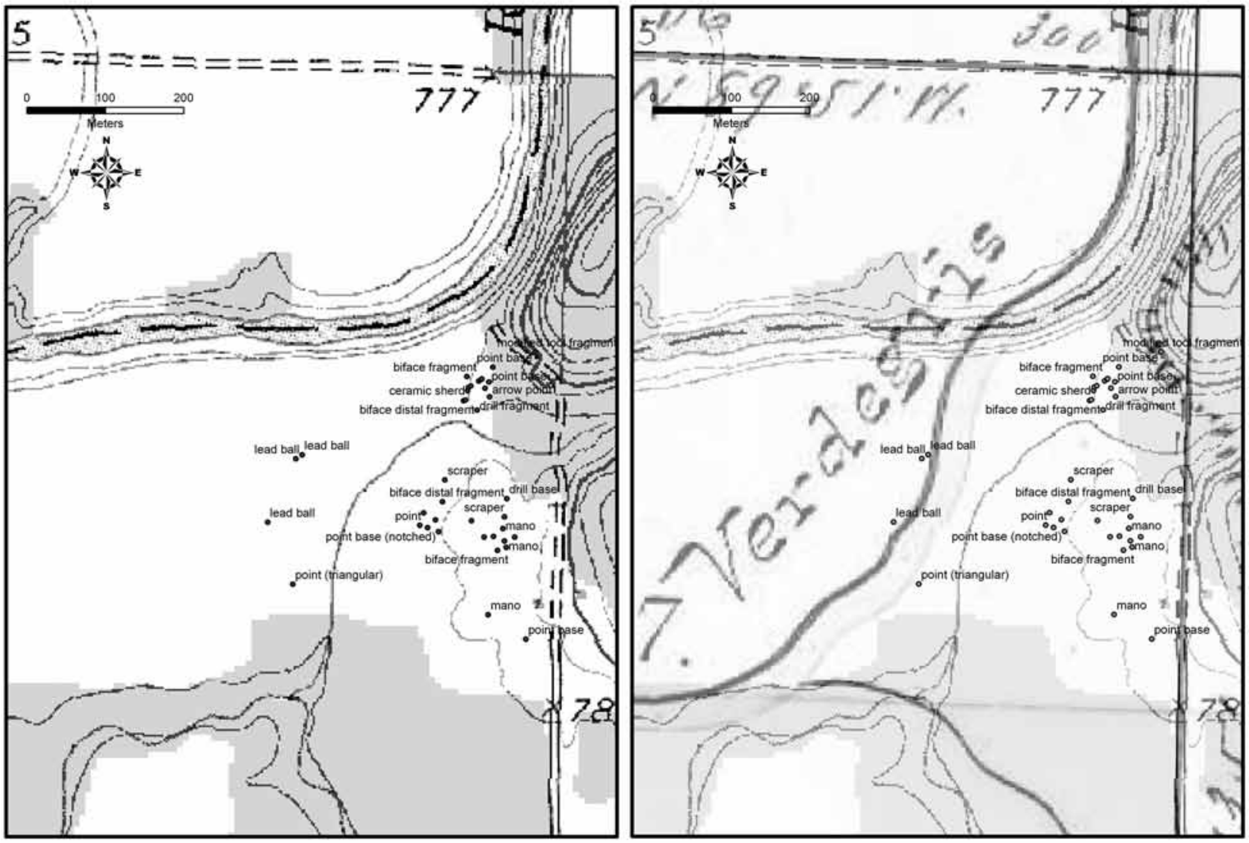

Figure 20. GPS locations of artifacts recovered during pedestrian survey shown atop a USGS topographic map (left) and a georeferenced partially transparent nineteenth-century GLO map and USGS topographic map (right).

samples from A101 and two samples from A102. In addition, three samples from the river bank were taken and submitted for AMS radiocarbon age determination. These samples are reported separately by Mandel (this volume).

One of the samples was obtained from a piece of charcoal, which was located in Soil 2 approximately 50 cm below ground surface and not associated with cultural features. The remaining four samples were taken from charcoal associated with excavated features. The relative ages of all five samples were in proper stratigraphic order. The most recent date (340 ± 15 B.P.) came from a piece of charcoal with no associated artifacts in Soil 2. Two samples, taken from the river bank shelf excavations, dated to 2175 ± 15 B.P. and 2210 ± 15 B.P. One sample from a hearth approximately 1 m below the excavations dated to 2320 ± 15 B.P., and the earliest date of 2790 ± 20 B.P. came from the deepest hearth exposed in the cutbank. In A102 a charcoal sample taken from the base of pit feature F2201 dated to 1955 ± 20, and a charcoal sample from the burned rock feature F2204 dated to 3190 ± 20.

All seven samples were calibrated using CALIB 6.0 (Stuiver and Reimer 1993) with the intcal09.14c dataset (http://calib.qub.ac.uk/calib/calib.html). Calibrated radiocarbon dates are listed in Table 1 along with provenience information, including sample elevations.

CERAMIC ARTIFACT ANALYSIS

Ceramics were recovered from 22 contexts over the course of research at the site. Most of the ceramic sherds are small and highly eroded, which hindered their typological identification. Moreover, the vast majority of sherds were recovered from the surface of A102 or the plow zone in A102 excavation units. An exception is a large vessel section (Fig-

Table 1. Calibrated Dates Obtained from CALIB 6.0 (Stuiver and Reimer 1993). All radiocarbon dates calibrated using the intcal09.14c dataset.

ISGS Lab Number	Description (KSHS Sample Number)	Elevation in Meters	Sample Type	^{13}C Ratio	Radiocarbon Age BP and Standard Deviation	One Sigma (68.3%) Calibrated Date Range (area under probability distribution)	Two Sigma (95.4%) Calibrated Date Range (area under probability distribution)
A1463	Excavations on Area 101 Shelf (Sample 35)	233.439	Charcoal	–24.5	2175±15	350–305 cal BC (.790) 209–196 cal BC (.210)	355–289 cal BC (.656) 232–174 cal BC (.344)
A1464	Hearth 1 Meter below Area 101 Shelf (Sample 92)	232.775	Charcoal	–23.3	2320±15	399–390 cal BC (1.000)	402–384 cal BC (1.000)
A1565	Excavations on Area 101 Shelf (Sample 46)	233.482	Charcoal	–25.2	2210±15	358–348 cal BC (.116) 317–282 cal BC (.406) 257–244 cal BC (.129) 235–207 cal BC (.349)	363–339 cal BC (.140) 329–204 cal BC (.860)
A1566	Sample from Area 101 Soil 2 (Sample 95)	235.715	Charcoal	–26.8	340±15	1495–1523 cal AD (.353) 1559–1563 cal AD (.034) 1571–1602 cal AD (.415) 1615–1630 cal AD (.198)	1477–1529 cal AD (.345) 1543–1634 cal AD (.655)
A1662	Deepest Feature on Area 101 Riverbank (Sample 168)	229.344	Charcoal	–23.5	2790±20	975–954 cal BC (.375) 944–907 cal BC (.625)	1006–896 cal BC (.994) 864–860 cal BC (.006)
A1663	Burned Rock Feature Feature 2204 in Area 102 (Sample 245)	239	Charcoal	–24.0	3190±20	1493–1475 cal BC (.414) 1461–1436 cal BC (.586)	1499–1424 cal BC (1.00)
A1664	Pit Feature 2201 in Area 102 (Sample 447)	239	Charcoal	–24.1	1955±20	25–70 cal AD (1.000)	18–14 cal BC (.006) 0–86 cal AD (.976) 106–118 cal AD (.018)

ure 21), recovered in A101 by Bevitt (2008:6). This fragment was discovered in the river cutbank approximately 1.7 m below ground surface, placing it stratigraphically above the Early Woodland deposits excavated along the A101 cutbank shelf. Based on the surface attributes and vessel form, this pot was identified as Cuesta ware (Marshall 1972), a pottery type diagnostic of the Middle/Late Woodland Cuesta phase of southeastern Kansas (Cole and Neel 2010; Witty 1999). Furthermore, the radiocarbon age derived from one sample (Beta-367305) submitted by Mandel (this volume) is consistent with this ceramic typology.

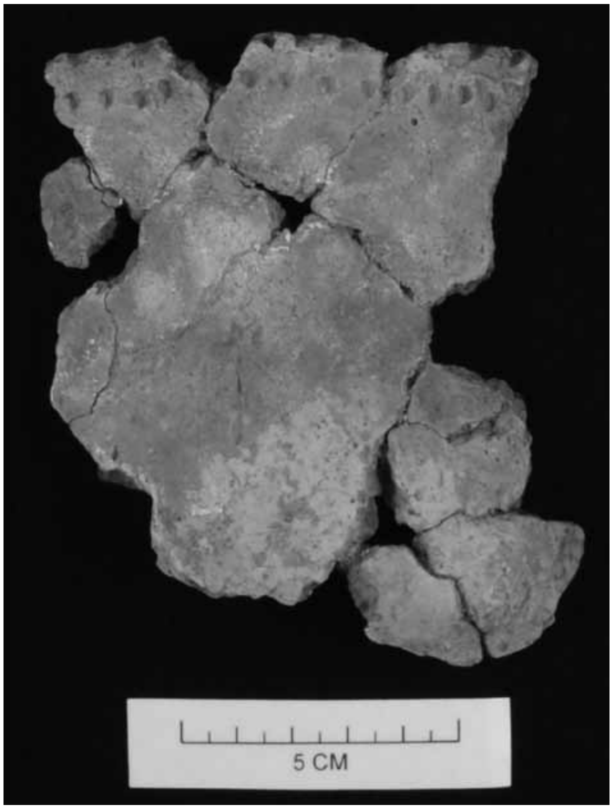

Figure 21. Cuesta phase vessel fragment recovered by Bevitt (2008) from A101.

CHIPPED STONE ARTIFACT ANALYSIS

All projectile points were classified based on the typology established by Justice (1987). All formal chipped stone tools (bifaces, scrapers, blades) were examined and classified according to raw material geologic source, based on the Kansas Historical Society's comparative lithic collection. In addition, several flakes visually identified as potential exotic raw materials were subjected to specialized laboratory analysis.

Projectile Point Typological Identification

The projectile point assemblage from the Eastep site is largely consistent with assemblages from Terminal Archaic/Woodland period sites in southeastern Kansas and northeastern Oklahoma. The majority is contracting-stemmed points, all of which fit in the Dickson Type Cluster, as defined by Justice (1987:189–198). Dickson Type Cluster points are considered dart points, rather than arrow points, based on quantitative measures of size (Thomas 1978; Wyckoff 1964).

Three specific point types in the Dickson Type Cluster have been identified at 14MY388: Gary Contracting Stemmed, Dickson Contracting Stemmed, and Adena Stemmed. Justice (1987:189) described Gary Contracting Stemmed points as trianguloid-bladed, contracting-stemmed points with pointed or slightly rounded bases. They date from the Late Archaic into the Middle Woodland period (1500 B.C.–A.D. 100) in the eastern United States. Also present in the assemblage are Dickson Contracting Stemmed points, which have wide trianguloid blades with rounded to square basal edges and are diagnostic of the Early Woodland period (500–100 B.C.) in the Midwest (Justice 1987:191). Finally, the assemblage includes "beavertail" ovate stemmed points known as Adena Stemmed in Ohio (Justice 1987:191–196) and Mason Stemmed in Illinois (Montet-White 1968). Regardless of cultural affiliation, Adena and Mason points are morphologically identical and are diagnostic of the Early Woodland period (800–300 B.C.) in the Midwest.

While Dickson Type Cluster points are diagnostic of the Late Archaic and Early/Middle Woodland in eastern North America (Justice 1987:189) and are considered diagnostic of the Early Woodland period in the midwestern United States (Martin 1997:17), in the Central and Southern Plains they apparently were a longer-lived point type (Witty 1999:169–172). Dickson Type Cluster points, frequently associated with Middle/Late Woodland (A.D. 1–1000) period sites in southeastern Kansas and northeastern Oklahoma (Vehik 1984:178), have been considered diagnostic of the Middle/Late Woodland Cuesta phase (Witty 1982:214).

In A101 all of the projectile points identified to type were assigned to the Dickson Type Cluster (Figures 22 and 23). In A102 point types diagnostic of later cultural periods also were recovered. In particular, several Snyders points were found in the survey and excavations. Snyders points are broad-bladed, corner-notched dart points that are diagnostic of the Early and Middle Woodland periods (200 B.C.–A.D. 400), according to Justice (1987:201–204). Snyders points are characteristic of Trowbridge phase (A.D. 1–250) Kansas City Hopewell sites, as well as other Middle Woodland cultures of

Figure 22. A101 bifaces and projectile points.

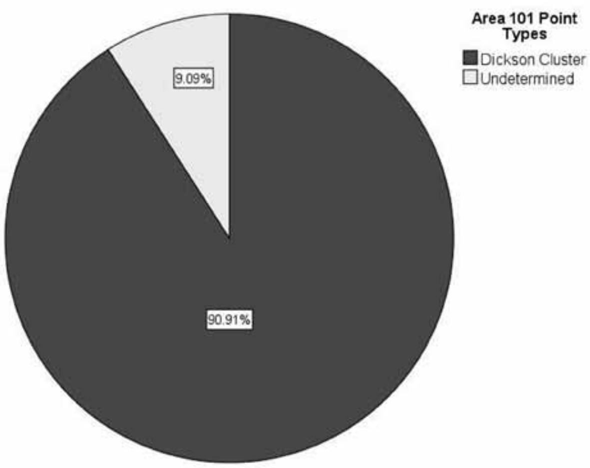

Figure 23. A101 projectile point type proportions.

the region, including the Cuesta phase of southeastern Kansas (Logan 2006:80).

Although the vast majority of projectile points at the Eastep site are identified as dart points, two probable arrow points were recovered in A102 (Figures 24 and 25). The first of these is identified as a Scallorn arrow point, and the second is identified as a Late Woodland/Mississippian Type Cluster arrow point. Scallorn points are small corner-notched, expanding-stemmed arrow points with barbed or serrated shoulders, and most date to the Late Woodland and Mississippian phases (A.D. 700–1100), according to Justice (1987:222). However, Scallorn arrow points appeared in Kansas City Hopewell assemblages by A.D. 400 (Logan 2006:80), suggesting that the A102 Scallorn point could date to the Middle or Late Woodland. Late Woodland/Mississippian Type Cluster arrow points are described as straight-sided unnotched triangular arrow points with straight to slightly concave bases. These points date from the Late Woodland to the beginning of the Historic period (A.D. 800–1350), according to Justice (1987:224–227). The presence of these later point types indicates that prehistoric activities in A102 may not be restricted to the Terminal Archaic or Woodland periods.

Evidence of Early Woodland Lithic Technology in Area 101

Given the long duration of Dickson Type Cluster points in southeastern Kansas, the exclusive presence of these points at the Eastep site did not assist in refining the period of occupation beyond a roughly 2,000-year window, spanning the Terminal

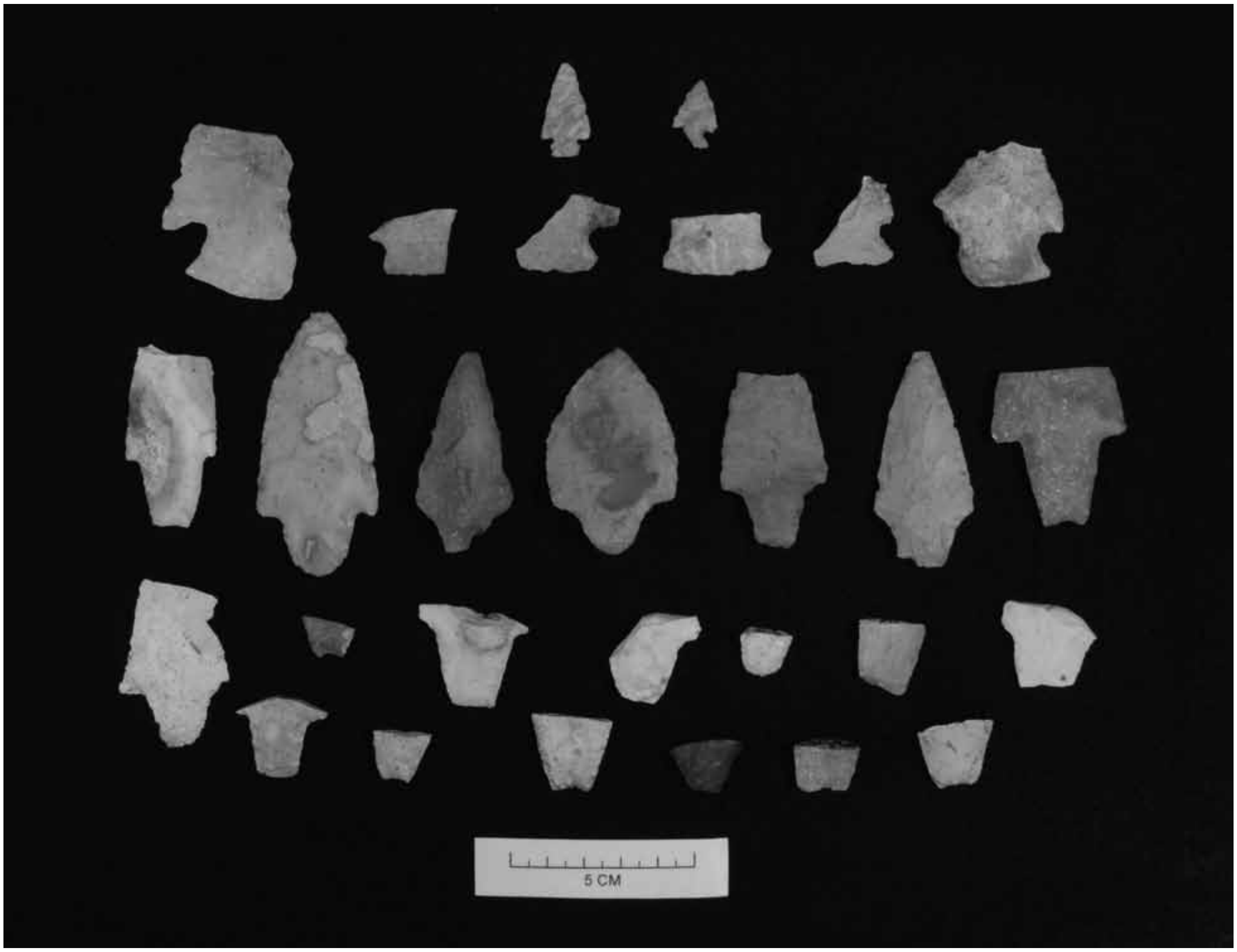

Figure 24. Projectile points recovered from A102.

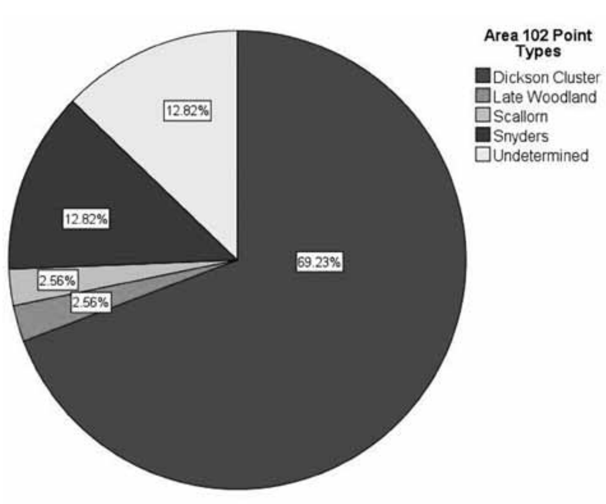

Figure 25. A102 projectile point types, shown in clockwise order.

Archaic and Woodland periods. However, A101 excavations provided additional data with which the buried deposits could be securely dated to a much shorter habitation period. In A101 all formal lithic tools were recovered in association with buried features that have been securely dated, based on two samples of carbonized material subjected to AMS radiocarbon dating. The first of these samples (A1463) generated a date of 2175 ± 15 B.P., with a 2 Sigma calibrated range of 355–289 B.C., 232–174 B.C. The second sample (A1565) generated a date of 2210 ± 15 B.P., with a 2 Sigma calibrated range of 363–339 B.C., 329–204 B.C. Based on the AMS dating of material from these features, the associated artifacts in A101 probably date to a relatively short span of time between 400 and 200 B.C.

The dating of A101's features and associated Dickson Type Cluster points to 400–200 B.C. is at odds with previous research, suggesting that Dickson Type Cluster points are diagnostic of the Middle and Late Woodland Cuesta phase in southeastern Kansas (Witty 1982, 1999). However, the dating of A101 artifacts fits quite well with the timeline for the appearance of Dickson Type Cluster points throughout Missouri (Emerson 1986:624; Martin 1997:17–18) and midwestern North America (Justice 1987).

Comparison of additional A101 lithic tool types with Early Woodland artifacts from sites throughout Missouri and the midwestern United States provides additional support for the relatively early dating of A101 features and associated artifacts to 400–200 B.C. Martin (1997) dates the Early Woodland to 600–100 B.C. in Missouri. Furthermore, diagnostic lithic tools at Early Woodland sites in Missouri and Illinois include distinctive knives, known as Goose Lake knives (Emerson 1983) in the American Bottom or Peisker diamond knives (Perino 1985) in the lower Illinois River valley, as well as steeply retouched ovate scrapers, known as turtle-backed scrapers (Martin 1997:17). Comparison revealed that these diagnostic Early Woodland tool types are also present in the A101 lithic assemblage (Figures 26 and 27).

Figure 26. A101 biface identified as a Goose Lake/ Peisker diamond knife.

Figure 27. A101 steeply retouched, ovate scrapers.

Raw Material Types

Classification of chipped stone tools as to raw material type was conducted using the KSHS comparative lithic collection, following the chert types and descriptions published by Janice McLean (1998) and Martin Stein (2006). It became evident that a substantial proportion of chert at the Eastep site was from non-local sources. However, significant variability exists between the A101 cherts, dating to 400–200 B.C., and the A102 cherts, dating to perhaps the entire Late Archaic and Woodland periods (1500 B.C.–A.D. 1000).

In A101 more than 30 percent of formal tools were made from Mississippian cherts from the Ozark region of southwestern Missouri (Figure 28). Only 17 percent of A102 formal tools were made of Mississippian cherts, with a greater proportion of locally obtained Pennsylvanian cherts (Figure 29). Apparently during the 400–200 B.C. period, A101 inhabitants acquired substantial quantities of non-local lithic raw materials from sources to the east, which parallels the common tool types shared by the A101 lithic assemblage and Early Woodland lithic assemblages in Missouri and the midwestern United States (Martin 1997).

Exotic Lithics

While the vast majority of chipped stone artifacts appear to be made of locally or regionally available cherts, a few artifacts were made of exotic raw materials acquired from hundreds of miles away. Specialized analyses, including X-ray fluorescence and neutron activation analysis provided momentous information regarding the degree to which Eastep site inhabitants participated in long-distance exchange networks.

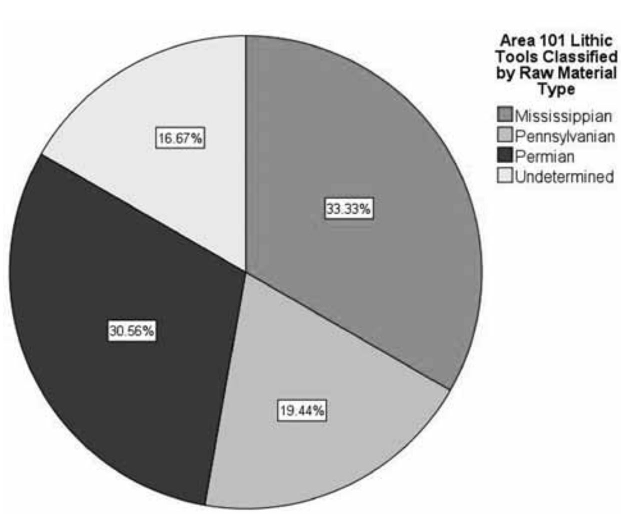

Figure 28. A101 lithic tools, classified by geologic raw material, shown in clockwise order.

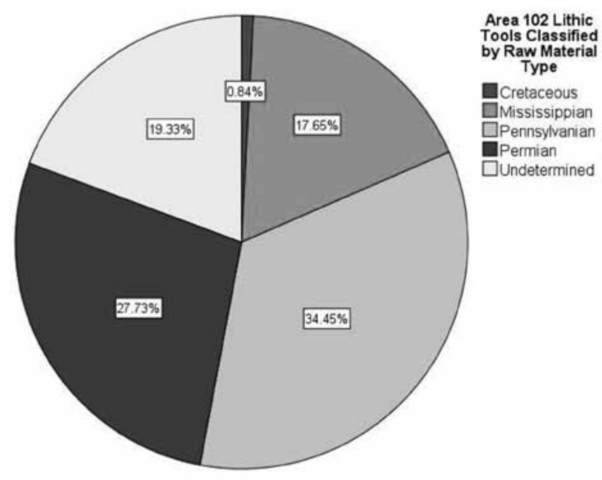

Figure 29. A102 lithic tools, classified by geologic raw material, shown in clockwise order.

Obsidian

Two obsidian flakes were excavated from A102. Unfortunately, both were encountered in contexts heavily disturbed by plowing and tree planting. As a result, it is not clear whether the obsidian flakes were deposited during the Late Archaic occupation of the A102 terrace or the subsequent Woodland period occupation of the same area.

In an attempt to determine the precise origin, one sample was analyzed using X-ray fluorescence at the Berkeley Archaeological XRF Laboratory. The analysis determined that the flake originated at the Obsidian Cliff source, which is located within the confines of modern-day Yellowstone Park, Wyoming, more than 900 miles from the Eastep site (Shackley 2010).

Knife River Chalcedony

The A102 excavations also recovered several flakes that appeared to be chalcedony from the Knife River region of western North Dakota, more than 800 miles away. These flakes were encountered in essentially the same contexts as the obsidian flakes, making precise chronological assignment of the samples difficult.

Initially, the flakes were examined under ultraviolet light, following the method described by Hofman et al. (1991) to visually identify the raw material source. The stone's response to the ultraviolet light supported the suspicion that the flakes were indeed Knife River chalcedony. Then one of the flakes was submitted to the University of Missouri Research Reactor and subjected to neutron activation analysis, which confirmed that the sample originated from the Knife River chalcedony source area (Boulanger 2011).

SYNTHESIS AND INTERPRETATIONS

The 2009–2011 excavations at the Eastep site generated data that has augmented scientific understanding of human adaptation in the Central Plains during the Late Archaic and Woodland periods (1500 B.C.–A.D. 1000). Specialized research by Rolfe Mandel, Edwin Miller, Mark Volmut, and Andrew Wyatt and colleagues contributed significantly to the study. Mandel's geomorphological research was crucial in understanding the relationship between landscape evolution, climate change, and human activity. Miller's mussel shell analysis generated key information, including evidence for seasonality of harvest and potential selectivity in mussel harvesting. Volmut's faunal analysis documented the wide variety of animal resources exploited by the site inhabitants, and he clarified functions of the burned rock features encountered in A102. Wyatt and his colleagues' paleoethnobotanical research provided essential information regarding plant exploitation and cultivation during the Late Archaic and Woodland periods, and their research also helped to clarify the potential uses of the A102 burned rock features.

Relatively new GIS mapping technologies and techniques provided critical information regarding the spatial distribution of artifacts and features. Creation of a site map using actual UTM coordinates allowed integration of a variety of spatial datasets in the project GIS, including historical maps, topographic maps, aerial imagery, and the geophysical survey results. The georeferencing of excavation plan photographs and excavation plan drawings graphically demonstrated the spatial distribution of individual artifacts relative to features.

The Eastep site research contributed to knowledge of the Early Woodland period in Kansas. As previously discussed, Martin (1997:24) defined the Early Woodland period in Missouri as a period between roughly 600 B.C. and A.D. 1, containing artifacts diagnostic of the Marion and Black Sand Cultures of Illinois. By Martin's definition, A101 at the Eastep site is clearly considered as an Early Woodland component, based on its Early Woodland lithic assemblage and supporting AMS radiocarbon dates. Despite the fact that one of the defining characteristics of Early Woodland in Kansas and Missouri has been the presence of ceramics, pottery should not be seen as the only artifact class used to identify Early Woodland sites. Johnson (1992) demonstrated that Early Woodland sites in Kansas can be identified by lithic technologies. The information in this report regarding the Early Woodland component at 14MY388 should stimulate debates regarding the origin of later Woodland peoples, including Kansas City Hopewell and Cuesta/Cooper phase peoples, and the degree to which indigenous developments versus migration and/or diffusion played a role in Middle and Late Woodland developments (Logan 2006).

Previous research by Logan (2006:78) and Patricia O'Brien (1984:45) suggested that Early Woodland adaptation in eastern Kansas probably did not differ markedly from Late Archaic adaptations in eastern Kansas. With the exception of the A101 Early Woodland lithic assemblage, evidence from the Eastep site tends to support their assessments. The lack of evidence for storage pits, ceramics, and house structures indicates that the activities in A101 and A102 probably were limited to short-term seasonal camps.

Human adaptation at the Eastep site does not appear to have differed dramatically from adaptations at other Late Archaic sites in the region. In fact, A101 is identical in many ways to the Late Archaic period Lawrence site, also located on the Verdigris River, approximately 50 m south of the 14MY388. The Lawrence site was intensively occupied a few centuries prior to the A101 occupation—around 2600–2700 B.P. (Wyckoff 1984:147). Neither the Eastep site nor the Lawrence site have evidence of permanent habitation, and both are interpreted as short-term camps (Baldwin 1969:110). Lithic assemblages have similar proportions of non-local Mississippian cherts from the Ozark region to the east (Baldwin 1969; Wyckoff 1984:150). Faunal remains are quite similar; deer were common, with a variety of smaller animals exploited as well, and bison and antelope bones largely absent. The faunal assemblages suggest hunting in a gallery forest environment, rather than an upland prairie setting.

Interestingly, only two significant differences exist between A101 of the Eastep site and the Lawrence site: the Lawrence site contained relatively few contracting-stemmed points, and it predates the Eastep site's A101 occupation by a few hundred years. Susan Vehik (1984:178) suggested that contracting-stemmed points do not appear in northeastern Oklahoma until around A.D. 1 in association with the Delaware A focus. Although speculative, the Early Woodland lithic assemblage in A101 might best be interpreted as evidence of incorporation of an Early Woodland Midwestern lithic technology into a preexisting Late Archaic way of life.

APPENDIX A: MUSSEL SHELL ANALYSIS

By Edwin J. Miller

The recent excavations at the Eastep site unearthed many relic unionid (Unionidae) mussels in contexts dating to the Late Archaic and Woodland periods (2000 B.C.–A.D. 1000). Today portions of the Verdigris River near 14MY388 have a diverse and relatively dense population of unionid mussels (Miller and Lynott 2006). These unionid mussel beds are concentrated in the gravelly substrate associated with riffle-run habitats. In 2009–2010 Kansas Department of Wildlife and Parks personnel surveyed eight sites along a 13.2-km stretch of the Verdigris River.

It is of archeological and ecological interest to document the species of mussels that were used as food at the Eastep site and to compare the mussel assemblage from prehistoric midden contexts with modern populations currently found in the Verdigris River. The objectives of this effort are:

1. Document the unionid mussel species that were used as a food source by the Late Archaic-Woodland period inhabitants living at 14MY388 along the Verdigris River.
2. Compare the species richness, diversity, evenness, and relative abundance of unionid mussels from the Eastep Site with the current Verdigris River assemblage.
3. Compare the size of intact mussel valves from the Eastep Site with samples recently taken from a nearby stretch of the Verdigris River.
4. Examine the growth rings of intact valves from 14MY388 to determine the season of harvest.

Methods

Unionid mussels encountered during Eastep site excavations were collected and placed in paper bags. Subsequently the mussel-shell contents of each bag were sorted in the laboratory into three categories: whole valves, identifiable fragments of valves, and unidentifiable fragments. Weights for each category were tallied and summed. The valves and valve fragments were compared to voucher specimens to verify accurate identification. The umbo shape, beak cavity, external sculpture, arrangement of pseudocardinal and lateral teeth, and muscle scars were used to identify the valves. The valves and identifiable valve fragments were also examined for tool marks.

The recent samples of extant unionid mussels from the Verdigris River came from eight riffle-run sites along a 13.2-km stretch of the Verdigris River. The archeological excavation occurred 6.5 km downstream from the most upstream sample site and 6.7 km upstream from the most downstream site (Figure 30). Sampling sites were selected because they had been sampled previously, were identified as sites of past commercial harvest, or had stable gravel substrates under riffle-run flow and nearby bedrock exposures.

Site sampling was conducted during low summer flows (<150 cfs). All sample sites were 100 m in length and 10 m in width, beginning from the shallow (gravel bar) side of the river and 1 m from shore. At each site 40, 1-m^2 quadrats were chosen from coordinates drawn from a random number table. The sample size was based on a previous survey (Cope 1983) and a pilot study that showed 95 percent of the species present were encountered by

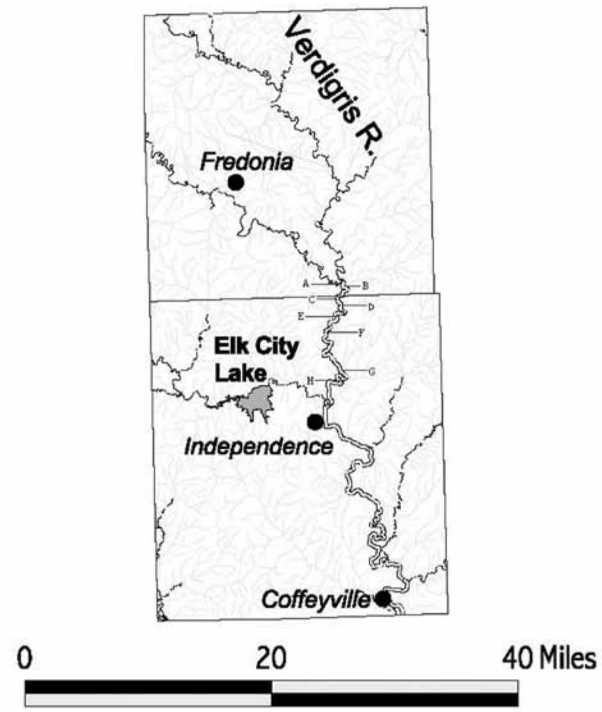

Figure 30. Map of the Verdigris River with sample sites (A-H) near the Eastep site, surveyed for live mussels in 2009–2010.

subsampling 4 percent of the sample site area. Each quadrat was sampled by hand-excavating the substrate to about 14–20 cm depth or until bedrock or a compacted layer of gravel was reached. Collected mussels were identified and measured before they were returned to the substrate.

Relative abundance of each species was calculated for the Eastep site excavation and the 2009–2010 Verdigris River survey. The comparison of overall species distributions between the archeological excavation and the river survey was made with a Kolmogorov-Smirnov test. In addition, species richness, Shannon index of general diversity, and evenness index (Odum 1971) were calculated. Individual species abundance figures were compared using a two-tailed Chi-square test and were considered significantly different at $P \leq 0.05$.

The intact valves from 14MY388 were measured with calipers. Height measurements were compared to the 2009–2010 Verdigris River samples. A Kruskal-Wallis statistic was generated to test for differences in shell size, where sample size for any species was ≥ 7 intact valves.

The intact valves from the Eastep site were visually examined in an effort to determine seasonality of harvest. Some mussel species, specifically Western fanshell (*Cyprogenia aberti*), show more pronounced ridging during arrested growth (winter) periods than other species. Because mussels grow rapidly and have widely spaced growth rings prior to sexual maturity, small valves have the widest growth zones and were sought to improve this assessment. For these reasons *C. aberti* valves were the target for this analysis. However, other small valves were examined for discernible growth rings to increase sample size.

Intact valves and large identifiable fragments were examined for tooling marks. Any other identifiable relics, mixed with the bagged 14MY388 unionid mussel shells, were noted. Finally, images of relic shells or identifiable fragments from the Eastep site and current fresh valves were taken as visual examples of the mussel species diversity.

Results

From the Eastep site 31 kg of excavated mussel shell were examined. The mussel shell collection was divided into three categories: measurable valves (5.8 percent), identifiable valve fragments (56.5 percent), and unidentifiable valve fragments (37.7 percent). Of this collection, 935 valves or valve fragments could be identified to species.

The eight sites sampled for freshwater mussels in the 2009–2010 Verdigris River survey documented 4,567 specimens. The mean/m^2 ranged from 7.8 to 47.6. The overall mean of the eight sites was 14.3 mussels/m^2 (SE = 4.78).

Species Richness, Relative Abundances, Shannon Diversity and Evenness Indices

Species richness is simply the number of species in the sample. Twenty-four species were documented at the Eastep site and 21 at the Verdigris River sampling sites. The Shannon diversity index was higher at 14MY388, as was the species evenness index. When the distribution of the mussel assemblages are compared, they are significantly different (Komlogorov-Smirnov statistic = 0.34, $P \leq 0.05$).

Four species now presumed extirpated from the Verdigris River in Kansas (Angelo et al. 2009) were found in the Eastep site mussel midden: *Quadrula cylindrica* (Rabbitsfoot), *Ligumia recta* (Black sandshell), *Lasmigona costata* (Flutedshell), and *Lampsilis siliquoidea* (Fat mucket). Two species, *Leptodea fragilis* (Fragile papershell) and *Truncilla donaciformis* (Fawnsfoot), were found in the Verdigris River survey of extant unionid mussels but were not documented in the archeological mussel midden at 14MY388.

Eight species of mussels from the archeological excavation had a relative abundance of >5 percent. These species range from 16.8 to 7.7 percent of mussels and occur in the following rank: *Amblema plicata* (Threeridge, 16.8 percent), *Quadrula pustulosa* (Pimpleback, 13.4 percent), *Ptychobranchus occidentalis* (Ouachita kidneyshell, 12.8 percent), *Pleurobema sintoxia* (Round pigtoe, 10.2 percent), *Cyprogenia aberti* (Western fanshell, 9 percent), *Fusconaia flava* (Wabash pigtoe, 8.7 percent), *Potamilus purpuratus* (Bleufer, 7.8 percent), and *Quadrula metanevra* (Monkeyface, 7.7 percent). Likewise, the Verdigris River survey had five species with a relative abundance of >5 percent: *F. flava* (29.3 percent), *Q. metanevra* (23.8 percent), *Q. pustulosa* (12.3 percent), *Tritogonia verrucosa* (Pistolgrip, 10 percent), and *P. sintoxia* (6.8 percent).

Five of the eight most abundant species at the Eastep site had significantly greater numbers than expected when compared to the 2009–2010 Verdigris River survey. They are *A. plicata*, *P. occidentalis*, *P. sintoxia*, *C. aberti*, and *P. purpuratus*. Also, two of the top eight species, *F. flava* and *Q. metanevra*, had significantly fewer numbers than expected at 14MY388. These two species are currently the predominant mussels documented in the Verdigris River and have a relative abundance of greater than three times that of the Eastep site collection. One of the commonly documented species in the river surveys, *Q. pustulosa*, was within the expected range at 14MY388. Also, *T. verrucosa* was much more common in the river surveys where it made up 10 percent of the relative abundance, but it was represented by only 2.5 percent of the valves identified at the Eastep site.

Size Comparison

At the Eastep site five species had ≥7 valves intact enough to get height measurements to compare with specimens from the river surveys: *A. plicata*, *P. occidentalis*, *P. sintoxia*, *C. aberti*, and *F. flava*. The results show that in four of the five cases, the valves excavated at 14MY388 were significantly smaller than those found in the 2009–2010 Verdigris River survey.

Seasonality of Harvest

Of the 63 intact valves from the Eastep site, 10 were harvested at a young enough age to show wide growth bands interrupted by rest zones. The species were *C. aberti* (n = 6), *P. occidentalis* (n = 2), *F. flava* (n = 1), and *L. rafinesqueana* (n = 1). In these 10 valves the growth zone at harvest indicated that they probably were approaching the end of the growing season. This would support the conclusion that harvest occurred in the late summer or early autumn.

Other Comments on the Eastep Site Mollusk Collection

Some of the relic mussel valves evidently were tooled with a drill hole, drill marks, or notches. A total of eight valves appeared to be notched, one had a partial drill indentation, and one was perforated. Tooling marks were noted on six different species.

Many gastropods (snails) were evident in the 14MY388 mollusk collection. The gastropods in one box (PC357–376) were identified. All are considered terrestrial in habitat. The vast majority (92 percent) were *Anguispira alternata* (Flamed Tigersnail). One fish tooth was identified; it is a pharangeal tooth from an *Aplodinotus grunniens* (Freshwater drum).

Discussion

Evidence from the Eastep site revealed that the Late Archaic-Woodland period inhabitants along the Verdigris River used a wide variety of mussel species. Twenty-four species were found in the mussel middens excavated at 14MY388. This diversity is comparable to the 21 species that were documented in the 2009–2010 survey at eight sampling sites near the excavation. The Shannon Diversity Index was slightly higher at the Eastep site, with four currently extirpated mussels documented. The Evenness Index indicated that the 14MY388 mussel assemblage was more evenly distributed than what is currently found in the Verdigris River. Although the species diversity was similar, the distribution of species was significantly different, and four species currently extirpated from the Verdigris River were found in the archeological excavation.

Several biases can occur when comparing extant mussels with those from an archeological investigation. Early inhabitants might have had preferences for a certain size or species of mussel, so they would occur at a different frequency in the middens than what was actually in the river at that time. For instance, *C. aberti*, is thought to have a spiritual significance, as that species has been found with the meat still intact between the valves in southwestern Missouri burial mounds (Oesch 1984). In addition, thick, heavy, and larger shells are more likely to remain intact over time, probably explaining the absence of the thin-shelled species, *L. fragilis*, at the Eastep site. Most riverine species possess heavy shells to withstand strong currents and lessen the likelihood of being transported downstream. Even thin-shelled species adapt by burying deeply into the substrate.

The dynamics of mussel populations is significantly influenced by the presence of the proper host fish, water clarity, water quality, and water quantity. Significant changes do occur in mussel populations within a few years' time that may significantly change the density of a single species (Miller and Obermeyer 1997) or several (Miller and Lynott 2006). Not surprisingly the mussel distribution has greatly shifted between the archeological assemblage found at 14MY388 and the recent survey results about 2,000 years later.

Assuming that the Late Archaic and Woodland period inhabitants who deposited the mussel shell middens at the Eastep site harvested mussels as they were found in the Verdigris River, some comparisons are deserving of comment. The extirpated species, the currently rare species, and the currently most common species are of particular interest.

The four extirpated species documented at 14MY388 were *Q. cylindrica*, *L. recta*, *L. costata*, and *L. siliquoidea*. Of these, only *Q. cylindrica* made up more than 1 percent of the identified valves. The only known population of *Q. cylindrica* remaining in the Verdigris River is from a site downstream of Oolagah Reservoir in Oklahoma. It is hypothesized that these species persisted in the Verdigris River of Kansas until row-crop agriculture and droughts of the 1930s pushed their populations to levels beyond recovery. Scammon's (1906) comment that *L. recta* was a common species in rivers south of the Kansas River lends support to this hypothesis.

Lampsilis rafinesqueana (Neosho mucket) is currently Kansas-listed as an endangered species and is under review for federal listing as threatened. In the 2009–2010 survey it is rare at any Verdigris River sample site, making up less than 1 percent of the relative abundance. Likewise, in the Eastep site excavation, it also comprised less than 1 percent of the relative abundance. This might indicate that it has never been a common mussel in the Verdigris River.

In contrast to *L. rafinesqueana*, two species listed in Kansas as endangered and threatened, *C. aberti* and *P. occidentalis*, could be considered a common occurrence in the Eastep site middens, as they were among the top five in relative abundance. In both cases there were significantly more than expected when compared to the recent Verdigris River survey. Interestingly, all three of these species are considered Ozarkian Highland endemics and have a natural range limited to a small portion of Missouri, Arkansas, Oklahoma, and Kansas.

Two of the most predominant mussels found in the Verdigris River survey were *F. flava* and *Q. metanevra*, comprising 29.3 percent and 23.8 percent, respectively. When compared to the survey, fewer than expected were documented at the Eastep site, contributing only 8.7 and 7.7 percent of the find, respectively.

Mussel species that display lures and use darters for fish hosts, such as *C. aberti* and *P. occidentalis*, apparently had more robust populations in the past. Currently species that are broadcast spawners or use sunfish species as fish hosts, such as *F. flava* and *Q. metanevra*, have the most robust populations in the Verdigris River. This might indicate that water clarity was better in the past and favored some species that use visual lures and members of the darter family (Percidae).

The other species that deserves mention is *A.*

plicata, the most commonly documented mussel at the Eastep site with a relative abundance of 15.4 percent. In the 2009–2010 survey *A. plicata* made up just 1.6 percent of the total. Because this species was the most intensely harvested mussel for the cultured pearl industry in the late 1980s and early 1990s, it drastically declined in status (Miller and Mosher 2008).

A variety of explanations might be offered for the smaller size of valves at 14MY388 compared to those currently found in the Verdigris River. Selection of smaller *A. plicata* and *Q. quadrula* was reported at the Child's Point site in Nebraska (Myers and Perkins 2000). Perhaps they were considered more palatable. Other reasons for smaller shells in mussel middens might include a spiritual significance attributed to large specimens, frequent heavy harvests that removed individuals before they could reach a large size, large individuals being left as parental stock, sustained natural predation, competition, or chance.

APPENDIX B: FAUNAL ANALYSIS

By Mark Volmut

Archeological investigations at the Eastep site recovered a total of 12,337 fragments of bone and teeth, weighing a total of 5,990.6 grams. Information provided here concerns use, cultural modifications, and burning during prehistoric occupations.

The recovered faunal elements are highly fragmented, resulting from both natural and cultural agents. Positive identifications were limited to the larger elements with identifying landmarks, for example teeth, tarsals and carpals (foot and hand bones), and articular epiphyses (end parts of long bones, initially growing separately from the shafts). Despite the highly fragmented nature, the condition and size of the pieces, which average 20 mm in measurement, were sufficient for tabulating cultural indicators, such as cut marks, burning, fractures, and other modifications. However, only limited species-level identification was possible.

Deer, elk, and bison, as well as canids, raccoons, rabbits, beaver, moles, squirrels, mice, turtles, birds, fish, snakes, and frogs make up the 14MY388 assemblage, indicating that at least four microenvironments were used by site inhabitants. Elk and deer, as well as raccoons and squirrels, were exploited in timbered environments, bordering the main streams and tributaries or in clearings near wooded areas (Brohn and Robb 1955; Cockrum 1952). Bison indicate an open range environment with good visibility and access to rivers and creeks, including thickets and areas of abundant cover suitable for rabbits and hares (Hall 1955). Terraces and riverine environments were exploited for small mammals, reptiles, fish, and possibly amphibians (Larson and Van Nostrand 1968).

Methods

The faunal materials were sorted, counted, and weighed. Positive identifications were completed using the faunal comparative collections housed at the Archaeological Research Center at the University of Kansas. All faunal remains were identified to the lowest taxonomic level feasible. Evidence for burning, fragmentation (whether whole or fragmented), color, size, weight, siding, age, portion, cultural and animal modifications were noted for each specimen. Calculation of number of identified species present (NISP) and minimum number of individuals (MNI) was completed, based on the identified teeth and bone fragments, according to the most frequent paired element, measurement of size, and age. Age was determined from epiphyseal fusion and tooth eruption, along with level of growth, thickness, and the morphology of the periosteum (dense fibrous membrane covering the surface of bones except at the joints and serving as an attachment for muscles and tendons).

Analysis

Of the 12,337 fragments recovered, only 11.78 percent (1,453/12,337) were identified above taxon class. A higher success rate was achieved in identifying the remains to taxon class (mammal, reptile, avian, osteichthyes), with 87.31 percent (10,772/12,337) identified to nearest taxon. Mammalia fauna account for 89.18 percent (11,002/12,337) of the total remains; reptilian, 6.39 percent (788/12,337); avia, 3.01 percent (372/12,337); osteichthyes, 0.48 percent (59/12,337); and amphibian, 0.13 percent. Elements not identified to any taxa make up only 0.77 percent (95 fragments).

The lower success rate of identification may be attributed to the predominance of non-diagnostic skeletal elements and the high degree of fragmentation. Butchering indicators, such as cut marks, green breaks, and abrasion, were easily observed but few in number, being present on only 0.57 percent (70/12,337) of the specimens. Plausible explanations for the degree of fragmentation include marrow extraction and bone grease procurement by site occupants, post-depositional taphonomic processes, and burning.

More than 40 percent (5,038 fragments) of the assemblage shows evidence of burning, with the degree of burning on individual pieces ranging from slight to calcinated. Calcination is consistent with bones subjected to periods of intense heat, which could be produced by a hearth fire (Stiner et al. 1995). Evidence of hearth usage at the Eastep site included a large burned sandstone feature (F2204 in A102) that was interpreted as the remains of a hearth or cooking oven.

Distribution of Faunal Remains in Areas 101 and 102

The site was divided into two excavation areas: A101 along the cutbank of the Verdigris River and A102 atop the river terrace (Figure 1). The total NISP from A101 is 2,456 (19.91 percent), with a total weight of 1,725.90 grams (28.80 percent). The total number of burned fragments at A101 is 1,643, which is 32.60 percent of the whole faunal assemblage. A102 had an NISP of 9,881 (80.09 percent), with a total weight of 4264.70 grams (71.19 percent). Burned fragments at A102 numbered 3, 395, making up the larger portion (67.39 percent) of burned material. With the exception of bison, elk, and fish, the distribution of animal remains was fairly equal across all locations, features, and excavation levels, in A101 and A102, and in hearths.

A bison maxillary second molar was recovered in A101, and a tibia and fragments of teeth were found on the surface at the extreme northeastern and southeastern units of A102. All identified elk elements were burned and were recovered from the surface down to 10 cm at F50, and between 80 and 110 cm at F17 in A101 and in sporadic locations near hearths and the large pit feature (F2201) in A102. Partially burned fish bones were recovered only between 10 to 55.5 cm in F29, F50, and F100 at A101, throughout the hearths and features of A102, and only in the lowest excavation levels at all locations between N291 E991 and N228 E993.

Large Mammals

Large mammals dominate the 14MY388 assemblage, with 79.34 percent (9,788/12,337) fragments by count and 89.25 percent (5,346.80 g/5,990.60 g) by weight. The most frequent elements are long bone and tooth fragments, often in a highly fragmented state, allowing only 9.18 percent (1,133/12,337) to be identified to species.

Deer were a significant resource at the Eastep site and make up 95.68 percent (1,048/1,133) of the identified large mammals by count and 94.31 percent (2,179.60 g/2,311.00 g) by weight. Deer comprise 8.79 percent (1,084/12,337) of the total assemblage by count and 36.38 percent (2,179.60 g/5,990.60 g) by weight. The MNI for deer elements is seven individuals, based upon skull petrosal bones, which were the most complete paired elements for calculation.

Deer fragments were found at all locations and excavated levels throughout the site, including hearths. All elements of deer are present, with metapodials being the most frequent element by count and by weight. This suggests that at least some of the deer were brought back whole and dismembered at the site.

Cut marks were observed on 23 fragments (19 percent) on both the axial skeleton and appendages. The marks are located along areas of the bones in a manner consistent with the purposeful dismemberment of a carcass. The low frequency of cut marks could be attributed to the small and fragmentary nature of the bones, burning, and lack of preservation due to taphonomic conditions at the site. Green breaks are apparent among the highly fractured bone and are consistent with breakage for marrow extraction.

Burned deer elements make up 22 percent (485) of the fragments, with 53 percent in a calcined state. They were recovered from hearths and pit features and other locations near hearths, down to 40 cm in A102 and down to 115 cm in A101. The frequency of deer elements was equal for all excavated locations and features (including hearths) and increased in number down to the lowest excavation levels in most of the site.

Elk is poorly represented at the site, comprising only 0.34 percent (42/12,337) of the total assemblage by count and 1.67 percent (100.10 g/5,990.60 g) by weight. Both the axial bones and appendages of elk are present; however, these are fragmented and too few in paired elements to determine MNI beyond a single animal. Cut marks and green breakage, consistent with dismemberment and bone marrow extraction, are apparent on only one elk element.

Bison were recovered from the surface (0–10 cm) at only a few locations. Elements make up 0.05 percent (7/12,337) by count and 0.52 percent (31.30 g/5,990.60 g) by weight, consisting of a tibia shaft, maxillary teeth, and other tooth fragments. Cut marks and burning are not apparent on the bison materials.

Unidentified large mammal remains make up the largest portion of the assemblage with 70.14 percent (8,653/12,337) by count and 50.53 percent (3,026.80 g/5,990.60 g) by weight. Despite having comparable dimensions to deer and some elk bones, these materials were not identified beyond mammal class taxonomic designation because they are thoroughly fragmented (average length of 15 mm) and lack identifiable landmarks necessary for positive identification. Most of these remains consist of long bone and cancellous bone fragments, bone burned to a calcined state, and cortical periosteum fragments of less than 5 mm in length.

The weight ratio of the unidentified large animal elements to deer elements is 1.4:1 (3,026.80 g/2,179.60 g). The unidentified remains were recovered together with deer from all features and locations throughout A102 and nearly 90 percent of the features and locations from A101. Co-distribution and mean weight ratios suggest that these elements are likely deer bone fragments; however, their condition precludes further positive identification based upon morphological characteristics. Deer and unidentified large mammal fragments dominate the assemblage at nearly 80 percent when combined, emphasizing the importance of deer in the food economy at the time of occupation.

Small Mammals

Small mammals have a combined MNI of 18 and make up 8.57 percent (1,057/12,337) of the identified mammals by count and 4.45 percent (265.90 g/5,990.6 g) by weight. Rabbits and hares (*lagomorpha*) make up the largest percentage of identified small mammals at 1.58 percent (195/12,337) by count, followed by raccoon (*Procyon lotor*) at .10 percent (12/12,337), and beaver (*Castor canadensis*) at .02 percent (3/12,337). Beaver is the only small mammal elements that exhibit butchering marks and probably were exploited by the site occupants for food and pelts. However, small mammals do not represent a significant percentage of potential food animals. Canid (*canis* sp.) bones make up less than 1 percent of the total assemblage, with coyote-size canids predominating. These certainly could represent both intrusion animals and domestic dogs.

Squirrels (*Scuridae*) and mouse-size mammals, such as voles, shrews, and mice, account for 2.59 percent (319/12,337) by count and 2.90 percent (172.40 g/5,990.60 g) by weight. Although none of these specimens show tool marks, 1.21 percent are burned, suggesting possible contemporaneity with site occupation. Unidentified small mammal remains are abundant, mainly in the form of long bone and skull fragments, totaling 4.58 percent (565/12,337) by count and 0.48 percent (28.80 g/5,990.60 g) by weight.

Birds

Avian elements make up 3.02 percent (372/12,337) by count and 1.10 percent (65.60 g/5,990.60 g) by weight of the faunal assemblage. The identified species include turkey (*Meleagris gallopavo*), a small song bird (*Passerine*), and possibly duck (*Anas* sp.). Avian bones were abundant and recovered at most locations within the site, more frequently at lower levels down to 115 cm, including F2201 and F2204, respectively. Avian bones are represented largely by burned long bone diaphysis fragments (3.31 percent; 167/5,038), making species identification difficult. These unidentified avians make up 3 percent (370/12,337) by count and 1.09 percent (65.40 g/5,990.60 g) by weight. Butchering marks are apparent on two long bones, further suggesting that at least a small portion of unidentified avian bones represent exploitation for food. However, bone preservation is not sufficient for assessing their significance as a food source for Eastep site occupants.

Reptiles

Reptiles, namely turtles and snakes, make up 6.38 percent (788/12,337) by count and 4.84 percent (290.10 g/5,990.60 g) by weight of the assemblage. Turtles account for 6.14 percent (758/12,337) by count and 4.78 percent (286.80 g/5,990.60 g) by weight and were found at all locations throughout the site. Unidentified small turtles make up the largest portion (5.71 percent (708/12,337) of the reptile elements by count. Turtle faunal materials are mainly carapaces and plastrons with a small percentage of long bones. These mostly burned and calcined elements represent 6.11 percent (308/5,038) of total burned fragments.

Identified turtles consist of alligator snapping turtle (*Macroclemys temminckii*) and box turtles (*Terrapene* sp.); however, these make up only 7 percent (53/758) of the total turtle elements. Box turtles usually are found near wooded streams adjacent to open fields (Ernst and Barbour 1972), and alligator snapping turtles are common near streams and at the bottoms of rivers and tributaries, such as the environment near the site. However, because of the distribution throughout the site, the presence of cut marks, and calcination through burning, turtles are assumed to be part of the inhabitants' dietary resources.

Excavations recovered 30 partially calcined snake vertebrae in hearth features and near hearths at levels down to 40 cm. These are unidentified small snakes, probably less than 50 cm in length. Snakes would have been common in the area, and the level of burning and deposition of the elements suggested that snakes were exploited during the site occupation.

Fish

Burned fish vertebrae make up 0.47 percent (59 fragments) of the assemblage and were found throughout the site. The sample of fish remains includes river carpsucker (*Carpiodes carpio*), gar (*Actinopterygii*), and other unidentified small fish varieties, suggesting that the site occupants exploited the available riverine resources.

Amphibians

A total of 16 frog long bone fragments were recovered at levels down to 25 cm. Burning could not be determined on the fragments. Frogs may have been used at the Eastep site, but these fragments are likely intrusive components of the site.

Modified Bone

Bone tools and modified bone consist of only 12 specimens recovered in a fragmentary state, and more than 70 percent were burned. They comprise four modified and burned deer antler tines, five modified and burned fragments of long bone, and three partially burned awl tips. Each antler tine measures about 10 cm and is calcined, fractured from the base, abraded, and polished, with a notch on the point. They likely are flaking tools (Baker et al. 1941; Olsen 1979, 1980; Ritchie 1965).

The bone awls probably were made from deer long bones, one likely from a femur, and were ground and polished to workable points. One specimen exhibits abrasion and polish on the terminal shaft, and the point appears roughened and less polished than the shaft, in a manner that suggests possible resharpening before discard (Semenov 1964).

The five modified long bone fragments were ground, polished, and charred black. Four possibly were made from large mammal long bones, perhaps deer metapodials. The largest (30 mm) of these fragments has 10, 2-mm wide engraving marks along the lateral edge, spaced about 1mm apart. It is similar to a bison metapodial flesher, although bison fleshers typically are engraved along the terminal edge. The remaining modified bone tube fragment is a large avian tibiotarsus, which measures 21 mm and is abraded and highly polished.

Seasonality

Seasonality at the Eastep site is hard to determine based upon the faunal elements alone. Age is difficult to fully ascertain because of the low number of articular epiphyses recovered; only 2.79 percent (343/12,337) of the fragments are adequate for determining age. However, the abundant deer bones and antler fragments, recovered from all areas of the site, indicate a year-round exploitation of deer. The small mammals (Goldman and Jackson 1950; Larson and Van Nostrand 1968; Linhart and Knowlton 1967) and reptiles (Carpenter 1957) would have been abundant from the spring through the fall and available during warmer periods in the winter months, which also suggests a year-round occupation of the site.

Discussion

The taxonomic composition of the faunal assemblage is dominated by large mammals (79.34 percent) and strongly suggests site-based activities, including resource extraction for the processing and cooking of hunted animals. Primary exploited species comprised deer, duck and turkey-size avians, and riverine resources, such as fish and turtle. Bison were underrepresented, as opposed to the profusion of deer and elk to a lesser extent. Animal elements were recovered equally throughout the site often down to the lowest levels, with a few exceptions (bison, elk, and fish) as mentioned. The inhabitants exploited the resources from both riverine and land assemblages, and evidence of processing, butchering, and burning are apparent. The abundant and highly fragmented bones indicate an intensive site occupation.

Deer were a significant resource at the Eastep site and make up 8.79 percent (1,084/1,2337) of the total assemblage by count and 36.38 percent (2,179.60g/5,990.60g) by weight. Despite the large amount of materials identified as deer, an MNI of only seven individuals is calculated because of the highly fragmented state of the faunal materials.

The profusion of deer and other large mammals suggests that hunters likely operated in the open woodland environment immediately surrounding the site. Cut marks were found on 19 percent of the deer fragments and are present on both the axial skeleton and the appendages in a manner consistent with the purposeful dismemberment of the carcass. All elements of deer are represented in the assemblage, with an abundance of long bone elements; metapodials are the most frequent element by count and by weight. This suggests that at least some of the deer were brought back whole and dismembered at the site.

Other animal remains include canids, raccoon, rabbit, beaver, mole, squirrel, mouse, turtle, bird, fish, snake, and frog, reflecting the use of at least four microenvironments: timber bordering the river, streams, and tributaries (Cockrum 1952; Brohn and Robb 1955); open range with thickets and areas of abundant cover (Hall 1955); high terraces along river and stream edges; and riverine (Larson and Van Nostrand 1968). Seasonal shifts in hunting and occupation are difficult to ascertain because of the condition of the faunal elements. However, the abundance of deer and other identified species, which have the potential of year-round exploitation in most of the environments, support a year-round occupation of the site.

The archeological recovery of faunal materials demonstrated the vast and abundant fauna available during the Late Archaic and Woodland periods (2000 B.C.–1000 A.D.). Site recovery methods of the faunal elements were appropriate for determining the extent of cultural use of the materials. Cultural modifications, such as cut marks and burning, tools, and locations of cooking and food processing were well documented. Such evidence is useful for quantifying and tabulating the recovered faunal remains and contributes to an understanding of the importance that these animals had in the subsistence practices of the Eastep site inhabitants.

APPENDIX C: PALEOETHNOBOTANICAL ANALYSIS

BY ANDREW R. WYATT AND
REBECCA FRIEDEL

Fifty flotation samples from the Eastep site were analyzed for the identification of archaeobotanical remains. These included samples from both fractions: the light (the fraction of the flotation sample that rises to the surface of the water) and the heavy (the fraction that sinks). The site did not yield any macrofossils (botanical remains recovered during the course of excavations rather than through flotation). The processed flotation samples were analyzed at the archaeobotanical laboratory of Professor Andrew R. Wyatt at the University of Illinois at Chicago with assistance from Rebecca Friedel, a recent graduate of UIC, and Whitney Cleaver, a current UIC student.

Methods

The samples that arrived at UIC had been processed through flotation, dried in the field, and packed in individual Ziploc bags. The flotation samples had been given unique identification numbers, beginning with 10001. Information on each sample was recorded on the Flotation Data Record form, including archeological time period, lot number, context, date collected, date analyzed, archaeobotanical analyst, and any observations of the condition of the sample. Before sorting, the flotation samples were sieved through two graduated screens of 2 mm and 1 mm, dividing the samples into <2 mm, 1–2 mm, and >1 mm sizes for ease of sorting and identification. Some samples were small enough that this initial step was unnecessary. After sieving, the three separate samples were weighed.

Samples were sorted into taxonomically distinct groups, based on anatomical characteristics, using a 40x magnification light microscope. Archaeobotanical remains were identified through comparisons with a reference collection borrowed from the Kansas Historical Society, a small reference collection acquired by Tomasic and carbonized in the UIC laboratory by Wyatt, and a seed identification manual (Davis 1993). Each individual archaeobotanical remain, or group of similar remains, was given a unique item number and weighed. Item identifications were recorded on a Broadly Provenienced Organic Material form. Finally, this information was recorded on a Microsoft Excel spreadsheet with columns for the unique sample number, provenience information, total number of specimens of that type (family, genus, species, etc.), individual sample weight, taxonomic plant name, plant part, and whether the specimen was carbonized. The spreadsheet of all archaeobotanical remains appears in Tomasic (2012:139–141). The techniques of identification and recording follow the standards set by V. L. Bohrer and K. R. Adams (1977) at the site of Salmon Ruin in New Mexico.

Botanical Remains

The archaeobotanical remains were sparse, with many of the recovered specimens uncarbonized. Although the site is located in a riverine environment, which can contribute to the preservation of uncarbonized plant remains if permanently waterlogged, the Eastep site area is seasonally inundated, and regular flooding and desiccation tend to have a deleterious effect on preservation. In addition, open sites are an unforgiving environment for the preservation of plant remains, and any remains that are uncarbonized generally are considered modern intrusions (Pearsall 2000). Therefore, it was not possible to determine with any certainty if the uncarbonized remains at 14MY388 were archeological. Unless it can be determined unequivocally that the archaeobotanical remains are ancient (either through the identification of undisturbed stratified deposits or the direct dating of the remains), it must be assumed that they are modern or more recent intrusions.

Unidentifiable Remains

A small number of archaeobotanical remains were identified only to the level of Spermatophyte or Angiosperm. Spermatophytes are plants that produce seeds, including both angiosperms and conifers; thus, they are the most inclusive of plant categories used here (Esau 1977). The identification of a particular sample as Spermatophyte tissue indicates that the item came from a seed-bearing plant. Identification beyond this simple categorization was not possible, either due to a lack of identifiable structure or damage to the archaeobotanical remains during post-depositional processes or carbonization. A number of plant remains were classified as Angiosperms. Angiosperms are seed-producing plants that are distinguished from conifers by the production of flowers, seeds with endosperms, and seed-bearing fruits (Esau 1977). The identification of some remains as Angiosperm indicates that they were identifiable as tissue from a seed or an identifiable part of a seed-producing plant, but identification beyond this level was not possible due to their condition.

Uncarbonized Remains

Despite the questionable nature of the uncarbonized remains, it is worthwhile to classify those items in the assemblage that were identifiable to family, genus, or species. The most prevalent of these items were seeds from the *Amaranthus* genus and from the Chenopodiaceae family. Although amaranth and chenopods have been used as food plants, they are also weed species indicative of disturbed areas, such as near a stream. In fact, the entire uncarbonized archaeobotanical assemblage recovered from the Eastep site is disturbance taxa, including a small number of remains from the Solanaceae, Poaceae, Molluginaceae, and Scrophulariaceae families. The contexts in which these seeds were found, as well as their uncarbonized state, suggest that these are likely more recent intrusions that reflect the disturbed nature of this inundated riverine environment, rather than representing economic plants used by Archaic inhabitants.

Carbonized Remains

The majority of recovered carbonized botanical remains is hardwood charcoal. At the most general level, hardwood consists of trees that are distinct from pine and often represent the most varied remains in an archaeobotanical assemblage. Hardwood may be used for construction materials and fuel and represents many different types of economically useful species, including fruit and nut trees. Therefore, archaeobotanical remains of hardwood need to be identified at least to the family level to provide an analysis of their presence in the archeological record. However, most of the carbonized hardwood remains at 14MY388 were too small, fragmentary, and damaged by post-depositional activity to identify even to the family level. Without this rudimentary identification, it is difficult to state with any certainty what activities these remains represent or what information about the environment they could provide. The generally small size of the remains indicates that they were used mainly for firewood.

Although further analysis using Scanning Electron Microscopy (SEM) is necessary, initial observations suggest that the majority of the wood used was small twigs and branches. The curvature of the arc of annual growth rings can indicate the size of the particular specimen; greater curvature indicates a small piece of wood, such as a small branch or twig, whereas less curvature indicates a large piece of wood, such as the trunk of a large tree. The majority of the hardwood remains with visible curvature growth rings were significant. Although conclusions are preliminary, further analysis could hint at the wood resources available to the ancient inhabitants and whether they had access to heavily forested areas of large trees or had access only to branches and twigs from small trees or shrubs.

Whereas hardwood was identifiable at a broad level, other archaeobotanical remains could be identified to the family, genus, and even species level. The greatest number of these included the carbonized remains tentatively identified in the Juglandaceae family, including both hickory (*Carya* spp.) and walnut (*Juglans* spp.). These remains consisted mainly of small fragments of the hard inner shell or endocarp that encases the actual nut or cotyledon. The small size of the remains precluded a more specific identification. The shells were identified based upon their interior morphology and compared with hickory and walnut shells collected in the field and carbonized in the lab. One of the specimens retained enough morphology to tentatively identify it to the genus *Juglans*. Hickory and walnut are common remains identified in archaeobotanical assemblages in the Great Plains and the Midwest (Adair 2006). The trees are common and highly productive, leading to extensive exploitation.

Two seeds indicative of the exploitation of wild species were identified as well, including one carbonized grape pip (*Vitis* spp.) and a seed from the Polygonaceae family. Grape has been recovered from Archaic assemblages in the area, suggesting the antiquity and ubiquity of its exploitation. The seed from the wild buckwheat (Polygonaceae) family could be representative of the *Polygonum* genus, which includes a number of economically important species, or it could be a member of the *Rumex* genus, which includes dock. Both of these were collected and exploited as food species and have been found in archaeobotanical assemblages throughout the region (Adair 2006).

Two thin rind fragments of gourd (*Cucurbita* spp.) were identified in the floral assemblage. Gourds have been identified in Archaic assemblages throughout the Great Plains and the Midwest, suggesting substantial antiquity in their use (Smith 1992). Although gourds were originally domesticated in Mesoamerica (Flannery 1986), there is evidence for an independent domestication in North America (Smith 1992). The gourd rinds identified were quite small and thin (2 mm), indicating that they likely represent the wild variety.

Maize (*Zea mays*) possibly was found in the form of a small fragment of a carbonized kernel. The maize kernel was identified by its characteristic internal structure that develops during carbonization. Because maize has a high proportion of sugars, a glossy, bubbly interior is created when kernels are heated and carbonized. The maize kernel was too small to identify with certainty, and a small number of remains makes one wary of drawing any definite conclusions regarding maize production and use.

Discussion

The relatively small quantity of carbonized botanical remains from the Eastep River Bank Stabilization Project precludes a detailed analysis of quantitative, spatial, or temporal patterns in the archaeobotanical assemblage. The recovered carbonized remains do provide a tantalizing suggestion of what could be retrieved through the continued collection of samples and the flotation and analysis of archaeobotanical remains from specific contexts. The remains of nut shell from the Juglandaceae family and seeds of grape and Polygonaceae indicate the exploitation of wild resources, consistent with the findings of Archaic assemblages throughout the region. Furthermore, the recovery of gourd rinds and corn kernels point to the beginnings of indigenous cultivation of domesticated species at this time.

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GEOARCHAEOLOGY AND PALEOENVIRONMENTAL CONTEXT OF THE EASTEP SITE (14MY388), SOUTHEAST KANSAS

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A geoarchaeological investigation was conducted at the Eastep site (14MY388), a multicomponent prehistoric occupation on the valley floor of the Verdigris River in southeastern Kansas. Whereas Area 102 is an archeological palimpsest, Area 101 contains deeply stratified cultural deposits dating to the Late Archaic and Woodland periods. This paper provides a geomorphic, sedimentologic, and soil-stratigraphic context for interpreting the archeological record, assesses site formation processes, and provides a numerical chronology for the alluvial deposits and associated soils. Also, the $\delta^{13}C$ values of pedogenic organic matter are used to infer bioclimatic change during the period of occupation in Area 101.

The Eastep site (14MY388) is located in Montgomery County, Kansas, adjacent to the Verdigris River (Figure 1). The site consists of Area 101 (A101) on the south bank of the Verdigris, and Area 102 (A102) at the foot of the valley wall (Figures 1 and 2). Although an archeological palimpsest occurs in A102, well-stratified Late Archaic and Middle Woodland cultural deposits were recorded in A101. Tomasic et al. (this volume) present the results of archeological investigations at the site, so those details are not repeated here. Instead, the author provides a geomorphic, sedimentologic, and soil-stratigraphic context for interpreting the archeological record, assesses site formation processes, and determines the numerical chronology of the alluvial deposits and associated soils at 14MY388. Also, the $\delta^{13}C$ values of pedogenic organic matter are used to infer bioclimatic change during the period of occupation in A101.

Emphasis is placed on describing and interpreting the soil-stratigraphy at 14MY388. This strategy is employed because in A101 the cultural deposits are associated with buried soils. Also, soils can provide important clues about the role of natural processes in the formation of cultural deposits at a site (Mandel and Bettis 2001).

GEOMORPHOLOGY

The Eastep site is located on the valley floor of the Verdigris River, one of the largest streams in southeastern Kansas. The Verdigris River flows south through Montgomery County before crossing into northeastern Oklahoma, where it joins the Arkansas River near the town of Muskogee. At 14MY388 the Verdigris is a sixth-order stream with a drainage area of about 4,650 km^2.

Several alluvial landform-sediment assemblages comprise the valley floor of sixth-order segments of the Verdigris River, including a floodplain complex (T-0a and T-0b), a low terrace (T-1), and a high terrace (T-2) (Mandel 2012). The lowest surface of the floodplain complex, T-0a, is 20–30 m wide and about 1–2 m above the mean water level of the Verdigris River. T-0a is seasonally flooded. The T-0b surface is 50–100 m wide and about 2 m above the T-0a surface. Despite its higher elevation compared to T-0a, T-0b also is seasonally flooded. Natural levees, abandoned channels, and flood chutes are common on T-0b.

The T-1 terrace is 3 m above the T-0b surface and dominates the valley floor of the Verdigris River. At the Eastep site the T-1 terrace frequently

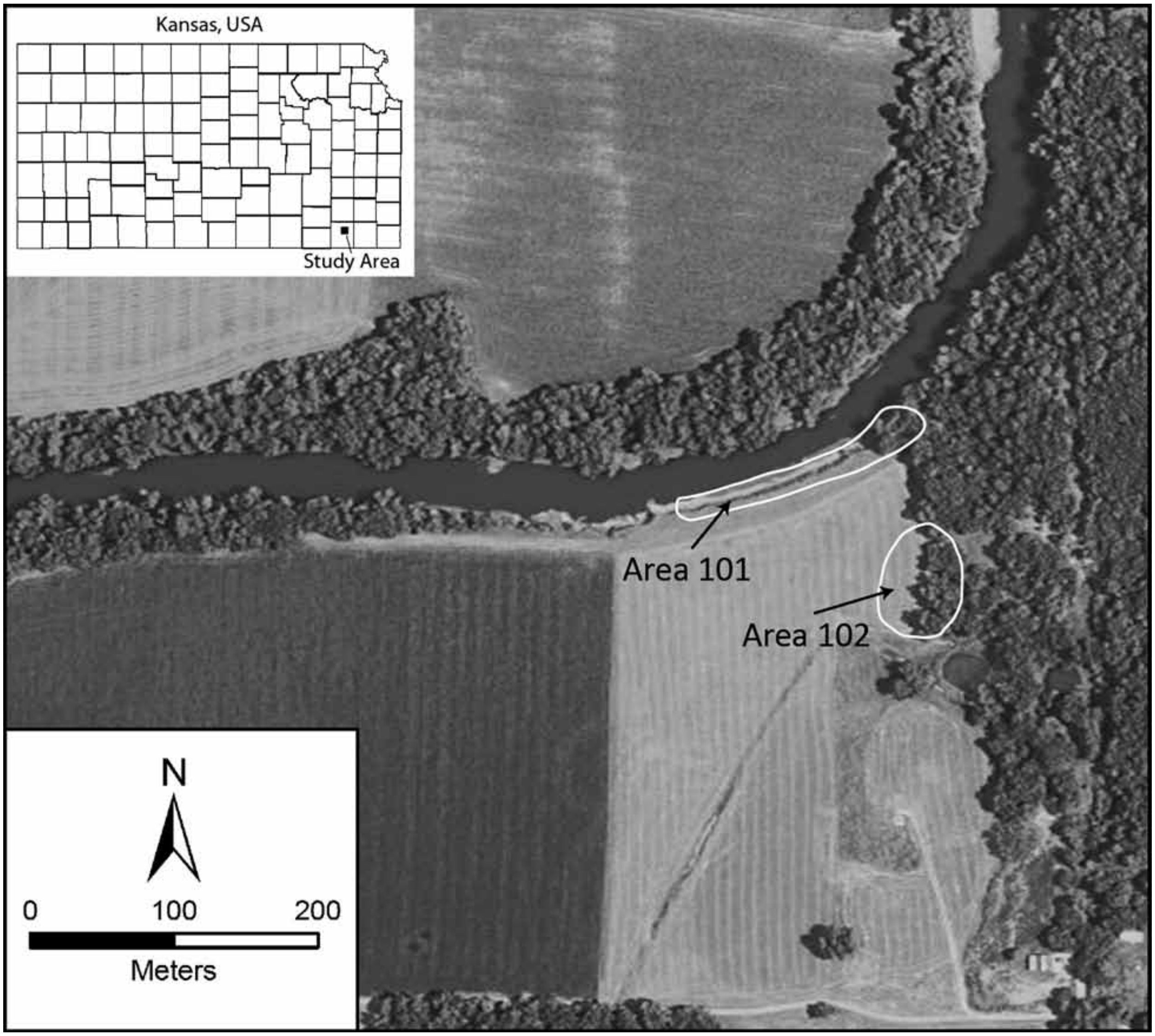

Figure 1. Modified Google Earth image showing the location of A101 and A102 at the Eastep site (imagery date: 2006). The inset map shows the location of the site in Montgomery County, Kansas.

floods, with a recurrence interval of two to three years. T-1 is a paired terrace and typically is 2–4 km wide. Although most of the tread of T-1 is flat and featureless, channel scars and natural levees occur on this geomorphic surface.

The T-2 terrace occurs as scattered remnants along the margin of the valley floor. This geomorphic surface is 4–5 m above T-1 and is rarely flooded. The T-2 terrace is flat and featureless.

Only one alluvial landform-sediment assemblage comprises the valley floor at 14MY388: the T-1 terrace. A101 is associated with the T-1 terrace, and A102 is on bedrock comprising a footslope that merges with T-1 at the base of the valley wall.

METHODS

Field Methods

Most of the information about the soil-stratigraphy and sedimentology of the Eastep site was gleaned from a backhoe trench and a section of valley fill exposed in a cutbank that marks the northern boundary of A101. The backhoe trench was exca-

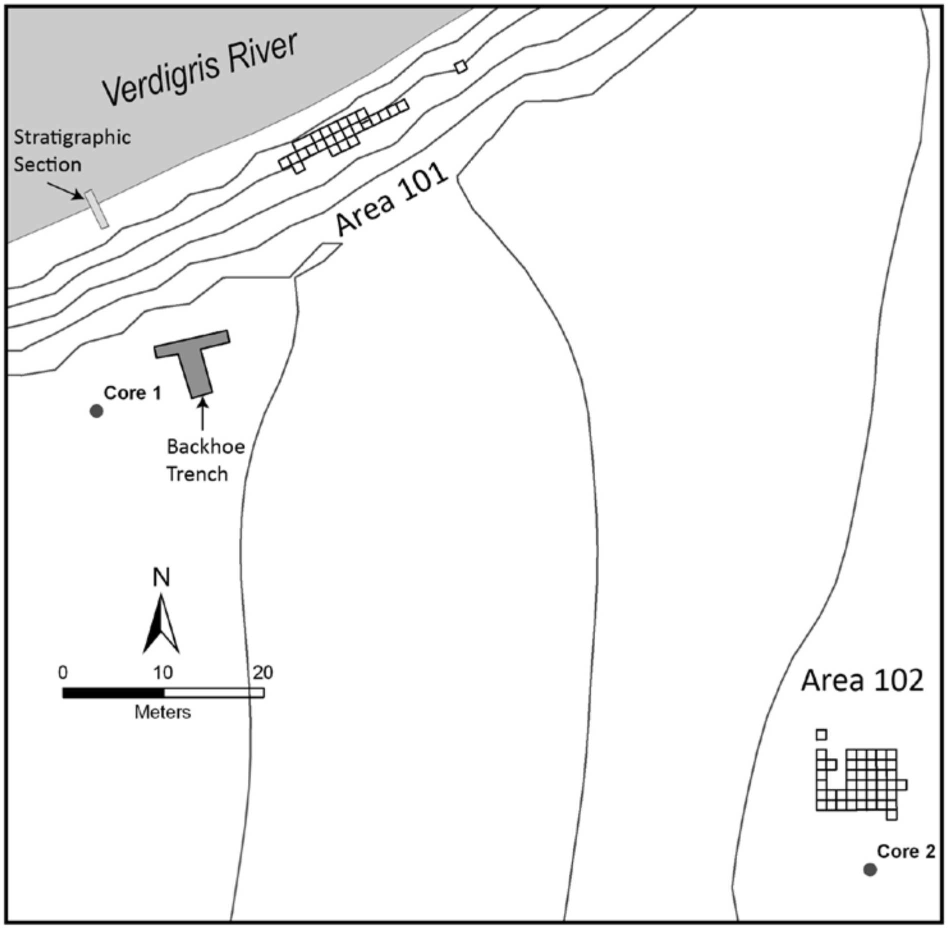

Figure 2. Topographic map of the Eastep site showing the locations of the cores, excavation units, backhoe trench, and stratigraphic section.

vated on the T-1 terrace in A101 (Figure 2). The trench was 4 m long and 2.3 m deep, and a ramp was excavated at a right angle to it in order to provide safe entrance and allow sunlight to illuminate the west wall. The north wall was cleaned with a trowel, examined for cultural materials, and photographed (Figure 3). A profile in the middle of the wall was described and sampled.

A section of T-1 fill exposed in the cutbank immediately north of the backhoe trench was used to study soils and sediments below a depth of 2.3 m (Figure 4). The section was cleaned with a hand shovel to a depth of 7 m and described. Soil and sediment samples were systematically collected from the section, and six charcoal samples, including three from cultural features, were collected for AMS radiocarbon dating.

A Giddings hydraulic soil probe was used to collect two cores: Core 1 next to the backhoe trench and Core 2 on the footslope in A102 (Figure 2). Core 1 was terminated at a depth of only 2.1 m because the anchors holding down the Giddings probe were dislodged as the core barrel penetrated firm, clay-rich alluvium. Core 2 was 1.2 m long and ended in weathered shale. The cores were wrapped in cellophane, placed in core boxes, and transported to the Kansas Geological Survey (KGS), where they were described.

Soils and sediments in the backhoe trench, cutbank exposure, and cores were described and sampled following standard United States Department of Agriculture-Natural Resource Conservation Service (USDA-NRCS) procedures (Schoeneberger et al. 2002; Soil Survey Staff 1982). After soils were identified and described, they were numbered consecutively, with 1 (the modern surface soil) at the top of the profile. When multiple buried soils were present, which was the case in A101, the horizon nomenclature presented by Holliday (2004:339) was used. Specifically, the buried soils were numbered consecutively from the top of a section downward, with the number following the suffix "b." For

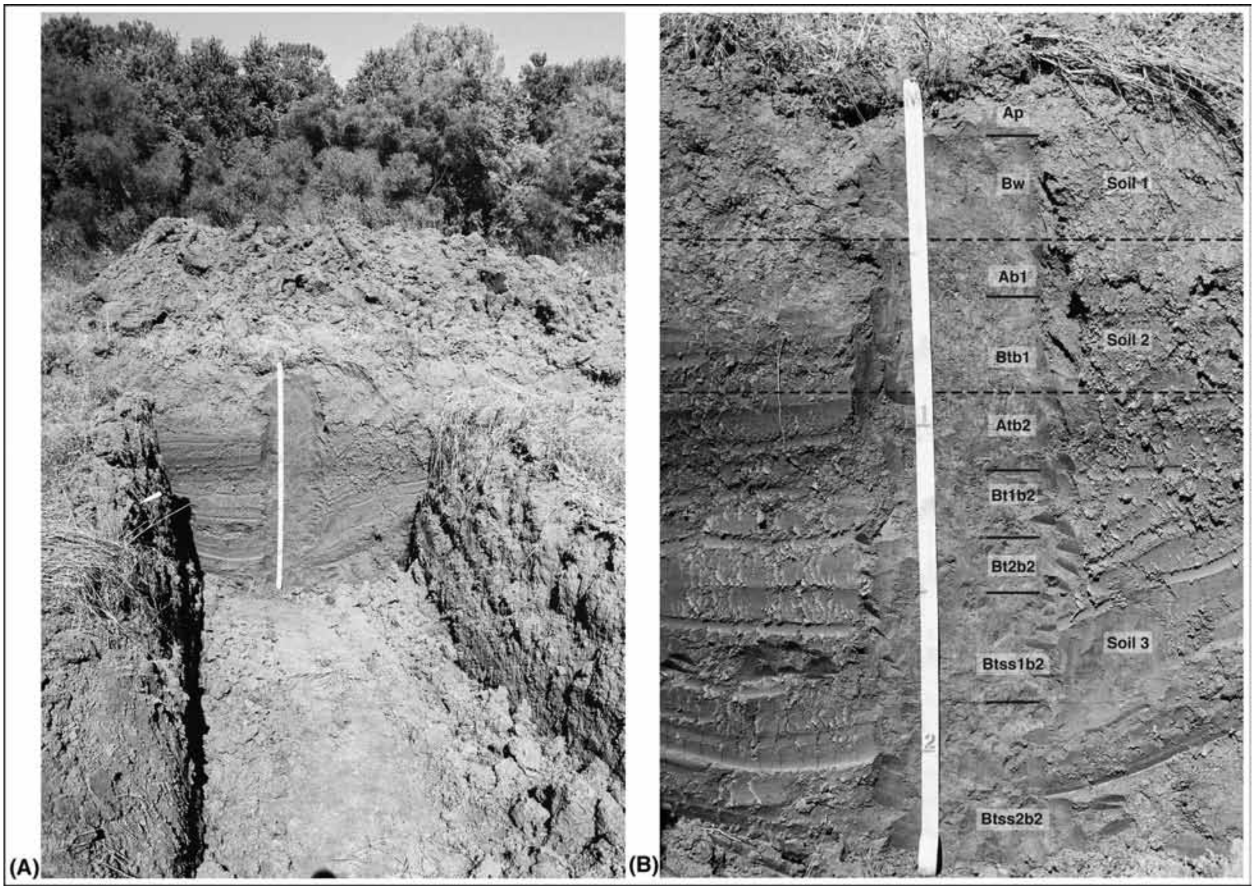

Figure 3. (A) The T-shaped backhoe trench excavated in A101. View is to the northwest. (B) North wall of the backhoe trench showing the sequence of buried soils and soil horizonation in the described profile.

example, the A horizons of two superposed buried soils were numbered Ab1 and Ab2 from top to bottom.

Bulk soil and sediment samples and the cores were transported to the KGS, where physical and chemical analyses were conducted to (1) characterize and confirm field descriptions, (2) assist in interpretation of depositional processes and post-depositional weathering, and (3) reconstruct the relative proportions of C_3 and C_4 vegetation and by extension, the environmental setting associated with the vegetation assemblage.

Laboratory Methods

Soil and sediment samples collected from the backhoe trench, cutbank exposure, and Core 1 were air dried at the KGS and mechanically split into equal halves. Next, the split samples were gently ground in a ceramic mortar and passed through a 2-mm sieve to remove coarse fragments.

One split of samples was dried in an oven at 50º C then homogenized with a ceramic mortar and pestle. Next, 20 ml of 0.5 N hydrochloric acid was added to 1 g of soil in order to remove calcium carbonate. Decalcified samples were oven-dried at 50º C, pulverized using a synthetic ruby mortar and pestle, and transferred to glass vials. The decalcified samples were submitted to the University of Kansas W. M. Keck Paleoenvironmental and Environmental Stable Isotope Laboratory (KPESIL) to determine organic carbon content and $\delta^{13}C$ values of the soil organic matter (SOM). The samples were analyzed on a Costech ECS 4010 Elemental Analyzer in conjunction with a ThermoFinnigan MAT253 isotope ratio mass spectrometer. The $\delta^{13}C$ values are reported in parts per thousand (per mil, expressed as ‰). The precision of reported $\delta^{13}C$

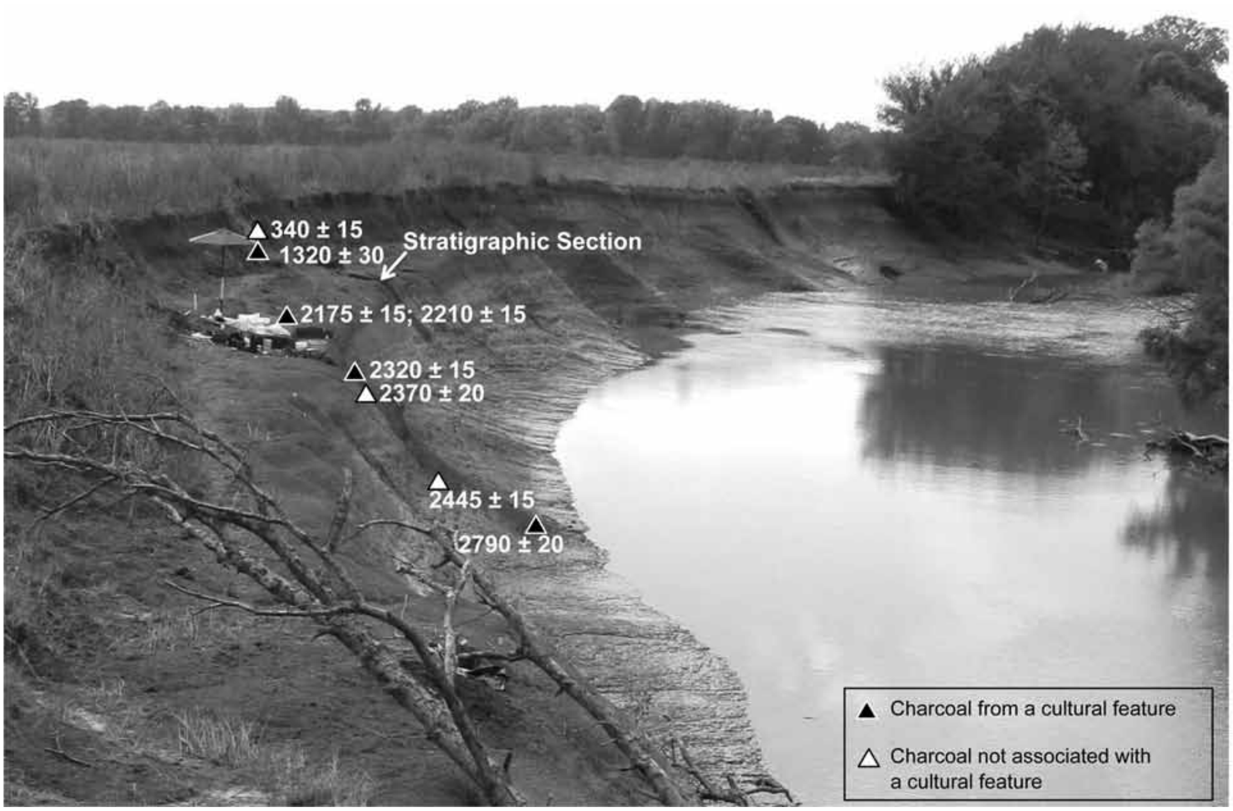

Figure 4. Cutbank along the northern edge of A101. The stratigraphic section noted on the image was used to describe the T-1 fill below a depth of 2.5 m. Radiocarbon ages determined on charcoal samples collected in A101 are shown. With the exception of the top two radiocarbon ages, all of the ages were determined on charcoal samples collected from the cutbank. View is to the west.

values is based on a linear correction of observed values versus expected values of laboratory standards. Carbon isotope ratios ($^{13}C/^{12}C$) are measured against the Vienna Pee Dee Belemnite (VPDB) standard. Typical standard calibration curves yield an R^2 of 0.9994 or greater.

The second split of samples was retained for particle-size analysis at the KGS's Soil Laboratory. The grain-size distribution of these samples was determined using a slightly modified version of the pipette method (Gee and Bauder 1986). The samples were dispersed in a sodium hexametaphosphate solution and shaken on a reciprocal shaker overnight. Silt and clay aliquots were drawn from the appropriate pipette depth based on particle-size settling velocity, oven dried, and weighed to the nearest milligram. The results, presented as weight percentages, total to 100 percent of the < 2 mm mineral fraction. The silt fractions were subdivided as follows: coarse silt (50–20 m), medium silt (20–5 m), and fine silt (5–2 m). Loess standards were used for inter-run comparisons of grain-size data.

RESULTS OF INVESTIGATIONS

Area 101

As previously noted, a backhoe trench was excavated to a depth of 2.3 m on the T-1 terrace in A101 at the Eastep site. The trench was placed near the cutbank that forms the northern boundary of the site. The upper 2.3 m of the T-1 fill was described and sampled in the trench, and a section of T-1 fill exposed in the cutbank immediately north of the backhoe trench was used to describe and sample soils and sediments below a depth of 2.3 m. A composite diagram showing the soil horizonation, radiocarbon chronology, and archeological stratigraphy of the upper 7 m of the T-1 fill was crafted from the trench and cutbank (Figure 5).

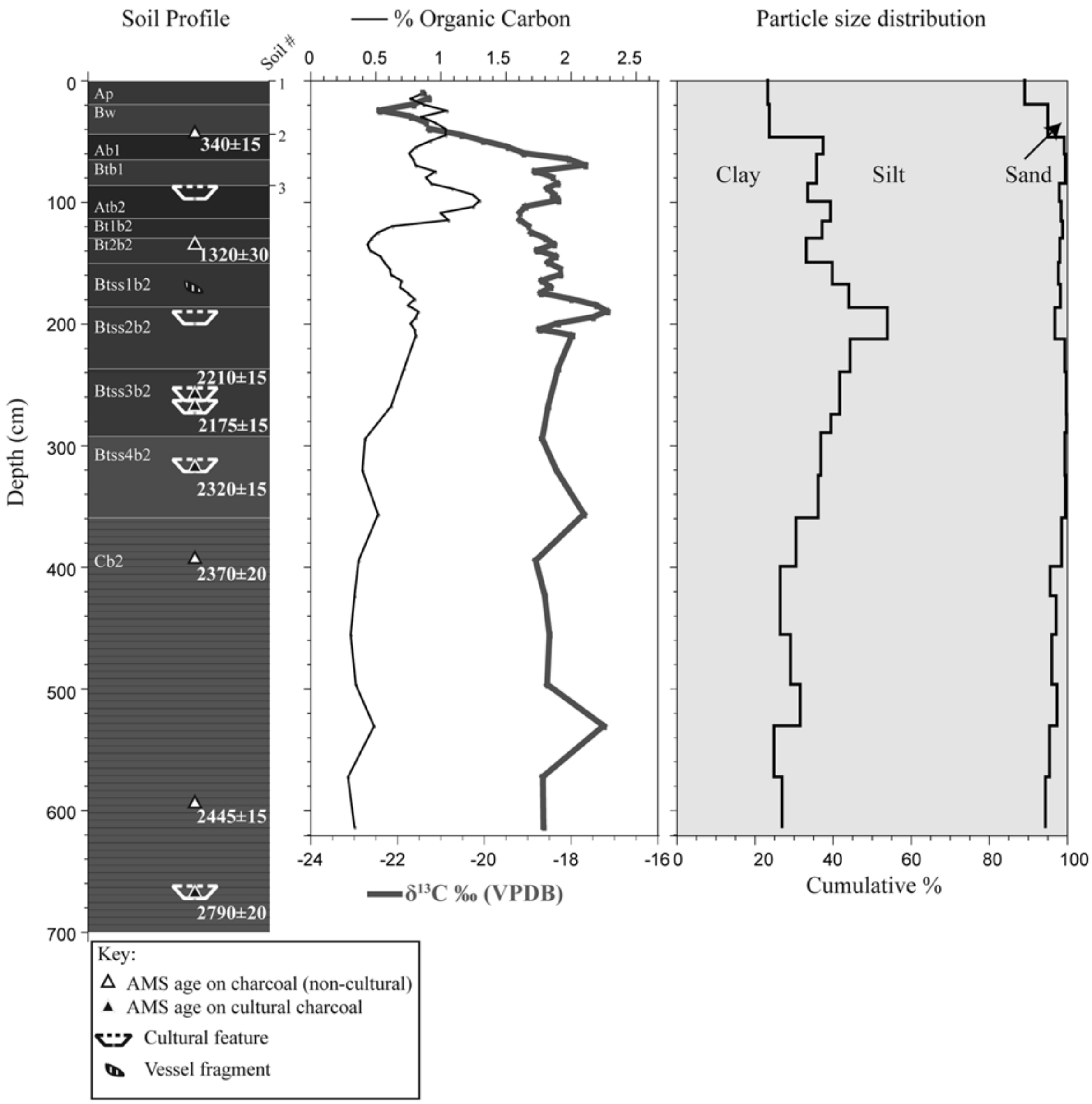

Figure 5. Diagram showing the soil stratigraphy and horizonation, cultural stratigraphy, organic carbon content, d13C values, and radiocarbon chronology of the T-1 fill in A101. The diagram is a composite of the north wall of the backhoe trench and the stratigraphic section exposed in the cutbank.

The upper 7 m of the T-1 fill consists of fine-grained alluvium that was deposited on the distal portion of the late-Holocene floodplain (now the T-1 terrace). Such a low-energy depositional environment accounts for the high clay content of most of the alluvium, especially in the upper 4 m of the fill.

Three strata of fine-grained alluvium comprise the upper 7 m of T-1 fill. The surface soil (Soil 1) has a weakly expressed Ap-Bw profile developed in the 47-cm-thick top stratum (Table 1 and Figure 5). The Ap horizon is 20 cm thick and consists of brown (10YR 4/3, dry) silt loam. It overlies a thin, weakly developed cambic (Bw) horizon consisting of brown (10YR 5/3, dry) silt loam. A clear, smooth boundary separates the Bw horizon from the underlying A horizon of Soil 2.

Soil 2 has a well-expressed A-Bt profile that

Table 1. Description of Section 1 at Locality 101, Eastep Site (14MY388), Verdigris River Valley, Montgomery County, Kansas.

Landform: T-1 terrace
Parent Material: Fine-grained alluvium
Slope: 1%
Drainage: Moderately well drained
Described: September 29, 2009
Described by: Dr. Rolfe D. Mandel

Depth (cm)	Soil Horizon	Description
0–20	Ap	Brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; weak fine granular structure; friable, hard; many fine and very fine roots; abrupt smooth boundary.
20–47	Bw	Brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; few fine faint brown (10YR 5/3) and yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; friable, hard; many fine and very fine roots; many worm casts and open worm burrows; clear smooth boundary.
47–62	Ab1	Dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; few fine faint olive brown (2.5Y 4/3) mottles; weak medium and fine subangular blocky structure parting to moderate medium and coarse granular; firm, hard; common fine and very fine roots; common worm casts and open worm burrows; gradual smooth boundary.
62–85	Btb1	Dark grayish brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; common fine faint dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; very firm, very hard; common distinct discontinuous dark grayish brown (10YR 4/2) clay films on ped faces; common fine and medium pores; common fine and few very fine roots; few worm casts and open worm burrows; gradual smooth boundary.
85–116	Atb2	Very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure; very firm, very hard; common distinct discontinuous dark grayish brown (10YR 4/2) clay films on ped faces; common fine and very fine roots; few worm casts and open worm burrows; gradual smooth boundary.
116–130	Bt1b2	Dark grayish brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; common fine faint dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) mottles; weak medium angular blocky structure parting to weak fine angular blocky; very firm, very hard; common distinct discontinuous dark grayish brown (10YR 4/2) clay films on ped faces; common very fine, fine and medium pores; few fine and very fine roots; few worm casts and open worm burrows; gradual smooth boundary.
130–150	Bt2b2	Dark grayish brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; common fine faint dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; very firm, very hard; common distinct discontinuous dark grayish brown (10YR 4/2) clay films on ped faces; common very fine, fine and medium pores; few fine and very fine roots; few worm casts and open worm burrows; gradual smooth boundary.
150–187	Btss1b2	Dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; common fine faint dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; extremely firm, extremely hard; common distinct discontinuous dark grayish brown (10YR 4/2) clay films on ped faces and clay flows in macro-pores; 10 percent continuous distinct intersecting slickensides throughout; few fine, medium, and coarse pores; few fine roots; few worm casts and open worm burrows; gradual smooth boundary.

Table 1. (continued)

Depth (cm)	Soil Horizon	Description
187–240	Btss2b2	Dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; common fine faint dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) mottles; moderate medium and coarse prismatic structure parting to moderate medium angular blocky; extremely firm, extremely hard; common distinct discontinuous dark grayish brown (10YR 4/2) clay films on ped faces and clay flows in macro-pores; 15 percent continuous distinct intersecting slickensides throughout; few fine, medium, and coarse pores; few fine roots; few worm casts and open worm burrows; gradual smooth boundary.
240–290	Btss3b2	Dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; common fine faint olive brown (2.5Y 4/3) mottles; moderate coarse prismatic structure parting to moderate medium angular blocky; extremely firm, extremely hard; common distinct discontinuous dark grayish brown (10YR 4/2) clay films on ped faces and clay flows in macro-pores; 15 percent continuous distinct intersecting slickensides throughout; few fine, medium, and coarse pores; few fine roots; few worm casts and open worm burrows; gradual smooth boundary.
290–360	Btss4b2	Olive brown (2.5Y 4/3) heavy silty clay loam, dark olive brown (2.5Y 3/3) moist; few fine faint yellowish brown (10YR 5/4) mottles; moderate coarse prismatic structure parting to moderate medium and fine angular blocky; extremely firm, extremely hard; common distinct discontinuous very dark grayish brown (2.5Y 3/2) clay films on ped faces and clay flows in macro-pores; 15 percent continuous distinct intersecting slickensides throughout; few fine, medium, and coarse pores; gradual smooth boundary.
360–700	Cb2	Stratified light olive brown (2.5Y 5/3) to olive brown (2.5Y 4/3) silty clay loam coarsening downward to silt loam, dark olive brown (2.5Y 3/3) moist; common fine distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 4/6) mottles; massive; firm, hard; few fine, medium, and coarse pores.

spans the 38-cm-thick middle stratum and is welded to the underlying buried soil (Soil 3). The Ab1 horizon consists of dark grayish brown (10YR 4/2, dry) silty clay loam. The underlying argillic (Btb1) horizon is a dark grayish brown (2.5Y 4/2) silty clay loam with angular-blocky structure and distinct, discontinuous clay films. The Btb1 horizon is welded to the top of Soil 3, which accounts for the clay films and subangular-blocky structure in the Atb2 horizon.

Soil 3 has a well-expressed At-Bt-Btss profile developed through the upper 2.75 m of the bottom stratum exposed in the cutbank at 14MY388. The Atb2 horizon is 31 cm thick and consists of very dark grayish brown (10YR 3/2, dry) silty clay loam. Distinct, discontinuous, dark grayish brown (10YR 4/2, dry) clay films extend downward from the Btb1 horizon of Soil 2 into the Atb2 horizon of Soil 3. The Bt1b2 and Bt2b2 horizons have a combined thickness of 34 cm and consist of dark grayish brown (2.5Y 4/2, dry) silty clay loam. Clay content increases dramatically immediately below the Bt2b2 horizon, with values ranging between 36 and 54 percent in the Btssb2 horizons (Table 2 and Figure 5). The Btss1b2, Btss2b2, and Btss3b2 horizons consist of dark grayish brown (2.5Y 4/2) silty clay with 10–15 percent continuous, intersecting slickensides (ss). The Btss4b horizon consists of olive brown (2.5Y 4/3) heavy silty clay loam with 15 percent intersecting slickensides. The Cb2 horizon is stratified and consists of beds of silty clay loam and silt loam. Below a depth of 360 cm there is a coarsening-downward sequence; clay content generally declines and silt and sand contents generally increase with depth (Table 2 and Figure 5).

Stratified cultural deposits were recorded in the Atb2, Bt2b2, Btss1b2, Btss2b2, Btss3b2, Btss4b2, and Cb2 horizons of Soil 3. The cultural deposits recorded in the Atb2, Bt2b2, and Btss2b2 horizons consisted of hearth-like features containing fire-cracked rocks, burned earth and charcoal. A large vessel fragment identified as Cuesta ware diagnostic of the Middle/Late Woodland Cuesta Phase of southeast Kansas was recovered at a depth of 1.70

Table 2. Grain-size Data for A101 at the Eastep site. [1]

			Particle Size Distribution (%)						
			Silt[2]				Clay[3]		
Depth (cm)	Soil Horizon	Sand Total	C	M	F	Total	C	F	Total
0–20	Ap	**11**	28	28	10	**66**	13	10	**23**
20–47	Bw	**5**	31	29	12	**72**	13	10	**23**
47–62	Ab1	**1**	14	30	18	**62**	20	17	**37**
62–85	Btb1	**1**	15	31	18	**64**	19	16	**35**
85–100	Atb2	**2**	13	29	23	**65**	20	13	**33**
100–116	Atb2	**2**	11	26	22	**59**	22	17	**39**
116–130	Bt1b2	**1**	15	29	18	**62**	19	18	**37**
130–150	Bt2b2	**2**	15	35	15	**65**	16	17	**33**
150–168	Btss1b2	**2**	2	37	19	**58**	23	17	**40**
168–187	Btss1b2	**2**	5	28	21	**54**	25	19	**44**
187–213	Btss2b2	**3**	3	25	15	**43**	29	25	**54**
213–240	Btss2b2	**1**	8	33	14	**55**	23	21	**44**
240–275	Btss3b2	**1**	9	35	14	**58**	23	18	**41**
275–290	Btss3b2	**0**	11	37	12	**60**	22	18	**40**
290–325	Btss4b2	**1**	15	38	10	**63**	18	18	**36**
325–360	Btss4b2	**1**	14	38	11	**63**	19	17	**36**
360–400	Cb2	**2**	25	36	7	**68**	15	15	**30**
424–429	Cb2	**4**	30	33	6	**69**	14	13	**27**
456–461	Cb2	**3**	28	36	6	**70**	15	12	**27**
497–502	Cb2	**4**	27	33	7	**67**	14	15	**29**
531–536	Cb2	**3**	25	34	7	**66**	18	13	**31**
573–578	Cb2	**5**	35	30	5	**70**	13	12	**25**
614–619	Cb2	**6**	35	27	5	**67**	13	14	**27**

[1] Soil descriptions combined from core (0–210 cm) and cutbank/backhoe trench profiles (210–619 cm)

[2] Silt fractions: C = Coarse (50–20μm); M = Medium (20–5μm); F = Fine (5–2μm)

[3] Clay fractions: C = Coarse (2–0.2μm); F = Fine (<0.2μm)

m (Bevitt 2008:6), placing it in the Btss1b2 horizon. The cultural deposits recorded in the Btss3b2 and Btssb4b2 horizons are substantial and include chipped-stone artifacts, prominent burned-rock features, and faunal remains. By contrast a small basin-shaped feature containing charcoal and burned earth was recorded at a depth of 6.74 m in the Cb2 horizon; no other cultural materials were recorded at this level in the T-1 fill.

Eight AMS radiocarbon ages were determined on charcoal collected at various depths in A101 (Table 3 and Figures 4 and 5). These ages are in correct stratigraphic order and range from 2790±20 yr B.P., determined on charcoal from a feature at a depth of 6.74 m below the T-1 surface, to 340±15 yr B.P., determined on charcoal from the top of Soil 2 (0.47 m below surface). The suite of radiocarbon ages is important for understanding both the alluvial and cultural chronology at the Eastep site. It indicates that aggradation of the upper 7 m of fine-grained T-1 fill was underway around 2800 ^{14}C yr B.P. Aggradation was initially very rapid, with approximately 2.8 m of alluvium accumulating in about 400 years. However, aggradation of the T-1 fill slowed by ca. 2300 ^{14}C yr B.P. As the late-Holocene floodplain gradually stabilized, it became a more favorable geomorphic surface for human occupation. The rate of aggradation continued to

Table 3. Radiocarbon Ages Determined on Samples from the T-1 Fill in A101 at the Eastep site.

Material Assayed	Sample depth (m)[1]	Soil Horizon	d^{13}C (‰)	^{14}C age (yr B.P.)	Cal age (yr B.P.)[2]	Median cal age (yr B.P.)	Lab No.
Charcoal	0.47	Ab1	–26.8	340±15	316–473	380	ISGS-A1566
Charcoal	1.39	Bt2b2	–25.5	1320±30	1180–1210	1195	Beta-367305
Charcoal	2.60	Btss3b2	–25.2	2210±15	2153–2312	2231	ISGS-A1565
Charcoal	2.65	Btss3b2	–24.5	2175±15	2123–2304	2263	ISGS-A1463
Charcoal	3.35	Btss4b2	–23.3	2320±15	2333–2351	2344	ISGS-A1464
Charcoal	3.97	Cb2	–25.3	2370±20	2342–2459	2361	ISGS-A1561
Charcoal	5.97	Cb2	–25.3	2445±15	2360–2695	2480	ISGS-A1560
Charcoal	6.74	Cb2	–23.5	2790±20	2809–2955	2891	ISGS-A1662

[1]Depth below the surface of the T-1 terrace.

[2]Two Sigma. Calibration to calendar years was performed with CALIB 5.0 (Stuiver and Reimer 1993) using calibration dataset intcal04.14c (Reimer et al. 2004).

decrease between ca. 2200 and 1300 ^{14}C yr B.P., thereby allowing Soil 3 to thicken through cumulization. With cumulic soils the A horizon builds up with the slowly accumulating parent material, in this case alluvium, and the material in the former A horizon can eventually become the B horizon (Birkeland 1999:165).

At least six discrete episodes of human occupation occurred on the late-Holocene floodplain as Soil 3 formed; one at ca. 2300 ^{14}C yr B.P., one at ca. 2175–2200 ^{14}C yr B.P., two between ca. 2175–2200 and 1300 ^{14}C yr B.P., one at ca. 1300 ^{14}C yr B.P., and another soon after 1300 ^{14}C yr B.P. The material remains of each occupation were sealed in Soil 3 as it thickened, thereby creating a stratified archeological record (Figure 5). Sometime between ca. 1300 and 350 ^{14}C yr B.P., Soil 3 was buried by alluvium and a soil (Soil 2) developed at the top of the middle stratum. Charcoal from the upper 1 cm of the Ab1 horizon yielded a radiocarbon age of 340±15 yr B.P.; hence Soil 2 was buried by alluvium comprising the top stratum after ca. 350 ^{14}C yr B.P. The presence of a cambic (Bw) horizon in Soil 1 indicates that aggradation of the top stratum must have ended soon after ca. 350 ^{14}C yr B.P.

The time when T-1 aggradation ceased and the Verdigris River incised its late Holocene fill, thereby creating the T-1 terrace, is unknown. However, based on the record of other large streams in the region, entrenchment probably occurred around 1000 ^{14}C yr B.P. (see Hall 1990; Mandel 1995, 2006).

Area 101 Stable Carbon Isotope Ratios

The δ^{13}C values determined on organic carbon from soils and sediment in A101 at the Eastep site range from –22.4 to –17.2 ‰ (Table 4 and Figure 5), indicating a mixed C_3/C_4 plant community for the entire period of record. The lightest value, –22.4‰, occurs in the Bw horizon of the modern soil. The heaviest value, –17.2‰, occurs in the Btss1b2 horizon and deep within the Cb2 horizon of Soil 3. The difference between the maximum and minimum δ^{13}C value is 5.2‰. Identifying the point at which changes in the δ^{13}C values reflect actual changes in vegetation composition (C_3 versus C_4) is difficult (Cyr et al. 2011). According to Krull and Skjemstad (2003), changes between 1 and 3‰ are related to inherent soil processes, whereas differences exceeding 3‰ result from changes in the contribution of C_3 and C_4 vegetation. Ehleringer et al. (2000), however, noted that changes as slight as 1‰ may be caused by environmental stress. A 1–3‰ shift in the δ^{13}C values may reflect increased fractionation against ^{12}C by C_3 plants due to changes in respiration rates during drought but also may represent small increases in C_4 plants within a C_3-dominated community.

Three distinct δ^{13}C excursions occur in the up-

Table 4. Stable Carbon Isotope and Organic Carbon Data for A101 at the Eastep site.[1]

Depth (cm)	Soil Horizon	$\delta^{13}C$ (‰)	OC[2] (%)	Depth (cm)	Soil Horizon	$\delta^{13}C$ (‰)	OC[2] (%)
5–10	Ap	–21.4	0.9	140–145	Bt2b2	–18.3	0.5
10–15	Ap	–21.3	0.8	145–150	Bt2b2	–18.5	0.6
15–20	Ap	–21.6	0.9	150–155	Btss1b2	–18.2	0.6
20–25	Bw	–22.4	1.1	155–160	Btss1b2	–18.2	0.6
25–30	Bw	–21.7	0.9	160–165	Btss1b2	–18.7	0.7
30–35	Bw	–21.3	1.0	165–170	Btss1b2	–18.5	0.7
35–40	Bw	–21.3	1.0	170–175	Btss1b2	–18.7	0.8
40–45	Bw	–20.5	1.0	175–180	Btss1b2	–18.0	0.8
45–47	Bw	–20.0	0.9	180–185	Btss1b2	–17.4	0.8
47–52	Ab1	–19.5	0.8	185–190	Btss1b2	–17.2	0.8
52–57	Ab1	–19.1	0.8	190–195	Btss1b2	–17.5	0.8
57–62	Ab1	–18.1	0.8	195–200	Btss1b2	–18.3	0.8
62–67	Btb1	–17.7	0.8	200–205	Btss1b2	–18.7	0.8
67–72	Btb1	–18.8	1.0	205–210	Btss1b2	–18.0	0.8
72–78	Btb1	–18.4	0.9	237–242	Btss2b2	–18.3	0.7
78–85	Btb1	–18.3	0.9	268–273	Btss3b2	–18.5	0.6
85–90	Atb2	–18.5	1.1	295–300	Btss4b2	–18.7	0.4
90–95	Atb2	–18.4	1.3	321–326	Btss4b2	–18.3	0.4
95–100	Atb2	–18.3	1.3	357–362	Btss4b2	–17.7	0.5
100–105	Atb2	–19.0	1.3	395–400	Cb2	–18.8	0.4
105–110	Atb2	–19.2	1.0	424–429	Cb2	–18.6	0.3
110–116	Atb2	–19.2	1.1	456–461	Cb2	–18.5	0.3
116–120	Bt1b2	–19.0	0.6	497–502	Cb2	–18.5	0.4
120–125	Bt1b2	–18.9	0.5	531–536	Cb2	–17.2	0.5
125–130	Bt1b2	–18.6	0.5	573–578	Cb2	–18.6	0.3
130–135	Bt2b2	–18.4	0.4	614–619	Cb2	–18.6	0.3
135–140	Bt2b2	–18.8	0.5				

[1] Soil descriptions combined from core (0–210 cm) and cutbank/backhoe trench profiles (210–619 cm)

[2] OC = Organic Carbon

per 2.5 m of the T-1 fill in A101: one within the upper half of the Btss1b2 horizon of Soil 3, one from the lower 11 cm of the Atb2 horizon of Soil 3 to the top of the Btb1 horizon of Soil 2, and another from the Btb1 horizon of Soil 2 to the top of the Bw horizon of the modern surface soil (Soil 1) (Figure 5). The $\delta^{13}C$ values determined on soil organic matter from the Btss1b2 horizon of Soil 3 become heavier upward, shifting from –18.7‰ at a depth of 200–205 cm to –17.2‰ at a depth of 185–190 cm. This represents a 1.5‰ excursion and may indicate a small increase in C_4 plants resulting from warmer conditions sometime between ca. 2200 and 1300 ^{14}C yr B.P. The $\delta^{13}C$ value shifts back to –18.7‰ at a depth of 170–175 cm.

Another small excursion occurs soon after ca. 1300 ^{14}C yr B.P., with $\delta^{13}C$ values shifting from –19.2‰ in the lower 11 cm of the Atb2 horizon of Soil 3 to –17.7‰ in the upper 5 cm of the Btb1 horizon of Soil 2. This represents a 1.5‰ excursion and may indicate a small increase in the abundance of C_4 plants resulting from warmer conditions.

A distinct shift from –17.7‰ to –22.4‰ occurs from the upper 5 cm of the Btb1 horizon of Soil 2 to the upper 5 cm of the Bw horizon of Soil 1 (Figure 5). This 4.7‰ excursion reflects a steady increase in contributions of organic matter from C_3 plants. Although cooler and/or wetter conditions may have driven this shift in $\delta^{13}C$ value, the influence of the former riparian forest in A101 cannot be ruled out. Trees were cleared in the recent past to allow cultivation on the T-1 terrace.

The $\delta^{13}C$ values determined on soil samples from the portion of the stratigraphic sequence that contains the most abundant archeological record in A101—the Btss4b2 and Btss3b2 horizons of Soil 3—range from –17.7‰ to –18.5‰. These values reflect a stable mixed C_3/C_4 plant community.

In sum, the $\delta^{13}C$ data for A101 do not indicate any major changes in the plant community for the period of record. Specifically, a fairly stable mixed C_3/C_4 plant community has been in place for the past 2,500 years. Slight shifts towards heavier $\delta^{13}C$ values that occurred sometime between ca. 2200 and 1300 ^{14}C yr B.P. and soon after ca. 1300 ^{14}C yr B.P. may have been caused by warmer conditions, and the latter excursion may be associated with the Medieval Warm period (ca. 1000–750 ^{14}C yr B.P.) (see Diaz and Hughes 1994; Mann et al. 2009). However, a mixed C_3/C_4 plant community continued to dominate the late-Holocene floodplain. Increased contributions of organic matter from C_3 plants occurred over the past 500 years at 14MY388, based on $\delta^{13}C$ values for the upper 70 cm of the stratigraphic sequence in A101, yet the mixed C_3/C_4 plant community persisted.

SITE FORMATION PROCESSES

Like all archeological sites, the Eastep site is a product of a series of sedimentary, pedogenic, biological, and physical processes (see Schiffer 1987; Wood and Johnson 1978). In order to understand the role humans played in the formation of 14MY388, it is important to consider how non-cultural agents have affected the cultural deposits.

Area 101

Based on the sedimentological record in A101, prehistoric people were occupying the distal portion of the late-Holocene floodplain (now the T-1 terrace). This low-energy depositional environment is inferred from the high clay content of the alluvium (Table 2 and Figure 5), especially in the bottom stratum containing most of the archeological record at the site. All of the alluvium comprising the upper 7 m of the T-1 fill is a product of vertical accretion, i.e., overbank deposition during flood events. Vertical accretion distal to the channel resulted in burial of cultural deposits in clay-rich alluvium, and because people were occupying a low-energy floodplain environment, it is unlikely that fluvial processes, such as flood scouring, disarticulated the archeological materials before burial occurred.

Soils also provide important clues about the role of natural processes in the formation of cultural deposits (Mandel and Bettis 2001). The portion of Soil 3 in A101 that contains stratified cultural deposits does not have many biogenic features, such as krotovina, indicative of soil mixing by animals. Sedimentation on the late-Holocene floodplain probably was too rapid to allow intensive bioturbation. However, Soil 3 has a distinct physical property that is relevant to the determination of site formation processes: the presence of slickensides. Slickensides are polished grooved surfaces that occur along shear planes within the soil. These shear planes result from the shrink-swell action of highly expansive smectite clays that accompanies cycles of wetting and drying. As the soil is wetted, the soil volume increases; the volume then decreases as the soil dries. Slickensides form along the internal shear-planes as soil aggregates move past one another in response to these volume changes.

Soils with common intersecting slickensides, like the ones observed in Soil 3, usually are affected by argilliturbation—the mixing of the soil matrix as a result of the shrinking and swelling of expandable clay minerals that produce slickensides. When expandable clays shrink during dry periods, large vertical cracks tend to form at the surface. These cracks typically are less than 10 cm deep, but under very dry conditions they can reach depths of over 1 m. Artifacts and other surface material can fall into these cracks when they are open. As the moisture content in soil increases, the expandable clay minerals swell and close the cracks. This results in the burial of any artifacts that fell into the cracks (Schiffer 1987; Wood and Johnson 1978). Hence, when Soil 3 was at the surface, the cultural deposits likely were affected to some degree by argilliturbation.

Area 102

A102 is located on a footslope at the bottom of the valley wall south-southeast of A101 (Figure 1).

Core 2, taken to a depth of 1.2 m in A102, revealed a 23-cm-thick veneer of colluvium overlying material weathered from shale (residuum).

The surface soil in A102 has a well-expressed Ap-AB-2Bt1-2Bt2-2BC-2Cr profile (Table 5). The Ap and AB horizons were formed in cobble-rich colluvium derived from sandstone and shale outcrops in the valley wall. An abrupt boundary separates the grayish brown (10YR 5/2, dry) cobbly silty clay loam AB horizon from the cobble-free light olive brown (2.5Y 5/4, dry) silty clay 2Bt1 horizon. The 2Bt2 and 2BC horizons consist of light yellowish brown (2.5Y 6/4, dry) silty clay loam, and laminated light yellowish brown (2.5Y 6/4, dry) silty shale was penetrated at a depth of 80 cm below the land surface.

The numerical age of the thin colluvial mantle in A102 is unknown, but colluvial aprons generally formed in southeastern Kansas between ca. 9000 and 3000 ^{14}C yr B.P. (Mandel 1995, 2006). Because the colluvial apron is only 23 cm thick and the underlying residuum is a product of long-term surface stability (> 10,000 years), archeological materials dating to the Paleoindian, Archaic, and Ceramic cultural periods may occur in the upper 20–30 cm of the soil. However, the vertical and horizontal integrity of those deposits, especially pre-Ceramic archeological materials (if present), probably has been affected by bioturbation, including soil mixing resulting from prehistoric and historic human activity. Also, archeological palimpsests created from accumulated constant use or repeated sea-

Table 5. Description of Core 2 at Locality 102, Eastep Site (14MY388), Verdigris River Valley, Montgomery County, Kansas.

Landform: Footslope
Parent Material: Colluvium overlying weathered shale
Slope: 2–3%
Drainage: Poorly drained
Described: September 29, 2009
Described by: Dr. Rolfe D. Mandel

Depth (cm)	Soil Horizon	Description
		COLLUVIUM
0–18	Ap	Dark grayish brown (10YR 4/2) cobbly silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to weak fine and medium granular; friable, hard; many fine and very fine roots; about 30% sandstone and shale fragments; abrupt boundary.
18–23	AB	Grayish brown (10YR 5/2) cobbly silty clay loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; friable, hard; many fine and very fine roots; about 40% sandstone and shale fragments; abrupt boundary.
		RESIDUUM
23–43	2Bt1	Light olive brown (2.5Y 5/4) silty clay, olive brown (2.5Y 4/4) moist; very hard, very firm; strong medium angular blocky structure; common distinct discontinuous grayish brown (2.5Y 5/2) clay films on ped faces; common fine and very fine roots; gradual boundary.
43–60	2Bt2	Light yellowish brown (2.5Y 6/4) heavy silty clay loam, olive brown (2.5Y 4/4) moist; common distinct brownish yellow (10YR 6/4) mottles; very hard, very firm; moderate medium subangular blocky structure; few distinct discontinuous grayish brown (2.5Y 5/2) clay films on ped faces and in macro-pores; few fine and very fine roots; gradual boundary.
60–80	2BC	Light yellowish brown (2.5Y 6/4) light silty clay loam, olive brown (2.5Y 4/4) moist; many distinct brownish yellow (10YR 6/4) mottles; very hard, very firm; very weak fine subangular blocky structure; hard, firm; many horizontal shale fragments; gradual boundary.
80–120	2Cr	Light yellowish brown (2.5Y 6/4) laminated silty shale.

sonal use of a stable geomorphic surface are difficult to unravel.

SUMMARY AND CONCLUSIONS

A101 of the Eastep site is associated with the T-1 terrace of the Verdigris River. The upper 7 m of the T-1 fill consists of fine-grained alluvium that accumulated in a low-energy environment distal to the channel. Three strata, two buried soils (Soils 2 and 3), and a modern surface soil (Soil 1) were recorded in the upper 7 m of the fill.

The T-1 fill rapidly aggraded from ca. 2800 ^{14}C yr B.P. to ca. 2400 ^{14}C yr B.P., with approximately 2.8 m of alluvium accumulating during that period. The earliest evidence of human occupation dates to 2790±20 ^{14}C yr B.P. and consists of a single hearth-like feature in stratified alluvium. At that time the late-Holocene floodplain (now the T-1 terrace) was unstable and, therefore, was not a favorable location for human occupation. This explains the sparse archeological record dating to ca. 2800 ^{14}C yr B.P.

Aggradation of the T-1 fill slowed by ca. 2300 ^{14}C yr B.P., and a soil (Soil 3) began to form on the late-Holocene floodplain. The rate of aggradation continued to decrease from ca. 2300 to 1300 ^{14}C yr B.P. and Soil 3 thickened through cumulization. During that period at least six discrete episodes of human occupation occurred on the late-Holocene floodplain. The material remains of each occupation were sealed in the former surface soil (now Soil 3) as it thickened, thereby creating a stratified archeological record. Sometime between ca. 1300 and 350 ^{14}C yr B.P., Soil 3 was buried by alluvium and Soil 2 developed at the top of the middle stratum. Charcoal from the upper 1 cm of the Ab1 horizon of Soil 2 yielded a radiocarbon age of 340±15 yr B.P.; hence, Soil 2 was buried by alluvium comprising the top stratum after ca. 350 ^{14}C yr B.P. The soils evidence, i.e., presence of a cambic (Bw) horizon in the modern soil (Soil 1), indicates that aggradation of the top stratum ended soon after ca. 350 ^{14}C yr B.P.

Because aggradation of the T-1 fill was fairly rapid, with 7 m of alluvium accumulating in about 2,800 years, cultural deposits within the fill were not exposed to long episodes of bioturbation before or immediately after they were buried. However, the vertical and horizontal integrity of archeological materials within the Btss3b2 and Btss4b2 horizons of Soil 3 may have been affected by argilliturbation, the process of soil mixing associated with shrinking and swelling of the expandable clay minerals. The presence of distinct, intersecting slickensides in most of Soil 3 indicates an abundance of clay minerals that tend to swell when wet and shrink when dry.

Based on the results of the stable carbon isotope analysis of soil organic matter, a mixed C_3/C_4 vegetation community has been in place on the valley floor at 14MY388 since ca. 2800 ^{14}C yr B.P. Three δ^{13}C excursions occur in the upper 2.5 m of the T-1 fill in A101. The bottom and middle shifts, which occurred sometime between ca. 2200 and 1300 ^{14}C yr B.P. and soon after 1300 ^{14}C yr B.P., respectively, are 1.5‰ excursions that may indicate slight increases in the abundance of C_4 plants resulting from warmer conditions. The shift towards heavier δ^{13}C values soon after ca. 1300 ^{14}C yr B.P. may reflect an increase in contributions of organic matter from C_4 plants in response to the Medieval Warm period (ca. 1000–750 ^{14}C yr B.P.). However, the prominent 4.7‰ upward shift towards lighter values that begins in the Btb1 horizon of Soil 2 and continues into the upper 5 cm of the Bw horizon of Soil 1 clearly indicates a steady increase in contributions of organic matter from C_3 plants. Although cooler and/or wetter conditions may have driven this shift in δ^{13}C value, trees associated with the former riparian forest may have caused it.

A102 is located on a footslope at the bottom of the valley wall. A 23 cm-thick veneer of colluvium overlies a soil formed in shale. The numerical age of the colluvial mantle is unknown, but it probably aggraded between ca. 9000 and 3000 ^{14}C yr B.P. Because the deposit of colluvium is only 23 cm thick and the underlying residuum is a product of long-term surface stability (> 10,000 years), cultural deposits dating to the Paleoindian, Archaic, and Ceramic cultural periods may occur in the upper 20–30 cm of the surface soil. However, bioturbation, including soil mixing resulting from prehistoric and historic human activity, probably has compromised the vertical and horizontal integrity of cultural deposits, especially pre-Ceramic archeological materials (if present).

In sum, the geoarchaeological investigation at Eastep provided a geomorphic, sedimentologic, and soil-stratigraphic context for interpreting the archeological record, identified site formation processes, and determined the numerical chronology of the alluvial deposits and associated soils at the site. Also, the $\delta^{13}C$ values of pedogenic organic matter were used to infer bioclimatic change during the period of occupation. Understanding the paleoenvironmental context of the cultural deposits is crucial to understanding the relationships between landscape evolution, bioclimatic fluctuations, and human activities at the site.

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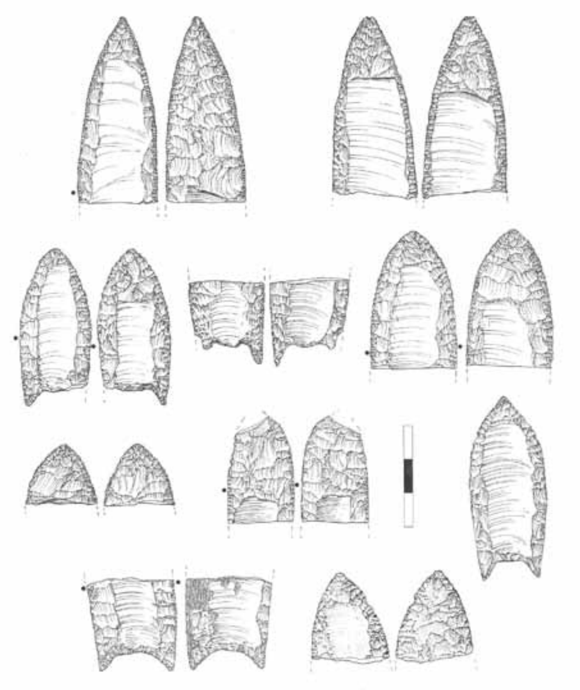
BOOK REVIEWS

Folsom: New Archaeological Investigations of a Classic Paleoindian Bison Kill. DAVID J. MELTZER (with contributions by Meena Blakrishbnan, Donald A. Dorward, Vance T. Holliday, Bonnie F. Jacobs, Linda Scott-Cummings, Todd A. Surovell, James L. Theler, Lawrence C. Todd, and Alisa J. Winkler). University of California Press, Berkley, 2006. xiv + 374 pp., including 122 figures, 68 tables, 5 appendices, references cited, index. $55.00 (hardcover). ISBN 0-520-24644-6. *Reviewed by* Jim D. Feagins, St. Joseph Museum.

"While Folsom is one of the best known sites in American archaeology, it is also one of the least known sites in American archaeology—scientifically speaking" (p. 1). *Folsom: New Archaeological Investigations of a Classic Paleoindian Bison Kill* has corrected the site's published scientific deficiency. Meltzer and colleagues tease apart the warp and weft of the site's "tapestry," exposing it with modern field and laboratory techniques, coupled with updated analytical methods, to firmly establish its scientific basis. They re-weave the abundant newly gained interdisciplinary knowledge from the site with its long-standing historic perspective.

Folsom is the eastern New Mexico site that changed archeology's perception of prehistoric time depth in the Americas. Thanks to Folsom, and its association with long extinct species of large bison, the arrival of humans in the New World was proven to be much earlier than originally thought; it was finally accepted to be during the late Pleistocene. This oft retold, electrifying story is presented in numerous publications, assuring Folsom's place in the history of New World archeology. It was the first nail in the coffin, which buried the old paradigm that limited the antiquity of people on the continent. Meltzer is to be commended for finally placing the site on a fully scientific, comprehensively well documented footing. One of Meltzer's objectives was to reconcile the data from the 1926–1928 excavations with his 1997–1999 excavated data. He has restated old questions while asking new ones in an attempt to glean new details from the site.

Meltzer's renewed research was designed, as much as possible, to investigate the following questions at the Folsom site: Are there intact archeological deposits remaining? What is the geological history and context? What is the age of the Folsom bison kill? What was the climate at the time of the site's occupation? What biotic resources were available to hunter-gatherers at the time of the site's occupation? Did Folsom groups occupy protected foothills and intermontane basins during the cold season? Did Folsom hunter-gatherers exploit faunal resources other than bison? What might be inferred of the tactics and strategies of bison hunting? Is there evidence for more than one bison kill at Folsom? What was the nature of the butchering and processing of the bison? What is the taphonomic history of the bison bonebed? Where or how did the Folsom hunters procure the stone for their toolkits? How did the hunter-gatherers organize their technology? What tactics did hunter-gatherers use to maintain their toolkits? What is revealed in the breakage and discard patterns of the artifacts? How do Folsom points vary and is that variation a result of raw material technology, function, or style? Are there any associated camp/habitation areas? Why was the Folsom site the most successful for convincing skeptics, but not any of the other sites



previously championed as Pleistocene in age? Why was credit for resolving the human antiquity controversy given to others, not Cook and Figgins? What made Folsom so important to American archeology?

Generally, when possible, Meltzer's research design was organized to attempt to address these questions, and the volume documents what was learned. Most (but not all) of these questions could be answered in full or in part. Meltzer provides the excavation details necessary to document the site along with the comprehensive explanations essential for understanding and comparing it with other regional Paleoindian sites.

Folsom is a fall kill-site where 32 bison from a cow-calf herd were killed approximately 10,500 years ago. The Folsom point manufacturing technology and the butchering tools used at the site are well explained; however, a minor criticism is that the lithic debitage is poorly documented. The stratigraphy, processes of site formation, bone-bed taphonomy, and occupational history are well described. The data obtained from the research allows the site to be placed in an overall Folsom settlement pattern.

This research and writing is a tour-de-force about one of the more important sites in the Americas. *Folsom: New Archaeological Investigations of a Classic Paleoindian Bison Kill* is a large format, generally well-illustrated volume set in small type on 374 pages—obviously containing a tremendous amount of information, including considerable descriptive data previously unavailable to researchers. The book has been a long time coming, but it clearly has been worth the wait, as new techniques and methods are brought to bear with the latest research at the Folsom type site. This reviewer highly recommends this volume, which will become a classic in Paleoindian investigations, used by avocational and professional members of the archeological community, as well as some members of related disciplines and the general public. The research and writing by Meltzer and his colleagues has changed the Folsom site from one of the "best known" Paleoindian sites to one of the "best understood."

Clovis Lithic Technology: Investigation of a Stratified Workshop at the Gault Site, Texas. MICHAEL R. WATERS, CHARLOTTE D. PEVNY, and DAVID L. CARLSON (with contributions by William A. Dickens, Ashley M. Smallwood, Scott A. Minchak, Eric J. Bartelink, Jason M. Wiersema, James E. Wiederhold, Heidi M. Luchsinger, Dawn A. J. Alexander, and Thomas A. Jennings; foreword by Michael B. Collins). Texas A&M University Press, College Station, 2011. xxii + 226 pp., 99 fig., 38 tables, references cited, index. $45.00 (hardcover). ISBN-13: 978-1-60344-278-7. *Reviewed by* Jim D. Feagins, St. Joseph Museum.

The Gault site (41BL323) is an extensive prehistoric workshop, chert quarry, and campsite located along Buttermilk Creek in central Texas. Occupying approximately 40 acres, this site has been intermittently inhabited for 13,000 years. It is especially noted for its Paleoamerican occupation. This well stratified site certainly is, as the authors state, "one of the most important Clovis sites in North America" (p. 1).

The upper layers of Gault have been subjected to indiscriminate, undisciplined digging by looters for many decades. Despite the extensive size of the site, nearly all of the upper levels, those younger than approximately 8,000 years old, have been destroyed or at best severely damaged. While not minimizing the great loss to the archeological record and ability to learn about these more recent cultures and the generations of people that they represent, thankfully the oldest occupations from the deepest levels, are still intact.

After the extensive looting, archeologists, environmental scientists, and members of the general public with an interest in North American archeology are fortunate to still have this ancient in-the-soil record to document, analyze, and interpret. Not only is the site enormous, but it is also complex. While plant preservation is very poor, the stone tools, lithic debitage, faunal remains, site use patterns, soil and other site formation and environmental data are abundant. With its intact deeply buried late Quaternary levels, and because it contains camp, workshop, and quarry areas, the Gault site holds a rich record, supplying data that allows archeologists an unprecedented detailed view of Clovis lithic technology. The authors write:

> This single site contains more Clovis artifacts than any other 13,000-year-old site west of the Mississippi River . . . Bifaces, in all stages of reduction, chronicle the Clovis trajectory of biface manufacture. Hundreds of cores, core-tablet flakes, and blades document the trajectory of biface manufacture. Just as important are the tens of thousands of pieces of debitage left behind from these tool-making activities (p. 1).

Clovis Lithic Technology: Investigation of a Stratified Workshop at the Gault Site, Texas focuses on just one area of 41BL323: Excavation Area 8. Essentially all the lithic tools and debitage from Area 8 are manufactured from Edwards chert. This chert outcrops along Buttermilk Creek, as well as an extensive area in central Texas. Adjacent to the Area 8 habitation/workshop, the Clovis and later people extensively quarried this well-known material. Along with abundant subsistence resources, the stone clearly was an important factor, encouraging repeated reoccupations of the site for thousands of years.

In 2000 Texas A&M University excavated the two Clovis-bearing levels in this area, recovering almost 67,000 lithic artifacts and approximately 5,700 faunal specimens. From only one season of work in Area 8, analysis of the Clovis information has taken nine years and generated five M.A. theses and two Ph.D. dissertations. Much of the book's content updates these theses and dissertations. This volume presents only the Clovis materials from secure geological contexts, and archeological work conducted in other areas of the site is generally mentioned only in passing.

The investigators of Area 8 make extensive use of scientific technology and modern analytical methods in their multidisiplinary approach to analyzing the cultural and natural information obtained. The volume contains chapters on geoarchaeological studies; details on the manufacture of blades, bifaces, and other stone tools in the context of Clovis lithic technology; microscopic usewear studies of the lithics; the faunal remains; the spatial distribution of lithic and faunal materials and comparison of Area 8 with ethnological studies of modern hunter-gatherer sites; interpretations of how the Clovis people used the area and site in general; and discussion of how this Gault site information helps illuminate overall Clovis subsistence, mobility, and technology.

If readers are interested in the Clovis occupation of North America and especially in Clovis lithic technology, they can obtain this well-written, handsome, and useful volume from Texas A&M University Press, 4354 TAMU, College Station, TX 77843-4354 or through its website at http://www.tamupress.com. Note that readers who are members of the Center for the Study of the First Americans (CSFA) can get a 20 percent discount by ordering on the CSFA order form.

Late Pleistocene Archaeology and Ecology in the Far Northeast. CLAUDE CHAPDELAINE (editor). Texas A & M University Press, College Station, 2012. xvi + 147 pp., 119 figs., 24 tables, contributors, index. $68.00 (cloth). ISBN 978-1-60344-790-4. *Reviewed by* Jim D. Feagins, St. Joseph Museum.

The latter portion of the Late Pleistocene in northeastern North America was a period of time when Paleoindians (Paleoamericans) pushed northward, following wild game and searching for newly exposed and developing resources, as the glacial ice slowly retreated. The "Far Northeast" is defined in this volume as encompassing the New England states, the Canadian Maritime Provinces, and the regions east of the Hudson River in New York and south of the St. Lawrence River/Gulf of St. Lawrence in Quebec. This area was mostly inhospitable to human habitation prior to 13,500 years ago—especially in the northernmost latitudes of the region.

How did Clovis pioneers and those who lived in the region shortly thereafter adapt to this extreme change in an improving but still harsh environment? What tools were used and how did the artifacts deviate from those produced by their "neighbors" to the south and southwest? These are a few of the questions asked and discussed in *Late Pleistocene Archaeology and Ecology in the Far Northeast*. The volume provides an up-to-date synthesis of the very oldest archeology in the Far Northeast, presents new data, and revises earlier interpretations.

Paleoamerican studies in the region have been plagued by poor preservation of faunal remains. With some supporting evidence, most researchers agree that caribou were probably the primary large animal prey obtained by early hunters in a then-tundra environment. An additional obstacle facing researchers of the Paleoamerican period is radiocarbon dating. Substantial differences between calendar and radiocarbon years, the plateau effect, and (especially acute in the Far Northeast) the lack of hearths with charcoal and/or bone hamper interpretations of cultural and environmental evolution within various sub-areas.

The general framework for this volume resulted from a symposium presented at the annual meeting of the Quebec Archaeological Association in 2009. All nine of the symposium participants agreed to modify their papers into chapters. Ten additional authors soon joined the collaborative effort.

After a fine introductory chapter by Claude Chapdelaine and Richard A. Boisvert, the volume is divided into two parts: Part I, Regional Syntheses and Part II, Specialized Studies. Part I has four chapters: "Paleoindian Occupations in the Hudson Valley, New York" by Jonathan C. Lothrop and James W. Bradley; "Maritime Mountaineers: Paleoindian Settlement Patterns on the West Coast of New England" by John G. Crock and Francis W. Robinson IV; "The Paleoindian Period in New Hampshire" by Boisvert; and "Geographic Clusters of Fluted Point Sites in the Far Northeast" by Arthur Spiess, Ellen Cowie, and Robert Bartone. The latter chapter focuses on Maine and discusses the concept of Paleoindian site clustering within seasonal aspects of settlement patterns.

"New Sites and Lingering Questions at the Debert and Belmont Sites, Nova Scotia" by Leah Morine Rosenmeier, Scott Buchanan, Ralph Stea, and Gordon Brewster is the leadoff chapter in Part II. The new sites also appear to form a cluster in the Debert site vicinity. The well-known Debert site is updated with information from multidisciplinary studies.

Two chapters examine the Cliche-Rancourt site: "The Early Paleoindian Occupation at the Cliche-Rancourt Site, Southeastern Quebec" by Chapedelaine and "The Burial of Early Paleoindian Artifacts in the Podzols of the Cliche-Rancourt Site Quebec" by Francois Courchesne, Jacynthe Masse, and Marc Girard. This site ". . . is the single known site for the entire province of Quebec that could be assigned to the Early Paleoindian period on the basis of fluted points and other distinctive artifacts" (p. 3). Here information is presented as a case study of how soil evolution, involving pedogenetic processes by living organisms and ice-soil interaction, is the major cause of artifact burial at the site.

"The Bull Brook Paleoindian Site and Jeffreys Ledge: A Gathering Place near Caribou Island?" is written by Brian S. Robinson. He develops a hypothesis concerning changing sea level and the potential for Jeffreys Ledge, a now-drowned maritime island, to have been an available landscape for communal caribou drives. He also proposes how the well-known Bull Brook site could have related to this late, short-lived Pleistocene landscape.

The last two chapters, "Between the Mountains and the Sea: An Exploration of the Champlain Sea and Paleoindian Land Use in the Champlain Basin" by F. Robinson and "Late Pleistocene to Early Holocene Adaptation: The Case of the Strait of Quebec" by Jean-Yves Pintal are to some degree related. The former chapter discusses how the geologic shoreline of the Champlain Sea relates to the Paleoindian settlement pattern in Vermont. It focuses on sites, such as the Reagen site, and how the diversity of flora and fauna around this body of water may have made an impact on the humans living in the vicinity. In the volume's last chapter Pintal discusses the human chronology in the Quebec City area of the Champlain Basin during the Late Paleoindian period, as it was ready to transition into the Early Archaic. These Quebec City sites represent the end of the fluted point tradition and continued human adaptation to a changing environment.

Late Pleistocene Archaeology and Ecology in the Far Northeast is a lesson in extreme human adaptability by often highly mobile populations—as reflected by an impressive network of toolstone sources. With the collaborative efforts of many authors, the volume presents the latest finds and current thinking within a good synthesis of the region's ecology and the Paleoamericans who lived there. A succinct summarizing chapter would have been helpful.

This nicely illustrated volume can be obtained from the Texas A&M University Press, 4354 TAMU, College Station, TX 77843-4354 or online at www.tamupress.com.

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Debi is a member of the Kansas Anthropology Association and currently serves as secretary of the state organization. Since attending her first Kansas Archeology Training Program field school at Scott Lake State Park in 2009, Debi has been working on earning her KAA Certification. In 2011 Deb worked with Dr. Jack L. Hofman, Associate Professor of Anthropology at the University of Kansas, on recording Clovis points in Wilson, Montgomery, and Republic counties and in 2011–2013 on stone arched-ceiling caves in Republic County. Archeologically speaking, she loves everything from Paleo to Historical. Debi Aaron nee Holtzen was born and raised in Deshler, Nebraska. She has three children, Steven, Kelsey, and Colin. Debi has been employed by Thayer County Health Services since 1998 as director of nutrition and environmental services. In addition to archeology, Debi volunteers at the Red Cross and the Thayer County Museum in Belvidere, Nebraska. She enjoys spending time with her children, camping, canoeing, and exploring anything and everything.

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Jack Hofman teaches archeology in the Department of Anthropology at the University of Kansas. He has done archeological research in the Great Plains region since 1971 and has interests in early prehistoric hunters, large scale land use, and studies of technological and cultural change. During the past few years he has been involved in the Republic County Area Archaeology and Paleoecology Project of which the research reported here is a part.

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With over 25 years of experience surveying freshwater mussels in southeast Kansas, Ed continues to be intrigued with the complicated life cycle, ecology, and human uses of the native freshwater mussels. He has co-authored several papers on the status of freshwater mussels in Kansas and an educational booklet, *A Pocket Guide to Kansas Freshwater Mussels*. Ed is coordinator of the Threatened and Endangered Species Program for KDWPT and holds a B.S. in animal ecology from Iowa State University and M.S. in wildlife science from Virginia Polytechnic Institute and State University.

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Rolfe is executive director of the Odyssey Archaeological Research Program at the Kansas Geological Survey and an associate professor in the Department of Anthropology, University of Kansas. He has spent more than 30 years working with archeologists on projects throughout the United States and eastern Mediterranean, but his research has focused on the Great Plains. He is especially interested in the effects of geologic processes on the archeological record and was instrumental in the Kansas Archeology Training Program field schools in 2003 at the Claussen site and in 2005 at the Kanorado locality. In 2010 he received the Geological Society of America's Kirk Bryan Award, and in 2012 he was recognized by the Higuchi-KU Endowment Research Achievement Awards with the Irvin Youngberg Award for Applied Sciences.

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John obtained his bachelor's degree in anthropology at Kansas State University, his master's at the University of Kansas, and his doctorate at Vanderbilt University. He has participated in and led numerous prehistoric and historic archeological excavations throughout the state of Kansas. In addition, he has extensive field experience at Maya archeological sites in Central America; his 2009 dissertation was entitled, "Investigating Terminal Pre-Classic and Classic Period Power and Wealth at K'O, Guatemala." From 2009 until early 2012, he was employed as an archeologist at the Kansas Historical Society. John is a Kansas native and has been actively involved in the historic preservation of the Strawberry Hill area of downtown Kansas City, Kansas.

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Mark's experience with faunal analysis began in 1992 as an avocational archeologist, leading him into formal study at the University of Kansas. He earned his M.A. in anthropology with a strong emphasis in zooarchaeology in 2012. Mark's work in faunal analysis encompasses nearly eight years, working with animal assemblages recovered from archeological and paleontological sites in Kansas, Missouri, Colorado, Arkansas, and Washington. He currently works as an independent contractor in faunal analysis, archeological consultation, and site assessment for regions in the Great Plains and Pacific Northwest. Mark lives in Olympia, Washington with his fiancée and enjoys a pastime of rainy day research of flora and fauna from Washington's temperate rainforests.

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Rose Marie is a native of McPherson County and has lived in Lindsborg since 1977. She is a graduate of McPherson High School and received a B.A. in anthropology from the University of Kansas. After college Rose Marie and husband Mike served two years in the Peace Corps in Nicaragua. Rose Marie has been an active member of KAA since 1992 and has participated in every KATP field school since that time. She is a member of the Mud Creek Chapter and has held the offices of president and secretary for that group. She served on the KAA executive committee as certification chair from 2002 through 2007, as treasurer from 2004 through 2007, and as president from 2008 through 2011. Rose Marie has previously written articles in *The Kansas Anthropologist* and the *Kansas Preservation* newsletter and is a frequent contributor to the *KAA Newsletter*. She was appointed to the Kansas Unmarked Burial Sites Preservation Board in 2006 in continues to serve as one of two public representatives. Other pursuits include historic preservation, house restoration, and art. Rose Marie and Mike have renovated six houses "in their spare time," and Rose Marie achieved placement of their home on the State and National Historic registers in 1995. She is a docent and former board member of the Birger Sandzén Memorial Gallery and is a studio artist in Lindsborg.

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NUSBAUM	GAIL	623 E LINCON	IOLA	KS	66749-2417

NUSBAUM	ZACHARY	3964 SW CANTERBURY TOWN RD	TOPEKA	KS	66610-1405
O'BRIEN	DR PATRICIA J	501 HOUSTON ST #3	MANHATTAN	KS	66503-6293
ODELL	GEORGE H				
OLNEY	BRAD	8936 CEDAR LN	PRAIRIE VILLAGE	KS	66207-2218
OLSON	BILL & BETH	203 W COLOMBUS ST	LINDSBORG	KS	67456-1527
ORNELAS	JULIE	1147 SW MEADOW LN	TOPEKA	KS	66604-2024
O'TOOLE	JOHN	854 LINWOOD AVE APT 4	ST PAUL	MN	55105-3375
OVERMYER	NANCY	PO BOX 1213	TOPEKA	KS	66607-1213
PAUL	DENNIS	1422 LUTHER ST	EMPORIA	KS	66801-6041
PETERSEN	CASEY	1410 15TH AVE	KEARNEY	NE	68845-6590
PETZ	AL	819 BANNOCK BURN RD	HUTCHINSON	KS	67502-2033
PLANTIKOW	CARLA	7515 S 18TH ST	BELLEVUE	NE	68147-2152
PLUMER	JAY	3248 S HOLMES RD	SALINA	KS	67401-9094
POLSON	DAVID	15890 GARDNER PL	GARDNER	KS	66030-9669
RACK	KIM	5113 KINGSMILL RD	LAWRENCE	KS	66047-1897
RALSTON	JAMES	15603 W 81ST ST	LENEXA	KS	66219-1831
REDINGTON	JAMES	8572 SW 50TH ST	TOWANDA	KS	67144-9102
REED	EVELYN	PO BOX 141	COLDWATER	KS	67029-0141
REINERT	KAREN	511 E KIRKLAND ST	HERINGTON	KS	67449-1613
RES & COLLECT CTR LIB	ILLINOIS STATE MUSEUM	1011 E ASH ST	SPRINGFIELD	IL	62703-3500
RESSER	KENNY	337 SE 36TH ST	TOPEKA	KS	66605-2823
RET-SERV DEPT SERL	WATSON LIBRARY UNIV OF KS	1425 JAYHAWK BLVD R 210S	LAWRENCE	KS	66045-7594
REXROAD	VIRGINIA	3712 ALDERSGATE DR APT B	HUTCHINSON	KS	67502-2367
RHODES	DIANE	12827 W ARIZONA PL	LAKEWOOD	CO	80228-3558
RIEMER	WILLARD	450 N GARFIELD ST	BONNER SPRINGS	KS	66012-1546
RILEY	ZELLA	6109 W 76TH TER	PRAIRIE VILLAGE	KS	66208-4544
ROBERTS	JAMES	1036 ARROWHEAD RIDGE	INDEPENDENCE	MO	64056-1179
ROBERTS	PAUL	PO BOX 201	DENTON	KS	66017-0201
ROBINETT	MARK	3511 SE PARK LANE CT	TOPEKA	KS	66605-2342
ROECKERS	HENRY	34 LAKEVIEW DR	GARNETT	KS	66032-1737
ROPER	DONNA C	1924 BLUEHILLS RD	MANHATTAN	KS	66502-4503
ROWLINSON	DANIEL & JIMMETTE	1271 ELVIRA ST	AUBURN	KS	66402-9484
ROWLINSON	TYLER	1825 SW MISSION AVE	TOPEKA	KS	66604-3345
ROWLISON	DON	RT 1 BOX 57M	STUDLEY	KS	67759-9326
RUDKIN	JANN & TOM	15000 BLACKBERRY HILL RD	LOS GATOS	CA	95030-7504
SAGE	SHARON	9130 SW 97TH ST	AUBURN	KS	66402-9610
SALLEE	KENT	PO BOX 592	INMAN	KS	67546-0592
SCHMIDT	JANIE & REX	14026 U ST	WILMORE	KS	67155-5437
SCHUETZ	PETE	725 VIRGINIA ST	SABETHA	KS	66534-1933
SERL ACQ -TOZZER LIB	HARVARD LIB ITS	625 MASS AVE LOWER LEVEL	CAMBRIDGE	MA	02139-3357
SHAUGHNESSY	SARA	3900 NW 36TH TER	TOPEKA	KS	66618-3539
SHAVER	CAMDEN	3520 NW 60TH TER	KANSAS CITY	MO	64151-2866
SHAVER	DOUGLAS	3520 NW 60TH TER	KANSAS CITY	MO	64151-2866
SHERIDAN	ALAN	656 OLD HWY 40	WILSON	KS	67480-8777
SHERRADEN	KEN	PO BOX 302	CHAPMAN	KS	67431-0302
SHIVELY	BARON	823 N ELM ST	MCPHERSON	KS	67460-2013
SIMPSON	PATIENCE	1155 SW GLENDALE DR #E	TOPEKA	KS	66604-2163
SKAGGS	CHAD & STEPHANIE	6810 E 27TH ST N	WICHITA	KS	67226-1640
SMITH	JERRY G	215 HUMMINGBIRD DR	MCPHERSON	KS	67460-3948
SMITH	RANDALL	15264 NW PRAIRIE CREEK RD	NEWTON	KS	67114-8035
SMITH	STACY	2204 LAWRENCE RD	MANHATTAN	KS	66502-2026
SMITH III	WALTER J	350 E 181ST ST	SCRANTON	KS	66537-9225
SPILLER	JACK & GAYNELL	1601 WATSON ST	EMPORIA	KS	66801-5211
STEIN	MARTIN	PO BOX 1477	CARLSBAD	NM	88221-1477
STELLWAGON	KIEFER	915 W 29TH ST	LAWRENCE	KS	66046-4635
STITES	DEAN & VALORIE	405 W BUFFALO ST	GIRARD	KS	66743-1407
STRICKLER	BRENDA				
STROM	BYRON	632 E DOUGLAS AVE	DES MOINES	IA	50313-4567
STUBBS	MICHAEL	PO BOX 5040	SANTA BARBARA	CA	93150-5040
SUDBURY	BRYON	PO BOX 2282	PONCA CITY	OK	74602-2282
SUDEKUM	CLAUDIA	5515 HARRISON ST	KANSAS CITY	MO	64110-2703
SULLIVAN	MELONIE	5205 DEER RUN CT	LAWRENCE	KS	66049-4709
SUTERA	JUDITH	801 S 8TH ST	ATCHISON	KS	66002-2724
TAYLOR	DOUG	308 N BIRCH ST	HILLSBORO	KS	67063-1135
TERRY	TRACY & ELIZABETH	3419 YODER RD	HUTCHINSON	KS	67501-9253
THIES	RANDALL M	5033 SE 4TH TER	TECUMSEH	KS	66542-9605
THOMPSON	ROBERT & FREDA	817 COLLEGE ST	ATCHISON	KS	66002-3057
THURMOND	J PETER	RT 1 BOX 62B	CHEYENNE	OK	73628-9729
TITUS	REV MARY AL	26 EASTWOOD DR	HUTCHINSON	KS	67502-8438
TODD	ARTHUR & HELEN	18396 29TH AVE	GREENSBURG	KS	67054-6792
TODD	CLARENCE & MARJORIE	PO BOX 82	EFFINGHAM	KS	66023-0082

TOMC	BERNIE	13410 ABERCROMBIE DR	ENGLEWOOD	FL	34223-4085
TRABERT	SARAH	926 BOSTON WAY APT 4	CORALVILLE	IA	52241-1264
TREMBLAY	LELAND	2759 HWY 24	HILL CITY	KS	67642-2800
TUCKER	VITA & KEITH	7015 W 133RD ST	BURLINGAME	KS	66413-8778
UBERT	MAUREEN	4441 W 52ND TER	ROELAND PARK	KS	66205-2305
UNIV OF OKLA LIBRARIES	SERIALS DEPT RM LL211	401 W BROOKS ST	NORMAN	OK	73019-0001
VEHIK	DR SUSAN	2622 S PICKARD AVE	NORMAN	OK	73072-6922
VINCENT	JOHN M	112 E 16TH ST	HAYS	KS	67601-3635
WAGGONER	TRICIA	1416 SW JEWELL ST	TOPEKA	KS	66604-2733
WALKER	DANNY	1687 COUGHLIN ST	LARAMIE	WY	82072-2321
WALLEN	ANNE	1720 W 22ND ST	LAWRENCE	KS	66046-2724
WALLEN	MIRIAM	116 E MILL ST	LINDSBORG	KS	67456-2815
WALLEN	ROSE MARIE & MIKE	116 E MILL ST	LINDSBORG	KS	67456-2815
WARD	ROGER	828 AUDREY DR	EL DORADO	KS	67042-2220
WATKINS	AUSTIN	22385 US HWY 75	HOLTON	KS	66436-8343
WATKINS	KENNETH	327 W BURBANK ST	FREDERICKSBURG	TX	78624-3356
WEDEL	DALE	2675 MONROE ST	LARAMIE	WY	82070-6551
WERDER	DOLORES & FRANK	16645 KING RD	VALLEY FALLS	KS	66088-5046
WERHAND	KRISTINE	2123 S 89TH ST	WEST ALLIS	WI	63227-1615
WERNER	NORBERT	2302 POST AVE	DODGE CITY	KS	67801-2556
WESTON	TIM KSHS SHPO	6425 SW 6TH AVE	TOPEKA	KS	66615-1099
WIECHERT	ALLEN	813 HIGHLAND DR	LAWRENCE	KS	66044-2431
WILDGEN	MIKE	801 LOUISIANA ST	LAWRENCE	KS	66044-2649
WILLIAMS	BARRY	4807 GRANITE DR	BISMARCK	ND	58503-6127
WITT	CLAIRE	3852 CHARLOTTE ST	KANSAS CITY	KS	64109-2614
WITTY	THOMAS	5910 S 91ST ST	LINCOLN	NE	68526-9542
WORKMAN	FRANK	304 MERCURY ST	SILVER LAKE	KS	66539-9607
WRIGHT	BARBARA	5756 NW STARFIELD RD	GOWER	MO	64454-9485
WULFKUHLE	VIRGINIA	840 N 1500 RD	LAWRENCE	KS	66049-9195
YARMER	ROBERT E	PO BOX 158	ELLINWOOD	KS	67420-0158
YOUNG	A I	PO BOX 467	BELOIT	KS	67420-0467
ZOLLNER	ELIZABETH	2204 KINGSTON DR	LAWRENCE	KS	66049-1613
ZOLLNER	JOSEPH	2204 KINGSTON DR	LAWRENCE	KS	66049-1613