Volume 38
**2017**

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The Kansas Anthropologist

**Journal of the Kansas Anthropological Association**

# KANSAS ANTHROPOLOGICAL ASSOCIATION

**P.O. Box 750962, Topeka, KS 66675–0962; www.katp.org**

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# The Kansas Anthropologist

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# Notes



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# WHAT WERE THEY DOING UP THERE? ARCHEOLOGY OF MOUNT SUNFLOWER, WESTERN KANSAS

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*University of Kansas*

BARBARA M. CRABLE
*R.C. Goodwin and Associates*

*This paper provides a description and discussion of materials collected between 1998 and 2015 from the surface of Mount Sunflower (14WC411) in Wallace County, northwest Kansas near the Colorado border. The chipped stone assemblage contains a diverse array of lithic materials, representing local gravels and other sources from throughout the region. Diagnostic artifacts include specimens from Paleoindian to the Protohistoric period. A variety of tool types indicate diverse activities associated with production and maintenance of stone tools and processing of other materials. The site apparently served as a camp and hunting overlook throughout prehistory.*

Mount Sunflower is located in western Kansas about 0.8 km east of the Colorado state line (Figure 1) on the divide between the Smoky Hill River and the North Fork of the Smoky Hill River near the head of Goose Creek (Buchanan and McCauley 1987). This highest point in Kansas sits at an elevation of about 4,039 feet amsl (measurements vary by source) and offers a panoramic view of the rolling high plains (Figures 2 and 3), an exceptional vantage point from which to monitor miles of landscape. Higher hills are visible a short distance to the west in Colorado, heralding that state's lowest elevation. While there is no water source at Mount Sunflower, access to water in streams and springs to the south, east, and north is within 1.2 km of the headwaters of Willow Creek, a tributary of the south Smoky Hill River. The Mount Sunflower site (14WC411) is close to the historic Smoky Hill Trail and Overland Butterfield Dispatch routes, which extended along the north side of the North Fork (Socolofsky and Self 1988:Figure 23), and it is situated near important east-west pathways that have been used by herd animals and people since early prehistoric time.

## SITE MATERIALS AND CONTEXT

The materials described here were accumulated during a few brief visits to Mount Sunflower between 1998 and 2015. All items were collected from the surface in exposed areas of the two-track trail and pathways at and around the monument atop Mount Sunflower, over an area less than 2 acres in size. The full extent of 14WC411 is undefined. The possibility of deep cultural deposits is unevaluated and depends largely on the depth of loess (wind-deposited sediments). Erosional exposure of fire-cracked rock in place at the surface suggests that at least shallowly buried deposits and features are present. In 1976 a brief test by Tom Witty (1976) and KAA members Nadine and Melvin Cheney of Tribune, Kansas, also confirmed the presence of near-surface burned rock features.

Regular automobile traffic, foot traffic, and cattle trampling possibly have contributed to the commonly fragmented nature of surface finds. Because fractures and edge damage frequently occur due to post-depositional trampling in areas of high traffic (e.g., Knudson 1979), many of the objects with modified edges very likely were broken incidentally. Consequently, the authors have been very conservative in designating specimens as tools.

A total of 219 items comprise this assemblage. Given the relatively small size of the sample, the diversity of lithic materials and diagnostic pieces is remarkable. Diagnostic artifacts include a partial Paleoindian Allen point base, portions of large



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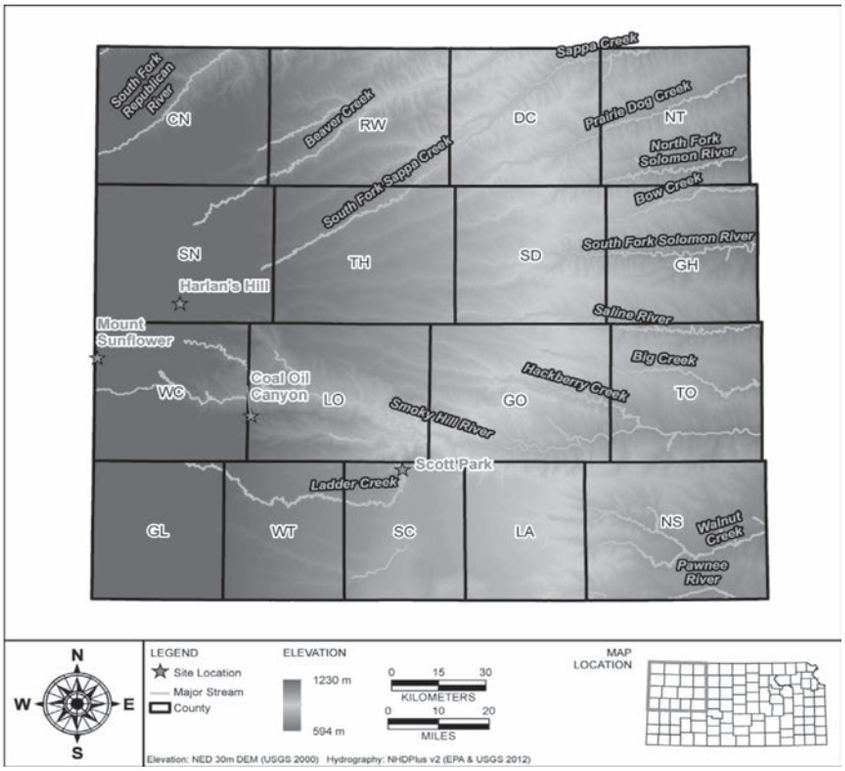


**Figure 1.** Location of Mount Sunflower and other sites mentioned in the text: Harlan's Hill, Coal Oil Canyon, and Scott Park.

**Figure 2.** View west toward Colorado from Mount Sunflower in 2015. In foreground Chris Hord photographs a burned rock feature. Others are, left to right, Lauren Johnson, Helen Sangster, Melonie Sullivan, and Barbara Crable.

dart points of probable Archaic age, a corner-notched arrow point of Plains Woodland age, side-notched arrow points of late prehistoric age, and an unnotched triangular arrow point of probable proto-historic (post A.D. 1000) age. These artifacts indicate that Mount Sunflower has been used repeatedly since Paleoindian times by many different groups of people. Biface sections reflect stone tool production, and scraper fragments and flake tools reveal a variety of processing and maintenance activities.



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**Figure 3.** View northwest from Mount Sunflower in 2015. Burned rocks from a hearth feature are visible in the lower right.

### *Features*

Features at 14WC411 were not formally defined or investigated, but discrete clusters of gray thermally altered caliche were noted, exposed by erosion but still in situ at the surface. Presumably these features are prehistoric in age, as chipped stone debitage and bits of burned bone, as well as ash and bits of charcoal, were observed among the rocks. One of these concentrations was located within about 15 m east-northeast of the monument. Three elements of burned bone and tooth enamel and three angular chert pieces demonstrate the presence of hearths or campfires. A few chipped stone specimens have been burned (n = 10, 4.7 percent of all chipped stone), perhaps as a result of association with fire hearths.

The similar feature tested by Witty and the Cheneys in 1976 was located about 60 m north of the monument. This feature was defined by burned gray rocks, concentrated in an area about 1 m in diameter and up to 15 cm in depth. The feature was partially excavated, and probing helped define its limits. The fill around the rocks contained particles of burned earth, bits of charcoal, two flakes, and some unburned bone fragments (Witty 1976). The surface collection and feature ỳ elded more than 15 pieces of burned gray caliche, an unspecified biface, a broken arrow point, 5 partial small cobbles, a broken ground quartzite cobble, and 31 flakes that included basalt, cherts, and other materials. These are not incorporated in the following tables or descriptions.

### *Artifacts*

Each artifact from the Mount Sunflower site was numbered individually in no particular order. The specimen numbers are noted here to enable track ing and recheck ng of items.

#### Debitage (N = 182)

In the appendix the 182 flakes and flake fragments from 14WC411 are categorized by flake type, con-



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dition, lithic material, platform attributes, and presence of cortex. Proportions of flake types and lithic materials are illustrated in Figures 4 and 5. Many pieces are broken, and this might be due in part to the exposed area of the site being one of high traffic in terms of pedestrians, vehicles, and livestock.

A high percentage of flakes (n = 52, 24 percent of all chipped stone) display some cortical surface, many of which exhibit gravel or stream abrasion. This reflects the local and near-local origins of these materials that commonly were used for production of expedient tools. They are dominated by quartzites, silicified wood, basalt, chalcedony, and unidentified cherts, which mainly occur locally in secondary gravel deposits. However, some of the quartzites, notably the Dakota quartzite, probably were derived primarily from bedrock and secondary gravel sources to the south and southwest of Mount Sunflower. Lithic materials and sources are discussed further below.

### Cores (N = 3)

Three small cobbles, measuring 2–4 cm in length, have water-worn cortical surfaces with multiple flake removals and represent cores or cobbles tested to evaluate the material's quality. Each is a different stone: silicified wood (#192), Dakota quartzite (#193), and chalcedony (#219). These are bipolar cores with opposing platforms and battered surfaces. They may have served as sources for small flakes, as small knapping hammers, or even as wedges for splitting wood or bone.

### Flake Tools and Scrapers (N = 6)

While functional terms, such as scraper, drill, and knife, are applied, no microscopic use-wear analysis has been performed on these artifacts. Descriptive names refer only to the outline form and thickness of specimen edges and not to determined functions. Many objects undoubtedly were multi-functional in actual usage. Both hafted and unhafted (curated and expedient) tools probably are present here.

Drill Tip (#3). This rounded or blunted drill or reamer tip is made of Elizabeth wood (Figure 6C). It is plano-convex in cross section with a flake scar ridge extending the length of the convex (dorsal) surface. Marginal retouch is primarily on the dorsal surface with only minimal scaring on the ven-

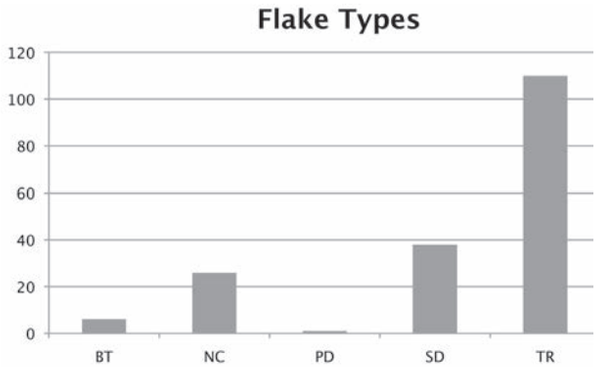


**Figure 4.** Proportions of debitage types.

BT = biface thinning, NC = no cortex and no platform, PD = primary decortication, SD = secondary decortication, TR = tertiary

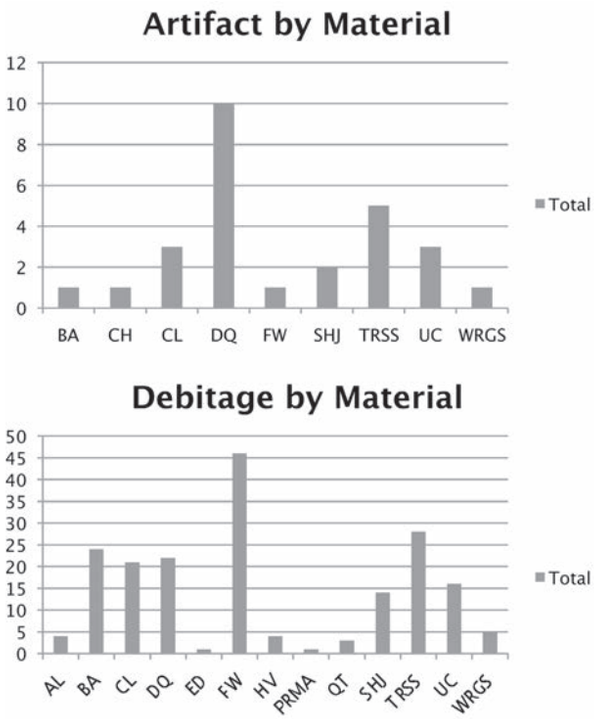


**Figure 5.** Lithic material types for debitage and artifacts.

AL = Alibates silicified dolomite, BA = basalt, CH = unidentified chert, CL = chalcedony, DQ = Dakota quartzite, ED = Edwards chert, FW = fossil wood, HV = Harville Uplift chert, PRMA = Permian A, QT = quartzite, SHJ = Smoky Hill jasper, TRSS = Tongue River silicified sediment, UC = unidentified cherts, WRGS = White River Group silicates



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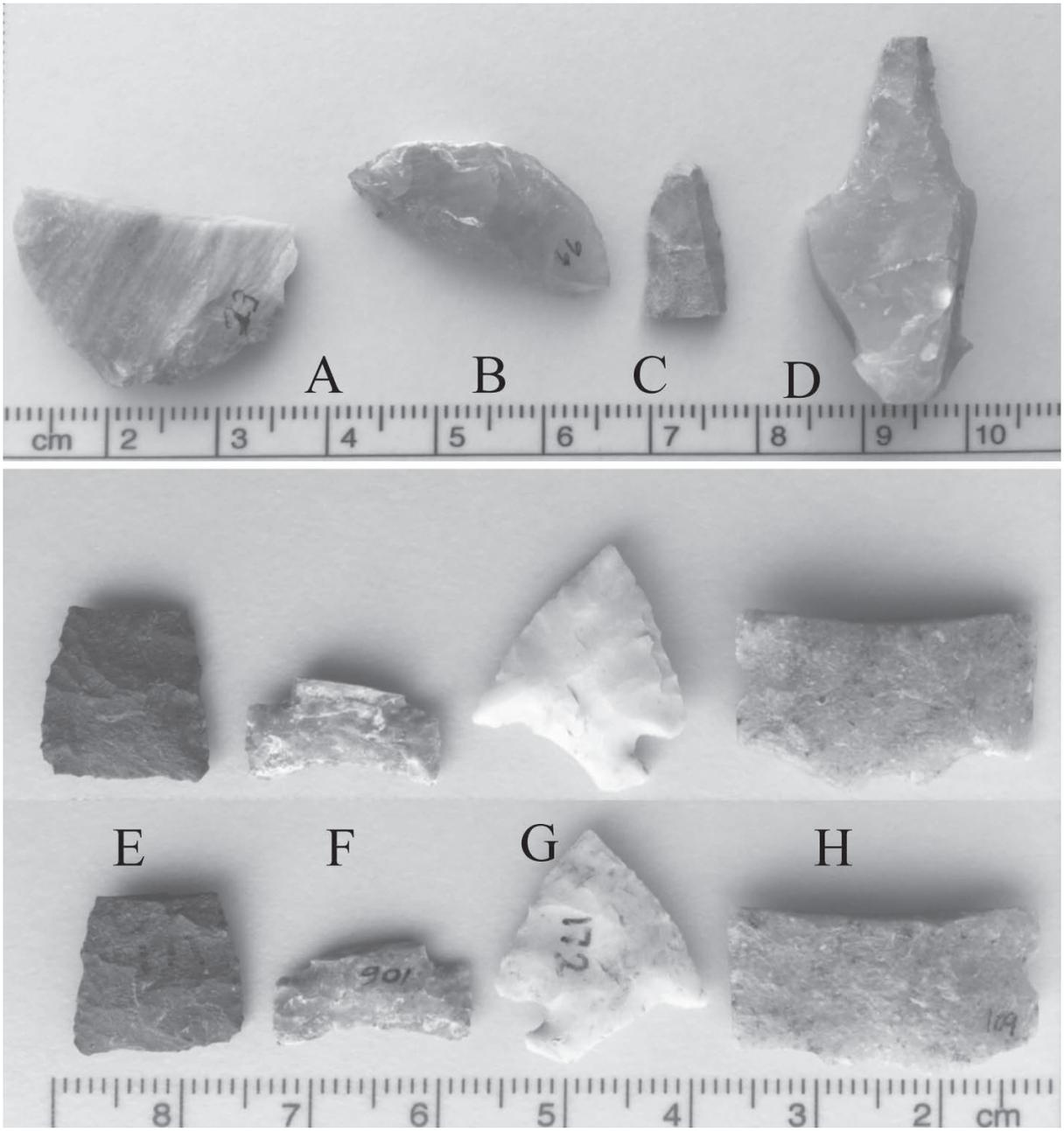


**Figure 6.** Selected artifacts from 14WC411: A. flake tool (#23), B. preform tip (#66), C. perforator tip (#3), D. flake-drill (#104), E. basalt unnotched arrow point (#171), F. side-notched arrow point base (#106), G. corner-notched arrow point (#172), H. Allen point basal fragment (#109).

tral surface along one edge near the tip. The fracture across the blade appears to be a simple snap.

End Scraper Fragment (#14). This is the proximal end of a Smoky Hill jasper tertiary flake. Dorsal retouch occurs on both lateral edges with notable polish on the flake scar ridges. The piece is plano-convex in cross section but approaches bi-plano due to the flat dorsal surface on the remaining portion. The size, flaking, wear, and overall configu-



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ration conform to the base of an end scraper that likely broke in its haft during use. The break across the blade is compound, and crushing and nibbling along the fracture edges probably happened after the scraper was broken.

Side Scraper (#23). This tertiary flake of gray and brown banded silicified wood has fine regular retouch along the dorsal surface of one lateral edge (Figure 6A). The flake scar ridges on this edge exhibit a high degree of polish. The opposing edge is short and irregular and has limited bifacial retouch and unsystematic ventral surface retouch. The artifact is wider than it is long and has a hinge termination. It is interpreted as a small unhafted expedient tool.

Flake Tool (#35). This tertiary flake of Hartville Uplift chert has a sequence of small incidental flake scars on the ventral surface of one lateral edge, which is presumed to result from use damage. The flake scar ridges display polish. The specimen is thought to be a small expedient knife. The piece has been severely burned and has multiple fire-craze fractures. Perhaps it was lost or discarded in the proximity of a hearth. It is one of the relatively few (n = 10) burned flakes or chipped stone items from this Mount Sunflower collection.

End Scraper Edge (#49). This distal end of an end scraper is made of opaque gray Tongue River silicified sediment or Tongue River silcrete. Steep retouch appears along the dorsal flake surface with crushing and nibbling along the dorsal side of the scraper edge, suggesting use on hard or resistant materials, such as wood or bone. The break across the blade is a compound twist and likely occurred during use. Presumably the implement was hafted, but as only the distal edge remains, its original size and form are unknown.

Flake Drill (#104). This drill is made on a thick, angular yellow-brown chalcedony flake (Figure 6D). The tip is fashioned on the distal end, and the extremity is snapped and is reddened. The remaining drill tip length is 7 mm. The base is thick and does not seem to have been modified for hafting, so the tool presumably was hand held. Some polish or wear is evident on the drill edges and on the basal ridges.

## Bifaces (N = 6)

These mostly small pieces are evidence of bifacial reduction, potentially related to the production of projectile points from bifacial preforms. Many, if not all, of these specimens are preforms for dart points or knives. Intermediate and late stage bifaces are present.

Biface Edge (#26). This small fragment is from a bifacial preform of Dakota quartzite. Only a small edge portion exists, but the size implies a knife or dart point preform. Flaking is regular and well executed. There is no grinding, as might be expected on a preform or near the base of a lanceolate point, and no obvious wear on the flake scar ridges. It is presumed to be a late stage preform or dart point.

Biface Edge (#40). This thick and irregular fragment is made from Tongue River silicified sediment. It may be an intermediate-stage preform, and its size supports identification as a dart point or knife preform. A large fracture is perverse across the width of the artifact. Perverse fractures occur when attempted flake removals split the biface rather than removing a flake from the artifact's face. A smaller one is a bending break on a strongly biconvex edge segment. Possibly a drill or reamer projection split off here, suggesting that this irregular biface was repurposed for something other than a preform after the perverse fracture occurred.

Biface Edge (#43). This fragment is made from translucent gray Dakota quartzite. It is an example of an edge that collapsed because it was struck too far from the edge (on the face of the biface rather than the extreme edge) and perhaps with too much force. The knapper apparently was trying to thin a thick area on the biface edge and simply miscalculated the blow. Some abrasion appears on the edge, probably due to use modification or edge preparation during flaking and shaping. Size indicates that this was a dart point or knife preform.

Biface Fragment (#55). This small biface section is made from brown and gray mottled opaque



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Dakota quartzite. The item is likely from a finished dart point and exhibits multiple post-manufacture break. About 1.5 cm of the edge survives and has a bend/snap fracture across the blade. A compound break occurred roughly parallel to the biface edge, and a longitudinal flake scar extends down the long axis of one face. This may be an impact flute from the tip of the original point. All fractures could have happened as the result of impact against a hard substance or surface. This tip might have been transported to the site in an animal carcass.

Biface Edge (#62). This small edge fragment of a well-flaked biface is made of a slightly translucent White River Group silicate. The orangish color is slightly different from the usual patterns that are found at Flattop Butte, northwest of Sterling, Colorado, but the material is commonly seen in Folsom artifacts throughout this region. The specimen represents a collapsed edge or possibly part of a snapped tip, as is frequently recognized in late-stage Folsom point production (Amick 2002; Jodry 1999; Judge 1970, 1973; Titmus 2002).

Biface Fragment (#66). This portion of a little chalcedony biface presumably is a small projectile point or knife preform (Figure 6B). Some cortex and weathered surface remain, but most of one face and the margins have been flaked. The item is concavo-convex in cross section, and light grinding or abrasion occurs on one convex edge. A perverse fracture split the piece, and no post-break use or recycling is evident.

## Projectile Points (N = 11)

A variety of projectile points are present in the collection and are largely incomplete (Figure 6E-H). Repair and replacement of damaged points was apparently a routine activity, and a number of late-stage bifaces may reflect manufacture of substitute projectile points. Eleven partial projectile points are in this sample: one nearly complete, four base fragments, two blade fragments, and four tip fragments.

Arrow Point Fragment (#9). This blade and tip segment of Smoky Hill jasper might be from a corner-notched arrow point.

Arrow Point Fragment (#11). This basal corner of a notched point is made from Smoky Hill jasper.

Arrow Point Fragment (#73). This distal section is made from brown translucent Dakota quartzite. It has a compound fracture across the blade, including a snap, a hinge, and edge damage, that could have resulted from impact. The flaking is well executed, and the extreme tip is unbroken. No evidence for the base or hafting elements remains.

Arrow Point Fragment (#106). This base of a side-notched point is made from mottled gray Dakota quartzite with some red and black inclusions (Figure 6F). Its slightly concave base is intact, but a compound fracture crosses the stem. The notches are deep and well made, creating a stem width of 8.78 mm. This common late prehistoric, Plains Village-era projectile point of the Washita type (Bell 1958:98) was in use from about A.D. 1200 through 1500 (Bevitt 1999; Blakeslee and Hawley 2006; Bowman 1960; McLean 1996; Wedel 1959).

Arrow Point Fragment (#107). This well-made delicate tip of a long arrow point has straight outline edges. The whitish gray chert is unidentified. The break across the blade is a snap, and one edge is slightly damaged. The base and hafting elements are missing.

Dart Point Fragment (#108). This blade section is made from gray translucent Dakota quartzite. It is relatively large and noticeably thicker than the 14WC411 arrow points and probably represents a small dart point. No portions of the stem, base, or hafting elements remain. The artifact has suffered two breaks: a hinge from the tip and a compound from the proximal end of the blade. These are typical fractures that result from impacts on hard surfaces, such as bone or rock.

Dart Point Fragment (#109). The base of this Allen point is made of gray translucent Dakota quartzite (Figure 6H). Both basal corners or ears are broken, exhibiting hinge removals in the same direction, as might happen during an in-haft impact. The short segment is snapped across the blade with crushing along one edge of the fracture, perhaps due to an impact or subsequent post-depositional trampling.



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The lateral margins are well ground, although one is nicked; the base is ground also. Thinning flakes were removed from the center of the base on both faces. The cross section is lenticular, relatively flat and broad. Only a few flake scars are present on each face, but these reflect a parallel flaking pattern that is very slightly oblique. The flaking, cross section, basal form, and lithic material are characteristic of Allen points in this region (Hofman 2001). The type of break, an in-haft snap close to the base, corresponds with a large piece that could be refurbished and reused. Retooling and thinning a snapped base to make it suitable for rehafting usually required a series of removals that created a deeply concave base on the reworked point (Hofman 2016:212).

Dart Point Fragment (#110). This extreme tip is made from Tongue River silicified sediment. Its thickness and robust nature suggest that it represents a dart rather than an arrow point and is likely of Archaic or possibly Early Ceramic age. No indication about the configuration of the haft elements remain.

Arrow Point Fragment (#111). This short broad blade portion is made from Tongue River silicified sediment. The segment is from near the tip, and the edges are slightly convex. Whether the point was notched or stemmed is unknown, but the overall size and shape imply that it was a notched arrow point of some kind. A hinge on the tip and a compound fracture on the proximal end of the blade are visible.

Arrow Point Fragment (#171). This specimen is made from basalt. It is a small unnotched triangular point of the Fresno type, described by Bell (1960:44). It has a compound break across the blade, and the tip is missing (Figure 6E), presumably damaged during use and discarded to be replaced by a complete and functional point. In 1976 Witty apparently found part of an unnotched triangular arrow point.

Arrow Point (#172). This nearly complete short, broad corner-notched arrow point is made of white chalcedony (Figure 6G). It has a short but well-shaped blade with a well-formed tip. The tip angle is very broad, and the point probably was reworked at the tip. The shoulders at the base of the blade are pointed or barbed, and one is broken. The stem is produced by deep notches, which are fairly broad and rectangular, resulting in a stem width of 8.25 mm. One basal corner is missing, but the basal outline was convex. The fracture across the base is a snap, and it is not clear whether this happened in the haft or after the point was lost/discarded. The break would have made the point dysfunctional, and it is too short to have been reworked again.

## CHIPPED STONE MATERIALS

Artifacts from 34WC41 are fashioned from many lithic materials discussed briefly below. Table 1 provides a summary of material types by chipped stone category. Lithic descriptions can be found in Asher (2016), Banks (1990), Lopinot et al. 2010, Ray (2010), Stein (2005, 2006), and other publications as noted. These materials originate in multiple sources and source areas, as indicated in Figure 7. Several presumably are derived from local and regional gravels, which were deposited in outwash sediments from the Rocky Mountains and foothills region of the Hahn Divide. Basalt or trachyte (Blasing 1990; Hoard 2009; Lopinot et al. 2010; Ray 2010) and Tongue River silicified sediment (see Ahler 1977) are examples. This or very similar rock in the Central and Southern Plains is referred to as Potter chert (Hughes 1968), Ogallala chert (Tunnell and Hughes 1955; Hofman 1973; Leonhardy 1966), Ogallala quartzite (Hofman 1978:5, Table 3; Saunders and Lopez 1973), Ogallala silicified sediment (Holen 1991), and other terms (Lopinot et al. 2001; Ray 2001). A variety of other unidentified or unnamed cherts, quartzites, and chalcedony are incorporated in these gravels as well. Petrified or silicified wood is well represented and may have been derived primarily from secondary gravel sources, as some pieces exhibit water-worn cortex. Some of the petrified wood comes from the Hahn Divide area near Black Forest, Colorado, and commonly is referred to as Elizabeth wood (Asher 2016; Hofman et al. 2002; Holen 1991; Jodry 1999). Opalite or chalcedony also occurs within the Ogallala bedrock (mortar board or caliche caprock) in this region, as residual material and in local gravels (Franks and Swineford 1959; Frye and Swineford 1946; Lintz 1997; Lopinot et al. 2010; Ray 2010).



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**Table 1.** Frequency of Lithic Material Types by Category from Mount Sunflower, Compared with Assemblages from Harlan's Hilltop and Scott Park Sites.

| Locality | Mount Sunflower | | | | | Lake Scott State Park | | Harlan's Hill | | 14SC409 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Artifacts | | Debitage | | | | | | | | |
| Material Type | Number | % | Number | % | Total | Number | % | Number | % | Number | % |
| SHJ | 3 | 10.3 | 13 | 7.1 | 16 | | | 13 | 8.6 | 499 | 77 |
| DQ | 10 | 32.2 | 22 | 12.1 | 32 | 61 | 4.7 | 13 | 8.6 | 11 | 1.7 |
| FW | 4 | 12.9 | 43 | 23.6 | 47 | | | 32 | 21.2 | | |
| TRSS | 5 | 16.1 | 28 | 15.3 | 33 | | | 28 | 18.5 | | |
| CL/OP | 4 | 12.9 | 20 | 11 | 24 | 34 | 2.6 | 2 | 1.3 | 8 | 1.2 |
| WRGS | 1 | 3.2 | 5 | 2.7 | 6 | 1 | 0.1 | | | | |
| HV | 1 | 3.2 | 3 | 1.6 | 4 | | | | | | |
| BA/trachyte | 1 | 3.2 | 24 | 13.2 | 25 | 93 | 7.2 | 30 | 19.8 | 11 | 1.7 |
| PRA | | | 1 | 0.5 | 1 | 23 | 1.8 | | | 1 | 0.2 |
| Quartz | | | 3 | 1.6 | 3 | | | 3 | 2 | | |
| AL | 1 | 3.2 | 3 | 1.6 | 4 | 22 | 1.7 | | | 7 | 1.1 |
| ED | | | 1 | 0.5 | 1 | | | | | | |
| UC | 1 | 3.2 | 16 | 8.8 | 17 | 208 | 15.9 | 30 | 19.8 | 111 | 17.1 |
| Total: | 31 | 100.4 | 182 | 99.6 | 213 | 442 | 34 | 151 | 99.8 | 648 | 100 |

Key to material types: SHJ = Smoky Hill jasper; DQ = Dakota quartzite; FW = fossil wood; TRSS = Tongue River silicified sediment; CL/OP = chalcedony/opaline; WRGS = White River Group silicates; HV = Hartville Uplift chert; BA = basalt/trachyte; PRA = Florence A; AL = Alibates silicified dolomite; ED = Edwards chert; UC = unidentified cherts

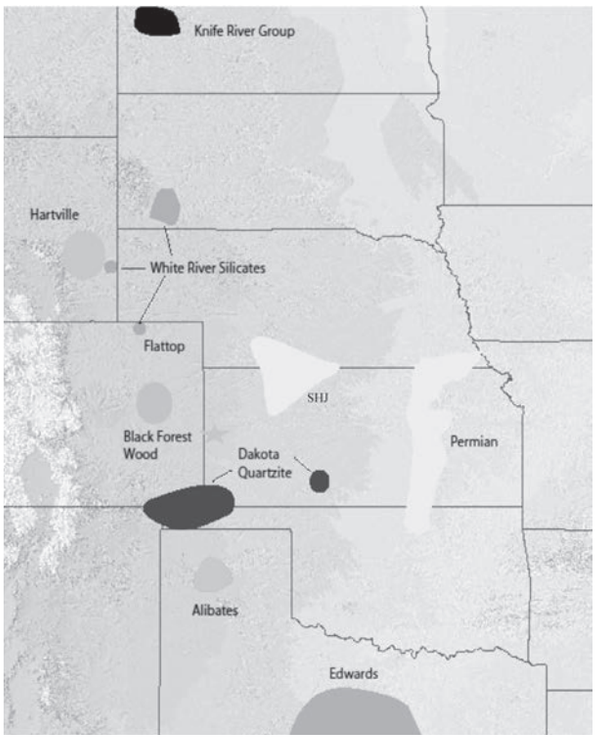


**Figure 7.** Lithic material source areas. Location of Mount Sunflower is indicated by the star.

More distant sources are Smoky Hill jasper, a silicified chalk that is transported from outcrops more than 100 km east of Mount Sunflower and is not derived from local gravels (Stein 2006); Dakota quartzite, probably from sources to the west and southwest in southeastern Colorado and southwestern Kansas (Banks 1990; Stein 2006); Alibates flint or silicified dolomite from the central Texas Panhandle along the Canadian River and found in gravel deposits downstream from the source area (Banks 1990; Wyckoff 1993); possibly Edwards chert from central Texas (Banks 1990; Tunnell 1978); White River Group silicates, including Flattop chalcedony from northeastern Colorado (Greiser 1974; Hoard et al. 1993); chert from the Hartville Uplift region of eastern Wyoming (Miller 1991); and Florence A chert from the southern Flint Hills of the Kansas-Oklahoma border region (Banks 1990; Stein 2006).

Most of these lithic materials are present in the artifact assemblage from the Norton bison kill site (14SC6), which is a 9,000 year old Allen complex arroyo kill on Ladder Creek south of Lake Scott State Park (Hofman 2010). Norton projectile points



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are made from Smoky Hill jasper, basalt, Alibates silicified dolomite, Dakota quartzite, and White River Group silicates. A bifacial knife is made from silicified wood, and scrapers and other implements include items made from opaline (chalcedony), basalt, and Edwards chert. This diverse array of materials in the 14SC6 collection is reflected in the debitage and is relatively common for Paleoindian assemblages in the region. At 14SN106 in the Kanorado locality 30 km north of Mount Sunflower, this assortment of lithic materials is represented by the tools and debitage in the Folsom age deposit (Ray n 2006).

At 14WC411 the primary materials from local and near-local gravel sources are silicified woods (n = 47, 22 percent of all chipped stone), Tongue River silicified sediment (n = 33, 15 percent), basalt or trachyte (n = 25, 12 percent), chalcedony (n = 24, 11 percent), and unidentified cherts and quartz that were likely from local gravels (n = 20, 9 percent). Altogether the local or probably local lithic materials constitute 69 percent of the total. Among the materials not available in local gravels, Dakota quartzite (n = 32, 15 percent) and Smoky Hill jasper (n = 16, 8 percent) are from non-local sources located in opposite directions. These may reveal primary directions of movement by the groups that used Mount Sunflower. Florence A and Edwards cherts, limited to only one or two pieces, might depict trade or the end of the use range for materials at those distances. However acquired, lithic materials with slightly higher or intermediate frequency (i.e., White River Group silicates, Hartville Uplift chert, and Alibates silicified dolomite) possibly were repeatedly and generally used but had become expended at this use-distance from the sources.

Use-distance simply refers to the number of utilization episodes that a tool assemblage has experienced since the tools were fabricated or the tool stone was obtained, not the linear distance from the tool stone source. This distance typically is unknown, but the relative use-distance can be estimated by material frequency and the amounts of reworking and prior damage evident (e.g., Hofman 1992). Sometimes tool stone is represented only by retouch flakes from "ghost" artifacts, which were not lost or discarded but were used or retouched at the site and then carried away.

The differences in proportions of lithic materials represented by retouched specimens, as opposed to debitage, is notable. Ten of 31 (32 percent) of retouched objects but only 12 percent of the flakes are Dakota quartzite. By contrast, basalt and fossil wood are much more frequently represented by debitage than retouched artifacts (Table 1).

## DISCUSSION

The range of artifacts at the Mount Sunflower site encompasses projectile points, drills and perforators, bifacial preforms, scrapers, flake knives, expedient flake tools, cores, and debitage. Other than debitage, projectile points are the most common artifact group. These mostly incomplete specimens attest to refurbishing and discard of broken and damaged points. Production of replacement projectile points is reflected by some of the biface sections and biface reduction flakes. Projectile point bases are found when reworking occurred and hafts were refitted with new or refashioned points (e.g., Davis 1953). Projectile tips were lost more frequently during hunting and usually were not returned to camps where retooling took place. Exceptions are projectile point tips that broke within animal carcasses and were returned to camp or processing locales where the body parts were used or further processed (Hofman 1986). The variety of projectile point types in this sample indicates that 14WC411 was used by Paleoindians during the early Holocene, by mid-Holocene Archaic dart point-using people, and by late prehistoric peoples using assorted arrow point styles. It apparently was used repeatedly by different groups who lived or hunted in the area.

Few other specialized implements are recognized, but the drills and tips indicate use of perforators for a number of activities, perhaps in conjunction with manufacturing or repairing wooden, skin, or hide items. Several scrapers are present, including proximal portions of end scrapers that seemingly broke in their hafts during use. These potentially were used for hide working, but, because the distal ends are missing, assessment of their specific functions is not feasible. Other steep-edged scrapers appear to have been hand-held expedient tools that may have been employed for a wide range of tasks. Thinner edged utilized flakes may have served in cutting functions. Various retooling and maintenance activities can be suggested.



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The setting, presence of hearths, selection of lithic materials, and tool forms make 14WC411 very similar to Harlan's Hilltop site (14SN9), located about 25 km to the northeast, where two hearths were tested in 2015. The variety of lithic materials from Harlan's Hilltop is comparable to that from Mount Sunflower (Table 1), and both sites would have served well as overlooks and retooling stations. These stand in relatively dramatic contrast to sites such as Coal-Oil Canyon (14LO1, McLean renumbered this site in her 1996 report), which is located in a protected setting near a spring about 53 km east of Mount Sunflower (Bowman 1960; McLean 1996). Coal-Oil Canyon has a broad array of features, tool types, and artifacts, including ceramics; however, information on lithic material types is not available. Throughout much of prehistory, extending back at least into middle Holocene Archaic time, 14LO1 was a camp. The deepest and earliest deposits have not been investigated, but see Bowman 1996.

Many of the sites in Lake Scott State Park along Ladder Creek in Scott County probably were camps with occupations of longer duration than those of 14WC411 (Hoard 2009). Lithic materials in the assemblages are notably different than those from Mount Sunflower or Harlan's Hilltop (Table 2). In particular, Smoky Hill jasper averages more than 60 percent of each Lake Scott collection and constitutes 77 percent of the chipped stone from 14SC9. The park is located 98 km southeast of Mount Sunflower and within 70 km of good Smoky Hill jasper sources.

The Mount Sunflower site represents a repeatedly used short-term camp and overlook on the highest elevation in Kansas. This unprotected setting is ideal for observation of animals, people, or weather, for signaling, and for staging or planning movement across an expansive landscape. It is a great location to benefit from summer breezes but not a good place to be during a winter blizzard.

People have been visiting and enjoying Mount Sunflower for more than 10,000 years. Unfortunately, the registry book was not there in prehistoric times, so the names of specific visitors from that era are not known. The property was homesteaded by Edward and Elizabeth Harold in 1905, and their family has continued to live the high life in Kansas since then. "Some would describe Mount Sunflower as a barely noticeable rise in the middle of a field on a ranch 1/2 mile from the Colorado border, but they would lack vision" (Stokes 2017).

## ACKNOWLEDGMENTS

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## REFERENCES CITED

Amick, Daniel S.
2002 Manufacturing Variation in Folsom Points and Fluted Preforms. In *Folsom Technology and Lifeways*, edited by John E. Clark and Michael B. Collins, pp. 159–187. Lithic Technology Special Publication No. 4. Department of Anthropology, University of Tulsa, Tulsa, Oklahoma.

Asher, Brendon
2016 *From the Continental Divide to the Plains-Woodland Border: Clovis and Folsom/Mill and Land Use and Lithic Procurement.* Ph.D. dissertation, Department of Anthropology, University of Kansas, Lawrence.

Banks, Larry D.
1990 *From Mountain Peaks to Alligator Sloughs: A Review of Lithic Sources in the Trans-Mississippi South, the*



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*Southern Plains, and Adjacent Southwest.* Memoir No. 4. Oklahoma Anthropological Society, Norman.

Bell, Robert E.
1958 *Guide to the Identification of Certain American Indian Projectile Points*. Special Bulletin No. 1. Oklahoma Anthropological Society, Norman.
1960 *Guide to the Identification of Certain American Indian Projectile Points*. Special Bulletin No. 2. Oklahoma Anthropological Society, Norman.

Bevitt, C. Tod
1999 Life on the High Plains Border: Archeological Investigation of Three Late Prehistoric Habitation Sites in Southwest Kansas. *The Kansas Anthropologist* 20: 1–106.

Blakeslee, Donald J., and Marlin Hawley
2006 The Great Bend Aspect. In *Kansas Archaeology*, edited by R. J. Hoard and W. E. Banks, pp. 165–179. University Press of Kansas, Lawrence.

Blasing, Robert K.
1990 Mineralogical Identification of Trachite in Trego County, Kansas. Paper presented at the 48th Annual Plains Anthropological Conference, Oklahoma City, Oklahoma.

Bowman, Peter W.
1960 *Coal-Oil Canyon (14LO1) Report on Preliminary Investigations.* Bulletin No. 1. Kansas Anthropological Association, Hays.
1996 Coal-Oil Canyon (14LO401): Progress Report, Area 7. *The Kansas Anthropologist* 17(2):33–38.

Buchanan, Rex, and James R. McCauley
1987 *Roadside Kansas*. University Press of Kansas, Lawrence.

Davis, E. Mott
1953 Recent Data from Two Paleo-Indian Sites on Medicine Creek, Nebraska. *American Antiquity* 18: 303–306.

Franks, Paul C., and Ada Swineford
1959 Character and Genesis of Massive Opal in Kimball Member, Ogallala Formation, Scott County, Kansas. *Journal of Sedimentary Petrology* 29(2):186–196.

Frye, John C., and Ada Swineford
1946 *Silicified Rock in the Ogallala Formation*. Bulletin No. 64, Pt. 2. Kansas Geological Survey, Lawrence.

Greiser, Sally T.
1974 A Preliminary Statement about Quarrying Activity at Flattop Mesa. *Southwestern Lore* 49(4):6–14.

Hoard, Robert J.
2009 Archeological Survey of Scott State Park: 2009 Kansas Archeology Training Program Field School. *The Kansas Anthropologist* 30:33.

Hoard, Robert J., John R. Bozell, Steven R. Holen, Michael D. Glascock, Hector Neff, and J. Michael Elam
1993 Source Determination of White Rock Group Silicates from Two Archaeological Sites in the Great Plains. *American Antiquity* 58:698–710.

Hofman, Jack L.
1973 CD-177, A Small Archaic Camp in West-Central Oklahoma. *Bulletin of the Oklahoma Anthropological Society* 22:71–106.
1978 An Analysis of Surface Material from the Little Deer Site, 34CU10, of Western Oklahoma: A Further Investigation of the Wheeler Complex. *Bulletin of the Oklahoma Anthropological Society* 27:1–109.
1986 Eva Projectile Point Breakage at Cave Spring: Pattern Recognition and Interpretive Possibilities. *Mid ontinental Journal of Archaeology* 11(1):79–95.
1992 Recognition and Interpretation of Folsom Technological Variability on the Southern Plains. In *Ice-Age Hunters of the Rockies*, edited by D. J. Stanford and J. S. Day, pp. 193–224. University Press of Colorado, Niwot.
2010 Allen Complex Behavior and Chronology in the Central Plains. In *Exploring Variability in Early Holocene Hunter-Gatherer Lifeways*, edited by S. Hurst and J. L. Hofman, pp. 135–152. Publications in Anthropology No. 25. University of Kansas, Lawrence.
2016 Seedorf: A Small Allen Complex Assemblage in Eastern Colorado. *Plains Anthropologist* 61(239):203–224.

Hofman, Jack L., Grayson Westfall, and Tom Westfall
2002 A Folsom Camp in the Black Forest Area of Colorado. *Current Research in the Pleistocene* 19:34–37.

Jodry, Margaret A.
1999 *Folsom Technological and Socioeconomic Strategies: View from Stewart's Cattle Guard and the Upper Rio Grande Basin, Colorado*. Ph.D. dissertation, Department of Anthropology, American University, Washington, D.C.

Judge, James
1970 Systems Analysis and the Folsom-Midland Question. *Southwestern Journal of Anthropology* 26:29–45.



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1973 *Paleoindian Occupation of the Central Rio Grande Valley in New Mexico*. University of New Mexico Press, Albuquerque.

Knudson, Ruthann
1979 Inference and Imposition in Lithic Analysis. In *Lithic Use-Wear Analysis,* edited by Brian Hayden, pp. 269–281. Academic Press, New York.

Leonhardy, Frank C.
1966 Test Excavations in the Mangum Reservoir Area of Southwestern Oklahoma. *Contributions of the Museum of the Great Plains* 2. Great Plains Historical Association, Lawton, Oklahoma.

Lintz, Christopher R.
1997 The Occurrence and Prehistoric Aboriginal Utilization of Opalite in the Palo Duro Creek Vicinity of the Texas Panhandle. *Bulletin of the Oklahoma Anthropological Society* 46: 107–126.

Lopez, David R., and Roger Saunders
1973 Current Lithic Studies in Oklahoma. *Oklahoma Anthropological Society Newsletter* 21(9):1–4.

Lopinot, Neal H., A. Holly Jones, Jack H. Ray, and David Byers
2000 The Horsethief Site and Upper Republican Adaptation along the Edge of the High Plains. *The Kansas Anthropologist* 31: 127–147.

McLean, Janice A.
1996 Coal-Oil Canyon Revisited: History of Investigations, 1955–1996. *The Kansas Anthropologist* 17(2): 132.

Miller, James
1991 Lithic Resources. In *Prehistoric Hunters of the High Plains*, by George C. Frison, pp. 449–476. Academic Press, New York.

Ray, Jack H.
2000 Lithic Analysis. In *Archaeological Investigations of the Horsethief Site (14HO308), Hodgeman County, Kansas*, by N. H. Lopinot, A. H. Jones, J. H. Ray, and D. Byers, pp. 45–83. Research Report No. 1352. Center for Archaeological Research, Missouri State University, Springfield.

Ryan, Shannon
2016 *Recognizing Paleoindian Hide Working Activity Areas on the Great Plains.* Ph.D. dissertation, Department of Anthropology, University of Kansas, Lawrence.

Stein, C. Martin
2005 *Sources of Smoky Hill Silicified Chalk in Northwest Kansas*. Anthropological Series No. 17. Archeology Office, Kansas State Historical Society, Topeka.
2006 Kansas Lithic Resources. In *Kansas Archaeology*, edited by R. J. Hoard and W. E. Banks, pp. 264–282. University Press of Kansas, Lawrence.

Stokes, Keith
2017 Mount Sunflower. Electronic document, http://www.kansastravel.org/mountsunflower.htm, accessed 2017.

Titmus, Gene
2002 An Analysis of the Folsom Preform. In *Folsom Technology and Lifeways*, edited by John E. Clark and Michael B. Collins, pp. 227–247. Lithic Technology Special Publication No. 4. Department of Anthropology, University of Tulsa, Tulsa, Oklahoma.

Tunnell, Curtis D.
1978 *The Gibson Lithic Cache from West Texas*. Office of the State Archeologist Report No. 30. Texas Historical Commission, Austin.

Tunnell, Curtis D., and Jack T. Hughes
1955 An Archaic Bison Kill in the Texas Panhandle. *Panhandle Plains Historical Review* 28: 67–70.

Wedel, Waldo R.
1959 *Introduction to Kansas Archeology*. Bulletin No. 174. Bureau of American Ethnology, Smithsonian Institution, Washington, D.C.

Witty, Thomas
1976 Progress Report, 14WC411, the Mount Sunflower Site. Archeological Site Files. Archeology Department, Kansas State Historical Society, Topeka.

Wyckoff, Donald G.
1993 Gravel Sources of Knappable Alibates Silicified Dolomite. *Geoarchaeology: An International Journal* 8(1): 35–58.



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**APPENDIX.** Inventory of Materials Collected from 14WC411

| Specimen Number | Class | Type | Portion | Category | Material | Cortex | Thermal Alteration | Length (mm) | Width (mm) | Thickness (mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CS | FK | NP | TR | TRSS | NO | NO | 12.00 | 10.00 | 5.90 |
| 2 | CS | FK | NP | SD | TRSS | 1 | NO | 13.00 | 13.00 | 6.90 |
| 3 | CS | FT | TP | TP | FW | NO | NO | 15.75 | 7.31 | 2.96 |
| 4 | CS | FK | NP | SD | DQ | 4 | NO | 10.00 | 17.00 | 3.67 |
| 5 | CS | FK | NP | TR | SHJ | NO | NO | 17.00 | 12.00 | 5.00 |
| 6 | CS | FK | CO | TR | SHJ | NO | NO | 8.00 | 12.00 | 3.10 |
| 7 | CS | FK | NP | TR | SHJ | NO | NO | 24.00 | 14.00 | 5.40 |
| 8 | CS | FK | CO | TR | TRSS | NO | NO | 10.00 | 11.00 | 3.00 |
| 9 | CS | PT | TP | AP | SHJ | NO | NO | 17.00 | 10.00 | 2.50 |
| 10 | CS | FK | PL | TR | SHJ | NO | NO | 15.00 | 14.00 | 3.90 |
| 11 | CS | PT | BA | AP | SHJ | NO | NO | 8.00 | 11.00 | 2.80 |
| 12 | CS | FK | PL | BT | TRSS | NO | NO | 17.50 | 22.00 | 4.80 |
| 13 | CS | FK | NP | TR | FW | NO | NO | 13.00 | 14.00 | 3.10 |
| 14 | CS | FT | PR | ES | SHJ | NO | NO | 14.40 | 26.89 | 8.10 |
| 15 | CS | FK | CO | TR | TRSS | NO | NO | 20.00 | 18.00 | 4.40 |
| 16 | CS | FK | NP | SD | TRSS | 2 | NO | 16.00 | 20.00 | 7.00 |
| 17 | CS | FK | PL | TR | TRSS | 1 | NO | 14.00 | 16.00 | 6.60 |
| 18 | CS | FK | CO | TR | FW | NO | NO | 19.00 | 16.00 | 3.70 |
| 19 | CS | FK | NP | TR | FW | NO | NO | 10.00 | 9.00 | 2.00 |
| 20 | CS | FK | PL | SD | FW | 1 | NO | 11.00 | 13.00 | 3.80 |
| 21 | CS | FK | PL | TR | HV | NO | NO | 14.00 | 12.00 | 4.60 |
| 22 | CS | FK | NP | TR | AL | NO | NO | 15.00 | 24.00 | 3.50 |
| 23 | CS | FT | PR | SS | FW | NO | NO | 19.00 | 26.00 | 4.70 |
| 24 | CS | FK | NP | TR | CL | NO | NO | 28.20 | 17.20 | 8.60 |
| 25 | CS | FK | NP | TR | ED | NO | NO | 7.00 | 12.00 | 3.30 |
| 26 | CS | BF | EG | PF | DQ | NO | NO | 18.00 | 16.00 | 7.10 |
| 27 | CS | FK | NP | SD | FW | 1 | NO | 13.00 | 22.00 | 4.40 |
| 28 | CS | FK | NP | SD | SHJ | 1 | NO | 27.00 | 10.00 | 11.60 |
| 29 | CS | FK | NP | TR | DQ | NO | NO | 18.50 | 14.00 | 5.50 |
| 30 | CS | FK | PL | TR | UC | 1 | NO | 12.00 | 12.00 | 4.10 |
| 31 | CS | FK | NP | SD | TRSS | 1 | NO | 16.00 | 18.00 | 7.90 |
| 32 | CS | FK | NP | TR | DQ | NO | NO | 18.00 | 18.50 | 2.80 |
| 33 | CS | FK | NP | TR | SHJ | NO | NO | 13.00 | 18.00 | 3.70 |
| 34 | CS | FK | CO | SD | UC | 3 | NO | 21.00 | 19.00 | 6.30 |
| 35 | CS | FK | CO | TR | HV | NO | YES | 19.87 | 24.93 | 6.29 |
| 36 | CS | FK | NP | TR | FW | NO | NO | 13.00 | 11.00 | 5.60 |
| 37 | CS | FK | PL | SD | TRSS | 3 | NO | 26.78 | 18.40 | 9.57 |
| 38 | CS | FK | NP | SD | CL | 1 | NO | 17.50 | 11.00 | 4.60 |
| 39 | CS | FK | NP | SD | CL | 1 | NO | 20.40 | 17.80 | 7.20 |
| 40 | CS | BF | EG | PF | TRSS | NO | NO | 26.90 | 16.75 | 9.40 |
| 41 | CS | FK | NP | SD | DQ | 1 | NO | 20.00 | 20.00 | 10.50 |
| 42 | CS | FK | PL | TR | FW | NO | NO | 16.50 | 10.20 | 3.20 |
| 43 | CS | BF | EG | PF | DQ | NO | NO | 14.47 | 23.47 | 7.50 |
| 44 | CS | FK | NP | TR | DQ | NO | NO | 13.48 | 13.37 | 3.74 |
| 45 | CS | FK | PL | TR | DQ | NO | NO | 20.64 | 16.75 | 6.35 |



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**APPENDIX.** (CONTINUED)

| SPECIMEN NUMBER | CLASS | TYPE | PORTION | CATEGORY | MATERIAL | CORTEX | THERMAL ALTERATION | LENGTH (MM) | WIDTH (MM) | THICKNESS (MM) |
|---|---|---|---|---|---|---|---|---|---|---|
| 46 | CS | FK | NP | SD | FW | 4 | NO | 20.12 | 25.34 | 7.71 |
| 47 | CS | FK | PL | TR | DQ | NO | NO | 23.18 | 31.72 | 11.06 |
| 48 | CS | FK | CO | SD | DQ | 2 | NO | 25.05 | 13.81 | 9.23 |
| 49 | CS | SC | DS | ES | TRSS | NO | NO | 12.51 | 27.42 | 8.11 |
| 50 | CS | FK | NP | TR | DQ | NO | NO | 12.00 | 12.00 | 2.10 |
| 51 | CS | FK | PL | TR | UC | NO | NO | 11.00 | 11.00 | 2.99 |
| 52 | CS | FK | NP | TR | TRSS | NO | NO | 7.00 | 5.50 | 1.38 |
| 53 | CS | FK | NP | SD | DQ | 1 | NO | 8.89 | 12.15 | 3.57 |
| 54 | CS | FK | CO | TR | DQ | NO | NO | 10.10 | 8.90 | 2.40 |
| 55 | CS | BF | EG | PF | DQ | NO | NO | 14.70 | 7.20 | 5.10 |
| 56 | CS | FK | PL | TR | TRSS | NO | NO | 11.97 | 15.79 | 3.17 |
| 57 | CS | FK | PL | TR | TRSS | NO | NO | 14.72 | 17.98 | 3.62 |
| 58 | CS | FK | CO | TR | TRSS | NO | NO | 23.80 | 24.60 | 11.20 |
| 59 | CS | FK | NP | SD | TRSS | 4 | NO | 21.45 | 21.67 | 6.57 |
| 60 | CS | FK | PL | TR | TRSS | NO | NO | 12.19 | 15.43 | 4.30 |
| 61 | CS | FK | PL | TR | TRSS | NO | NO | 16.34 | 12.45 | 4.80 |
| 62 | CS | BF | EG | PF | WRGS | NO | NO | 15.18 | 7.54 | 3.99 |
| 63 | CS | FK | NP | TR | CL | NO | NO | 10.65 | 11.41 | 3.10 |
| 64 | CS | FK | NP | TR | WRGS | NO | NO | 8.50 | 6.50 | 2.70 |
| 65 | CS | FK | PL | TR | WRGS | NO | NO | 8.01 | 6.05 | 1.60 |
| 66 | CS | BF | PR | PF | CL | 1 | NO | 26.19 | 11.97 | 4.98 |
| 67 | CS | FK | NP | TR | UC | NO | NO | 14.96 | 9.93 | 1.92 |
| 68 | CS | FK | NP | TR | CL | NO | NO | 8.55 | 7.47 | 1.77 |
| 69 | CS | FK | PL | BT | FW | NO | NO | 7.87 | 11.91 | 2.27 |
| 70 | CS | FK | NP | TR | CL | NO | NO | 5.27 | 8.25 | 2.35 |
| 71 | CS | FK | PL | BT | WRGS | NO | NO | 8.90 | 8.66 | 2.15 |
| 72 | CS | FK | NP | SD | CL | 2 | NO | 7.93 | 8.62 | 4.10 |
| 73 | CS | PT | TP | AP | DQ | NO | NO | 14.37 | 9.88 | 2.89 |
| 74 | CS | FK | NP | SD | FW | 1 | NO | 11.12 | 7.50 | 4.64 |
| 75 | CS | FK | NP | BT | WRGS | NO | NO | 14.26 | 18.02 | 4.43 |
| 76 | CS | FK | PL | SD | CL | NO | NO | 14.10 | 8.00 | 2.00 |
| 77 | CS | FK | PL | BT | CL | NO | NO | 8.80 | 7.00 | 1.20 |
| 78 | CS | FK | NP | TR | BA | NO | NO | 45.80 | 23.70 | 9.80 |
| 79 | CS | FK | NP | TR | CL | NO | NO | 8.10 | 5.10 | 2.30 |
| 80 | CS | FK | NP | TR | CL | NO | NO | 10.00 | 6.10 | 1.60 |
| 81 | CS | FK | PL | TR | TRSS | 1 | NO | 14.70 | 11.80 | 3.20 |
| 82 | CS | FK | NP | TR | DQ | 3 | NO | 13.20 | 7.20 | 3.10 |
| 83 | CS | FK | PL | BT | HV | NO | NO | 6.10 | 4.80 | 1.30 |
| 84 | CS | FK | PL | TR | FW | NO | NO | 10.50 | 7.10 | 2.00 |
| 85 | CS | FK | PL | TR | TRSS | NO | NO | 12.70 | 9.70 | 3.30 |
| 86 | CS | FK | NP | TR | FW | NO | NO | 13.90 | 7.80 | 2.50 |
| 87 | CS | FK | NP | TR | FW | NO | NO | 18.80 | 9.60 | 2.40 |
| 88 | CS | ANG | FR | SD | UC | 4 | YES | 12.10 | 8.80 | 4.00 |
| 89 | CS | FK | PL | SD | FW | 1 | NO | 12.50 | 9.70 | 2.60 |
| 90 | CS | FK | PL | TR | FW | NO | NO | 7.60 | 6.61 | 1.40 |



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**APPENDIX.** (CONTINUED)

| SPECIMEN NUMBER | CLASS | TYPE | PORTION | CATEGORY | MATERIAL | CORTEX | THERMAL ALTERATION | LENGTH (MM) | WIDTH (MM) | THICKNESS (MM) |
|---|---|---|---|---|---|---|---|---|---|---|
| 91 | CS | FK | PL | BT | FW | NO | NO | 7.60 | 5.10 | 1.10 |
| 92 | CS | FK | PL | TR | SHJ | NO | NO | 16.20 | 11.20 | 3.20 |
| 93 | CS | FK | PL | TR | TRSS | 1 | NO | 12.60 | 12.00 | 3.40 |
| 94 | CS | FK | PL | TR | FW | NO | NO | 19.30 | 12.50 | 5.60 |
| 95 | CS | FK | NP | TR | SHJ | NO | NO | 9.90 | 4.60 | 2.00 |
| 96 | CS | FK | PL | PD | SHJ | 3 | NO | 11.40 | 8.80 | 3.70 |
| 97 | CS | FK | PL | TR | SHJ | NO | NO | 13.60 | 11.00 | |
| 98 | CS | FK | PL | TR | FW | NO | NO | 13.80 | 10.10 | 2.90 |
| 99 | CS | FK | PL | TR | FW | NO | NO | 11.90 | 10.40 | 2.40 |
| 100 | CS | FK | NP | TR | FW | NO | NO | 11.60 | 9.00 | 2.60 |
| 101 | CS | FK | PL | TR | CL | NO | NO | 23.30 | 17.60 | 4.60 |
| 102 | CS | FK | NP | SD | FW | 2 | NO | 19.30 | 13.30 | 6.20 |
| 103 | CS | FK | PL | TR | CL | 1 | NO | 14.30 | 12.40 | 3.30 |
| 104 | CS | FT | NC | TP | CL | NO | NO | 37.08 | 15.32 | 10.69 |
| 105 | CS | FK | PL | BT | FW | NO | NO | 15.90 | 10.40 | 2.40 |
| 106 | CS | PT | BA | AP | DQ | NO | NO | 7.92 | 15.41 | 2.69 |
| 107 | CS | PT | TP | AP | CH | NO | NO | 15.55 | 8.54 | 3.21 |
| 108 | CS | PT | BL | DP | DQ | NO | NO | 15.14 | 16.43 | 4.03 |
| 109 | CS | PT | BA | DP | DQ | NO | NO | 15.51 | 24.57 | 5.11 |
| 110 | CS | PT | TP | DP | TRSS | NO | NO | 16.25 | 12.55 | 5.82 |
| 111 | CS | PT | BL | AP | TRSS | NO | NO | 10.85 | 17.14 | 3.33 |
| 112 | CS | FK | PL | BT | TRSS | NO | NO | 11.44 | 8.60 | 1.50 |
| 113 | CS | FK | NP | TR | UC | NO | NO | 18.70 | 10.70 | 2.80 |
| 114 | CS | FK | NP | SD | FW | 1 | NO | 9.70 | 9.20 | 2.40 |
| 115 | CS | FK | NC | BT | WRGS | NO | NO | 5.80 | 5.30 | 0.70 |
| 116 | CS | FK | NP | TR | FW | NO | NO | 13.10 | 10.80 | 3.00 |
| 117 | CS | FK | PL | TR | CL | NO | NO | 14.60 | 8.00 | 1.60 |
| 118 | CS | FK | NP | SD | FW | 2 | NO | 12.70 | 15.60 | 4.70 |
| 119 | CS | FK | PL | TR | CL | 1 | NO | 15.00 | 11.70 | 4.00 |
| 120 | CS | FK | NP | TR | UC | NO | NO | 10.60 | 7.70 | 1.40 |
| 121 | CS | FK | PL | TR | FW | NO | NO | 15.00 | 9.70 | 4.10 |
| 122 | CS | FK | PL | SD | CL | 2 | NO | 9.60 | 7.50 | 0.80 |
| 123 | CS | FK | NP | TR | QT | NO | NO | 16.10 | 14.70 | 3.70 |
| 124 | CS | FK | NP | TR | FW | NO | NO | 6.40 | 4.30 | 1.20 |
| 125 | CS | FK | NP | TR | DQ | NO | NO | 12.90 | 8.00 | 1.80 |
| 126 | CS | FK | PL | TR | FW | NO | NO | 18.70 | 13.20 | 10.80 |
| 127 | CS | FK | NP | SD | FW | NO | NO | 10.90 | 9.80 | 4.80 |
| 128 | CS | FK | NP | TR | CL | NO | NO | 9.60 | 8.70 | 1.80 |
| 129 | CS | FK | PL | TR | UC | NO | NO | 13.60 | 11.00 | 3.40 |
| 130 | CS | FK | PL | TR | FW | NO | NO | 16.40 | 10.30 | 2.20 |
| 131 | CS | FK | NP | SD | FW | 3 | NO | 14.00 | 13.80 | 3.30 |
| 132 | CS | FK | PL | TR | DQ | 1 | NO | 18.50 | 13.30 | 4.10 |
| 133 | CS | FK | NP | TR | DQ | NO | NO | 12.10 | 11.50 | 2.30 |
| 134 | CS | FK | PL | TR | FW | NO | NO | 12.10 | 9.80 | 1.90 |
| 135 | CS | FK | NP | SD | QT | NO | NO | 15.50 | 11.00 | 4.60 |



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**APPENDIX.** (CONTINUED)

| SPECIMEN NUMBER | CLASS | TYPE | PORTION | CATEGORY | MATERIAL | CORTEX | THERMAL ALTERATION | LENGTH (MM) | WIDTH (MM) | THICKNESS (MM) |
|---|---|---|---|---|---|---|---|---|---|---|
| 136 | CS | FK | PL | TR | AL | NO | NO | 14.80 | 8.60 | 2.20 |
| 137 | CS | FK | NP | TR | DQ | NO | NO | 18.40 | 12.70 | 2.20 |
| 138 | CS | FK | NP | TR | UC | NO | YES | 14.10 | 14.00 | 3.60 |
| 139 | CS | FK | NP | SD | UC | 1 | NO | 13.60 | 11.80 | 3.00 |
| 140 | CS | FK | PL | PR | FW | NO | NO | 12.90 | 13.10 | 3.80 |
| 141 | CS | FK | PL | SD | FW | NO | NO | 7.40 | 13.80 | 3.40 |
| 142 | CS | FK | NP | SD | FW | NO | NO | 10.90 | 10.10 | 3.30 |
| 143 | CS | FK | NP | TR | HV | NO | NO | 7.70 | 4.60 | 1.60 |
| 144 | CS | FT | SC | BL | AL | NO | NO | 10.90 | 22.20 | 6.60 |
| 145 | CS | FK | PL | TR | QT | NO | NO | 10.20 | 10.50 | 2.90 |
| 146 | CS | FK | NC | BT | SHJ | NO | YES | 17.10 | 13.00 | 4.30 |
| 147 | CS | FT | SC | EG | FW | 2 | NO | 13.60 | 7.90 | 4.20 |
| 148 | BN | FR | | | BONE | NO | YES | 8.60 | 6.30 | 2.60 |
| 149 | BN | FR | | | ENAMEL | NO | YES | 7.40 | 2.70 | 1.30 |
| 150 | CS | FK | NP | TR | SHJ | NO | NO | 13.30 | 9.20 | 2.20 |
| 151 | CS | FK | PL | SD | TRSS | 1 | NO | 11.20 | 6.00 | 1.80 |
| 152 | CS | FK | NP | TR | TRSS | 1 | NO | 11.30 | 9.20 | 2.80 |
| 153 | CS | FK | NP | TR | UC | NO | YES | 9.30 | 8.80 | 2.60 |
| 154 | CS | FK | PL | TR | DQ | NO | NO | 15.70 | 10.00 | 3.00 |
| 155 | CS | FK | PL | TR | DQ | NO | NO | 25.80 | 11.70 | 7.10 |
| 156 | CS | FK | PL | SD | UC | NO | NO | 13.20 | 9.50 | 3.50 |
| 157 | CS | FK | PL | TR | FW | NO | NO | 17.50 | 26.80 | 4.10 |
| 158 | CS | FK | PL | TR | TRSS | NO | NO | 9.80 | 5.60 | 1.40 |
| 159 | CS | FK | NP | TR | TRSS | NO | NO | 5.70 | 4.30 | 1.00 |
| 160 | CS | FK | PL | TR | DQ | NO | NO | 12.40 | 19.50 | 5.20 |
| 161 | CS | FK | PL | TR | AL | NO | NO | 15.60 | 11.50 | 6.30 |
| 162 | CS | FK | NP | SD | TRSS | NO | NO | 18.90 | 11.80 | 4.40 |
| 163 | CS | FK | NP | TR | FW | NO | NO | 4.70 | 7.80 | 2.60 |
| 164 | CS | FK | PL | TR | TRSS | 1 | NO | 16.10 | 17.10 | 5.40 |
| 165 | CS | FK | NP | SD | SHJ | 1 | YES | 16.10 | 14.50 | 5.90 |
| 166 | CS | FK | NP | TR | CL | NO | NO | 10.60 | 15.00 | 3.20 |
| 167 | CS | BF | EG | PR | DQ | NO | NO | 10.50 | 13.70 | 6.80 |
| 168 | CS | FK | NP | TR | FW | 1 | NO | 20.00 | 13.20 | 3.90 |
| 169 | CS | BF | PL | EG | DQ | NO | YES | 11.90 | 6.20 | 6.00 |
| 170 | CS | FK | PL | TR | CL | NO | NO | 14.90 | 10.80 | 6.30 |
| 171 | CS | PT | BBL | AP | BA | NO | NO | 13.98 | 12.94 | 2.84 |
| 172 | CS | PT | NC | AP | CL | NO | NO | 19.75 | 16.96 | 3.74 |
| 173 | BN | FR | | | ENAMEL | NO | YES | 4.90 | 4.20 | 1.40 |
| 174 | CS | FK | NP | TR | UC | NO | NO | 13.10 | 8.50 | 4.30 |
| 175 | CS | FK | NP | TR | FW | NO | NO | 16.50 | 13.00 | 2.70 |
| 176 | CS | FK | NP | TR | FW | NO | NO | 12.70 | 9.40 | 2.30 |
| 177 | CS | FK | NP | TR | FW | NO | YES | 16.60 | 14.60 | 4.00 |
| 178 | CS | FK | NP | TR | BA | NO | NO | 11.40 | 9.20 | 2.80 |
| 179 | CS | FK | NP | TR | UC | NO | NO | 18.30 | 12.10 | 5.30 |
| 180 | CS | FK | NP | SD | UC | 2 | NO | 12.00 | 13.00 | 6.00 |



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**APPENDIX.** (CONTINUED)

| SPECIMEN NUMBER | CLASS | TYPE | PORTION | CATEGORY | MATERIAL | CORTEX | THERMAL ALTERATION | LENGTH (MM) | WIDTH (MM) | THICKNESS (MM) |
|---|---|---|---|---|---|---|---|---|---|---|
| 181 | CS | FK | NP | TR | DQ | NO | NO | 16.60 | 11.20 | 4.50 |
| 182 | CS | FK | NP | TR | CL | NO | NO | 21.4 | 14.40 | 12.30 |
| 183 | CS | FK | NP | TR | FW | NO | NO | 27.9 | 29.10 | 6.20 |
| 184 | CS | FK | PL | SD | UC | 3 | NO | 27.8 | 22.40 | 13.60 |
| 185 | CS | FK | PL | SD | TRSS | 1 | NO | 24 | 16.80 | 8.00 |
| 186 | CS | FK | PL | SD | DQ | 2 | YES | 29.7 | 23.60 | 12.80 |
| 187 | CS | ANG | NP | NC | UC | 3 | YES | 20.3 | 29.80 | 12.20 |
| 188 | CS | PT | BA | DP | TRSS | NO | NO | 21.3 | 17.50 | 9.30 |
| 189 | CS | FK | NP | TR | PRA | NO | NO | 19.6 | 27.40 | 6.80 |
| 190 | CS | FK | PL | SD | DQ | 1 | NO | 21.9 | 15.00 | 6.20 |
| 191 | CS | ANG | NP | TR | UC | 1 | NO | 20.3 | 14.90 | 8.80 |
| 192 | CS | CORE | NC | TR | FW | 1 | NO | 40.2 | 23.20 | 9.60 |
| 193 | CS | CORE | NC | SD | DQ | 2 | NO | 35.1 | 27.90 | 20.40 |
| 194 | CS | FK | NP | SD | FW | 1 | NO | 37.7 | 26.30 | 8.90 |
| 195 | CS | FK | NP | SD | TRSS | 2 | NO | 34.8 | 33.10 | 16.10 |
| 196 | CS | FK | NP | TR | BA | NO | NO | 15.5 | 11.00 | 3.90 |
| 197 | CS | FK | NP | TR | BA | NO | NO | 30.6 | 22.40 | 10.50 |
| 198 | CS | FK | PL | TR | BA | NO | NO | 26.4 | 17.30 | 5.00 |
| 199 | CS | FK | PL | TR | BA | NO | NO | 12 | 18.00 | 4.70 |
| 200 | CS | FK | PL | TR | BA | NO | NO | 10.5 | 10.40 | 3.10 |
| 201 | CS | FK | NP | TR | BA | NO | NO | 21.1 | 16.90 | 4.70 |
| 202 | CS | FK | NP | TR | BA | NO | NO | 15.4 | 11.70 | 2.80 |
| 203 | CS | FK | PL | SD | UC | 1 | YES | 12.6 | 13.10 | 3.40 |
| 204 | CS | FK | PL | TR | BA | NO | NO | 13.9 | 14.10 | 4.00 |
| 205 | CS | FK | PL | TR | BA | 1 | NO | 12.7 | 11.40 | 2.90 |
| 206 | CS | FK | PL | TR | BA | NO | NO | 11.6 | 10.50 | 2.00 |
| 207 | CS | FK | NP | SD | BA | 1 | NO | 19.4 | 13.20 | 3.70 |
| 208 | CS | FK | PL | TR | BA | 1 | NO | 18.1 | 16.80 | 8.90 |
| 209 | CS | FK | NP | SD | BA | 1 | NO | 33.3 | 28.90 | 8.10 |
| 210 | CS | FK | PL | TR | BA | NO | NO | 26.1 | 13.20 | 5.90 |
| 211 | CS | FK | NP | TR | BA | NO | NO | 15.7 | 14.20 | 8.30 |
| 212 | CS | FK | PL | TR | BA | NO | NO | 17 | 31.30 | 6.10 |
| 213 | CS | FK | NP | TR | BA | NO | NO | 16.8 | 12.30 | 4.10 |
| 214 | CS | FK | NP | TR | BA | NO | NO | 12.1 | 11.30 | 2.80 |
| 215 | CS | FK | NP | TR | BA | NO | NO | 17.9 | 17.30 | 5.10 |
| 216 | CS | FK | PL | TR | BA | NO | NO | 14.7 | 12.00 | 3.80 |
| 217 | CS | FK | NP | TR | BA | NO | NO | 15.5 | 10.40 | 2.30 |
| 218 | CS | FK | NP | TR | BA | NO | NO | 13.9 | 9.60 | 2.40 |
| 219 | CS | CORE | PL | | CL | 1 | YES | 19.49 | 22.92 | 12.85 |

Class: BN = bone; CS = chipped stone  Type: ANG = angular piece; BF = biface; FK = flake; FR = fragment; FT = flake tool; PT = projectile point; SC = scraper  Portion: AP = arrow point; BA = base; BBL = base & blade; BL = blade; CO = complete; DP = dart point; DS = distal; EG = edge; FR = fragment; NC = nearly complete; NP = no platform; PL = platform; PR = proximal; TP = tip  Category: BL = blade; BT = biface thinning; ES = end scraper; PD = primary decortication; PF = preform; SD = secondary decortication; SS = side scraper; TP = tip; TR = tertiary  Material: AL = Alibates silicified dolomite; BA = basalt/trachyte; CL = chalcedony/opaline; DQ = Dakota quartzite; ED = Edwards chert; FW = fossil wood/silicified wood; HV = Hartville Uplift chert; PRA = Permian Florence A chert; QT = quartzites; SHJ= Smoky Hill jasper; TRSS = Tongue River silicified sediment; UC = unidentified cherts; WRGS= White River group silicates/Flattop chalcedony  Cortex: no = none; 1 = less than 25% dorsal cortex; 2 = 25-50%; 3 = 51-75%; 4 = greater than 75% dorsal cortex



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# THE KRAUS 1 SITE (14EL313): INVESTIGATIONS BY THE 2015 KANSAS ARCHEOLOGY TRAINING PROGRAM FIELD SCHOOL

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*The Kansas Anthropological Association and the Kansas Historical Society investigated an Early Ceramic (ca. 400–1100 C.E.) Keith phase site in Ellis County, Kansas, in 2015. Cultural material lies within a buried soil 30–90 cm beneath the ground surface. Radiocarbon assays show that the Kraus 1 site was occupied 800–1,000 years ago. It was excavated with the hope of finding a house and associated artifacts and features, but the recovered evidence indicates that it was a seasonally occupied hunting and game-processing camp. This conclusion is based on the substantial amount of animal bone and the many projectile points and modified flakes that were collected. Also found were a maize kernel, kernel fragments, and maize phytoliths in ceramic cooking vessel residue, which is not typical of the Keith phase. Recognized across the site were signs of intense burning, the sources of which remain undetermined.*

Between 1,600 and 900 years ago, a technological shift occurred on the High Plains of Kansas and Nebraska. People began using pottery and the bow and arrow. The number of sites in the region increased significantly, and longer settlement periods are represented by houses and communal burial sites. This technological suite is referred to as the Keith phase, part of the Early Ceramic or Plains Woodland period, which was a time of rapid change on the Great Plains (Bozell 2006; Bozell and Winfrey 1994).

The Kansas Historical Society (KSHS) and the Kansas Anthropological Association (KAA) held the 40th annual Kansas Archeology Training Program (KATP) field school at the Kraus 1 site (14EL313) along Big Creek in Ellis County, Kansas. Preliminary investigations indicated that it represents one or more Keith phase occupations and may have been occupied as late as 1200 C.E. One hundred-twenty volunteers and six KSHS employees excavated a portion of the site in June 2015. Volunteers cleaned and cataloged artifacts during and after the field project, followed by analysis by the authors. Kraus 1 research goals were to better understand Keith phase components and, more importantly, to evaluate the social and technological changes taking place that led to the lifeway of the Central Plains tradition (CPt) that followed. (See Roper 2006 for a summary of the CPt in Kansas.)

## THE KEITH PHASE

Readers are directed to summaries of the Keith phase (Bozell 2006; Hoard and Bozell 2006; Kivett 1952; Kivett and Metcalf 1997), but a brief description follows. The Keith phase was established by



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Marvin F. Kivett (1949:284) in his discussion of work at Medicine Creek Reservoir (now Harry Strunk Lake) in Frontier County, Nebraska. Diagnostic artifacts of the Keith phase include small corner-notched arrow points and thick, crushed calcite-tempered, cord-marked pottery that Kivett (1952:63–64) called Harlan cord-roughened. Most publications place the Keith phase between 500 and 1000 C.E. (Adair 2012a; Bozell 2006:103; Hoard and Banks 2006:297–299; Hoard and Bozell 2016). The phase is located in southwestern Nebraska and northwestern and west-central Kansas (Figure 1). Almost all early investigations were done in southwest Nebraska (Grange 1980; Kivett 1949, 1952; Strong 1935) except the Woodruff Ossuary (14PH4) in Phillips County, Kansas (Kivett 1953). Reports of Kansas Keith phase sites discuss 14PH4, 14NT11 (Blasingham 1963), 14NT201 (Powell 2016a), and the Forrest site (14PA303) (Hoard and Bozell 2016).

Harlan cord-roughened pottery is characterized by thick-walled cone-shaped ceramic jars with vertical to out-flaring rims. They are tempered with calcite, sand, or both and have the occasional inclusion of hematite. Exterior surfaces were cord roughened by rolling a cord-wrapped dowel from the base to the lip of the vessel. Infrequently the interiors were cord marked, too; decoration is rare (Johnson 2001:169; Kivett 1949, 1952, 1953).

Both large and small projectile points are found at Keith phase sites. This reflects the change, apparently a gradual one, from using dart and spear-thrower to using bow and arrow (Bozell 2006:98–99; Kivett 1970:98; Wedel 1959:411). Well-made, small, corner-notched Scallorn arrow points are most common, as well as small preforms with rounded bases and pointed tips (Duncan et al. 2007:131–138; Justice 1987:220–222; see also Hoard and Bozell 2016 for a longer discussion). Larger dart points, such as stemmed Steuben points and corner-notched Snyders points, more often associated with the Middle Woodland period farther east (Justice 1987:201–204, 208–211), also are recovered from Keith phase sites.

Other stone tools typical in the region are not necessarily diagnostic of the Keith phase, specifically a variety of shapes and sizes of scrapers and bifacial knives, although the beveled diamond-shaped knives widespread in the Middle Ceramic or Plains Village period are absent. Large, coarsely flaked bifaces used to dismember large animals or cut larger pieces of wood are plentiful, as are chipped stone drills, gravers, expedient tools made from flakes and cores, hand stones and grinding slabs, and abraders.

Keith phase sites often have unusually rich bone and shell tool assemblages that include awls, shaft wrenches, fleshers, punches, bird bone tube beads, and freshwater mussel shell disk beads. The bone and shell beads are ubiquitous in Keith phase burial sites. Thousands of shell disk beads were associated with an adolescent male skeleton at the Woodruff Ossuary (Kivett 1953), and burials at the Pfaff site (14NS319) (Craine 1956) yielded hundreds of tubular bone beads.

Keith phase habitation sites ordinarily are situated on terraces above permanent streams and contain one or two small houses with saucer-shaped floors, few or no post molds, and only occasionally daub (Grange 1980:108–112; Hoard and Bozell 2016; Kivett 1952:27; Kivett and Metcalf 1997:11–19). One or more hearths may be present, not necessarily within houses, and occasionally there are shallow storage pits. These settlements may have been occupied for multiple seasons but not for multiple years. Burials have been found at several habitation sites, but separate cemeteries also have been recorded.

Until recently Keith phase diet had not been rigorously evaluated (Grange 1980; Hoard and Bozell 2016; Kivett and Metcalf 1997:27–30). Existing analyses indicate broadly varying amounts of bison, deer, and pronghorn remains and often substantial quantities of mussel shell and small mammals. Except for 14NT11 (Blasingham 1963), plant resources were not documented because recovery methods did not target plant remains. One objective of the current investigation was to use flotation of soil samples and analysis of residue in cooking pots to retrieve plant remains.

## ENVIRONMENTAL SETTING

The Kraus 1 site is situated on the eastern edge of the High Plains (Schoewe 1949:280, 302, 309–311). This is a region of continental climate: hot summers and cold winters. In Ellis County the mean annual precipitation is 19–30 inches, and the mean annual air temperature ranges from 48 to 57 degrees Fahr-



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**Figure 1.** Boundaries of the Keith phase and the locations of Kraus 1, 14EL313; Forrest, 14PA303; Woodruff Ossuary, 14PH4; and 14NT11.

enheit (Natural Resources Conservation Service 2015).

Vegetation is dominated by mixed bluestem-grama prairie (Küchler 1974:587, 591–592). Dominant plant species are big bluestem (Andropogan gerardi), little bluestem (Andropogan scoparius), sideoats grama (Bouteloua curtipendula), and blue grama (Bouteloua gracilis). Common forbs are western ragweed (Ambrosia psilostachya) and Heath aster (Aster ericoides; Dutt 1970:17). The species list of mammals includes the extirpated bison (Bison bison), mule deer (Odocoileus hemionus), white-tailed deer (Odocoileus virginianus), coyote (Canis latrans), gray fox (Urocyon cinereoargenteus), swift fox (Vulpes velox), red fox (Vulpes vulpes), bobcat (Lynx rufus), cougar (Puma concolor), American badger (Taxidea taxus), raccoon (Procyon lotor), and a variety of smaller mammals (Kansas Mammal Atlas 2015). Note that pronghorn (Antelocapra americana) is absent from the list. This species is better adapted to the western High Plains because sagebrush is an especially important food source (Lubinski and Herren 2000:35).

*Geology*

This region is dominated by Cretaceous-aged bedrock. Near the Kraus 1 site the succession of formations from oldest to youngest is Greenhorn limestone, Carlile shale, Niobrara chalk, and the Ogallala formation (Zeller 1968). Archeologically relevant resources include the Blue Hill shale, which may have been a clay source for ceramic vessels, and Smoky Hill chalk, which is an important source of knappable stone (Stein 2005, 2006), although no source areas for this material are recorded in Ellis County (in the Kansas archeological site files, when last accessed in 2017). Bedrock deposits of quartzite and secondary deposits of a variety of knappable stone types in the Ogallala gravels may have been available in the Ogallala formation on high ridges (Bass 1926:16–18). The limestone in these formations, along with sand, was a source of temper for ceramic vessels. Cobble- to boulder-sized nodules of silcrete, a local material similar to quartzite, is occasionally found in place above the Fort Hays limestone or the Smoky Hill chalk or in fields and



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was used as tool stone at the site (Charlie Kraus, personal communication 2014).

### *Soils*

Soils near and at 14EL313 are formed in alluvium. Aeolian deposits are nearly absent in the immediate site area (Zeller 1968:Figure 13). Soil development is an indication of landform stability. The period of 8,000 to 5,000 years ago was dominated by a dry climate that led to decreased vegetation, increasing erosion, and stream back-cutting and entrenchment (Mandel 2006:37). In contrast the late Holocene was a time of increased precipitation. Thicker vegetation prevented slope erosion, while higher water tables reduced channel incision (Mandel 1994:76). Paleosols are a product of slow or no sedimentation. High levels of vegetation contribute organic material, producing dark soils. Such organic-rich soils can be buried by other deposits, creating buried soils—paleosols. The Buckner Creek paleosol occurs in second- through fourth-order streams in western Kansas (Mandel 1994:67; 2006:40–41). It developed between 1600 and 1000 B.P. and overlies the Hackberry Creek paleosol (2000–1000 B.P.) (Mandel 2006:40; Mandel and Bettis 2001:38). Soil organic matter from the Buckner Creek paleosol at 14HO306 yielded a radiocarbon age determination of 1360 ± 60 B.P. (Mandel 1994:46).

A Giddings core sample from 14EL313 was taken to a depth of 6.4 m and demonstrates that both the Buckner Creek and Hackberry Creek paleosols are present (Appendix 1). Preliminary work determined that cultural deposits correlate with the breadth of the Buckner Creek paleosol, 35–90 cm below surface (cmbs).

### *Site Location*

The Kraus 1 site was discovered by Charlie Kraus, who manages the property. Kraus brought artifacts to a Collectors' Night event, sponsored by the KAA during the 2013 KATP field school. Continued contact between the primary author and Kraus led to the testing and 2015 excavation.

The site is located on a long, narrow peninsula between Big Creek and an unnamed spring-fed tributary (Figures 2–4). Keith phase people favored this type of setting, as it provided convenient access to water, a defensive position, and a natural firebreak in an area that may have had frequent prairie fires (Chris Hord, personal communication June 2015).

Big Creek is a significant regional drainage; its discharge is greater than that of the Smoky Hill River to the south (U.S. Geological Survey 2015). Charlie Kraus stated that the spring-fed tributary to the west and south of the site remains wet even when Big Creek ceases to flow, so water would have been available when the site was occupied.

## TIME

Testing at 14EL313 and 14EL315, a site just upstream, produced radiocarbon ages of 921 ± 27 and 987 ± 26, calibrated to 1098 C.E. and 1037 C.E. respectively, as shown in Table 1. These dates correspond roughly with the beginning of the CPt in western and central Kansas (Roper 2006a:110). Five more AMS age determinations, three on bone and two on annual plant seeds, have calibrated median dates of 1012 to 1201 C.E.

Most radiocarbon dates from Keith phase sites lie between 400 and 1100 C.E. (Table 1) (Adair 2012a; Bozell 2006:103; Hoard and Banks 2006:297–299, Hoard and Bozell 2016:4–6), and nearly all recent AMS assays have a median date more recent than 1000 C.E., coeval with the earliest CPt dates (Roper and Adair 2011:19). The end of the Keith phase may have overlapped the beginning of the CPt. Put another way, what is known as the Keith phase may have transformed into the CPt between 800 and 1,100 years ago. The Kraus 1 site is a part of that transition. Note in Table 1 that the most recent dates are from Kansas, suggesting that Keith phase occupations in Kansas are later than those in Nebraska, or possibly that more accurate dating methods lead to more recent dates (Hoard 2016). Further discussion of this issue is in this report's conclusions.

## PREVIOUS INVESTIGATIONS

Sites 14EL313 (Kraus 1), 14EL315 (Kraus 3), and 14EL316 (Kraus 4) were discovered by Charlie Kraus and recorded in June 2013 (Figure 2). These were expressed as separate exposures of mussel shell and occasional bone or debitage in the terrace scarp along Big Creek. Investigations were undertaken in early August 2014 to determine the areal



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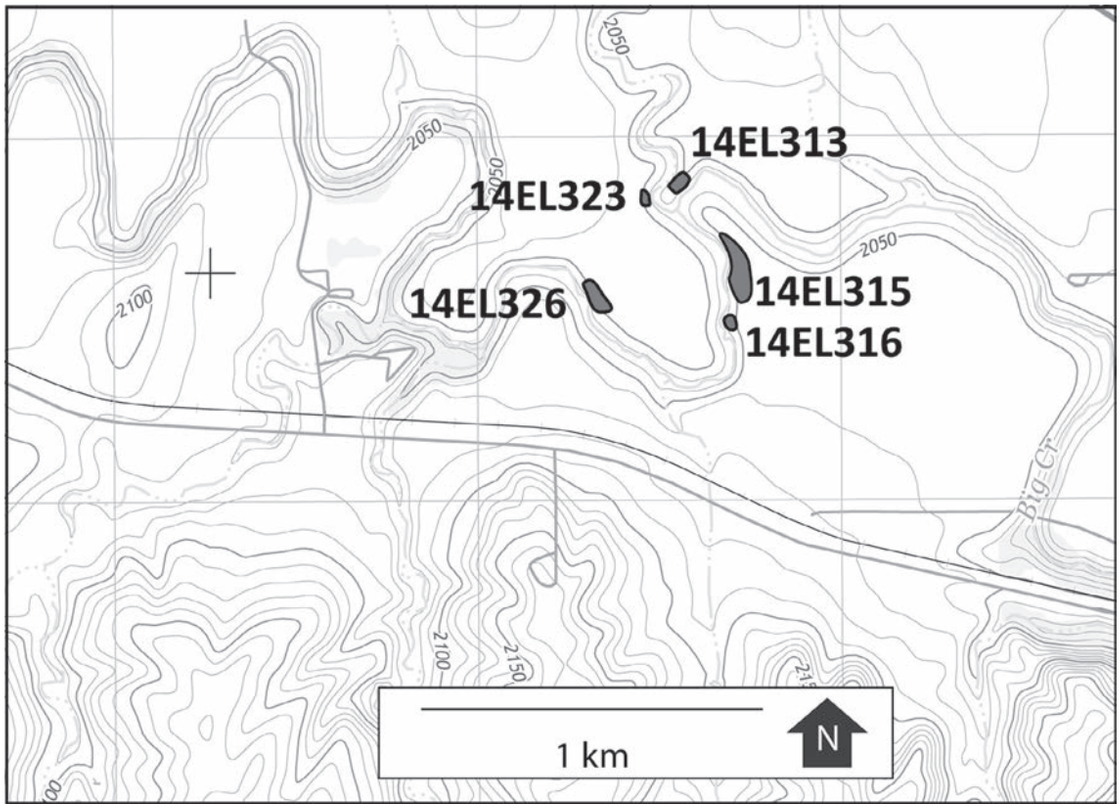


**Figure 2.** Location of the Kraus 1 site, 14EL313, and nearby sites. Sites 14EL315, 14EL323, and 14EL326 also have Early Ceramic diagnostic artifacts. Base map, USGS Yocemento 7.5 minute quadrangle, 2016.

**Figure 3.** The Kraus 1 site. View is to the north. Big Creek is to the right, and unnamed spring-fed tributary is on the left.



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**Figure 4.** View of the Kraus 1 site (arrow) from Big Creek. View is to the north-northwest. The site is surrounded by steep cut-banks on the west, south, and east.

extent, depth, and nature of these sites. Excavators used a combination of shovels and bucket augers to locate subsurface deposits, sifting the fill through ¼-inch hardware cloth and documenting the distribution of cultural evidence (Figure 5).

Kraus 1 auger tests confirmed the presence of cultural material at depths ranging from 5 to 105 cmbs but concentrated between approximately 30 and 70 cmbs. The cultural material is dominated by bone and mussel shell. The bone is fragmentary; some is burned. Debitage also is common. Four Harlan cord-roughened pottery sherds were recovered, as well as two arrow points, two scrapers, two bifaces, and small quantities of charcoal, burned earth, and hematite. The testing results demonstrated that 14EL313 would provide useful information for this period and this location.

Charcoal collected from an auger test at a depth of 39 cmbs produced a radiocarbon age of 921±27 B.P., with a calibrated median probability of 1098 C.E. (Table 1). Artifact density decreases as the landform becomes broader at the north edge of the testing, thus defining that boundary. The 230-cm profile on the site's west edge displays changes in sediment characteristics and artifact density similar to what was observed in the auger tests (Figure 6).

### *Stratigraphy*

Dr. Rolfe Mandel of the University of Kansas took a soil column sample in advance of excavations to acquire information on the depth of cultural material and the sedimentary history and to provide samples for stable isotope analysis. His soil description is presented in Appendix 1.

Briefly, Kraus 1 soils developed in alluvium. The modern soil extends to a depth of about 35 cmbs, where a clear boundary with the Buckner Creek



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**Table 1.** Radiocarbon Age Determinations from Keith Phase Sites

| Site number & name | Lab number | Provenience | Material dated | Dating method | Age RCYBP | Median probability | Reference |
|---|---|---|---|---|---|---|---|
| 25HK13 | M-181 | General site | Freshwater mussel | Standard | 2080±250 | 118 BCE | Kivett 1952; Crane & Griffin 1958:1121 |
| 25RW28, Doyle | UM-470 | 61-76 cmbs | Charcoal | Standard | 1940±80 | 62 CE | Grange 1980:126 |
| 25RW28, Doyle | UM-549 | 61-76 cmbs | Charcoal | Standard | 1920±70 | 86 CE | Grange 1980:126 |
| 25HN174 | Beta-10209 | Burial feature, 122 cmbs | Charcoal | Standard | 1600±100 | 453 CE | Tibesar et al. 1984:3 |
| 25FT18, Keith | SI-126 | Multiple features in occupation zone | Charcoal | Standard | 1580±100 | 471 CE | Long & Mielke 1966; Crane & Griffin 1960:40 |
| 25RW28, Doyle | SI-68 | Feature 8 | Charcoal | Standard | 1430±45 | 618 CE | Grange 1980:126 |
| 14SD351 | ISGS-5358 | Burial 1 | Charcoal | Standard | 1370±70 | 662 CE | Hoard et al. 2005:271 |
| 25RW28, Doyle | UM-466 | 76-91 cmbs | | Standard | 1370±100 | 668 CE | Grange 1980:126 |
| 14PH4, Woodruff | C-928 | Burial layer of site | Charcoal | Standard | 1343±240 | 696 CE | Libby 1955:104 |
| 25FT70 | SI-197 | Feature 2, house | Charcoal | Standard | 1260±80 | 769 CE | Long & Mielke 1966:414 |
| 25HN12 | UGa-5478 | Feature 1 | Charcoal | Standard | 1250±110 | 787 CE | Adair & Brown 1987:477 |
| 25HN12 | DIC-3325 | Feature 1 | Charcoal | Standard | 1220±55 | 802 CE | Adair & Brown 1987:477 |
| 14GL401, Herl | SI-134 | Feature 2A | Burned bone | Standard | 1180±120 | 847 CE | Long & Mielke 1966:414 |
| 25HO23 | M-637 | Feature 2 | Charcoal | Standard | 1131±238 | 896 CE | Crane & Griffin 1960:39 |
| 25FT18, Keith | M-841 | Several features combined | Charcoal | Standard | 1130±200 | 899 CE | Crane & Griffin 1960:40 |
| 25FT70 | SI-50 | Post from a rectangular house | Wood | Standard | 1070±70 | 960 CE | Sigalove & Long 1964:184 |
| 25HN12 | UGa-5482 | Feature 1 | Charcoal | Standard | 1050±70 | 983 CE | Adair & Brown 1987:477 |
| 14PA303, Forrest | ISGS-A0576 | Unit 131 | Bison bone | AMS | 1030±25 | 1005 CE | Adair 2012:207 |
| 14EL313, Kraus 1 | D-AMS 015285 | Feature 2 | Charred seed | AMS | 1016±24 | 1012 CE | Herein |
| 14EL313, Kraus 1 | D-AMS 015286 | Feature 2 | Maize kernel | AMS | 1013±24 | 1014 CE | Herein |
| 14GL401, Herl | SI-132 | Feature 2A, shallow pit | Burned bone | Standard | 1020±100 | 1016 CE | Long & Mielke 1966:414 |
| 14EL315 | D-AMS 007243 | E 461730 N 4307667, 55-62 cmbs | Charred organic | AMS | 987±26 | 1037 CE | Hoard & Bozell 2016:6 |
| 14GL401, Herl | SI-133 | Feature 7 | Burned bone | Standard | 1000±110 | 1038 CE | Long & Mielke 1966:414 |
| 14NT11 | D-AMS 004839 | Unit 20E 50S, 30-45 cmbs | Maize kernel | AMS | 989±31 | 1040 CE | Hoard & Bozell 2016:6 |
| 14PA363, Meckfessel | I-10983 | Test 1 | Charcoal | Standard | 1010±80 | 1080 CE | Adair 2012:207 |
| 25MO86 | WIS-1795 | Hearth | Charcoal | Standard | 970±70 | 1083 CE | Steventon & Kutzbach 1987:399 |
| 14EL313 | D-AMS 007242 | E 461554 N4307899, 39 cmbs | Charcoal | AMS | 921±27 | 1098 CE | Hoard & Bozell 2016:6 |
| 14EL313, Kraus 1 | D-AMS 015282 | 896N 558E, 20-30 cmbs | Bone | AMS | 878±25 | 1169 CE | Herein |
| 14EL313, Kraus 1 | D-AMS 015284 | 896N 558E, 80-90 cmbs | Bone | AMS | 875±22 | 1174 CE | Herein |
| 14NT11 | D-AMS 005314 | Unit 20E 50S, 30-45 cmbs | Maize cupule | AMS | 864±30 | 1181 CE | Hoard & Bozell 2016:6 |
| 14EL313, Kraus 1 | D-AMS 015283 | 896N 558E, 50-60 cmbs | Bone | AMS | 842±25 | 1201 CE | Herein |
| 25SX405 | NWU-61 | Burial feature | Charcoal | Standard | 750±90 | 1252 CE | Gill & Lewis 1977:68 |



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**Figure 5.** Testing at the Kraus 1 site.

paleosol is indicated by soil darker than the overlying modern B horizon (Figure 6). The organic-rich A horizon of the Buckner Creek paleosol extends approximately 35–90 cmbs. Most cultural material lies within the buried A horizon. In some units the upper 25 cm of the buried A horizon is particularly dark, almost black, suggesting unusually high biological activity, which can include human activity.

## EXCAVATION PROCEDURES

KSHS staff established a grid based on the UTM coordinates of two rebar markers placed on the site. Their positions were determined using survey grade GPS with accuracy of ±1.5 cm. The grid was oriented north-south, and 2-m$^2$ units were established as needed at even meter increments. Before selecting units to be dug, a geophysical survey of the site was conducted to guide excavations.

### *Geophysical Survey*

David L. Mak

Archaeo-Physics, LLC conducted a geophysical investigation of the Kraus 1 site with the objective of locating and mapping buried archeological features (Mak and Jones 2015). Three geophysical survey methods were employed: magnetic field gradient, electrical resistance, and electromagnetic induction

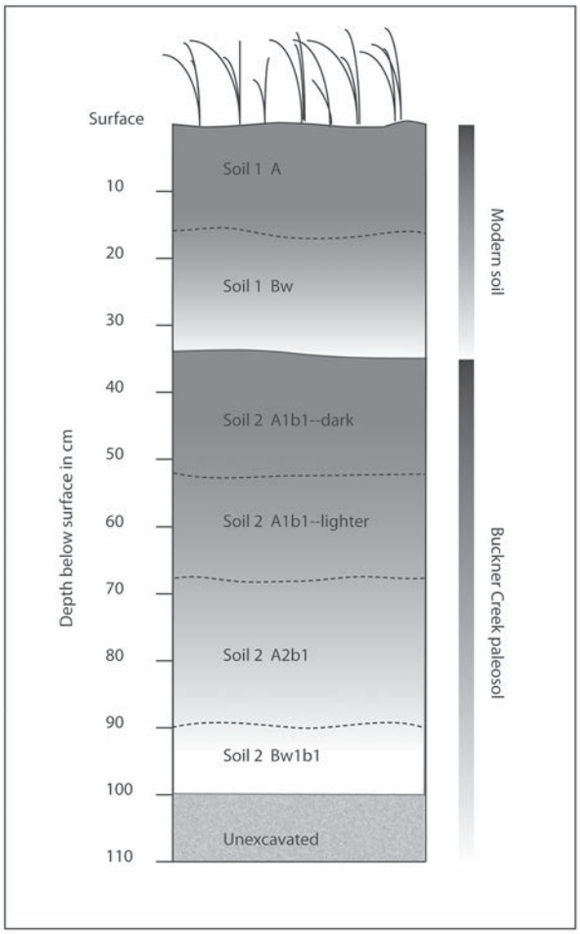


**Figure 6.** Generalized stratigraphy of the site. See Appendix 1 for a more detailed stratigraphic analysis.



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(EMI) survey. Survey transects used the previously established grid.

The strategy was to use magnetic field gradient survey as a form of archeological reconnaissance over a large area. Anomalies identified in the magnetic data were targeted for a high-resolution electrical resistance and EMI survey that covered a smaller area.

A brief description of the techniques and design parameters used during the geophysical investigation is presented below. A more comprehensive introduction to geophysical survey methods as applied to archeology can be found in Clark (1996), Gater and Gaffney (2003), Johnson (2006), and Bonsall et al. (2013).

## Magnetic Field Gradient Survey

Magnetic field gradient survey responds to local variations in the earth's magnetic field that are created by subsurface materials. The instrument responds most strongly to highly magnetic materials, such as ferrous metal artifacts, brick, and igneous rock. It also can detect very subtle anomalies caused by burned, organically enriched, disturbed, or compacted soils. It is rapid and capable of very high resolution.

Magnetic survey data were collected over 1,750 $m^2$, using a Geoscan Research FM256 fluxgate gradiometer. The FM256 has two fluxgate sensors, vertically separated by 60 cm. The data represent the difference between the two sensors. Magnetic data were collected in linear transects, recording eight samples per meter along transects separated by 60 cm, resulting in an overall density of 16 samples per $m^2$. The instrument was operated in its highest (0.1 nanoTesla) resolution setting.

## Electrical Resistance Survey

Electrical resistance survey responds to differences in the electrical resistivity of subsurface materials. The instrument responds to differences in grain size, organic content, moisture content, air void ratio, and soil chemistry. Many types of features are detectable if sufficient contrast exists between the feature and the surrounding matrix.

Electrical resistance survey data were collected over 370 $m^2$, using a Geoscan Research RM15 resistance meter combined with an MPX15 multiplexer (Figure 7). A square array system was used to collect two twin probe readings at stations located every 60 cm along transects spaced at 60-cm intervals, resulting in an overall density of eight samples per $m^2$. The twin probe readings consisted of measurements across both diagonal axes of the frame and to a nominal depth of 70.7 cmbs.

## Electromagnetic Induction (Emi) Survey

EMI surveys introduce a low frequency primary electromagnetic field into the soil through a transmitter coil. As the primary field infiltrates the soil, eddy currents are created as they pass through materials with conductive properties. Receiver antennas detect properties associated with secondary

**Figure 7.** Geophysical survey in progress at Kraus 1.



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fields produced by these eddy currents and record two associated properties: electrical conductivity and magnetic susceptibility. In this manner EMI surveys are capable of measuring two physical properties simultaneously, which increases the chances of detecting artifacts or areas where human activities have altered the landscape. Multi receiver EMI instruments also have the capability of measuring to several different depths at the same time, providing additional discrimination and utility in archeological prospection.

EMI survey data were collected over 370 $m^2$, using a CMD Mini Explorer by GF Instruments (Figure 7). The instrument has three receivers, spaced at 32 cm, 71 cm, and 118 cm from the transmitter coil. Data were collected with the coils in vertical coplanar coil orientation, resulting in depths of investigation of approximately 25 cm, 50 cm, and 90 cmbs. Data were collected every 50 cm in linear transects, spaced 50 cm apart, resulting in an overall density of four samples per $m^2$. EMI data were collected in manual mode with an averaging period of one second per reading.

## Results and Interpretations

Results of the magnetic field gradient reconnaissance are presented in Figure 8. A cluster of magnetic anomalies was identified as possible archeological features. The geometry and magnetic signal polarity and intensity of these anomalies are consistent with what might be expected from archeological hearths, pits, or shallow basins. Based on this information, the region containing the densest concentration of magnetic anomalies was targeted for electrical resistance and EMI survey.

Electrical resistance survey results are presented in Figure 9, both before and after high-pass background subtraction filtering. Close examina-

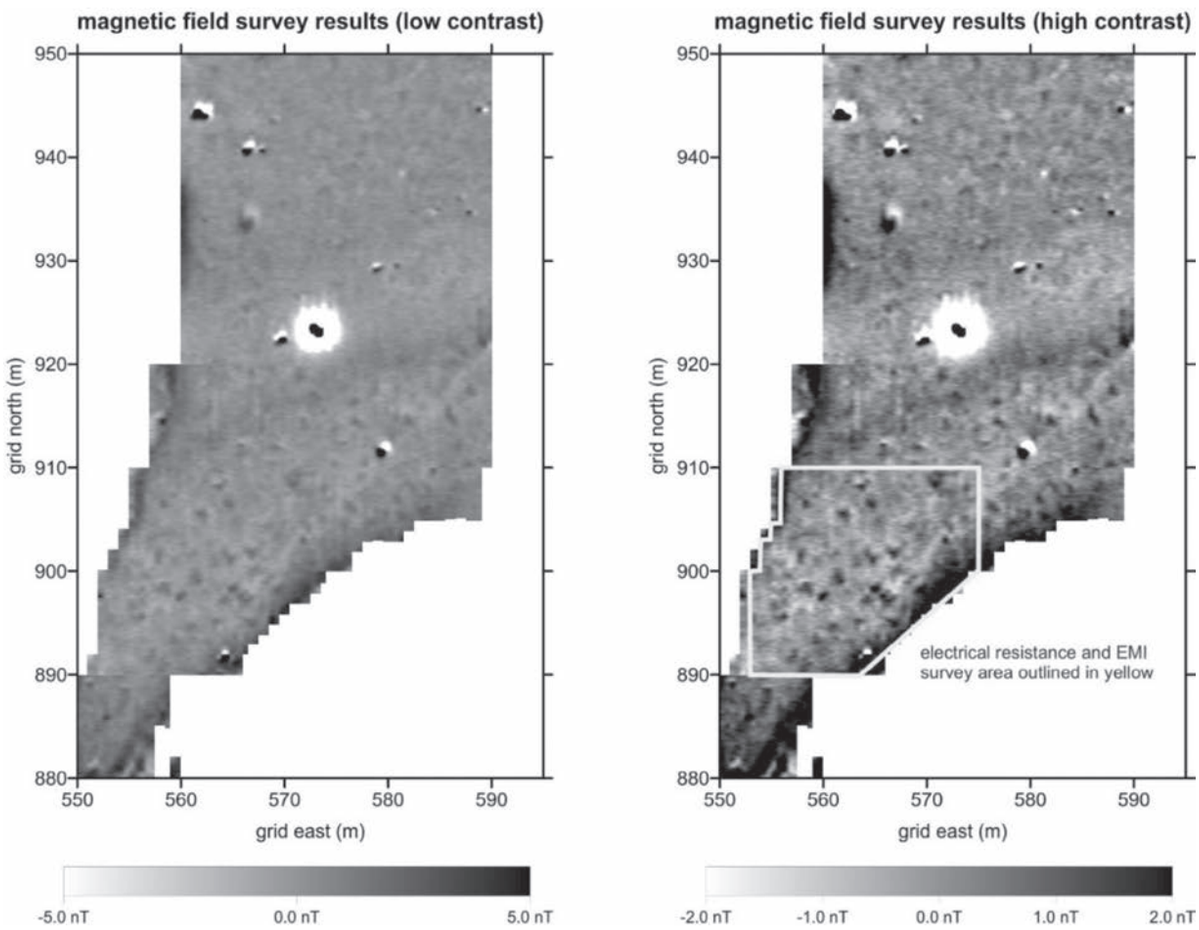


**Figure 8.** Magnetic field gradient survey results from Kraus 1.



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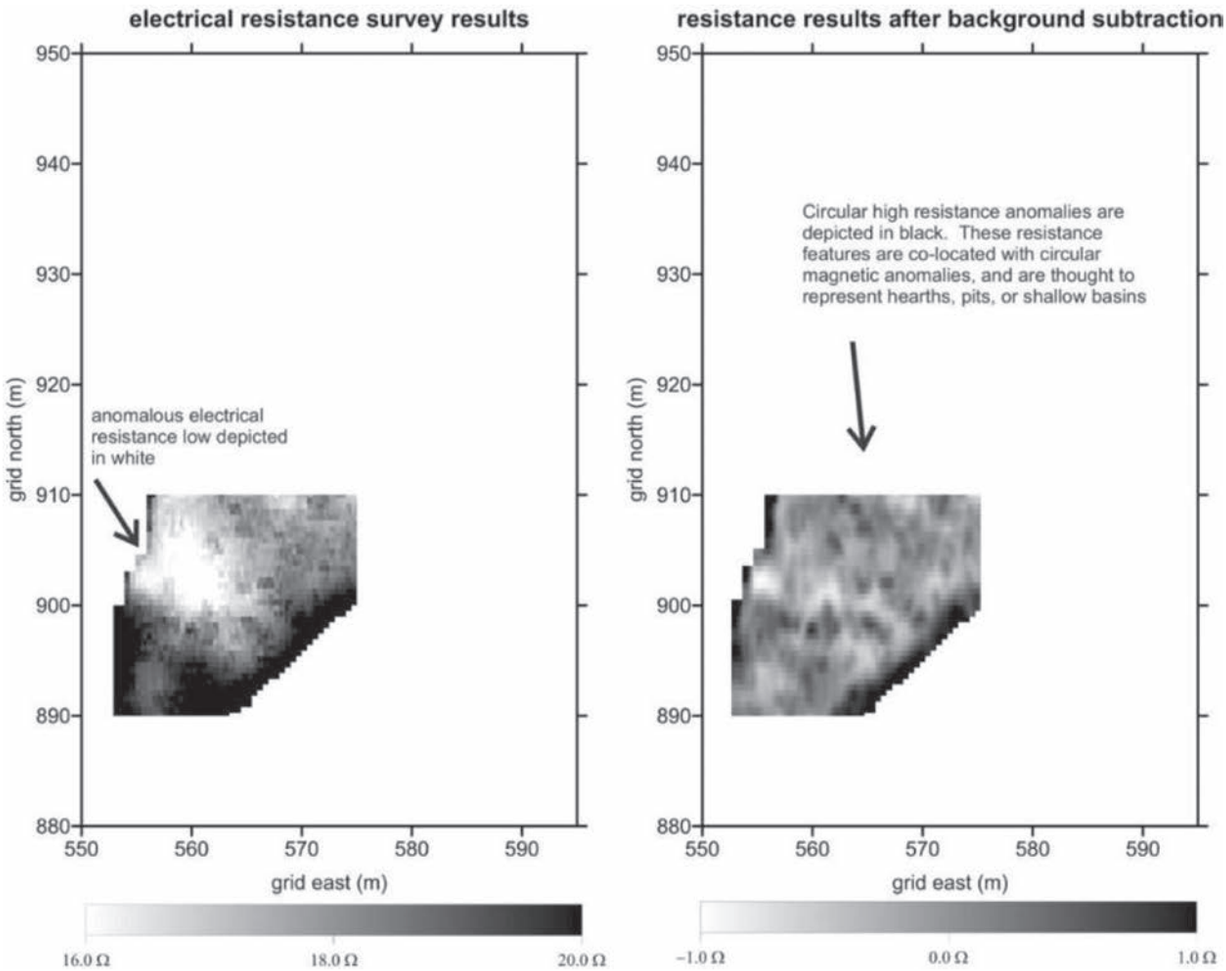


**Figure 9.** Electrical resistance survey results from Kraus 1.

tion shows that 11 of the magnetic anomalies have strong electrical resistance anomaly correlates. These resistance anomalies have higher values than the surrounding soils, are roughly circular or oval, have diameters ranging from 1 to 2 m, and are more readily visible in the high-pass filtered data image. An amorphous region of relatively low resistance values is centered at approximately 560E 903N. This low resistance region is approximately 7.5 m along the long axis and 5.5 m across the short axis.

EMI survey results are presented in Figure 10. A rectangular high conductivity anomaly is visible in the EMI data from 50 to 90 cmbs. This rectangular anomaly has a spatial correlation with the amorphous resistance low, centered at this spot. The rectangular conductivity high is most well defined in the 90 cmbs EMI data. The long axis of the rectangle is oriented northwest to southwest. The dimensions of the rectangle are approximately 6 by 4.2 m. A linear high conductivity anomaly is located on the southeast side of the rectangle and extends about 4.5 m to the southeast. One possible interpretation is that the rectangular high conductivity anomaly represents the compacted floor of a house with a compacted earth entryway extending from the southeast side of the house.

Some of the magnetic field gradient anomalies discovered during the reconnaissance appear as discrete electrical conductivity lows. However, there is a much stronger correlation with discrete high electrical resistance anomalies.

Eleven locations with magnetic and electrical resistance anomalies with strong spatial correlation were identified. Their coordinates are provided in



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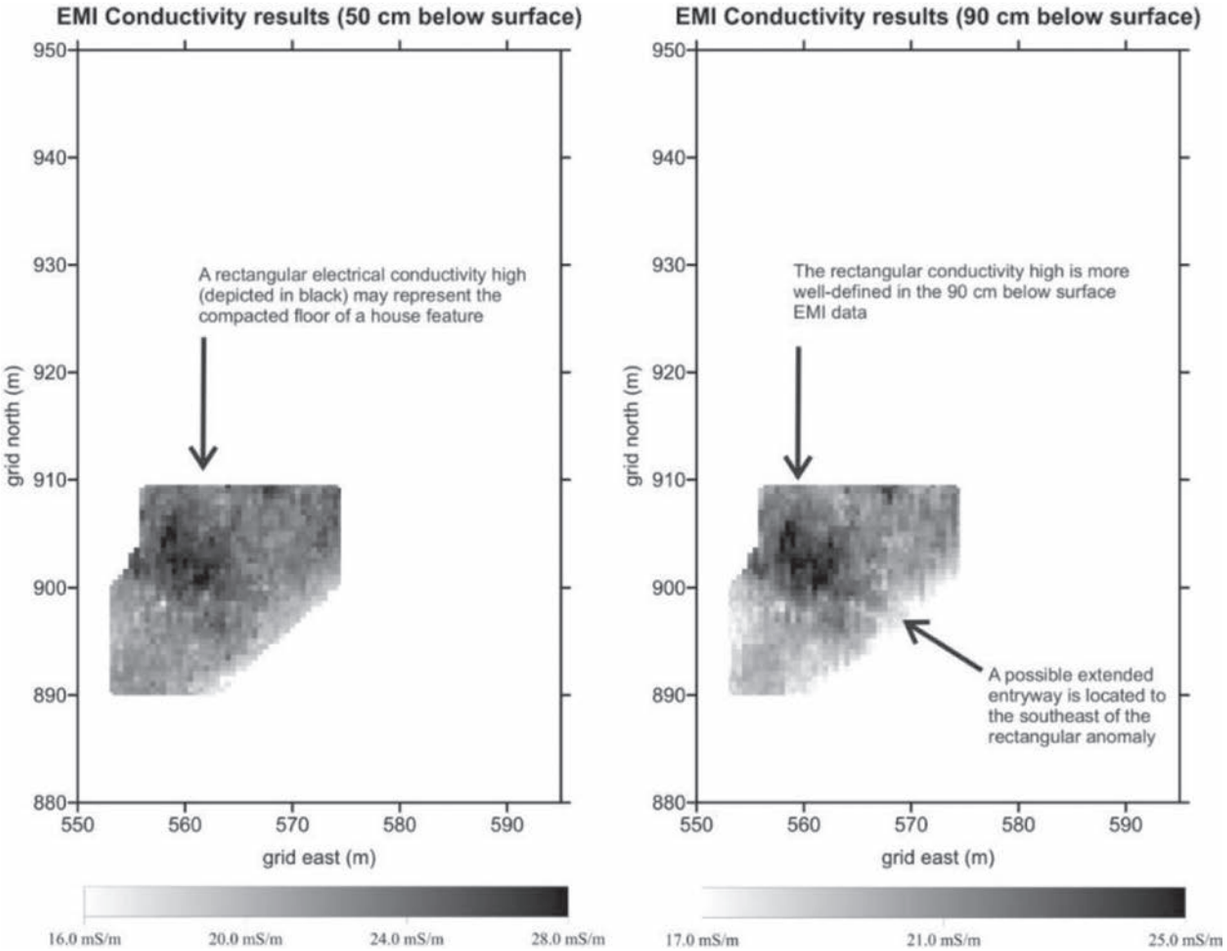


**Figure 10.** EMI survey results from Kraus 1.

Figure 11. The geometry and signal characteristics of these anomalies are consistent with what might be expected from hearths, storage pits, refuse pits, or shallow basins. The combined findings of the geophysical investigation suggested a possible rectangular compacted-earth house floor with extended entryway surrounded by more than a dozen external features.

### *Excavation*

The 2015 excavations at the Kraus 1 site focused on suspected features indicated by the geophysical survey, as well as cultural material concentrations identified by the 2014 auger testing. The grid defining 2-m$^2$ units maximized the potential to recognize subtle features (Figure 12).

Unit designations are the last three whole digits of the UTM coordinates (northing and easting) of their southwest corners. Except for the first level, every level was dug to an elevation evenly divisible by 10 (examples: 101.20 m, 98.00 m, but not 99.67 m). This provided consistent elevations across the site for evaluation of the elevations of cultural materials. Shovel skimming allowed for large areas of freshly exposed floor to be visible. This came at minor cost to securing precise locations of some artifacts but enhanced the ability to see features that were subtly expressed. In many instances participants elected to use trowels, either because of their physical abilities or because the density of cultural material required a finer technique than shovel skimming.

All sediments were dry screened through ¼-inch hardware cloth except flotation and water screen samples, as explained below. Artifacts not found in



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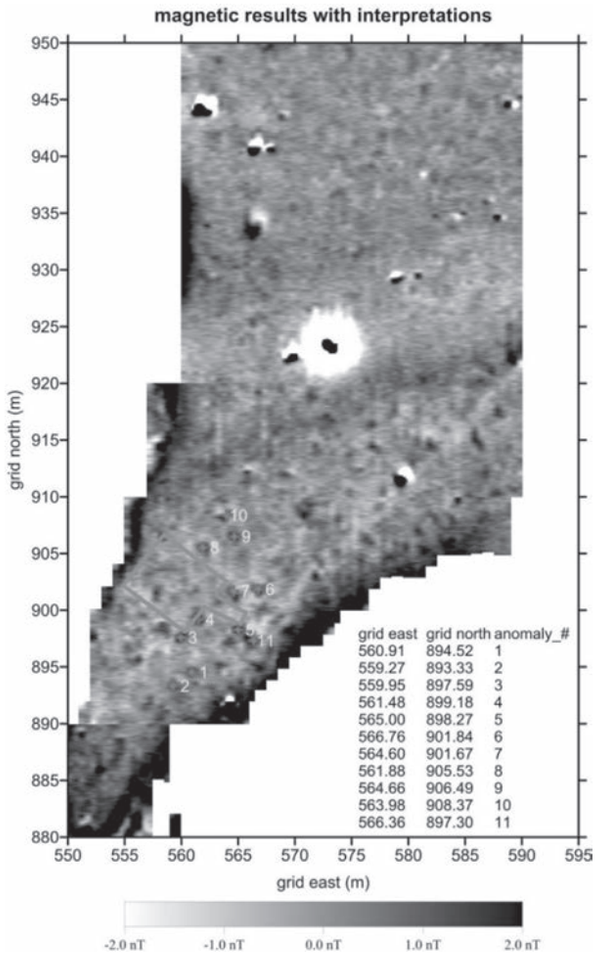


**Figure 11.** Combined interpretations from Kraus 1. A possible compacted earth house floor and extended entryway are traced in blue. The locations of possible external features are shown in red. Grid coordinates of these external features are provided in the lower right corner.

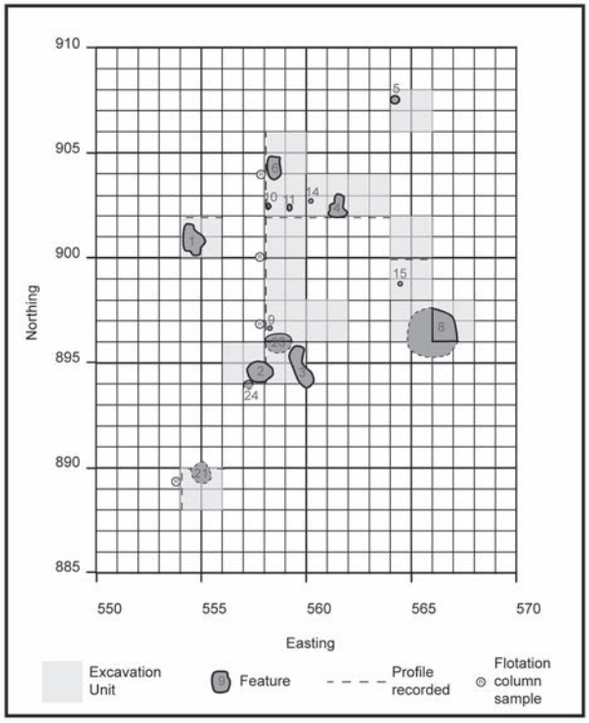


**Figure 12.** Grid, excavation units, features, drawn profiles, and locations of flotation column samples.

place, such as those retrieved during screening or in sediment displaced by troweling or shovel skimming, were placed in a general level bag, constituting the volume of cultural material from 0.4 $m^3$ of excavated sediment.

Proveniences of selected artifact classes, such as ground stone or chipped stone tools, pottery sherds, daub, and bone or shell tools, as well as mud dauber nests and radiocarbon samples, were recorded by a total station shot or by measuring from unit walls and from a level string of known elevation. Diagnostic artifacts from disturbed contexts, such as rodent burrows, were piece plotted, but their disturbed contexts were noted on piece plot forms.

Each feature was cleaned off at its level of discovery, photographed, and drawn in plan view. Then it was bisected, and one half was excavated, collecting the sediment for water screening through 1/16-inch (1.32-mm) mesh. The resulting profile was drawn and photographed. Ten-liter flotation samples were collected from the second half in stratigraphic zones where they were present. In the absence of stratigraphic variation, a 10-liter sample from each 10-cm level was taken for flotation; the rest was water screened. Total station shots recorded the top center and the bottom center.

Possible post molds were treated differently. Because animal burrows were very common and easily mistaken for post molds, suspected post molds were first bisected and inspected. The few candidates that appeared to be post molds were documented, excavated, and the sediments dry-screened.

In addition, four units were selected for flotation samples from a wall column. This was done to obtain a controlled sample of small floral and faunal remains. Samples of small (~3-mm long) gastropods were collected and analyzed by Dr. James Theler of the University of Wisconsin-La Crosse,



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providing information on environmental conditions. Specimen identifications are presented later in this report. Unfortunately, the analysis that might draw environmental information from these samples has not yet been conducted.

Most units were excavated to at least the first level below the Buckner Creek paleosol at approximately 90 cmbs across the site; some went as deep as 110 cmbs. No sterile levels were excavated, although most units showed a substantial reduction in cultural material below approximately 90 cmbs.

Workers noted significant evidence of pedogenic processes that affected the context of artifacts and the visibility of features (see Hill 1998:254–258 for a summary of these processes). Chief among these were animal burrows that were found in virtually all units and were active in some units during the field project. While most burrows were only 5 cm or so in diameter, burrows with diameters of more than 20 cm, made by animals as large as badgers, also occurred.

## Excavation Unit Selection

Units were chosen based on the results of the geophysical survey and auger and shovel tests. The goal was to ground-truth the geophysical anomalies, while ensuring an evaluation of all parts of the site. Another objective was to excavate several contiguous units to provide a broad view of the stratigraphy across the site.

## Large Anomaly

The large anomaly present in the geophysical survey was given special attention (Figure 13). It covers approximately 46 m$^2$ between 899–906N and 554–565E. Eight units were placed within or on the boundary of the anomaly. During excavation of three of the border units, soft sediment within the anomaly was distinguished from harder sediment outside of the anomaly between approximately 626.15 m above mean sea level (amsl) in one unit and 626.35 m amsl in the other two, with depths below surface ranging from approximately 60 cmbs in two units to 80 cmbs in the other, consistent with what the resistivity survey detected. None of the units was excavated to a depth at which the anomaly was not present, although at a meter below surface in 902N 560E, the anomaly appeared to be getting smaller, possibly reaching the bottom.

In two of the three units on the anomaly boundary, the harder and softer sides were excavated separately to determine if a difference in artifact content existed. More chipped stone tools and debitage were in the harder sediment, and more ceramic sherds were in the softer, but no significant difference was recognized in the quantities of other cultural material classes. Maps of proportions of cultural material classes by unit do not show any significant difference between units within the anomaly and those outside of it. It seems that the Keith phase occupation lies on top of and slightly within the upper reaches of the anomaly, which is not necessarily a cultural feature.

## Features

Few of the Kraus 1 features were well defined. No clear hearths, house floors, or pits were apparent. This reinforces the notion that the site represents one or more short-term occupations, although only 64 m$^2$ were excavated. Considering the varying depths of features, it appears that the site was occupied multiple times as soil accumulated. Features are summarized in Table 2 and are described below. In the field they were numbered starting with 200, but these numbers are shortened to the last one or

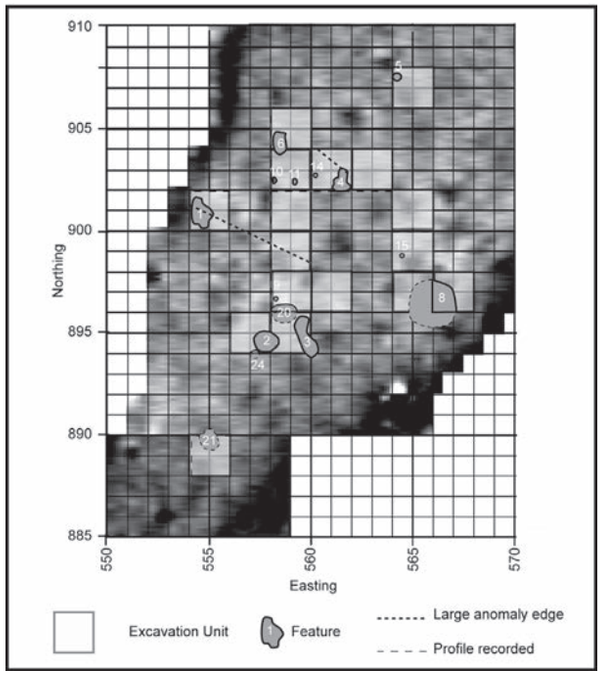


**Figure 13.** Map showing feature locations and the large anomaly.



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**Table 2.** Features at Kraus 1.

| Feature | Units | Horizontal dimensions | Vertical range (cmbs) | Description |
|---|---|---|---|---|
| 1 | 900N 554E | 122 cm SE to NW, 84 cm SW to NE | 10–18 | Irregularly shaped concentration of bone and charcoal that may be above the Buckner Creek paleosol; may be animal burrow back dirt |
| 2 | 894N 556E 894N 558E | 90 cm in diameter | 26–49 | Bone, trace amounts of shell, burned earth, and debitage, as well as one maize kernel and a little barley seed that produced radiocarbon ages of 1013±24 and 1016±24, respectively |
| 3 | 894N 558E | 190 cm SSE to NNW, 70 cm wide | 43–52 | Concentration of bison and small animal bone, debitage, and corner-notched arrow point |
| 4 | 902N 560E 902N 562E 900N 560E 900N 562E | Approximately 100 cm in diameter | 70–108 | Poorly defined concentration of small animal bone, shell, pottery, burned earth, microdebitage but no larger pieces |
| 5 | 906N 564E | 26 by 33 cm | 56–59 | Shallow, oval charcoal concentration; no artifacts noted |
| 6 | 904N 558E | 50 by 60 cm | 84–94 | Pile of mollusk valves, some stacked, above a gravel lens; possibly a point bar predating occupation |
| 8 | 896N 566E | Exposed area is 130 by 150 cm; could be as large as 3 m across | 56–68 | Small amounts of pottery, debitage, bone, shell, burned rock, and burned earth; most recovered from water screening. |
| 9 | 896N 558E | 29 cm in diameter | 35–40 | Circular basin; water screening of sediment recovered very small amounts of bone, shell, debitage, and fused silica |
| 14 | 902N 560E | 7 cm in diameter | 100–103 | Possible post mold |
| 15 | 898N 564E | 7 cm in diameter | 86–97 | Post mold |
| 20 | 896N 558E 894N 558E | Approximately 66 cm in diameter; not noticed during excavation of its south portion | 62–77 | Shallow basin of moist, loose, and dark fill, containing very small amounts of bone, shell, burned earth, and debitage |
| 21 | 888N 554E | 67 cm N to S by 61 cm E to W | 61–72 | Concentration of ash with small amounts of shell, bone, charcoal, and debitage |
| 24 | 894N 556E | 39 cm in diameter | 56–59 | Concentration of bone, small amounts of charcoal, debitage, fused silica, and burned earth |

two digits for this report. Suspected features were given numbers before further investigation; subsequently several were revealed not to be cultural. Consequently feature numbers 7, 12, 13, 16, 17, 18, 19, 22, and 23 were not assigned.

Feature 1 in 900N 554E is a large, amorphous concentration of bone and charcoal between 10 and 18 cmbs (Figure 14). It is above the Buckner Creek paleosol and thus may represent a later Middle or Late Ceramic component. A more likely explanation is that it is back dirt from an animal burrow later buried by alluvial deposits. No diagnostic artifacts or radiocarbon samples were recovered from this feature.

Feature 2 in 894N 556E and 894N 558E (Figures 15 and 16) was recognized originally in the west wall of 894N 558E after part of it had been excavated within the third level. Likewise it was documented in the west wall profile as an area of darker, moister sediment and bone. The circular feature appeared at a depth of 26 cm below the datum and extended to a maximum depth of 49 cmbs. About 90 cm in diameter, it was a shallow pit filled with bone that lay above or intruded slightly into the main cultural zone in the Buckner Creek paleosol and the Keith phase component. Seventy liters of feature fill were processed using flotation. Cultural material includes 20 g of bone and trace amounts of shell



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**Figure 14.** Plan view of Feature 1.

**Figure 15.** Plan view of Feature 2.



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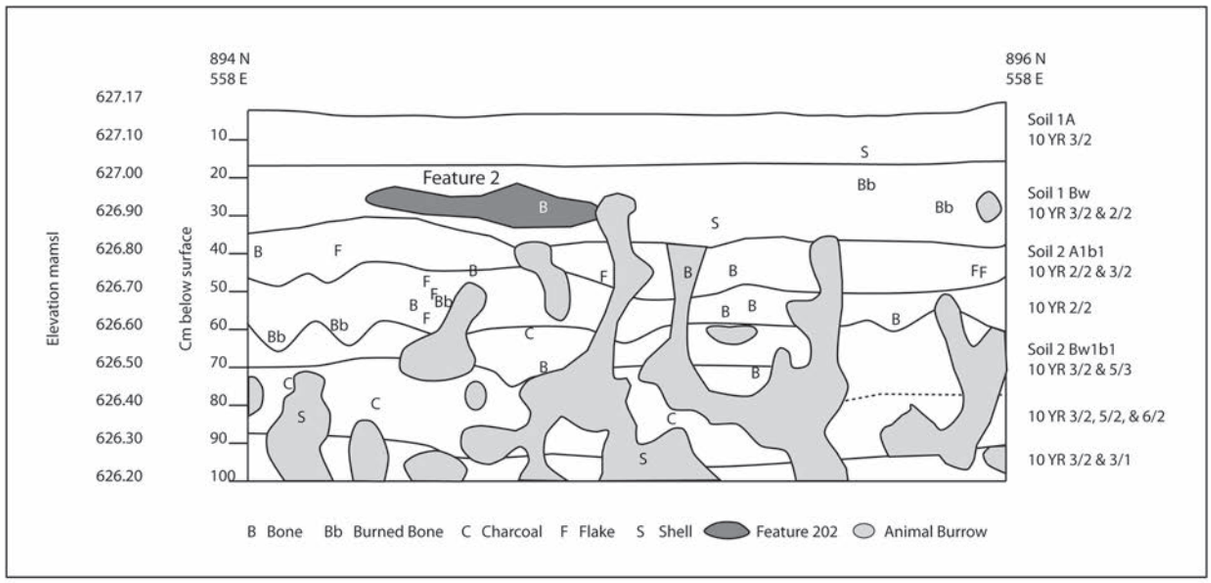


**Figure 16.** Profile of west wall of 894N 558E showing Feature 2.

(1.1 g), burned earth (0.6 g), and debitage (0.1g). One maize kernel and a little barley seed also were found, and AMS assays of these produced radiocarbon ages of 1006 ± 24 for the little barley and 1013 ± 24 for the maize (see Table 1). These are the oldest age determinations from the site, but the specimens were the highest stratigraphically. Burned and unburned bone fragments smaller than one inch were concentrated here.

Three corner-notched arrow points lay within 30 cm of the Feature 2 perimeter, indicating that it either was part of the Keith phase component or was later excavated into that component. Given the early radiocarbon ages, it seems to be part of the Keith phase occupation. Immediately beneath, the soil held more moisture, and the density of bone and carbonized material increased. The feature was not apparent in the geophysical survey but was located within a meter of anomaly 2, shown in Figure 11.

Feature 3 in 894N 558E was a concentration of animal bone from bison and one or more small animals. A corner-notched projectile point and debitage were recovered as well (Figure 17).

Feature 4 was exposed on the soft side of the large anomaly in 902N 560E and 902N 562E (Figure 18). It became evident at about 70 cmbs and extended to 108 cmbs in 902N 560E. Unit 902N 562E was suspended at 73 cmbs on the last day of the field project. The feature extended into unexcavated 900N 560E and 900N 562E. While difficult to distinguish and only partially excavated, it might be a meter in circumference. Small fragments of bone from turtle, rodent, and other small animals were collected; no large animal bone was noted. Also present in small pieces and small quantities were shell, body sherds, burned earth, heated rocks, and microdebitage, but no macrodebitage. Feature 14, a possible post mold, was northwest of Feature 4 at 104 cmbs.

Feature 5 in 906N 564E, near anomaly 10, was a distinct shallow oval (26 by 33 cm) concentration of charcoal pieces smaller than 1 cm at 56–59 cmbs, underlain by a lighter, charcoal-flecked zone (Figure 19). No artifacts other than the charcoal were recovered.

Feature 6 in 904N 558E was a concentration of at least 45 mollusk valves, including a stack of 11 whole valves (Figure 20). This discrete shell concentration lay above a gravel lens at 84–94 cmbs. None of the valves show evidence of being worked. Water-screen and flotation samples yielded very small bone, shell, and debitage fragments. No other compact shell concentrations were found.

Anomaly 11 of the geophysical survey proved to be Feature 8, a poorly delimited area darker than the surrounding sediment in the corner of 896N 566E. The exposed area was 130 by 150 cm and could have been as large as 3 m across (Figure 21).



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**Figure 17.** Plan view of Feature 3.

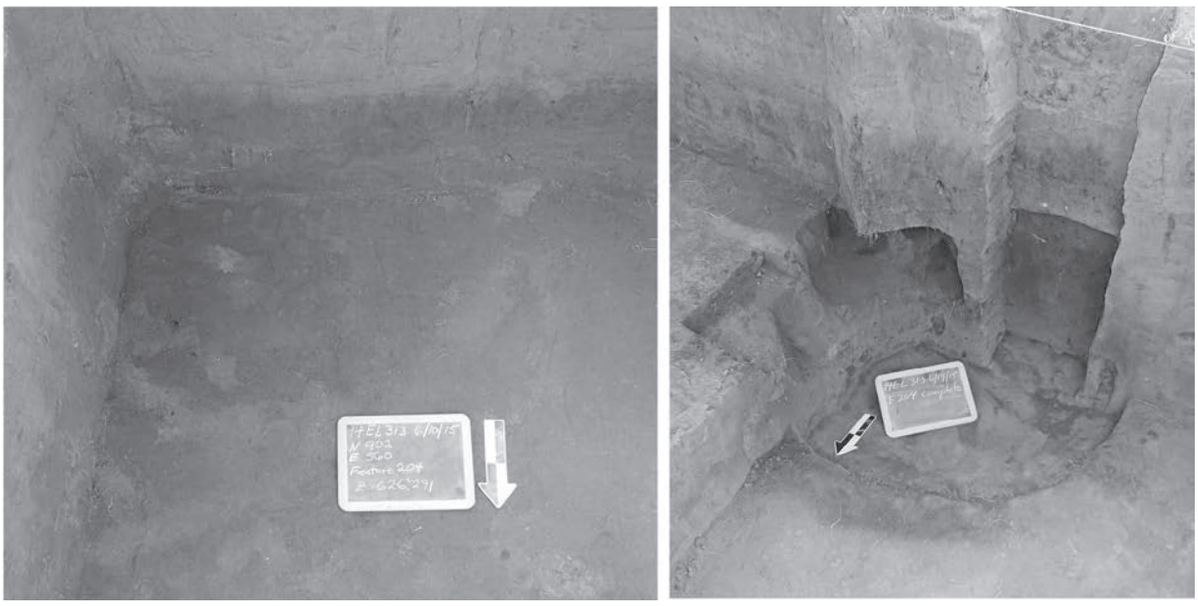

**Figure 18.** Plan views of Feature 4 before and after excavation.



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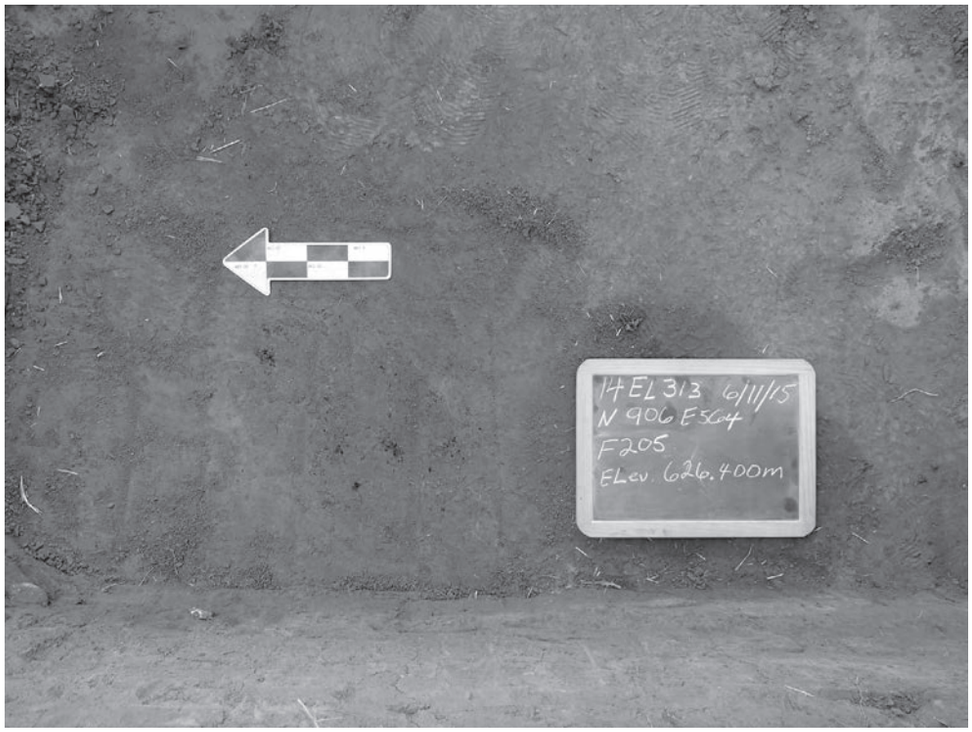


**Figure 19.** Plan view of Feature 5.

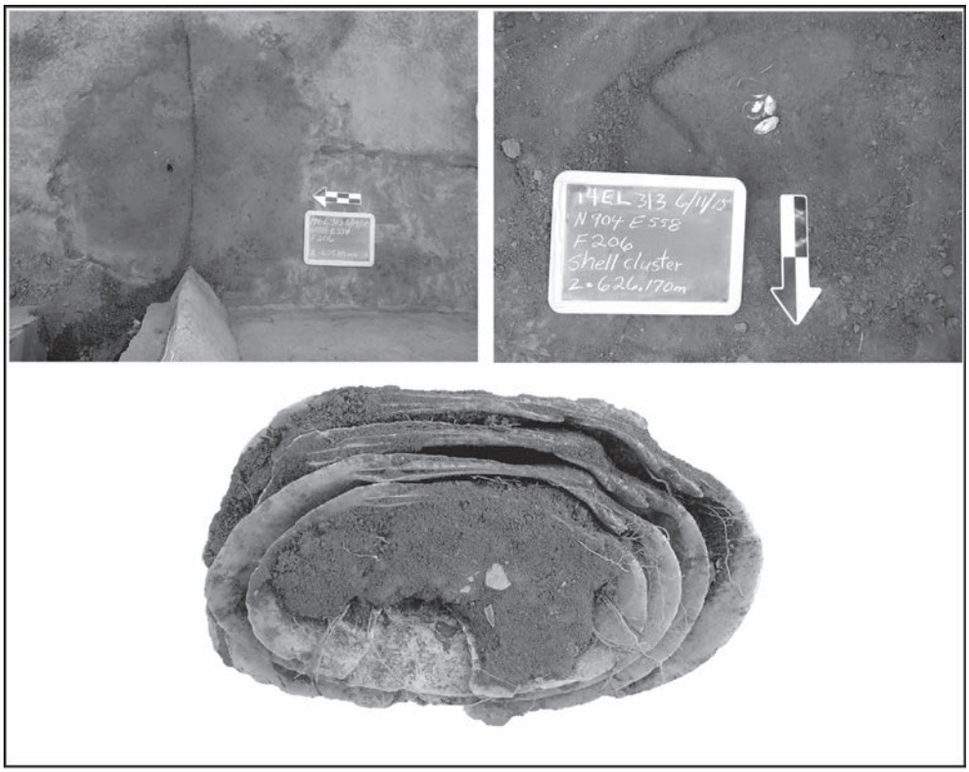


**Figure 20.** Plan view of Feature 6, detailed view of mussel valves in place, and view of stacked mussel shells.



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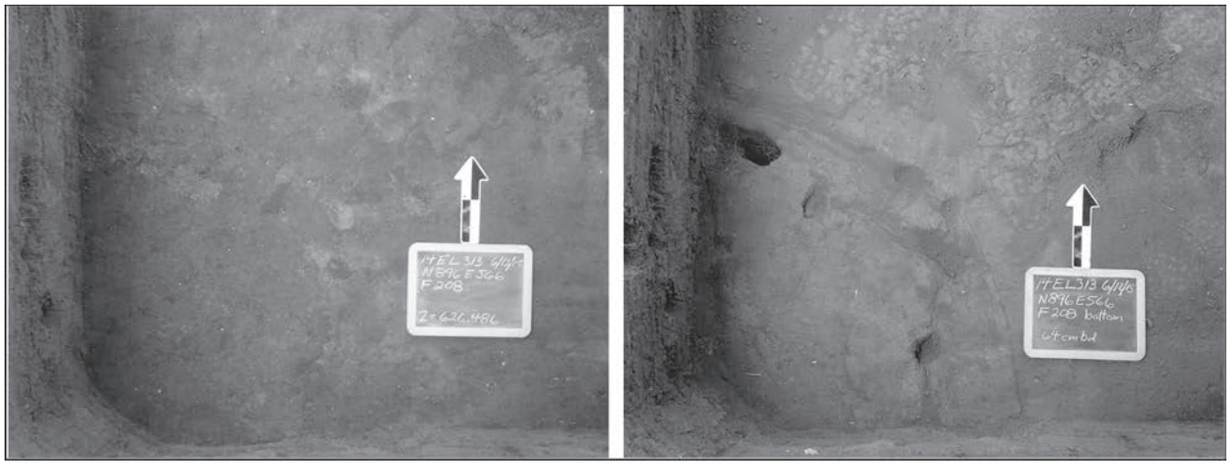


**Figure 21.** Plan views of Feature 8 when found (left) and when completed (right).

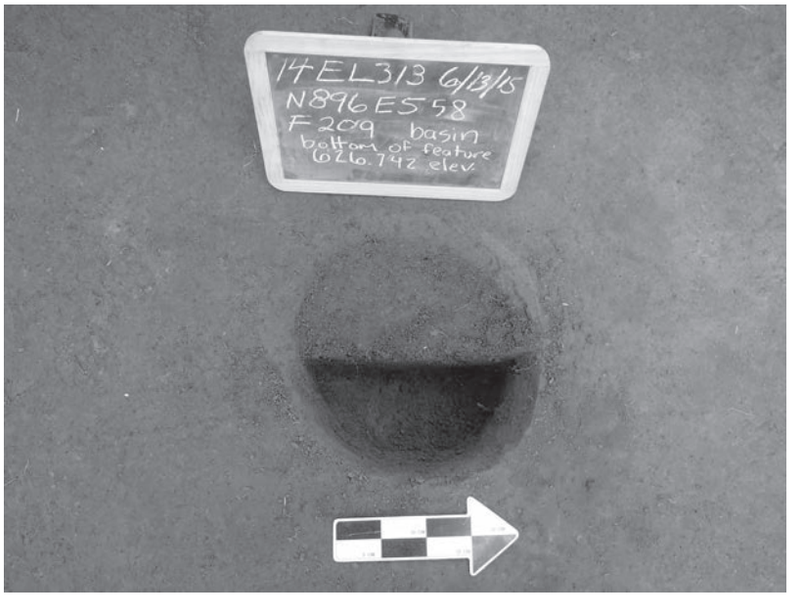


**Figure 22.** Plan view of Feature 9. The excavation of the east half extends below this shallow feature.

No flotation samples were taken, no profile was drawn, and adjacent units were not excavated. Artifact density was considerably higher outside of the feature, which contained small amounts of pottery, debitage, bone, shell, and some burned earth, most retrieved from water screening. Small quantities of burned rock and burned earth suggest a hearth that was used only briefly.

Feature 9 was in 896N 558E (Figure 22; also see Feature 20 in the same unit). It was a well-defined circular basin, 29 cm in diameter, 5 cm deep, and darker than the surrounding Buckner Creek paleosol. Water-screening of sediment produced very small amounts of bone, shell, debitage, and fused silica.

Feature 14 was a possible post mold at a depth of 625.99 cm below the datum and about a meter beneath the surface. It was 7 cm in diameter and 3 cm deep but not well delineated. It was on the soft side of the large anomaly in 902N 560E where Feature 4 occurred. No artifacts were recovered.

Feature 15 was a post mold in 898N 564E, measuring 18 cm deep and 7 cm in diameter. Numerous animal burrows in the vicinity might be mistaken for post molds.

Feature 20 in 896N 558E and 894N 558E (also



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**Figure 23.** Plan view of Feature 20.

**Figure 24.** Plan view of Feature 21.

see Feature 9 in 896N 558E) was a shallow basin, bisected by the 896N line and not properly documented in the unit to the south (Figure 23). It was characterized as being moister, looser, and darker than the surrounding sediment. Its longest dimension along the south wall was 66 cm; its maximum depth was 15 cm. All fill was water screened except for a flotation sample that has not yet been processed. This yielded very small amounts of bone, shell, burned earth, and debitage.

Feature 21 was a concentration of ash, 11 cm thick and roughly 64 cm in diameter, 61–72 cmbs in the southernmost unit, 888N 554E (Figure 24). Two flotation samples were taken. Cultural material includes small amounts of shell, bone, charcoal, and debitage. This may have been an ash dump or a hearth that was not used for long.

Feature 24 was a dense concentration of burned bone in the southeast quadrant along the south wall of 894N 556E (Figure 25). The exposed portion of



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**Figure 25.** Plan view of Feature 24.

Feature 24 ranged in depth between 56 and 59 cmbs and was 39 cm wide at the south wall. The density of bone was high, about three times as much as in Feature 2 and from a much smaller area. Other artifact classes are small amounts of charcoal, debitage, fused silica, and burned earth. The feature was not visible in the geophysical survey and was recorded on the last day of the field project. No flotation samples or water-screening samples were taken.

Much of the bone and many of the artifacts had been subjected to high heat. The source of this heat is not clear, but Feature 24, only partially excavated, may have been a part of that process.

## DESCRIPTION AND ANALYSIS OF ARTIFACTS

### *Structural Indicators*

Four analytical classes—burned earth, daub, fused silica, and mud dauber nests—are possible indicators of a structure. These materials, discussed below, were concentrated in the units excavated between 894 to 899N and 556 to 565E. However, the distribution of bone, chipped stone tools, and debitage showed similar concentration, weakening the idea of a structure in this area. Bone and shell were dispersed more widely over the site; pottery also was dispersed but more so to the western edge.

#### Burned Earth

Burned earth comprises 172.4 g of the artifact assemblage. It, like most artifact classes, was concentrated in the southern two-thirds of the site, south of 902N (Figure 26). No obvious burned earth concentrations representing hearths were found. Of 122 proveniences with burned earth, only six have more than 5 g. Widespread indications of an intense fire was noted most especially in the spalled and burned debitage that was common throughout the site; however, the paucity of charcoal is counter-intuitive. Still, the nature of the fire is not clear, and some of the burned earth might have resulted from that fire.

#### Daub

Daub, weighing 157.7 g, was concentrated south of 900N, especially in the five excavated units between 894 to 898N and 556 to 566E and in 888N 554E, where the amount of daub was more than double other areas (Figure 26). While daub sometimes is recovered from Keith phase structures, at 14EL313 no other evidence of a structure, such as post molds, a hearth, or a compacted floor, was associated with the daub.

#### Fused Silica

Excavations yielded 22.9 g of small pieces of vesicular glassy material from all but five units (Figure 27). These are pieces of fused silica, which can be



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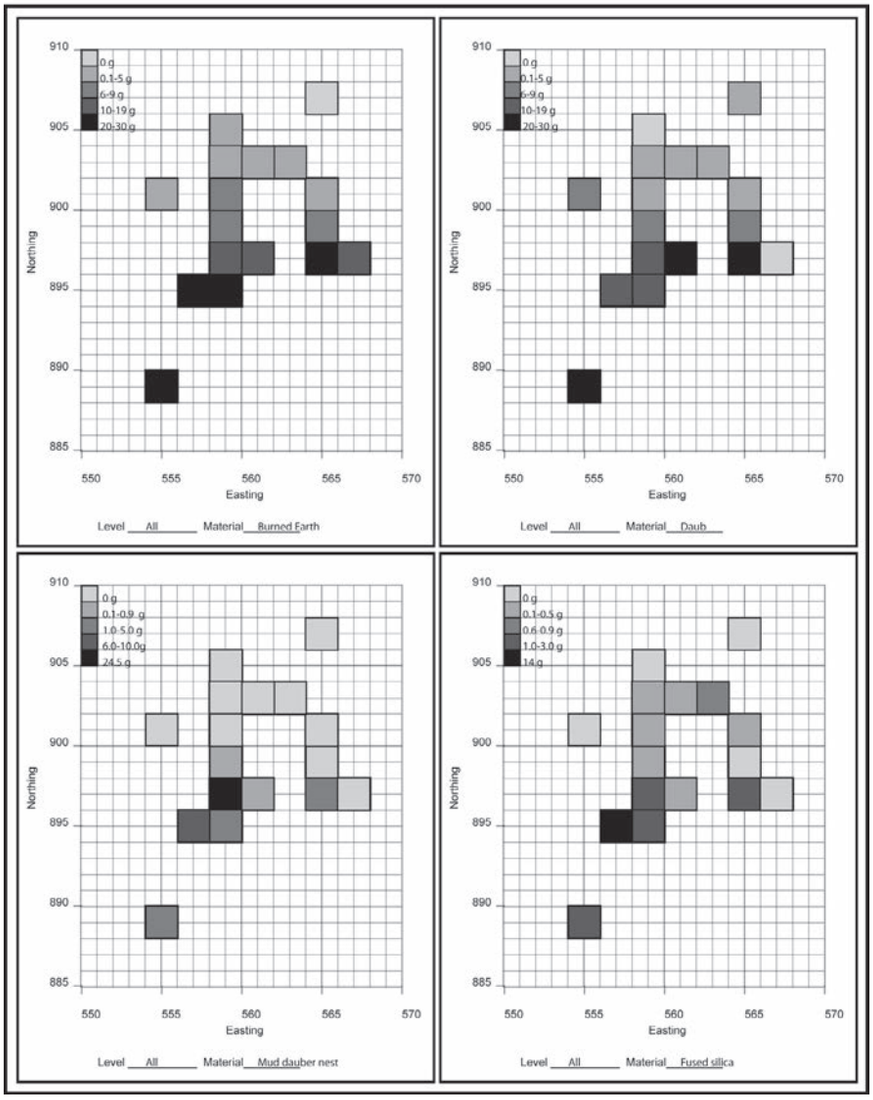


**Figure 26.** Distribution of burned earth, daub, fused silica, and mud dauber nests.

created by opal phytoliths in plant tissue precipitating and fusing during forest fires, grass fires, burning haystacks, and, arguably, burning grass-thatched structures (Baker 1968:1012; Baker and Baker 1964). Sometimes referred to as hay-silica glass (Baker 1968; Baker and Baker 1964), siliceous scoria (Thy et al. 2015), or silica slag, these phrases are misleading in that hay refers to plant material cut and cured to be used as food for livestock, slag is a byproduct of smelting metal, and scoria is a volcanic rock. The authors follow Sherard (2001), who simply referred to the material as fused silica. Baker and Baker (1964) documented the burned remains of two hay stacks, each 325 tons, predominantly grasses, but including some forbs. The resulting glass was light to dark gray and occasionally black. The hay stack left ash but also lumps, cakes, "fingers," and slabs of glass, the latter as large as 60 by 3 cm (Baker and Baker 1964:26). Some of the smaller pieces were so infused by bubbles that they floated. Thy et al. (2015:194), investigating burned straw-tempered mud brick houses in Syria, stated that opal phytolith melting and fusion is encouraged by the presence of potassium oxide in non-woody plants and by calcium oxide in wood, both of which act as a flux. Thus, chemical analysis of the fused silica may lead to the identification of its source. Slag from soils and sediments are characterized by aluminum oxide, sodium oxide, and iron oxide.



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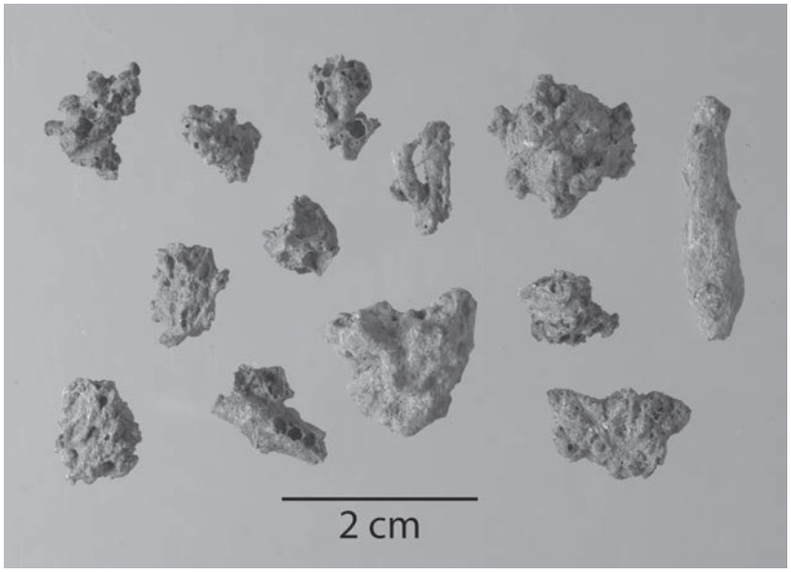


**Figure 27.** Fused silica.

Sherard (2001) used mass spectrometry to study five fused silica samples from a reconstructed and burned Caddoan house, from a suspected house at Mound V of the Moundville site in Alabama, from a possible copper smelting area at Moundville, and from two samples from a surface collection of Mound R at the Toltec Mounds site in Arkansas. The latter samples contained metals and probably are historic; the reconstructed house samples and samples from buried archeological settings did not, suggesting that slag and fused silica from prehistoric houses can be discriminated chemically.

Fused silica at 14EL313 was most concentrated in the center of the excavated area. A clear majority of the material came from a single unit, 894N 556E, which contained half of Feature 2 (Figure 26).

### Mud Dauber Nests

Because mud daubers build their clay nests on the undersides of suspended horizontal surfaces, they are plausible indicators of a structure. A large mud dauber nest fragment was recovered from level 4 in 894N 556 E. Other smaller fragments were found within 6 m of this piece in 888N 554E (Figure 26). The presence and concentration of fused silica, daub, burned earth, and mud dauber nest fragments bring to mind a grass-covered structure but do not conclusively affirm one.

Evaluation of the four cultural material classes that may indicate structures by themselves do not provide convincing evidence of a structure. Likewise, the features in the excavation units where these cultural material classes were concentrated do not confirm a structure. The small number of houses and the relatively sparse density of artifacts from Keith phase sites suggest short-term occupations, maybe for a year or several seasons. This might explain the large number of Keith phase sites along some stream channels (Hoard and Bozell 2016:Figure 1–2), which likely represent repeated seasonal occupations of a general region over hundreds of years.

### *Pottery*

Pottery from the Kraus 1 site shares attributes with Early Ceramic pottery traditions of the High Plains of Kansas and Nebraska, eastern Colorado plains, and Rocky Mountain foothills (Ellwood 2002; Gilmore 2008:30–33), as well as those of the Late Woodland of the plains-prairie border (Hoard 2000; Hoard et al. 2003; Hoard and Bozell 2016; Logan 2006; Reynolds 1979:70–71; Whittaker 2005:129–133; Williams 1989). More specifically, the descriptive type Harlan cord-roughened is widely considered diagnostic of the Keith phase. Because pottery generally matching the description of this type was recovered from 14EL313, it is discussed in some detail here. A typical Kraus 1 sherd is shown in Figure 28.

Kivett (1953:131–132) described Harlan cord-roughened pottery in his 1953 report on the Woodruff Ossuary in north-central Kansas as being "…



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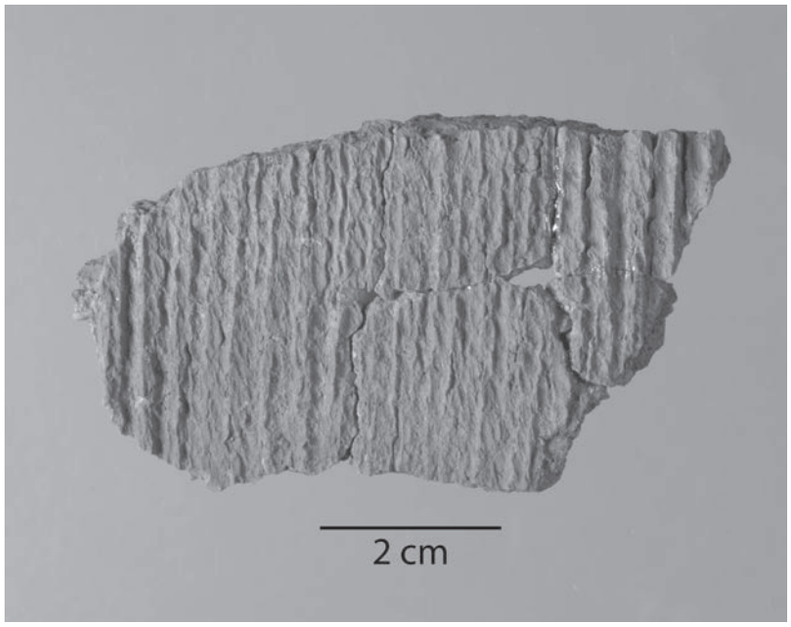


**Figure 28.** Body sherd of Harlan cord-roughened pottery from Kraus 1.

characteristically thick (having) over-all cord-roughening with the cord impressions vertical and parallel on the vessel; and … tempered with crushed calcite, with an occasional inclusion of hematite or fine sand." There is, of course, some variation. Grange (1980:113–116) and Kivett (1949:282) noted wares that are sand-tempered, elongated, and have cord roughening that is either parallel, crossed, or smoothed over. Some specimens have fine cord marking or cord marking on both the interior and exterior. Harlan cord-roughened vessels have pointed or occasionally flat bases, wide mouths, vertical or slightly angled rims, and slight or non-existent shoulders. Sherds typically average 9 mm thick but sometimes are as thick as 17 mm (Kivett 1949:282). Decoration is very rare.

There are few whole or reconstructed Harlan cord-roughened vessels. Amateur archeologist Earl Monger reconstructed two from Keith phase sites: one from the Forrest site and another from 14RU401 in Rush County. Both vessels are curated at the Santa Fe Trail Center in Larned (Hoard and Bozell 2016:Figure 1–13). They are cord marked, roughly conical with a wide opening, no shoulder, and no decoration. The following study evaluates Kraus 1 ceramics and the similarities to and differences from descriptions of Harlan cord-roughened pottery.

Most Kraus 1 sherds are cord marked or have smoothed-over cord marks. Cord impressions show the cord width is generally 1.5–2 mm, as is the width between cord marks. The depth of cord impressions ranges from 0.3–0.6 mm on most sherds. The pottery from the site is badly broken, so few sherds have a dimension more than 3 cm.

## Temper

Much of the Kraus 1 pottery is tempered either with limestone, which is predominantly calcite but also crystalline calcite or, less commonly, with sand. Harlan cord-roughened is portrayed as calcite tempered, and this description is widely used in the literature (Johnson 2001; Kivett 1949, 1952, 1953). However, this general description is not based on consistent or quantifiable observations. Petrographic thin-sections provide a rigorous and quantifiable analysis of temper particle composition and size. Josephs' (2010) petrographic analysis of five sherds from the Forrest site described the sherds as limestone tempered. Because the choice of temper in pottery can directly affect vessel performance and may give evidence of regional resource use, a better understanding of Keith phase pottery temper is in order. Margaret Beck examined three sherds from 14EL313, four from 14PA303, two from 14PA363, and one from 14PA411, all Keith phase sites, and all sherds generally fitting the Harlan cord-roughened descriptive type.



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## Petrographic Analysis of Ten Sherds from Keith Phase Sites in Kansas

Margaret E. Beck

This analysis of 10 Keith phase sherds from 4 sites identified the composition of inclusions and documents particle shape, size, and density, among other attributes (see Appendix 2). It revealed a bimodal grain size distribution in all the sherds and tentatively recognized intentionally added inclusions or temper (probably the larger inclusions) and natural inclusions (probably the finer inclusions). This is not a perfect assumption, since at least some added temper made its way into the finer particles (e.g., crushed calcite and grog). Five sherd composition categories were defined.

Category 1: Large calcite temper in fine matrix, n = 5 (KSHS2 from 14PA363, KSHS4 and KSHS5 from 14PA303, KSHS9 from 14EL313, and KSHS10 from 14PA411)

These sherds each contain 15–30 percent temper inclusions, mostly in the very coarse sand size range but with some as large as granule size. The temper is dominated by angular particles of calcite but also incorporates some micritic limestone with fossils. In sample KSHS4 the micritic limestone is attached to a calcite particle, suggesting that the calcite originated from this limestone. Another 5 percent of the volume in these sherds is fine sand to coarse silt. These fine inclusions, dominated by quartz, probably are natural inclusions, although they include some tiny angular calcite particles that may have been added along with the larger temper.

Category 2: Quartz-feldspar sand temper in sandy-silty matrix, n = 2 (KSHS1 from 14PA363 and KSHS8 from 14EL313)

These sherds are characterized by their mineralogy and their relatively high proportion of fine (presumably natural) inclusions. The samples each contain 5–10 percent temper inclusions, either mostly medium or very coarse sand but with some inclusions as large as granule size. These large quartz and feldspar grains might have been mistaken macroscopically for calcite inclusions, given the similar color and size of both temper types in the analyzed sherds, although they incorporate many more subrounded particles (in contrast to the angular calcite). Another 10–20 percent of the volume in these sherds is fine sand to coarse silt in size, also dominated by quartz and feldspar. KSHS1 had some occasional biotite mica among the fine inclusions, which was not observed in KSHS8.

Category 3: Rock or grit with grog, n = 1 (KSHS3 from 14PA303)

The rock or grit with grog sample is distinguished by 10 percent subangular temper inclusions, coarse to very coarse sand in size. Temper includes some subangular rock fragments with quartz and feldspar, as well as isolated quartz, feldspar, calcite, and grog, which itself holds quartz and calcite inclusions. Another 10 percent of the volume is mostly coarse silt to very fine sand in size, accompanied by quartz, calcite, and grog.

Category 4: Quartz-feldspar sand with grog n = 1 (KSHS7 from 14EL313)

The quartz-feldspar sand with grog is similar in mineralogy to the rock or grit with grog category except that it lacks calcite. The quartz and feldspar grains have many more subrounded and rounded particles and are assumed to be sand rather than crushed rock. The dark color and mottling of the matrix makes it difficult to distinguish the grog, so this is a tentative identification.

Category 5: Fossiliferous limestone temper, n = 1 (KSHS6 from 14PA303)

The fossiliferous limestone temper sample is very distinctive due to the density of fossils, including some relatively large pieces of fossil shell. The sample contains 30 percent temper, composed primarily of micritic limestone with a dense concentration of fossils. These limestone fragments are subangular and mostly very coarse sand size but with some inclusions as large as granule size. Occasional calcite crystals appear in the temper-size fraction as well. Another 10 percent of the volume is medium sand to coarse silt in size and has both small particles of micritic limestone and quartz.

### Low Magnification Temper Analysis

Because petrographic analysis could not be conducted on all sherds, they were inspected using 10X magnification to identify temper. Unaided vision is insufficient to make correct temper determination. Under magnification the distinctions are clear.



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Crushed limestone or calcite has angular edges and is white, yellow, or gray. Sand particles are small, typically about 1 mm in diameter but occasionally as large as 3 mm, with rounded edges and a range of color that encompasses clear, pink, red, brown, and black (Figure 29). Sand temper seems to be denser and comprises a higher percentage of clay body, although this was not quantified. While Harlan cord-roughened pottery is thought to be predominantly limestone-tempered, 48 percent by count and 43 percent by weight are tempered with sand or sand and limestone. Small particles of orange to red hematite, verified by comparing examples in sherds to a hand specimen under magnification, are present in both sand- and limestone-tempered sherds. Hematite in Harlan cord-roughened pottery is noted by Kivett (1953:132) in his original description of the type. It may have been intentionally added or could be a component of the clay source.

Table 3 presents the temper variation in Kraus 1 ceramics. Because different temper types may indicate specific clay body wares, temper type is evaluated against surface treatment. This analysis shows that temper type is consistent between plain and cord-marked vessels.

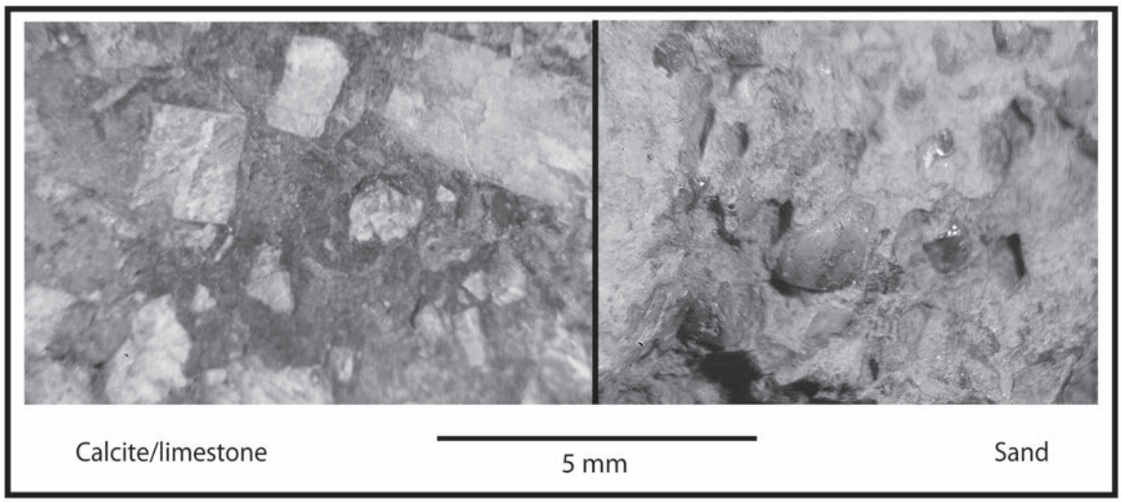


**Figure 29.** Image of temper particles in sherds from Kraus 1 under 10 x magnification.

**Table 3.** Quantities of Pottery from Kraus 1 Classified by Surface Treatment and Temper.*

| | Count | Percent | Weight | Percent |
|---|---|---|---|---|
| Cord-marked | 161 | 45 | 386.1 | 47 |
| Limestone, including calcite | 91 | 26 | 210.5 | 26 |
| Sand | 69 | 19 | 169.3 | 21 |
| Limestone and sand | 1 | <1 | 6.3 | <1 |
| | | | | |
| Plain | 16 | 5 | 24.4 | 3 |
| Limestone, including calcite | 1 | <1 | 0.6 | <1 |
| Sand | 15 | 4 | 23.8 | 3 |
| Totals | 354 | 100 | 821.0 | 100 |

*This table does not include the few sherds with indeterminate temper, no temper, or decorations.



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## Thickness

Kraus 1 sherds were sorted by temper and surface treatment and position on the vessel (rim, shoulder, body, or base). Body sherds that did not pass through a ½-inch (1.27-cm) sieve were measured for thickness. Thickness is an important factor of vessel strength. Within temper and surface treatment classes, thick vessels conduct less heat and are more vulnerable to thermal failure than thinner vessels (Braun 1983, 1987; Feathers 1989; Hoard 1992; Hoard et al. 1995; O'Brien et al. 2003).

Four thickness measurements were taken from the edges of these sherds at opposite ends of two axes intersecting at 90 degrees. Cord marking, when present, and curvature, when detectable, were used to orient sherds to the vertical and horizontal axes of the parent vessel. The average of these dimensions is used to represent each sherd's thickness.

Table 4 presents the mean thickness and standard deviation by temper type and surface finish for sherds that are large enough to be measured for thickness. Considering the standard deviations within classes, there is no significant difference in thickness among cord-marked sherds, which concurs with the results of the temper and surface treatment analyses. There are six sand-tempered smoothed cord-marked sherds. Four of these are from 40 to 60 cmbs in four adjacent units and may be from one vessel, although none refit. If so, substantial redistribution of artifacts within the site is implied.

## Rim Sherds

Excavations recovered only 10 rim sherds. Four are vertical, one turns inward, the other five turn out. Seven have a rounded lip; the rest are flat. There is no correlation between rim angle, temper, surface treatment, or lip shape, possibly a function of small sample size. Only two are large enough to measure for orifice diameter. Both are sand tempered and cord marked. One is from a vessel with an opening that is approximately 18 cm in diameter; the other is estimated at 22 cm in diameter. These values correspond with the larger pottery sample from the Forrest site, where the mean vessel orifice diameter is 20.4 cm (Hoard and Bozell 2016:19). The Kraus 1 sherds came from adjacent units and within 10 cm in depth. Because vessel openings rarely are perfectly round, they could be from the same pot.

**Table 4.** Thickness of Selected Sherds.

| | Thickness (mm) | |
|---|---|---|
| Surface treatment and/or decoration | Mean | Standard deviation |
| Cord-marked | | |
| Limestone, n = 31 | 6.78 | 1.01 |
| Sand, n = 34 | 6.14 | 1.42 |
| Smoothed-over cord-marking | | |
| Sand, n = 6 | 6.10 | 1.38 |
| Plain, incised | | |
| Indeterminate, n = 1 | 3.90 | 0.08 |

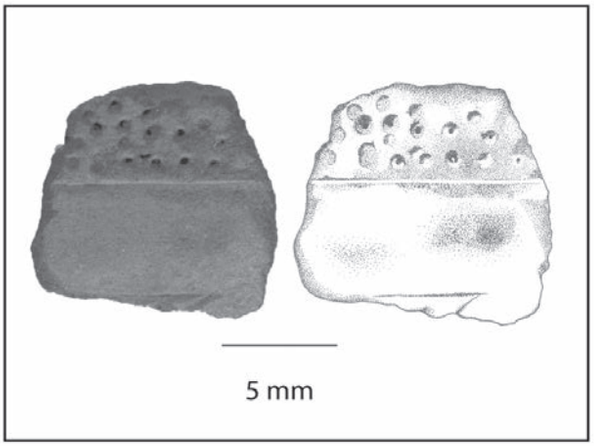


**Figure 30.** Photograph and drawing of a zoned punctate sherd, catalog number (71-21). Drawing by Tricia Waggoner.

## Decoration

Lack of decoration is consistent with documented Keith phase ceramics, but 6 of the 177 Kraus 1 sherds are decorated. Four limestone-tempered sherds and one small sand-tempered sherd (189–5) have incised lines. One sherd (71-21) from a very small vessel is zoned and punctated (Figure 30). It has no apparent temper and a mean thickness of 3.9 mm. Zoned punctate pottery, similar to Havana-Hopewell pottery in Illinois and Ohio, is found sporadically to Kansas' western border and probably beyond (McLean 2004:9). The zoned-punctate sherd from 14EL313 may have been influenced by those design features, and it is very similar to a single sherd from the coeval Forrest site about 6 km south of the Kraus 1 site (Bozell 2006:99, Figure



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6.3, upper right). Even so, these sherds are not typical of the zoned-punctate sherds associated with Hopewell.

## Pottery Discussion

A typical Kraus 1 ceramic vessel is straight walled with little or no shoulder. Lacking identifiable base sherds, vessel base shape cannot be determined. It is tempered with crystalline calcite, limestone, sand, or any combination of the three. It is roughened from base to lip and lacks decoration. Only 10 rims were recovered, and these vary in angle and lip treatment. The average body wall thickness is 6.3 mm with a standard deviation of 1.47 mm, about 2 mm thinner than pottery at the Forrest site (Hoard and Bozell 2006:66).

Most body sherds have little curvature in one dimension, often in the direction perpendicular to the cord marking when laid on a flat surface, indicating that they are body sherds from an elongated, generally straight-sided vessel and that the cord marking was applied vertically between the base and the lip. This, and the lack of overlapping of cord marks, is evidence that the impressions are not from a cord-wrapped paddle but from a cord-wrapped dowel and applied by rolling (see Hurley 1979 and Elwood 2002:15, 18, 23, 24, 25 for examples of rolled cord impressions). Experimental work demonstrates that ceramic vessels with deeply grooved or corrugated surface roughening have enhanced thermal shock resistance (Pierce 2005:127–131, 140–144; Schiffer et al. 1994:207). Furthermore, the surface treatment makes the vessel easier to grip and handle, whether it is used as a water vessel or a cooking pot (Rice 1987:138, 232).

Finger impressions, visible in several rim sherds from the Forrest site (Hoard and Bozell 2006: Figure 1–12), suggest mass modeling rather than coil or slab construction. Steinacher (2014:76) stated that parallel cord marks and finger impressions of Early Ceramic sherds differ from later CPt (ca. 900 to 1400 C.E., variable by region) pottery, which typically has overlapping cord-wrapped markings and interior anvil impressions rather than finger impressions. This suggests that the potter held an anvil inside the vessel and struck the outside of the vessel with a cord-wrapped paddle to thin the vessel wall (Rice 1987:141–142). Krause (1995:336–348) noted that these differences likely reflect different construction techniques, which may be temporally sensitive.

Radiographic and petrographic analyses of Early Ceramic pottery from the High Plains of eastern Colorado indicate that it was built by mass modeling, that paddling was not common, and that this mode persisted into the Late Ceramic, when coiling became the preferred construction method (Elwood 2002:24, 95–96; Parker 2002:111–12). Krause (1995, 2011:310, 312–313) also asserted that Early Ceramic vessels were mass modeled, based on breakage patterns.

Krause (1995) tentatively proposed that thick, calcite-tempered, parallel cord-marked Keith phase pottery was replaced by thinner, sand- and calcite-tempered—and eventually solely sand-tempered—vessels with intersecting cord marking, the latter resulting from use of a paddle and anvil to finish. This process, along with interior scraping to thin vessel walls, would lead to a rounder shape and more pronounced shoulder. Krause stated that strap rims and straight rims are seen late in the Early Ceramic sequence. No strap rims occur in the Kraus 1 assemblage, although most rims are small, less than 3 cm on the vertical axis, so it may not be possible to identify strap rims. CPt ceramic vessels typically are thinner, rounder, and have more constricted necks (Roper 2006:6).

Krause's (1995:343) data verifies that calcite-tempered wares are thickest, with sand- and calcite-tempered ware and sand-tempered ware becoming progressively thinner. At 14EL313 there is no significant difference in thickness between sand- and limestone/calcite-tempered sherds, but the small pottery sample is substantially thinner than that from the Forrest site, and a higher percentage is sand-tempered. In general Krause's (1995) proposed temporal sequence of Early Ceramic vessel manufacturing changes—from thick, straight-walled, calcite-tempered wares to thinner, rounder, sand-tempered wares—was not observed at 14EL313, which is very late for the Keith phase. However, the absence of intersecting cord marking and relatively straight walls of Kraus 1 vessels support the idea that a shift from mass modeling to coiled vessel construction, finished with a paddle and anvil, are not late Keith phase but initial Middle Ceramic CPt traits.

Pottery variation is encountered in Keith phase



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sites. The Massacre Canyon site (25HK3) pottery is tempered with fine to coarse sand; no limestone or calcite temper is noted (Kivett 1952:16–17), and Bowman (1960:17–51) reported variation in temper, cord-mark pattern, and vessel wall thickness in sherds characterized as Early Ceramic, presumably Keith phase, from Coal Oil Canyon (14LO401). Beck's thin-section analysis of a sample of Harlan cord-roughened sherds confirms that calcite is a component in some Harlan cord-roughened pottery. Crystalline calcite is a commonly occurring mineral in western Kansas and is the primary constituent of limestone. Large veins of it are present in the Niobrara chalk and other Cretaceous-aged formations (Buchanan 2001: 707–71). Reports by Beck (herein) and Josephs (2010) identify limestone temper, as well as sandstone, shale, and hematite. Hematite can be found in Cretaceous-age Dakota formation exposures in eastern Russell and Lincoln counties and is incorporated in clays and shales (Buchanan 2001: 76–78).

Crystalline calcite with adhering limestone indicates that the calcite, at least in some cases, is derived from limestone and not necessarily from pure calcite crystal aggregations. Another sherd in Beck's sample is solely limestone-tempered. Crushed rock other than limestone, as well as grog, are present as minority temper types. As noted earlier, Harlan cord-roughened pottery is referred to as calcite-tempered. Beck notes that quartz and feldspar sand particles can be mistaken for calcite crystals by the unaided eye, and microscopic evaluation of all sherds by the primary author supports Beck's observation. Based on these analyses, Harlan cord-roughened pottery would be described more accurately as calcite-, limestone-, or sand-tempered. In any case calcium carbonate in the form of calcite, limestone, or both is often an important component of the clay body, and sand also is frequently used for temper. No clay sources for Harlan cord-roughened pottery have been documented.

The Kraus 1 assemblage shows that sand-tempered sherds are almost as common as limestone-tempered sherds but are not different in terms of vessel shape or thickness. All dates are later than 1000 C.E., and yet there is no indication that ceramic vessel technology is changing in ways that are represented by the following CP: thinner, rounder vessels with more restricted orifices and commonly with decoration.

## *Section one*

## Chipped Stone Raw Material Use

Chipped stone tool raw material identification in archeological assemblages provides information about technology, land use, social contact (Montet-White and Holen 1991), foraging or territorial boundaries (Holen 1983, 2001), and exchange (Spielmann 1983; Vehik 1988, 1990, 2002; Vehik and Baugh 1994). In addition, some materials are better suited than others for specific tasks (for example, chopping as opposed to slicing) because they are more easily worked, more durable, or can be brought to a finer edge; thus, different sources may be used to produce different kinds of tools.

### Methods

Visual inspection of the color, texture, cortex, and presence or absence of fossils was used to classify chipped stone tools and debitage into source categories. There is some subjectivity in this process; when not straightforward, low level magnification was employed to see if distinguishing traits were present. In some instances, short and long wave ultraviolet light was used to ascertain if there were significant differences in materials that appeared similar to the naked eye (Hofman et al. 1991). However, this approach did not reveal any look-alike materials. Ideally quantitative methods, such as neutron activation analysis (Glascock and Neff 2003), would be used to differentiate stone sources, but these techniques often are destructive and expensive and so were not used in this analysis with one exception.

One of the corner-notched points (193–13), made of a dark translucent material, was thought to be obsidian. The specimen was examined using x-ray fluorescence, well-known as a practical, non-destructive means of identifying sources of this material. However, the analysis determined that the point is not obsidian (Hughes 2015). It probably is smoky quartz, which occurs in the Ogallala gravels, described below. Figure 31 shows the location of chipped stone tool raw material sources that have been documented in Kansas archeological sites.



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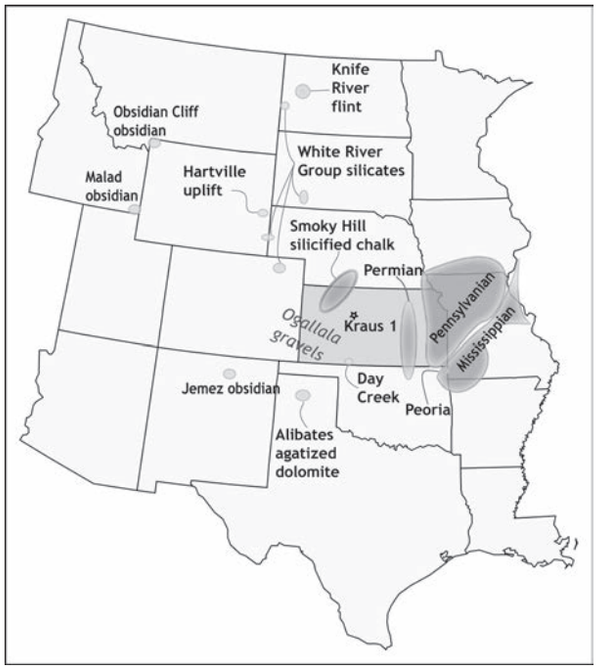


**Figure 31.** Selected raw material sources found in Kansas archeological sites.

Lithic Sources

*Local Sources*

Ogallala Gravels

The Ogallala formation is comprised of secondary deposits of igneous and metamorphic rocks from the Rocky Mountains and sedimentary rocks from eastern Colorado and western Kansas (Hurst et al. 2010). It caps the highest divides in Ellis County, where it contains chert nodules up to 2 inches in diameter (Bass 1926:16–18). The Ogallala formation is widespread across western Kansas and can be as thick as 350 feet. It often is exposed by fluvial erosion and is found as stream bed deposits (Stein 2006:277–278). Ogallala gravels, which incorporate cobble-sized stones, are used as a chipped stone tool source in the region and sometimes is the raw material for most chipped stone tools and debris at a site (Bevitt and Bauer 2003:333; Hoard and Bozell 2016:37, Hurst et al. 2010:96, 100–102; Hurst et al. 2015:207; Ray 2010:50). However, the small cobbles are difficult to work. Because of this, bedrock sources typically are important even in areas where Ogallala gravels are readily available and bedrock sources are a considerable distance away (Hoard and Bozell 2016). Ogallala formation gravels in Kansas include knappable chert, quartz, quartzite, rhyolite, petrified wood, basalt (or trachyte, see Blasing 1990), and opalite (Ray 2010:46–50).

Silcrete

Well-weathered cobble- to boulder-sized rocks of non-metamorphic silica-cemented sediment are found in cultivated fields in the Big Creek valley near Yocemento and occasionally in situ above the Fort Hays limestone. Cemented particles range from coarse to fine. Charlie Kraus (personal communication 2014) has identified this material as silcrete, which formed locally as a paleosol on the terrestrial surface of older marine Cretaceous sediments before the Ogallala formation formed. Later this material was incorporated into the Ogallala formation as lag deposits. Silcrete, then, is sedimentary, while quartzite is metamorphic. Silcrete nodules usually occur at or near the ground surface, and silcrete sometimes forms caprock. One specimen collected near 14EL313 has trace fossils (Greg Ludvigson, personal communication 2016), supporting the assertion that the material was formed in a paleosol.

Silcrete was used prehistorically for chipped stone tools in the Southern Plains, especially at sites near areas where silcrete is locally abundant (McCoy 2011, citing Holliday and Welty 1981). It is present in the upper portion of the Ogallala formation in Texas (Hurst et al. 2010:104). Hurst et al. (2010:109) note its use in the Macy locality of west-central Texas but point out that, even in areas where it is the dominant tool stone source, other sources, such as quartzites, are selected more frequently for chipped stone tools. It most often is used for expediency tools, though formal tools of silcrete also exist. It is used in hearth construction (McCoy 2011:99), and its generally rounded shape and tough exterior make it useful as a hammer stone.

To determine if some of the Kraus 1 raw stone is silcrete, two petrographic thin sections were made: one from a large, well-made biface (catalog number 26) and another from a hand specimen from the vicinity. Greg Ludvigson of the Kansas Geological Survey examined both thin sections under plain and cross polarized light and inspected the hand specimen using cathodoluminescence (Figure 32). These methods demonstrated that the samples



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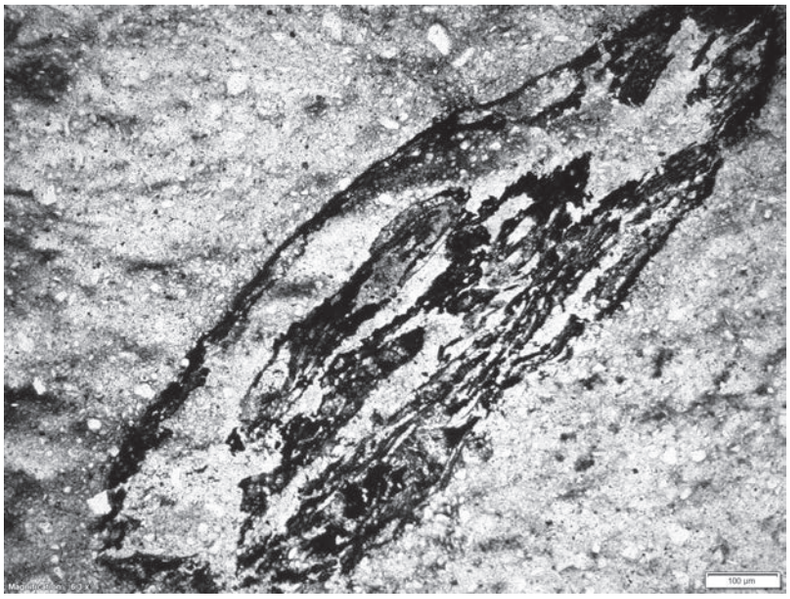


**Figure 32.** Cathodoluminescence image of a silcrete thin section showing plant material replaced by calcite which in turn is replaced by silica. Analysis and image courtesy of Greg Ludvigson, Kansas Geological Survey.

were comprised of angular, poorly sorted grains of quartz, feldspar, and other materials, cemented by low-temperature silica. The samples include fossil traces and fragments of plant materials—wood or roots—that in one instance is replaced by calcite, which in turn is being replaced by silica. This evidence suggests that the material is not metamorphic quartzite but more likely is sedimentary silcrete, being formed in an ancient paleosol in the Ogallala formation.

Quartzite

Quartzite, a metamorphic rock, is present in Ogallala formation deposits in Rooks, Graham, Trego, Phillips, and Norton counties north and west of Ellis County. It occurs in lenticular masses in gravel but more commonly in beds up to 3 m thick and sometimes is the caprock on bluffs. Frye and Swineford (1946) report primary deposits of quartzite and chert in the Ogallala formation, created by precipitation of volcanic ash that replaced calcium carbonate cement. This quartzite (or opaline-cemented sandstone; see Swineford and Franks 1959) typically is green, but weathers to white-gray, white, or reddish-brown. Texture ranges from very fine to coarse, even conglomeratic (Frye and Swineford 1946). Fractures travel through, rather than around, the cemented grains and typically display a subconchoidal fracture.

Precise source determinations for quartzites cannot be done casually (Pitblado et al. 2008). Unaided visual inspection is questionable. A recent article (Dalpra and Pitblado 2016) disclosed that a carbonate crystalline limestone was mistaken for quartzite, even when looking at a fresh surface under 10X magnification, until determined otherwise by laser-ablation inductively coupled plasma mass spectrometry and petrographic thin section analysis.

While quartzite is widely available nearby, Kraus 1 knappers had to find specimens with sufficiently fine grain structure and silica content for it to be useful in making chipped stone tools. Wedel (1986:30–31) and Banks (1990:90) mentioned its use prehistorically in Kansas and Nebraska. Stein (2006: 275–277) noted knappable quartzite from the Cheyenne and Dakota formations with known prehistoric acquisition areas in southwest Kansas. These quartzites range from brown to reddish-brown and less often pink or cream-colored. Quartzite colors at 14EL313 range from black to light gray, brown, pink, white, and olive green; textures range from coarse to very fine.

*Near-Local Resources*

For the purposes of this study, near-local resources are materials with sources approximately 50–100 km from the site at which they are used. This distance is established as being within the hunting or foraging range of a population, with the lithic material acquired as a task embedded within another



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activity (Holen 2001) or because of direct trade between neighboring groups (Spielmann 1983).

### Smoky Hill Silicified Chalk

Primary bedrock sources of stone for tool manufacture are not readily available at or near the Kraus 1 site. The nearest significant bedrock sources are about 50 km to the northwest in exposures of the Cretaceous system, the source of Smoky Hill silicified chalk (Stein 2005, 2006:275–277), also referred to as Republican River jasper, Smoky Hill jasper, or Niobrarite. The Walsh Archeological District, 60 km northwest of 14EL313, is a Smoky Hill silicified chalk outcrop surrounded by three sites that show evidence of tool stone acquisition and reduction.

Smoky Hill silicified chalk has a medium-grain texture and a chalky white cortex. It typically is pumpkin orange to brown, though it also has white, gray, green, and red variants. Munsell values for the most common hues represented in the KSHS source comparative collection range from 10 YR 6/8 (olive yellow) to 10 YR 7/8 (yellow), 10 YR 4/6 and 5/6 (olive brown), 2.5 YR 3/3 (dark reddish brown), and 2.5 YR 5/6 (red). It was widely used prehistorically in western Kansas and Nebraska.

## *Exotic Material*

Exotic lithic resources are defined here are materials with sources more than 100 km from the site at which they are used. This distance is likely outside of the typical range for populations traveling on foot. Exotic materials are more likely to have come to the site by trade.

### Permian Cherts

After Smoky Hill silicified chalk, the next closest bedrock source of chert is the Permian system (Bailey 2000; Stein 2006:270–275) in Clark County about 200 km south-southeast of the Kraus 1 site. This is referred to as Day Creek chert, which sometimes is mistaken for Alibates agatized dolomite. Source areas of Day Creek chert are spotty, the material is not widely distributed, and none was found at 14EL313. About 200 km to the east are exposures of Permian-aged Wreford and Florence formations of the Flint Hills, which produce an abundance of high-quality, widely distributed chert. Permian chert varieties from the Flint Hills are sometimes differentiated (Haury 1981, 1984), but they are similar enough in appearance and quality that discriminating among them was not attempted for this analysis. An exception is the distinctive Permian chert known as Florence A (Haury 1981, 1984), which is exceptionally high quality and is more readily identifiable because of its characteristic banding. Its source areas lie at the southern end of the Flint Hills on the Kansas-Oklahoma border, about 300 km from the Kraus 1 site.

### Alibates Agatized Dolomite

Alibates agatized dolomite (Holliday 1997) is a well-known and widely distributed material from the Canadian River valley in the Texas panhandle about 400 km southwest of 14EL313. This material is typically opaque and predominantly red with gray or white streaking or mottling but also can be gray, purple, blue, or white to yellowish white (Quigg et al. 2011; Shaeffer 1958). It often comprises a small percentage of the debitage and tools in larger assemblages in western Kansas.

## Debitage Analysis by Source

Proportions of stone types represented by Kraus 1 debitage are shown in Figure 33. Smoky Hill silicified chalk, a near-local resource, clearly dominates the assemblage, with all other materials combined totaling less than 10 percent. Exotic materials—Alibates agatized dolomite and Permian chert—do not exceed 2 percent of the assemblage, nor do local basalt, quartz, or silcrete.

## *Reduction Stage*

Analysis of indicators of reduction stage can provide information regarding the manufacture, refurbishing, or discarding of chipped stone tools at a site. By count 9.3 percent of the Kraus 1 flakes have cortex. Flakes with cortex, typically removed early in the tool-making sequence, tend to be larger and heavier than flakes without cortex. The average weight of a flake with cortex is 1.54 g; the average weight without cortex is 0.31 g.

As seen in Table 5, flakes of local and near-local sources are more likely to have cortex. Raw material acquisition likely was embedded in other tasks, and sources that are relatively close may have been in a raw state or minimally finished when they arrived, as opposed to exotic material that would be



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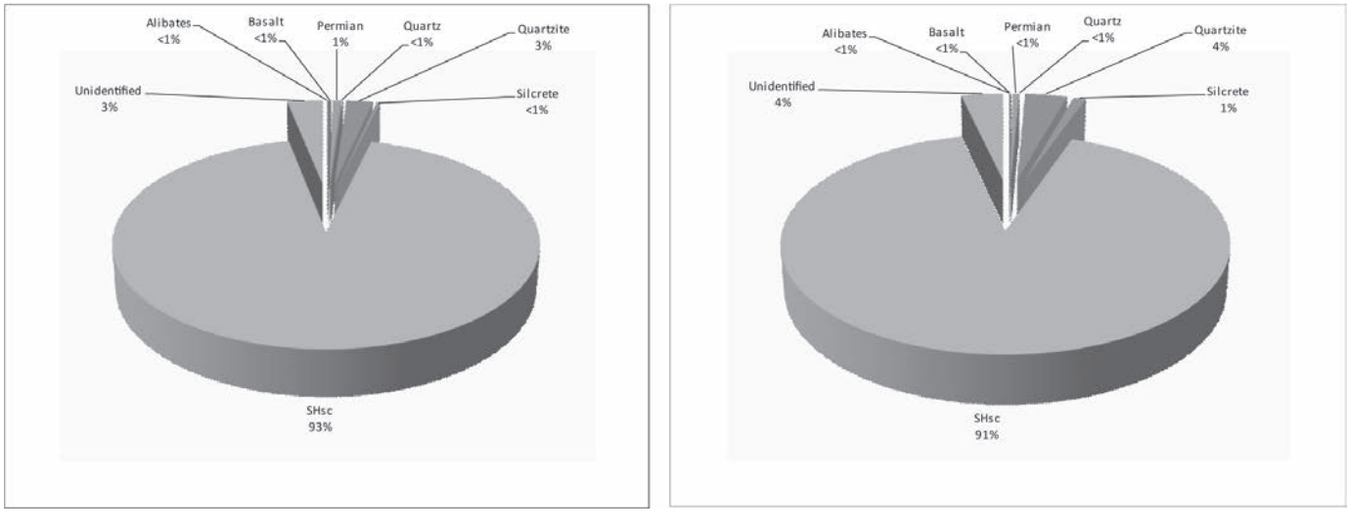


**Figure 33.** Raw material classes of debitage by count (left) and weight (right).

**Table 5.** Flakes with Cortex.

| Material | Percentage of flakes with cortex by count |
|---|---|
| Silcrete | 31.3 |
| Basalt | 13.3 |
| Smoky Hill silicified chalk | 9.7 |
| Permian | 4.2 |
| Quartzite | 3.4 |
| Quartz | 0 |
| Alibates | 0 |

expected to come in as blanks or finished tools with little to no cortex. Quartzite seems to be an exception. While it has been noted that quartzite outcrops occur near 14EL313, not all outcrops are acceptable quality for knapping. The low presence of cortex on quartzite flakes suggests that better quality material was acquired farther away.

*Microd b tage*

Chipped stone recovered from flotation and water-screening was considered in the site debitage analysis but also was evaluated separately to find areas where tool finishing, which produces a high proportion of small flakes, took place and to determine if exotic materials have a more robust representation than in the general study. This rests on the assumption that exotic chipped stone is likely to come to the site in more finished form and that most of the work on exotic materials will be done to create tools from blanks or to resharpen finished tools. There are 2,992 pieces of debitage, weighing only 32.0 g, that are smaller than ¼-inch and were captured in finer mesh or sieves (variable but including $^{1}/_{16}$-inch window screen and 1 and 2-mm sieves). The debitage was viewed using a variable 10–30X binocular microscope. The debitage was sorted, enumerated, and weighed by raw material type, noting the presence or absence of cortex and whether the material had been exposed to high heat. Even under magnification, the raw material source of very small debitage is often difficult to distinguish with certainty.

Ninety-six percent of the microdebitage by count and 93 percent by weight is recognized as Smoky Hill silicified chalk. None of the other stone types is present in the assemblage at more than 2 percent (Table 6). This is consistent with the percentages of debitage overall. Twenty-seven percent of the Smoky Hill silicified chalk microdebitage shows evidence of being intensively heated, as is 3 percent of the quartzite, and 5 percent of the unidentified material. This is addressed below.

One percent of the Smoky Hill silicified chalk microdebitage has cortex. Twelve specimens or 43 percent of the total are from a single provenience, PC 396, a 10-l flotation sample from the A1-A2 boundary in 896N 558E at 40–50 cmbs. This suggests the finishing or sharpening of a tool with some cortex on it at this location. The unit also is one that has a lot of debitage.



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**Table 6.** Analysis of Microdebitage by Source Material.

| Source material | Count | Weight (g) | Percent by count | Percent by weight |
|---|---|---|---|---|
| Smoky Hill silicified chalk | 2,875 | 29.63 | 96.09 | 92.59 |
| Unidentified | 44 | 1.26 | 1.47 | 1.47 |
| Quartzite | 31 | 0.61 | 1.04 | 1.91 |
| Permian | 20 | 0.21 | 0.67 | 0.66 |
| Silcrete | 9 | 0.10 | 0.30 | 3.94 |
| Basalt | 7 | 0.11 | 0.23 | 0.34 |
| Quartz | 6 | 0.08 | 0.20 | 0.25 |
| Totals | 2,992 | 32.00 | 100.00 | 100.00 |

### Summary of Chipped Stone Source Use

Kraus 1 residents used local Smoky Hill silicified chalk and little else. This good-quality material was readily available in the region and could have been obtained as an embedded task during foraging forays or visits with other groups. The locally available Ogallala gravels, represented by basalt and probably quartz and unidentified materials, typically are of poor quality and, therefore, were rarely chosen. Locally acquired silcrete and quartzite comprise a small part of the assemblage. The relative lack of exotic materials—Permian chert from the Flint Hills to the east or White River group silicates such as Flattop chalcedony to the west—is surprising. At the Keith phase Forrest site (Hoard and Bozell 2016), up to 20 percent of the assemblage was Flint Hills Permian chert. However, at both the Kraus 1 and Forrest sites, near-local material dominates.

## Debitage, Cores, and Tested Cobbles

### Cores

Cores are chipped stone pieces that are being prepared to produce flakes or are in the initial stages of reduction to become a tool. Cores exhibit multiple striking surfaces, and Kraus 1 flake scars are multidirectional (as opposed to blade cores, which can have multiple side-by-side unidirectional flake scars). Most cores are round to ovate, about as thick as they are wide, and worked bifacially. They are distinct from primary and secondary bifaces in that there is no apparent attempt to create a consistent edge. The shapes of multidirectional cores are irregular, so capturing useful dimensions is difficult. Following Andrefsky (1998:139), general core size is represented by the maximum length value multiplied by core weight (Table 7). Only five cores are in the artifact assemblage. Four are Smoky Hill silicified chalk; the other (catalog number 127–28) is a cobble of crypto-crystalline silicate from which flakes have been removed. It exhibits three faces with the smoothing and battering typical of stream-rolled abrasion, so it probably is from the local Ogallala gravels. Except for catalog number 127–28, cores are small and exhausted. This is indicative of the lack of a good bedrock raw material source nearby.

**Table 7.** Length and Weight Ratio of Cores.

| Catalog number | Length (cm) | Weight (g) | Product |
|---|---|---|---|
| 28-3a | 32.5 | 49.2 | 1,599.0 |
| 28-3b | 9.9 | 35.5 | 351.4 |
| 127-28 | 143.3 | 84.7 | 12,137.5 |
| 161-10 | 16.4 | 38.3 | 628.1 |
| 555-8 | 45.3 | 62.0 | 2,808.6 |

### Debitage

Debitage, numbering 9,938 and weighing 4,235.5 g, was separated into two major classes: shatter and flakes. Shatter refers to pieces of tool stone that are broken but do not display flake morphology. Observed attributes of flakes include a bulb of percussion, platform, ripples, material type, cortex, completeness, and evidence of heating, heat treatment, or burning. The count and mass of shatter and flakes from a given provenience were recorded; burned materials were tallied separately.

Relative amounts of shatter and flakes provide information on the different reduction sequences that occurred at the site. They are, however, not without problems. Cortex cover is presumed to be a function of how early in the production sequence a flake is made, assuming that the core is a cortex-covered cobble and that flakes removed from the core will present cortex on the dorsal side. However, a core may be a freshly quarried block of tool stone from a seam—a common situation for Smoky Hill silicified chalk—and may have cortex only on two sides to begin with (see discussion in Andrefsky 1998:211–214). Still, most raw materials used for chipped stone tools have some cortex, so the presence or absence of cortex is noted as an attribute of reduction stage. Likewise, shatter is more



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commonly produced early in the reduction process, when a large piece of stone is being worked.

Flake breakage may vary by quality of the tool stone source, the ability of the knapper, and post-depositional processes. Flakes are classed as whole or broken because partial flakes are less reliable indicators of reduction stage; they may be missing characteristics that are present in a whole flake and consequently be misclassified. Only 25 percent of the Kraus 1 flakes are complete. Also, there are very few biface rejuvenation flakes, that is, flakes with multiple fine flake scars on the dorsal side, arguing that more emphasis was on tool production than on tool rejuvenation.

### Heat Treatment and Burning

Heat treatment of tool stone for chipped stone tools is well-documented and widespread (see Stein 2006: 282 for references and discussion). It is a carefully controlled process that produces stone that is easier to flake. If done improperly, the stone can craze, shatter, or develop pot-lid fractures, none of which are beneficial for stone tool manufacture. During excavation it was clear that many of the flakes had been exposed to heat and in many instances to high temperatures. These are very dark red or blackened, and some have pot-lid fractures (Figure 34). Initially it seemed that these highly heated flakes would be easy to distinguish, but that is not always the case.

Smoky Hill silicified chalk can be a dark red color, and that redness can extend into the cortex. While some of this stone might have been carefully heat treated to enhance flaking properties, the heat-treating process could have been poorly executed, causing the stone to overheat. Stein (2005: 442) noted that the red and the green variants are not as well silicified as the more common brown to yellow to white hues of the material, so are considered less desirable material. Furthermore, Stein observed that experimental heat treatment of Smoky Hill silicified chalk did not cause color change; it did produce a gloss and improved the knapping quality of poorer quality stone. However, some broken pieces of red Smoky Hill silicified chalk show the interior to be yellow, suggesting that a red rind might result from heating. This red is a rustier hue than the limited samples in the KSHS type collection and is distinct enough to differentiate heated red from naturally red Smoky Hill silicified chalk.

**Figure 34.** A burned flake as indicated by the dark color and potlid fractures.

Conversely, some of the stone might have been inadvertently exposed to high temperatures, with no controlled heat treatment involved. This explanation is clear for at least some of the burned chert, as whole flakes show burning and spalling on their entire surfaces, including bulbs of percussion in some cases, evidence that the heating took place after a knapping episode.

The heating of chert at 14EL313 was not done to improve knapping quality. A large (74.8%) percentage of all flakes, with and without cortex, display signs of intense heating: spalling, crazing, and blackening. Twenty-seven percent of the Smoky Hill silicified chalk microdebitage bore these characteristics. This differs from the larger population of debitage and may result from intense heating being less visible on very small flakes or from microdebitage being sheltered from whatever process caused so much of the assemblage to be burned. All classes of raw material are affected, and burned stone is present throughout the site. Burning is evident on pottery and bone, too.

## Stone Tools

### Chipped Stone Tools

Kraus 1 chipped stone tools number 224 (Table 8). While modified flakes are most numerous, the largest class of formed tools is projectile points, followed by projectile point preforms.

#### *Modified Flakes*

Modified flakes are pieces of debitage that exhibit wear from use or light retouch. They were expedi-



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**Table 8.** Chipped Stone Tools by Count, Weight, and Material Type.

| Tool type | Count | Weight (g)* | Material |
|---|---|---|---|
| Dart points | 1 | 1.8 | Permian |
| | 1 | 6.7 | Petrified wood |
| Totals | 2 | 8.5 | |
| Arrow point | 2 | 0.8 | Basalt |
| | 5 | 2.0 | Ogallala gravel or unidentified |
| | 7 | 5.3 | Quartzite |
| | 5 | 2.9 | Permian |
| | 1 | 0.4 | Quartz, gray |
| | 43 | 24.2 | Smoky Hill silicified chalk |
| | 2 | 1.0 | Silcrete |
| Totals | 65 | 36.6 | |
| Preform | 21 | 18.2 | Smoky Hill silicified chalk |
| | 1 | 0.7 | Permian |
| | 1 | 2.7 | Quartzite |
| | 1 | 0.9 | Ogallala gravel or unidentified |
| Totals | 25 | 22.5 | |
| Unifacial knife | 1 | 8.9 | Smoky Hill silicified chalk |
| Biface | 19 | 204.7 | Smoky Hill silicified chalk |
| | 2 | 1.5 | Unidentified |
| | 1 | 14.7 | Permian |
| | 1 | 8.1 | Quartzite |
| | 1 | 57.0 | Silcrete |
| Totals | 24 | 286.0 | |
| Graver | 2 | 5.5 | Unidentified |
| | 2 | 1.6 | Smoky Hill silicified chalk |
| | 1 | 2.1 | Quartzite |
| Totals | 5 | 9.2 | |
| Scraper | 5 | 24.8 | Smoky Hill silicified chalk |
| | 2 | 80.5 | Quartzite |
| | 1 | 76.9 | Silcrete |
| | 1 | 5.2 | Ogallala gravel chert |
| | 1 | 3.7 | Permian |
| Totals | 10 | 191.1 | |
| Chopping tool | 1 | 174.9 | Silcrete |
| Modified flake | 80 | 246.7 | Smoky Hill silicified chalk |
| | 5 | 10.1 | Unidentified |
| | 4 | 11.5 | Quartzite |
| | 2 | 2.2 | Permian |
| | 1 | 1.8 | Basalt |
| Totals | 92 | 272.3 | |

*Some members of some classes are fragments.

ency tools and not shaped for a specific purpose. This artifact class is very common at the site, indicating an emphasis on expeditious processing rather than the manufacture and use of formal tool classes. Like the other tool classes, they are made predominantly of Smoky Hill silicified chalk.

### *Scrapers*

Ten scrapers were recovered (Figure 35). Most are small, less than 10 g in weight, and five are made of Smoky Hill silicified chalk, one of Permian chert, one of Ogallala gravel chert, two of quartzite, both large; and one of silcrete. The silcrete scraper (Figure 35, bottom right) is quite large, weighing 77 g. One square scraper with rounded corners was found (Figure 35, bottom left). Round scrapers are more common at the Forrest site (Hoard and Bozell 2016:27), the Medicine Creek site (25FT39) (Kivett and Metcalf 1997:25–26, Figure 15, 6–8), and Massacre Canyon (25HK13) (Kivett 1952:19). Two triangular pieces (catalog numbers 70–76 and 71–28) with unifacial flaking on two of the three sides probably are the pointed proximal ends of scrapers that broke in a haft during use. If this is correct, 12 scrapers are represented. Both fragments are north of 898N and away from the concentration of chipped stone tools. It is possible that a person using scrapers stepped away from the work area, removed the broken scraper end from a haft, and discarded it a short distance from the work area.

### *Gravers*

Gravers are chipped stone tools with tips that are sharp enough to score bone and antler and strong enough to hold up under this task. They often have pointed tips and rounded opposite ends, like arrow point preforms. The two are distinguished by sturdy tips with wear on the tips. Of the five gravers, two are made of Smoky Hill silicified chalk, one of quartzite, and two of an unidentified material.

### *Chopping Tool*

One large silcrete cobble is damaged and flaked from heavy chopping (Figure 36). This is not a formal tool but a utilized cobble, possibly after minimal coarse working of one edge. This makes sense because silcrete is very hard and tough to flake, but these attributes make it ideal for chopping wood or dismembering a large mammal.



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**Figure 35.** Scrapers.

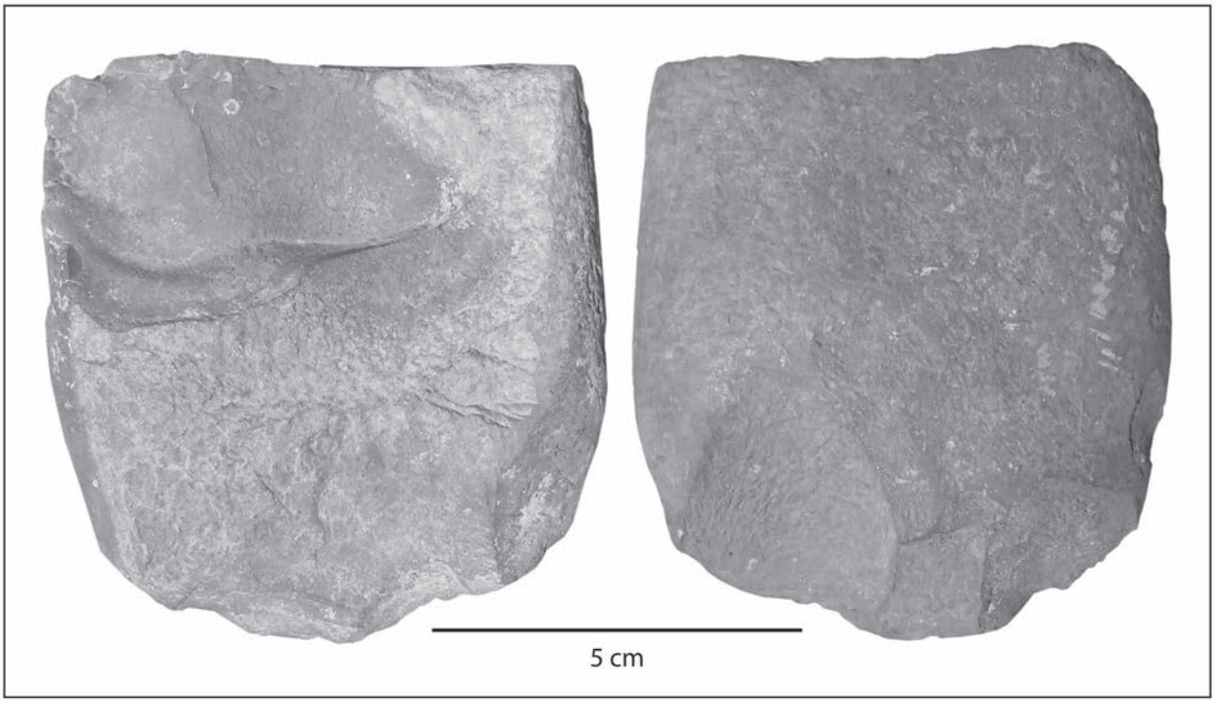


**Figure 36.** Silcrete chopping tool, catalog number 329-1.



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*Bifaces*

Crabtree (1972:38) defined bifaces as objects of chipped stone that are worked on both sides of the raw material. A biface can be a piece of material reduced to a readily transportable size, an object reduced to serve as a preform for a more distinct tool, such as a projectile point, or it can be used for cutting and sk nning.

Ray's (2010:58–59) classes of primary and secondary bifaces are used in this report. Primary bifaces are large, thick bifaces with unfinished sinuous edges and occasionally some cortex. They are an early stage of tool production or are pieces of worked stone that were abandoned because they broke or were unworkable. Secondary bifaces often have been thinned by soft hammer percussion, are lenticular in cross section, have less sinuous edges and little or no cortex. Secondary bifaces can be used as tools or can be modified further to create more specialized tools.

Twenty-two bifaces are represented by 20 fragments and two complete specimens, both with rounded bases and pointed tips (Figure 37). Most biface fragments are small, weighing less than 10 grams (Table 9). Six fragments are rounded ends, suggesting that the general shape of the two complete specimens is pervasive, though most of the rounded fragments are from smaller, thinner tools. Eighteen of the bifaces are made of Smoky Hill silicified chalk, and one each is made of Permian chert, quartzite, silcrete, and an unknown material. Eleven biface fragments and the two complete specimens are primary. One is a large well-shaped tool made of silcrete with one rounded end, one pointed end, and large but even flake scars (Figure 38). Because silcrete is so hard, it would be difficult to form into a thinner tool. The other whole biface has a similar shape but is thinner and made of Smoky Hill silicified chalk. The more intensively finished secondary fragments are thinner and break more easily. Only one specimen (catalog number 378-1) fits the form thought to be a knife: a long, slender tool designed for cutting with a sawing motion. This asymmetrical specimen is a fragment, approximately two-thirds of the original blade (Figure 39). Like other chipped stone tools, bifaces are concentrated in the southern units south of 896N.

*Unifacial Knife*

One tool is a long, slender flake with well-controlled, even unifacial flaking along one edge (Figure 40). The edge opposite the retouched edge is

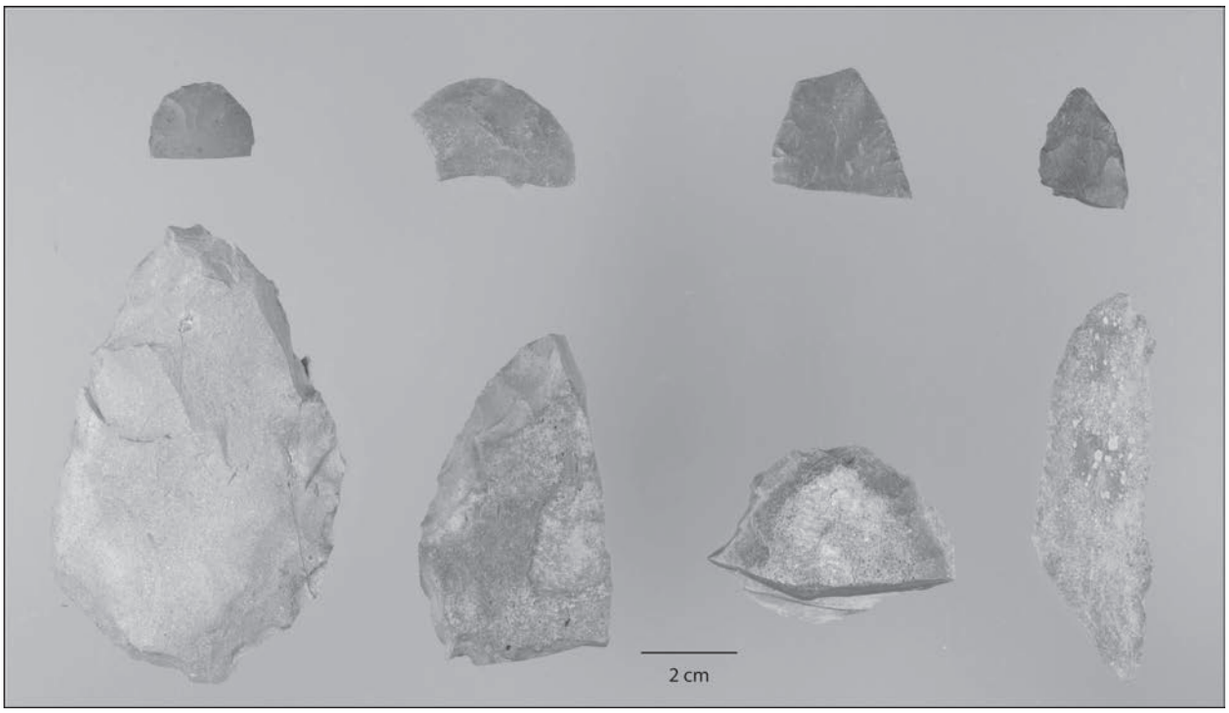


**Figure 37.** Seven of the 22 bifaces or biface fragments.



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**Table 9.** Bifaces.

| Catalog number | Weight (g) | Stage | Portion | Material | Comment |
|---|---|---|---|---|---|
| 57-15 | 0.8 | Primary | Fragment | Smoky Hill silicified chalk | Thin, midsection |
| 323-1 | 92.5 | Primary | Whole | Smoky Hill silicified chalk | Tabular, rounded end, pointed tip, rough |
| 266-1 | 57.0 | Primary | Whole | Silcrete | Large, coarse, well made, rounded end, pointed tip |
| 173-25 | 14.7 | Primary | Fragment | Permian | Rough, medial fragment |
| 149-2 | 8.1 | Primary | Fragment | Quartzite | Very thick, rounded end |
| 127-30 | 11.8 | Primary | Fragment | Smoky Hill silicified chalk | Thick, blocky |
| 138-26 | 3.2 | Primary | Fragment | Smoky Hill silicified chalk | Medium thickness |
| 138-28 | 11.0 | Primary | Fragment | Smoky Hill silicified chalk | Thick, lateral fragment, burned |
| 267-1 | 28.4 | Primary | Fragment | Smoky Hill silicified chalk | On thin slab, cortex on both sides, expedient |
| 292-1 | 24.1 | Primary | Fragment | Smoky Hill silicified chalk | Thick, round end, cortex |
| 378-1 | 9.9 | Primary | Fragment | Smoky Hill silicified chalk | Two-thirds of a long asymmetrical knife |
| 8-11 | 2.4 | Secondary | Fragment | Smoky Hill silicified chalk | Thick, lateral fragment |
| 102-3 | 0.6 | Secondary | Fragment | Smoky Hill silicified chalk | Very thin |
| 102-4 | 3.3 | Secondary | Fragment | Smoky Hill silicified chalk | Thick, rounded end |
| 102-5 | 6.6 | Secondary | Fragment | Smoky Hill silicified chalk | Large, thick |
| 112-9 | 1.7 | Secondary | Fragment | Smoky Hill silicified chalk | Slightly rounded, medium thickness |
| 112-19 | 0.1 | Secondary | Fragment | Smoky Hill silicified chalk | Small, thin fragment |
| 136-34 | 1.4 | Secondary | Fragment | Smoky Hill silicified chalk | Thin, rounded end |
| 138-27 | 1.9 | Secondary | Fragment | Smoky Hill silicified chalk | Thin, rounded end, burned |
| 158-1 | 4.1 | Secondary | Fragment | Smoky Hill silicified chalk | Thin, well made, medial fragment |
| 200-12 | 1.0 | Secondary | Fragment | Smoky Hill silicified chalk | Burned, spalled |
| 261-1 | 1.4 | Secondary | Fragment | Unknown | Thin, pointed end, could be from a dart point |

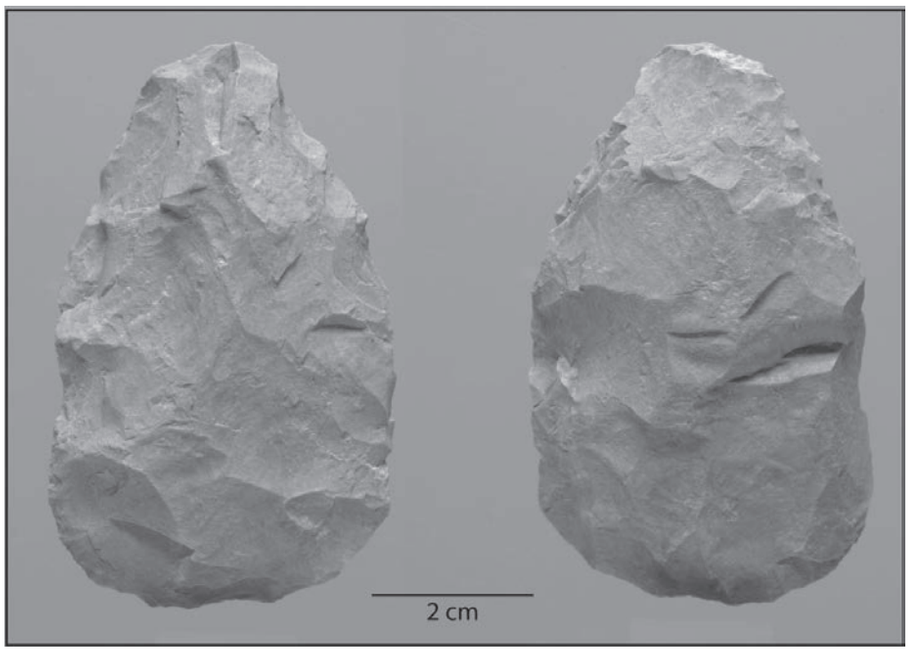


**Figure 38.** Primary biface, catalog number 266-1.



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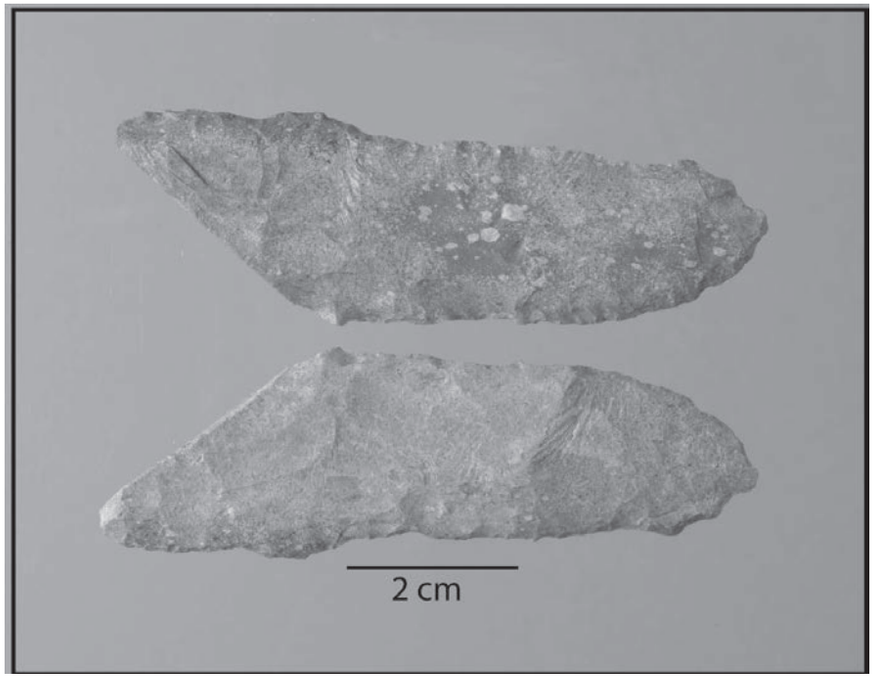


**Figure 39.** Both faces of a knife, catalog number 378-1.

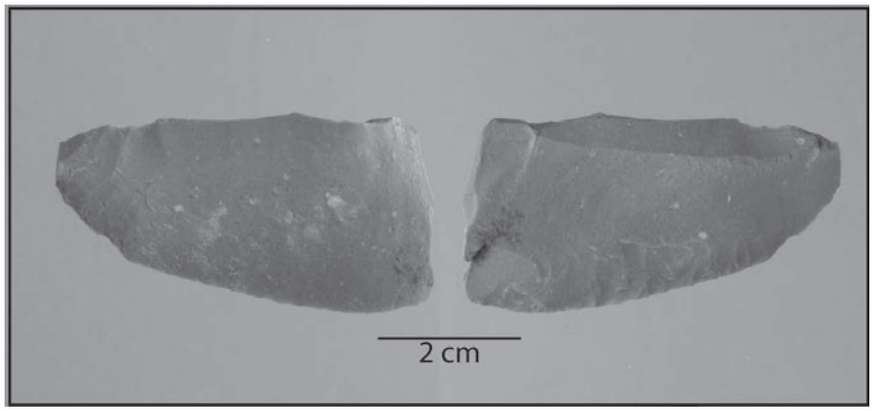


**Figure 40.** Both faces of a unifacial backed knife, catalog number 171-28.

backed, i.e., the bifacial edge was removed by a blow perpendicular to the edge, leaving it blunt rather than sharp, as is the proximal edge. Unifacial flaking defines a tip at the distal end. It would have functioned well for cutting and likely was used as a knife. Unifacial backed blade and flake knives are known from the European Upper Paleolithic but also from Kansas Great Bend aspect sites (Blake slee et al. 2012: 202–203) and certainly could have been produced earlier as well.

*Preforms*

A preform is the result of late-stage production that has the general dimensions of a finished tool without the final notching or edge retouch (Crabtree 1972:42, 85; Pavesic 1985:68). Small, thin bifaces with rounded proximal ends and pointed distal ends are classified as preforms from which points were made (Figure 41). Kraus 1 preforms tend to be made on flakes and are slightly larger and slightly thicker than most Scallorn points from the site. Twenty-one are made of Smoky Hill silicified chalk, and one each are Permian chert, quartzite, and an unknown stone type.

The 24 preforms demonstrate that point manufacturing was an activity that took place at 14EL313. Other artifacts support this assertion. Some nearly complete points have a single small corner notch



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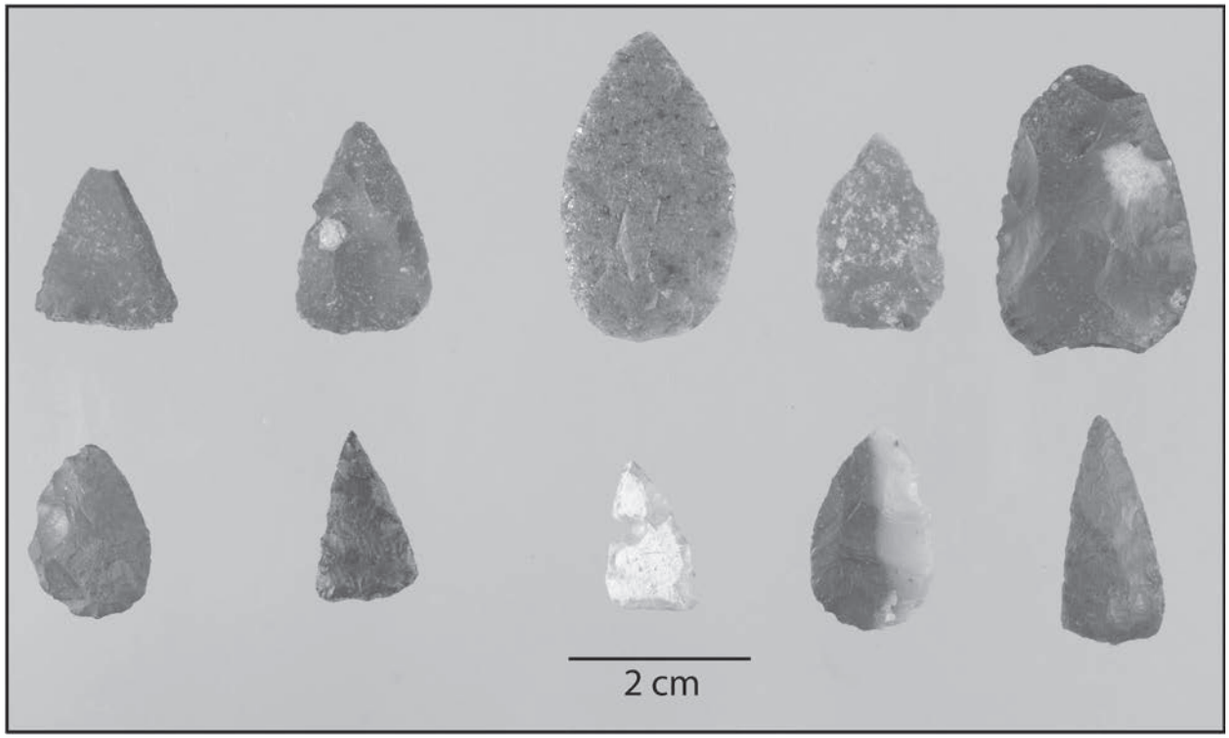


**Figure 41.** Selected preforms.

but are missing a tip or lateral edge, suggesting that they broke in progress. Another broken point has a knob of cortex that likely prohibited completion.

*Projectile Points*

The assemblage contains one complete dart point and one dart point base fragment, made on bifaces. Two medial biface fragments and a biface tip may represent either dart points or large arrow points, but these are not included in the point count. The other 65 projectile points are small arrow points, under 30 mm in length and averaging 20 mm, corner- or side-notched, with a straight or slightly convex bases. They are made on flakes, and some are worked unifacially with minimal flaking on both sides of an edge to make it sharp. An example is catalog number 81-1, which is curved, has a bulb of percussion at its base, and is worked along the ventral side margin only enough to create an edge.

Arrow Points

Arrow points are divided into corned-notched and side-notched classes. These differences are undoubtedly technological, but they also are chronological, with corner-notched points associated with the Early Ceramic period and side-notched points associated with the Middle Ceramic period (see chapters 5 and 11 in Hoard and Banks 2006).

*Corner-notched Points*

Thirty-nine arrow points are corner-notched and are placed into the descriptive class of Scallorn (Bell 1960; Duncan et al. 2007:113–117; Justice 1987) if interpreted broadly (see discussion in Hoard and Bozell 2016:21–23, but see Blakeslee 2014 for a contrasting approach). Their length-to-width ratio varies significantly, so some are short and wide and others longer and narrower, but all are less than 45 mm long (most are less than 30 mm long) and have corner notches at an angle approximating 45° (Figure 42). This is an important temporal distinction as it, for the most part, is one of several traits that separates Early Ceramic components from Middle Ceramic CPt components.

Included in the 39 points considered to be Scallorn are 10 outliers that have diminutive corner notches (Figure 43). Oddly, several of these have only one notch. Duncan et al. (2007:118) judge



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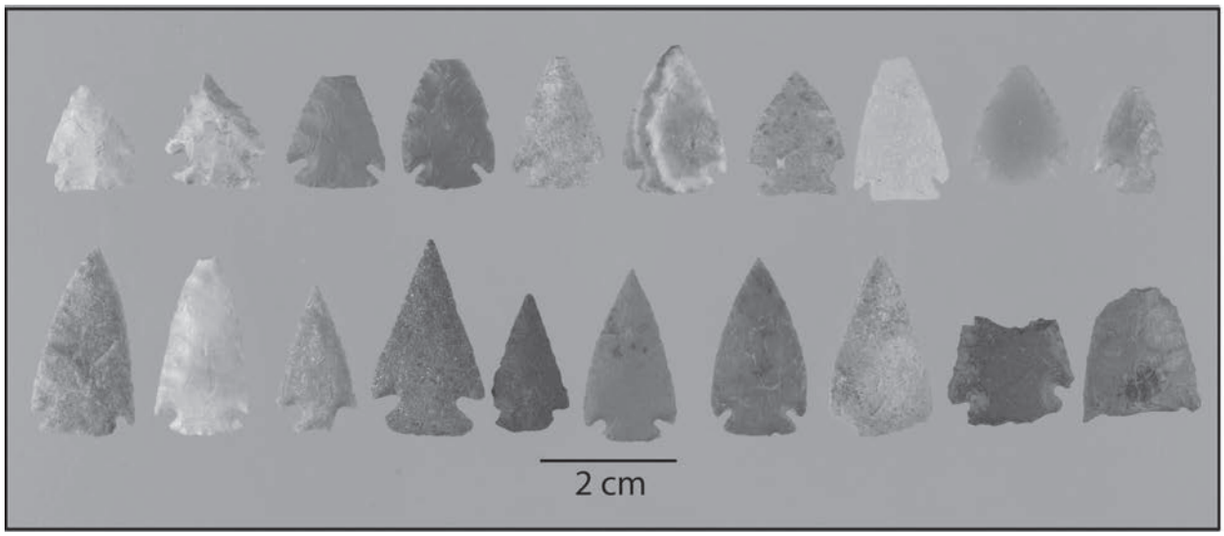


**Figure 42.** Corner-notched arrow points.

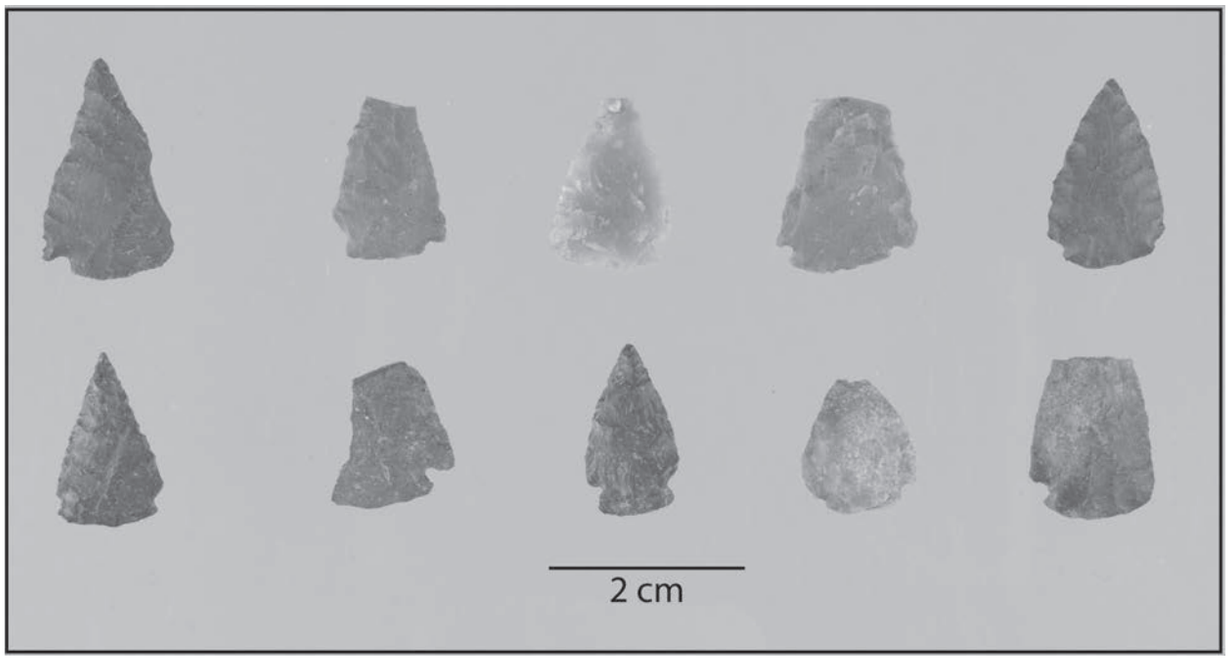


**Figure 43.** Points with diminutive corner-notches.

points like this to be preforms in the Scallorn class, which may explain their morphology. As noted above, point preforms are common.

*Side-notched Points*

Seven side-notched points were recovered from the Kraus 1 site (Figure 44). Two are typical of points, referred to as Washita (side notches, no basal notch), encountered in CPt sites. The notches are placed a quarter to half the distance from the base to the tip (Duncan et al. 2007:143), and the straight lateral edge follows the trajectory of the blade edge. However, the majority (five) of the side-notched points have narrow notches, very similar to those in the corner-notched points, and very short stems. Put another way, the notches are about 2 mm



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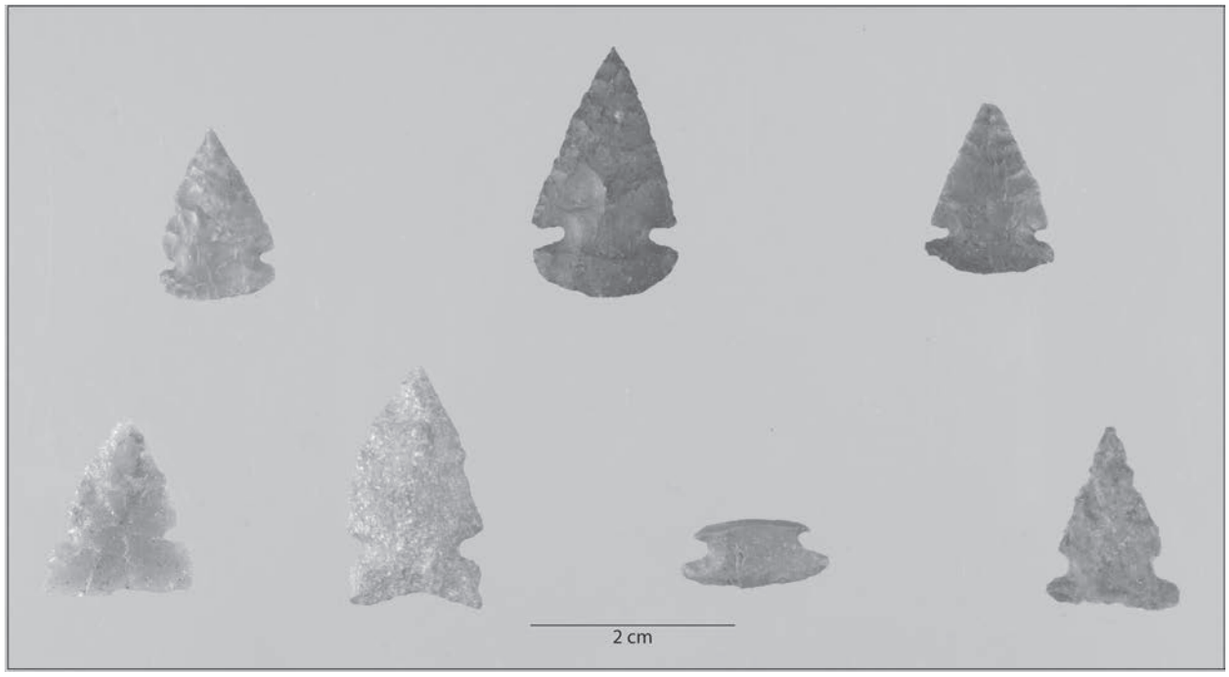


**Figure 44.** Side-notched points.

**Figure 45.** A point with both side and corner notches.

up from the base. Instead of the area from the bottom of the notch to the base being straight and following the angle of the blade edge, this portion is rounded or pointed. Four of these five points have convex bases; the other has a straight base. In addition to the points just described, there are fragments of points that cannot be classified because they are represented only by medial or distal fragments.

Finally, one point has both side- and corner-notches (Figure 45). This was found in an auger test, 39 cm below the surface, along with charcoal that produced a radiocarbon age of 921 ± 27 B.P., with a median calibrated calendrical age of 1098 C.E., about in the middle of radiocarbon dates for this site. Its morphology has attributes common to the Early Ceramic (corner notches) and the Middle Ceramic (side notches). This could be the result of experimentation on the part of a knapper but also could have been a hasty rehaft of a broken corner-notched point.

Dart Points

There is a single complete dart point (catalog number 248-1; Figure 46). It is thin and well crafted, made of petrified wood, probably from local Ogallala gravels. It has convex blade edges with a stem created by corner-notching and is similar to the



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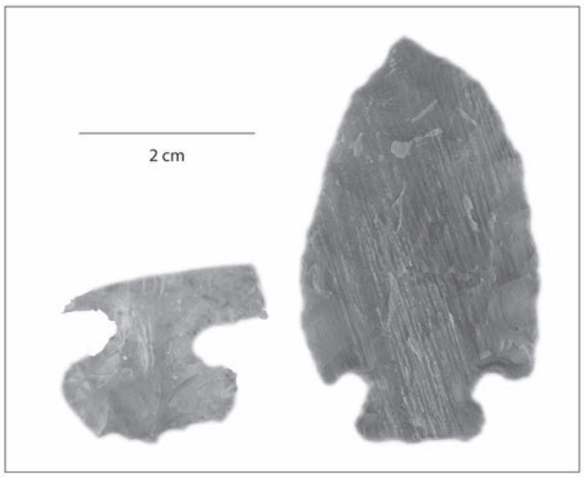


**Figure 46.** Dart points.

descriptive point type Snyders, most commonly associated with the Middle Woodland period in the lower Missouri River valley and the Mississippi valley. Catalog number 152-11, also shown in Figure 46, is the base of a side-notched biface, probably a dart point of heat-treated Permian chert. As noted earlier, two wide, thin medial biface fragments could be dart point midsections but could be thin knives. It is not unusual for both dart and arrow points to be present in Keith phase components.

*Range of Variation of Kraus 1 Projectile Points*
Among the arrow points the minimum values for maximum length, maximum width, and thickness are about half of the maximum values, and the range of values is continuous. That, and the differences between deep and shallow notches and choices about corner or side notching show the amount of variation in how projectile points were made. The variation reflected in the 14EL313 Keith phase component is followed by a more standardized technology in the later CPt, during which small, triangular, side-notched points became common throughout the Great Plains. Side-notched points are not concentrated in the upper levels, as might be expected for a later form, but instead one was found on the surface, two between 30 and 40 cm below the surface, one at 40–50 cm below the surface, and three at 50–60 cm below the surface. This is consistent with the radiocarbon age determinations, which do not follow an older and deeper to younger and shallower sequence. If there was more than one occupation, the deposits have been mixed.

The technological shift from corner-notched to side-notched points is evident in the Kraus 1 assemblage. This corresponds well with an increase in sand-tempered pottery, which is thinner than typical Harlan cord-roughened ware, and with the late dates from the radiocarbon assays. Plausibly 14EL313 represents the transition between the broad archeological characterizations of Early Ceramic (Plains Woodland) and Middle Ceramic (CPt).

Stone Sources of Chipped Stone Tools
Smoky Hill silicified chalk is by far the most common tool stone at the Kraus 1 site (Table 10, Figure 47). This high-quality material for knapping is the closest lithic resource, widely available in outcrops to the northwest.

Of the 19 documented chipped stone artifacts made of quartzite, 8 were flakes (modified or unaltered), and the remaining 11 are formal tools. Two scrapers, one graver, and a primary biface are of quartzite, but six are projectile points and one is a preform. Holen (1991:400–401) notes that coarse-grained Ogallala quartzite was used primarily for large cutting and chopping tools, but this is not the case at 14EL313. The low flake-to-tool ratio and the dominance of projectile points, an unexpected class for quartzite because it can be difficult to knap, suggests that several points and a preform came to the site as trade items.

## Ground and Battered Stone

Two mano fragments were recovered. Both appear to be made on ovate silcrete cobbles that are split along the long axis. The broad, flat surfaces were used for grinding. On one the rounded edge was used for pounding, as confirmed by impact fractures.

Three thick pieces of limestone with grinding on one surface are fragments of a grinding slab. One of the fragments is reddened by heat.

## Unidentified Object

A small fragment of unknown rock has been shaped to form a dull point (Figure 48). It has lines incised perpendicular to its long axis and was broken at some point after its manufacture. It could have been a decorative object or a gaming piece or may have served some other function.



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**Table 10.** Tools by Type of Material.

| Tool type | Count | Weight (g) | Material |
|---|---|---|---|
| Dart point | 1 | 6.7 | Petrified wood |
| | 1 | 1.9 | Permian |
| Totals | 2 | 8.6 | |
| Arrow point | 43 | 24.1 | Smoky Hill silicified chalk |
| | 6 | 4.9 | Quartzite |
| | 6 | 4.7 | Permian |
| | 3 | 1.2 | Unknown |
| | 2 | 0.8 | Chalcedony |
| | 1 | 0.4 | Quartz |
| | 2 | 1.2 | Basalt |
| | 2 | 1.0 | Silcrete |
| Totals | 65 | 38.3 | |
| Preform | 21 | 18.2 | Smoky Hill silicified chalk |
| | 1 | 2.7 | Quartzite |
| | 1 | 0.7 | Permian |
| | 1 | 0.9 | Unknown |
| Totals | 24 | 22.5 | |
| Biface | 17 | 204.7 | Smoky Hill silicified chalk |
| | 1 | 1.5 | Unidentified |
| | 1 | 14.7 | Permian |
| | 1 | 8.1 | Quartzite |
| | 1 | 57.0 | Silcrete |
| Totals | 21 | 286.0 | |
| Unifacial knife | 1 | 8.9 | Smoky Hill silicified chalk |
| Graver | 2 | 5.5 | Unidentified |
| | 2 | 1.6 | Smoky Hill silicified chalk |
| | 1 | 2.1 | Quartzite |
| Totals | 5 | 9.2 | |
| Scraper | 5 | 24.8 | Smoky Hill silicified chalk |
| | 2 | 80.5 | Quartzite |
| | 1 | 76.9 | Silcrete |
| | 1 | 5.2 | Ogallala gravel chert |
| | 1 | 3.7 | Permian |
| Totals | 10 | 191.1 | |
| Chopping tool | 1 | 174.9 | Silcrete |
| Modified flake | 80 | 246.7 | Smoky Hill silicified chalk |
| | 5 | 10.1 | Unidentified |
| | 4 | 11.5 | Quartzite |
| | 2 | 2.2 | Permian |
| | 1 | 1.8 | Basalt |
| Totals | 92 | 272.3 | |
| Grand totals | 202 | 999.2 | |

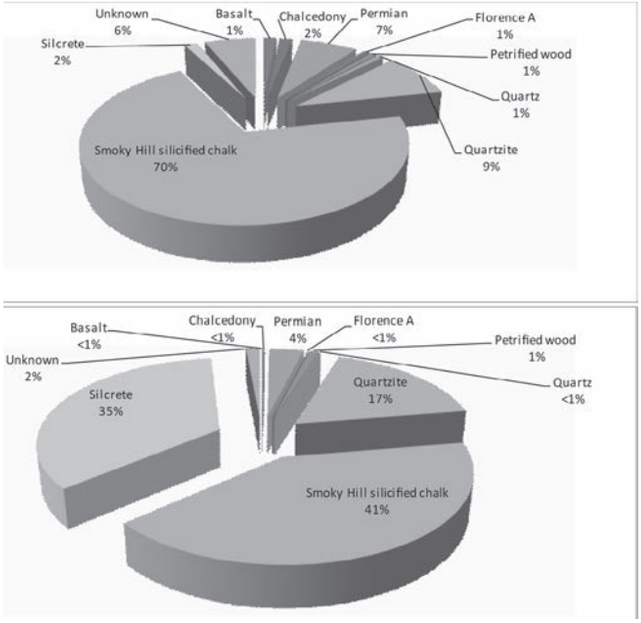


**Figure 47.** Raw materials of chipped stone tools by count (upper) and weight (lower).

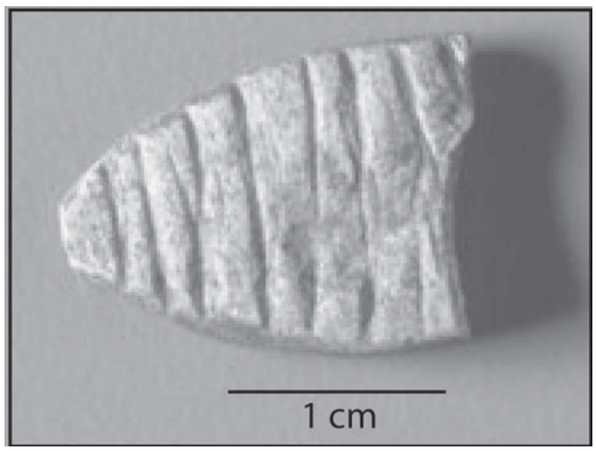


**Figure 48.** Incised rock; function unknown. Kansas Memory 312157.

## Summary of Stone Artifacts : A Diminished Toolkit

A low diversity of chipped stone tools is noticeable at the Kraus 1 site. Drills and chisels, often present in Keith phase sites, are absent, as are spoke shaves, except for a single modified flake with a rounded notch. There are five gravers, though these are difficult to discriminate from arrow point preforms. This implies that wood working and shell working were not major activities, and the lack of



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worked shell and the small amount of worked bone (see Bozell's report herein) corroborates this. There are surprisingly few scrapers, especially in a site with a large volume of bone. Apparently intensive hide processing did not occur here, although hide processing possibly took place in an unexcavated area. In contrast, points and preforms are abundant. Ground and battered stone tools are uncommon.

This evidence indicates a focus on hunting. Twenty-seven of the 67 projectile points are whole or minimally damaged, so 41 percent are broken. This, along with the relative lack of other tools, specifically scrapers, suggests that multiple game animals were processed, and this is corroborated by the faunal analysis. Broken points used in the kill would have been left behind. This, the high volume of modified flakes, and the large amount of animal bone indicates initial processing of game. Hides and the most desirable pieces of meat were then taken to another location for consumption or additional processing as appropriate.

## VERTEBRATE FAUNAL ANALYSIS

John R. Bozell

### *Method*

The Kraus 1 faunal remains include both modified and unmodified vertebrate material. Because 14EL333 appears to represent a series of stratigraphically indistinguishable short-term camping and hunting events, the faunal sample is handled as a single analytic unit with no further subdivision of the material into discrete occupation episodes or activity areas.

Contained features, such as structure floors, pits (other than shallow basins), and fire hearths, were absent. Several features were defined based on concentrations of animal bone and other debris. All general level fill was screened through either ¼-inch or 1/16-inch mesh, and most feature fill was water screened through 1/16-inch mesh with collection of flotation samples. With this level of fine-screening, it is likely that most avian, small mammal, and fish remains that were deposited in excavated areas were recovered archeologically. The present sample is not biased toward larger mammals.

This analysis addresses a variety of research themes: characterization of the diet, bone tool or ornament technology, butchering and carcass transport, and placement of the sample in a regional and temporal perspective. The author weighed the entire collection by provenience, with separate values listed for materials above and below 1 inch in size. Charred and uncharred weights also were recorded by gross size grade. Materials from each unit were segregated into identifiable and unidentifiable lots. The potentially identifiable material was organized by gross taxonomic categories, such as fish, reptile or amphibian, bird, small mammal, and large mammal. Unmodified specimens were considered identifiable if the element, side, and portion could be determined and assigned to a taxonomic grouping—typically at the family, genus, or species level. Those items judged to be unidentifiable were repackaged and are not further treated in this study. Modified specimens were separated for analysis. Modified materials encompass tools, ornaments, and debris from making such artifacts, but not food debris that simply exhibits butchering marks or is burned.

Specimen identifications were made through comparison with reference collections curated at the History Nebraska and the University of Nebraska State Museum. Several published manuals were consulted, including Brown and Gustafson (1979), Getty (1975), Gilbert (1980), and Miller (1962). Variables recorded for each identified item are catalog number, provenience, taxon, element, side or portion, and comment. Comment entries mention natural or cultural modifications, such as burning, butchering marks, and gnawing by carnivores and rodents. Immature specimens also were noted. In addition to these attributes, various basic descriptive measurements and narrative comments were collected for the modified assemblage.

The identified portion was quantified using the number of identified specimens (NISP) and minimum number of individuals (MNI) for each taxon (Grayson 1984). All sorting, identification, and analyses were completed by the author, excepting fish remains, which were done by Carl R. Falk of Paleocultural Research Group.

### *Spatial Distribution Of Fauna*

The entire sample consists of 35.4 kg of bone (Table 11, Figures 49 and 50). Bone fragments were not counted, but it is likely that the tally exceeds 50,000



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**Table 11.** Summary of Bone Weight by Provenience.

| Northing | Easting | > 1″ unburned | < 1″ unburned | >1″ burned | < 1″ burned | Total |
|---|---|---|---|---|---|---|
| 888 | 554 | 1,210 | 1,002 | 13 | 1,222 | 3,447 |
| 894 | 556 | 1,232 | 1,115 | 122 | 1,059 | 3,528 |
| 894 | 558 | 3,699 | 1,163 | 0 | 1,144 | 6,006 |
| 896 | 558 | 2,127 | 659 | 2 | 580 | 3,368 |
| 896 | 560 | 1,251 | 627 | 50 | 674 | 2,602 |
| 896 | 564 | 1,485 | 553 | 31 | 347 | 2,416 |
| 896 | 566 | 1,586 | 690 | 73 | 204 | 2,553 |
| 898 | 564 | 817 | 414 | 12 | 310 | 1,553 |
| 898 | 558 | 1,244 | 577 | 1 | 347 | 2,169 |
| 900 | 554 | 565 | 385 | 0 | 192 | 1,142 |
| 900 | 564 | 649 | 260 | 23 | 281 | 1,213 |
| 900 | 558 | 157 | 224 | 0 | 118 | 499 |
| 902 | 558 | 859 | 284 | 0 | 68 | 1,211 |
| 902 | 560 | 722 | 280 | 8 | 313 | 1,323 |
| 902 | 562 | 846 | 431 | 3 | 256 | 1,536 |
| 904 | 558 | 567 | 66 | 0 | 17 | 650 |
| 906 | 564 | 27 | 84 | 45 | 11 | 167 |
| | Totals | 1,9043 | 8,814 | 383 | 7,143 | 35,383 |

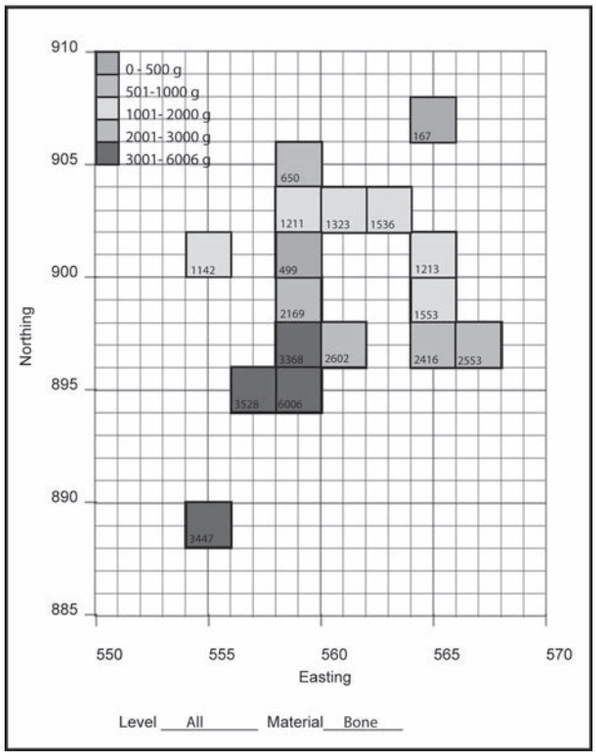


**Figure 49.** Density of animal bone by weight (grams).

pieces, and most of it is heavily fragmented bison bone. While all 17 excavation units yielded bone, the greatest concentration was from 894N 558E and adjoining 896N 558E and 894N 556E. A second concentration appears to be at 888N 554E to the south-southwest of the other units. Units to the north and east of these two concentrations have lower bone density. When subdivided by burned versus unburned and greater than and less than 1 inch, the distribution does not vary significantly from the total values (Figure 49).

Much of the bone was recovered from within or near several features: Feature 1, a moderate concentration of bone and other materials in 900N 556E; Feature 2, a shallow bone-filled pit at 894N 556–558E; Feature 3, a concentration of bone at 894–896N 559E; and Feature 24, a partially excavated dense concentration of burned bone exposed in the south wall of 894N 556E. Features 2, 3, and 24 were close to each other.

### *Modified Remains*

The sample of modified remains is made up of complete and broken tools and ornaments, as well as pieces of manufacturing debris (Table 12).



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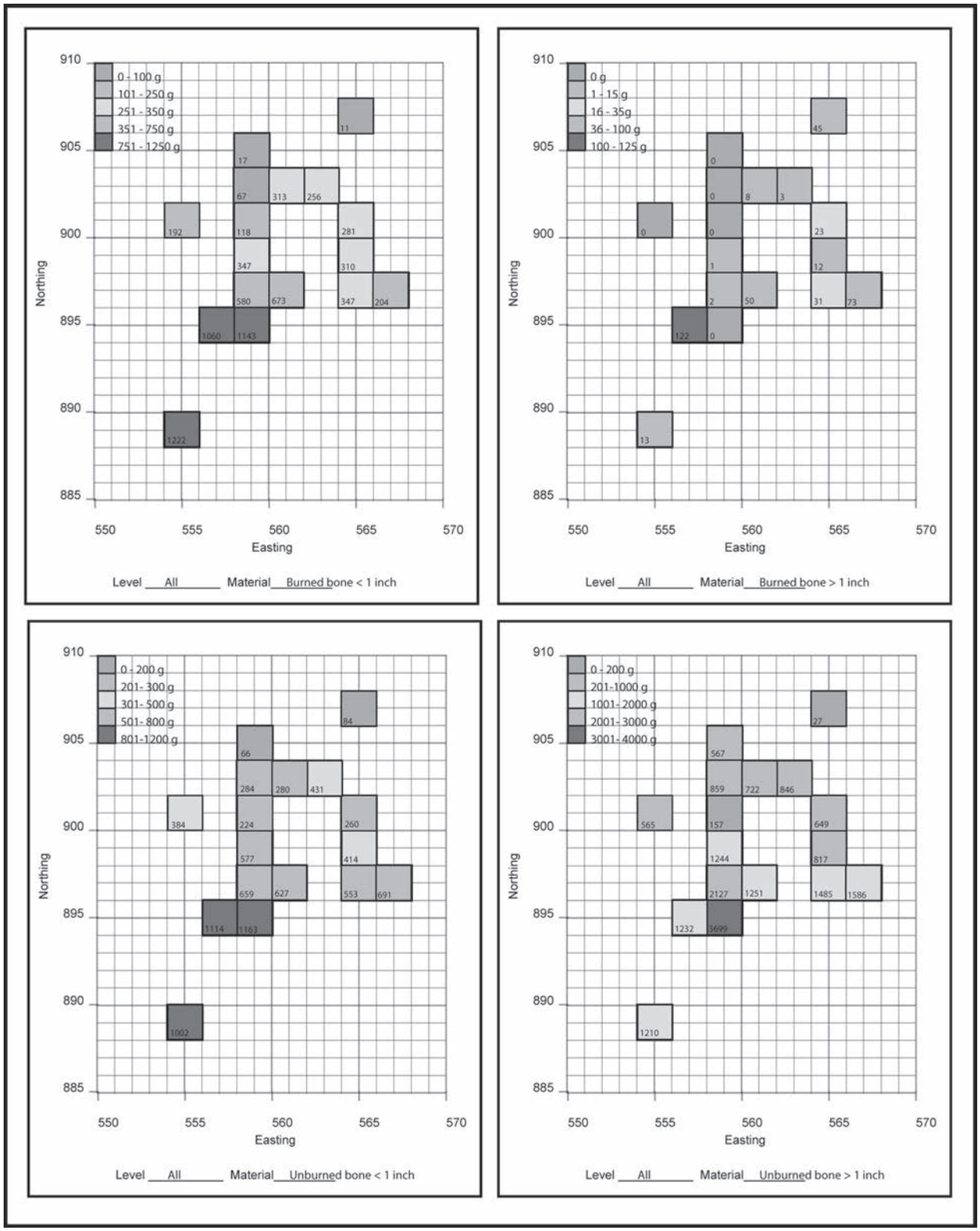


**Figure 50.** Density of animal bone by weight (grams) organized by size and burning.



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**Table 12.** Modified Faunal Remains.

| Descriptive category | Number | Percent |
|---|---|---|
| Expedient butchering tool | 3 | 14.3 |
| Perforated bone | 1 | 4.8 |
| Chisel | 1 | 4.8 |
| Grooved bone | 2 | 9.5 |
| Cut bone | 5 | 23.8 |
| Polished bone | 4 | 19.0 |
| Awl | 1 | 4.8 |
| Bead | 2 | 9.5 |
| Flattener | 2 | 9.5 |
| Totals | 21 | 100.0 |

### Expedient Butchering Tools

Three specimens exhibit distinct diaphysis spiral fractures, with the broken tips displaying obvious polish, striations, and several sets of small parallel marks. One specimen is a left distal bison metatarsal from 894N 558E; another example is a right proximal bison radius from 896N 564E (Figure 51). Both are complete tools, although they are broken bones. The third item is a broken tool and is a fragment of a bison ulna diaphysis. They were likely used as ad hoc butchering implements and are not formal manufactured and curated tools (Weston 1986:211). Similar items were recovered from the Forrest site about 60 miles south of the Kraus 1 site (Hoard and Bozell 2016:48, 51) and have been reported from Woodland sites as far north as eastern North Dakota (Bozell and Toom 2003:9.7).

**Figure 51.** Bison metapodial (left, catalog number 136-7) and radius (catalog number 155-19) with polish and striations on pointed tips resulting from expedient butchering work.

### Perforated Bone

A small fragment of compact mammal bone with a single drilled hole came from 888N 554E. The specimen appears to be complete, although its function is uncertain.

### Chisel

Specimen number 103-13 is an unidentified split bison long bone diaphysis fragment from 898N 564E (Figure 52). One end of the specimen is broken, but the other features a distinctive beveled edge with polish and striation from use. It appears to have been used as a chisel or perhaps a flesher. A similar item was recovered from the Forrest site (Hoard and Bozell 2016:47–49), and bison bone splinter scraping tools have been found in low frequencies from Woodland sites in eastern North Dakota (Bozell and Toom 2003:9.5, 9.7) and along the Missouri River at the South Dakota-North Dakota border area (Neuman 1975:161).

### Grooved Bone

Two specimens are grooved bone fragments. One is a thick large mammal long bone diaphysis fragment with two deep grooves from 896N 564E. The other piece, also incomplete, is a thin piece of burned mammal bone with a single deep groove from 902N 560E. The function of these items is not clear, but grooved bones have been discovered in other Keith phase samples (Hoard and Bozell 2016:48–49).

### Cut and Polished Bone

Nine broken specimens include a variety of bones that exhibit cuts and polish. None can be assigned to a specific patterned artifact type, and all are incomplete. Those with cuts are not simply specimens with marks from routine butchering but generally



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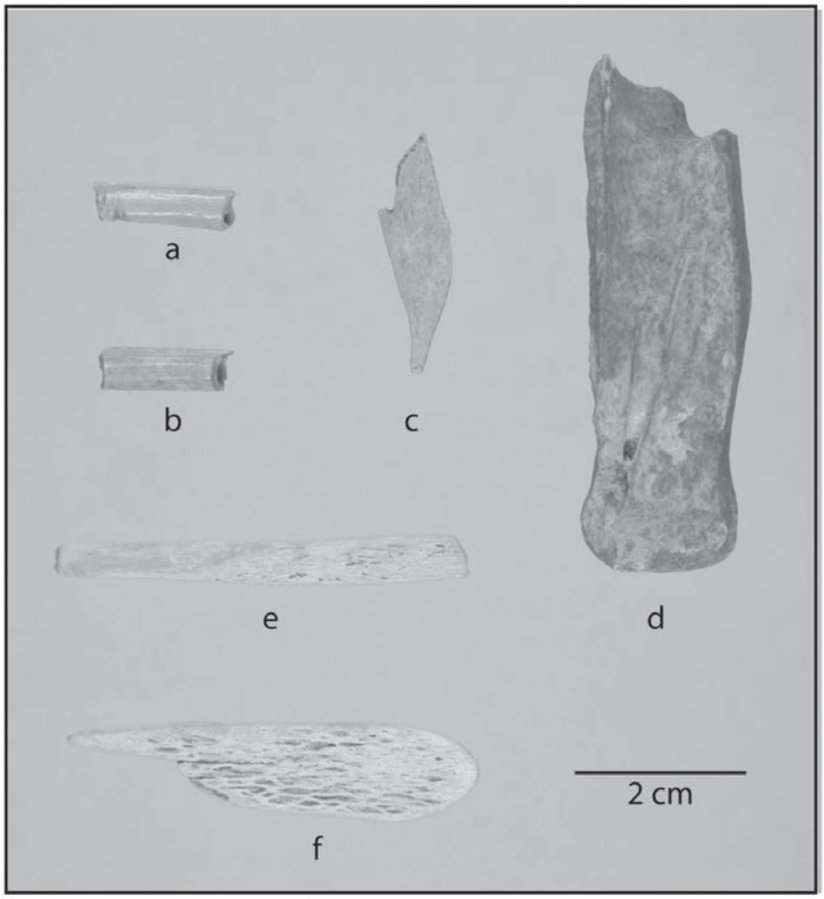


**Figure 52.** Examples of modified bone: a and b. beads; c. splinter awl; d. chisel; e. flattener; and f. flattener.

carry deeper or more numerous parallel cuts. One cut piece from 888N 554E is a large mammal skull fragment with multiple closely spaced cuts. Recovered from 902N 560E, a small long bone diaphysis fragment is from a small mammal or bird and has multiple closely spaced diagonal cuts. The other three cut objects are mammal long bone fragments, each with a series of parallel cuts or notches, from 894N 558E, 902N 560E, and 896N 566.

The polished bones are not named as any specific artifact type but show wear, polish, and striations from some form of use. Excavations yielded a burned deer antler tine fragment with numerous striations and polish, a bison rib or thoracic vertebra fragment with obvious polish on the exposed cancellous tissue, a polished bison long bone segment, and a small unidentifiable compact mammal bone.

### Splinter Awl

A small awl tip (Figure 52), collected during excavation of 888N 554, appears to have been made from a small long bone or rib splinter. The artifact is thin with a sharp tip that has been formed by grinding and polishing. Awls are some of the more common modified faunal specimens recovered from Keith phase components (Hoard and Bozell 2016:45; Kivett and Metcalf 1997:28–29).

### Beads

Two small mammal or bird long bone beads were found (Figure 53). Both are complete and grooved and snapped on both ends. Small quantities of bone beads are not uncommon from central Plains Woodland habitation sites, such as the Forrest site that yielded 10 bone beads (Hoard and Bozell 2016:47,49) and the Wallace site (25GO2), a Valley phase community in south-central Nebraska (Bleed 1991). Large numbers of tubular bone beads also have been recovered from two Keith phase burial sites: Young (14SC2) with 89 bone beads and Pfaff (14NS319) with 688. The Woodruff Ossuary, known for the thousands of shell disk beads associ-



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ated with a burial, produced 28 tubular bone beads (Kivett 1953:120).

### Flatteners

Two broken specimens are thin flat split segments of mammal long bones or ribs that have had the cancellous tissue and the lateral margins extensively worn smooth (Figure 52). The exact function of these artifacts is not known. They are broadly similar to other objects referred to as porcupine quill flatteners, pottery modeling tools, and weaving tools. They certainly could have been used to burnish or flatten a variety of pliable materials (Coscolluela 2013; Koch et al. 2010:150–151; Lehmer 1971: 88; Wheeler 1956).

### Unmodified Identified Remains

The Kraus 1 unmodified identified vertebrate faunal sample consists of 442 bones. Twenty-seven vertebrate taxa, representing a minimum of 44 individuals, comprise the collection. NISP and MNI values are listed in Table 13. Table 14 provides a summary of various cultural and natural characteristics, such as cut marks, chop marks, rodent gnawing, carnivore gnawing, and immaturity.

#### Fish

The fish sample is restricted to five vertebrae, amounting to about 1.1 percent of the combined identified total of unmodified bone. The fish sample incorporates the Cyprinidae (minnow), Catostomidae (sucker), and Ictaluridae (catfish) families. A variety of species from these three families inhabit streams in central Kansas (Cross and Collins 1995). Based on variation in vertebrae size, two fish are represented in each of the sucker and catfish samples. One of the sucker elements is burned. Fish remains are not abundant in Keith phase samples, but 51 bones (4.6 percent of total) were recognized at the Forrest site (Hoard and Bozell 2016:51,55). Fish generally make up less than 6 percent of other identified central Plains Woodland faunal samples (Bozell 1991; Falk and Angus 1983; and Falk and Semken 1990) but are significantly more common from Woodland sites in the Midwest and Prairie Peninsula (Bozell 2003; Kelly and Cross 1984).

#### Amphibian and Reptile

Reptile and amphibian bones are frog or toad, snake, and turtle remains. The sample consists of 29 specimens, which constitutes 6.56 percent of the

**Table 13.** Unmodified Faunal Remains.

| | NISP | | | MNI | | |
|---|---|---|---|---|---|---|
| Taxon | Count | % Class | % Total | Count | % Class | % Total |
| **Fish** | | | | | | |
| cf. Cyprinidae (minnow) | 1 | 20.00 | 0.22 | 1 | 20.00 | 2.3 |
| cf. Catostomidae (sucker) | 2 | 40.00 | 0.45 | 2 | 40.00 | 4.5 |
| cf. Ictaluridae (catfish) | 2 | 40.00 | 0.45 | 2 | 40.00 | 4.5 |
| Subtotal | 5 | 100.00 | 1.10 | 5 | 100.00 | 11.3 |
| **Amphibian or Reptile** | | | | | | |
| Anurans (frog or toad) | 3 | 10.30 | 0.68 | 2 | 33.30 | 4.5 |
| Emydidae (box or water turtle) | 3 | 10.30 | 0.68 | 1 | 16.60 | 2.3 |
| Serpentes (snake) | 13 | 44.80 | 2.90 | 1 | 16.60 | 2.3 |
| Colubridae (non-venomous snake) | 6 | 20.70 | 1.40 | 1 | 16.60 | 2.3 |
| Crotalidae (venomous snake) | 4 | 13.80 | 0.90 | 1 | 16.60 | 2.3 |
| Subtotal | 29 | 99.90 | 6.56 | 6 | 99.70 | 13.7 |
| **Bird** | | | | | | |
| *Aquila chrysaetos* (golden eagle) | 1 | 100.00 | 0.22 | 1 | 100.00 | 2.3 |
| Subtotal | 1 | 100.00 | 0.22 | 1 | 100.00 | 2.3 |

continued



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**Table 13.** continued

| Taxon | NISP Count | NISP % Class | NISP % Total | MNI Count | MNI % Class | MNI % Total |
|---|---|---|---|---|---|---|
| **Mammal** | | | | | | |
| *Scalopus aquatius* (eastern mole) | 2 | 0.50 | 0.45 | 1 | 3.10 | 2.3 |
| *Sylvilagus* sp. (cottontail) | 3 | 0.74 | 0.68 | 2 | 6.25 | 4.5 |
| *Spermophilus* sp. (ground squirrel) | 4 | 0.98 | 0.90 | 1 | 3.10 | 2.3 |
| *Cynomys ludovicianus* (black-tailed prairie dog) | 1 | 0.24 | 0.22 | 1 | 3.10 | 2.3 |
| *Geomys bursarius* (plains pocket gopher) | 4 | 0.98 | 0.90 | 2 | 6.25 | 4.5 |
| *Chaetopidus hispidus* (hispid pocket mouse) | 2 | 0.50 | 0.45 | 1 | 3.10 | 2.3 |
| *Castor canadensis* (beaver) | 3 | 0.74 | 0.68 | 2 | 6.25 | 4.5 |
| Cricetinae (mice) | 1 | 0.24 | 0.22 | 1 | 3.10 | 2.3 |
| *Neotoma floridana* (eastern woodrat) | 2 | 0.50 | 0.45 | 1 | 3.10 | 2.3 |
| *Microtus ochrogaster* (prairie vole) | 15 | 3.70 | 3.40 | 6 | 18.60 | 13.6 |
| *Canis* sp. (dog or coyote) | 16 | 3.90 | 3.60 | 1 | 3.10 | 2.3 |
| *Vulpes velox* (swift fox) | 2 | 0.50 | 0.45 | 1 | 3.10 | 2.3 |
| *Spilogale putorius* (spotted skunk) | 2 | 0.50 | 0.45 | 1 | 3.10 | 2.3 |
| *Mephitis mephitis* (striped skunk) | 4 | 0.98 | 0.90 | 1 | 3.10 | 2.3 |
| *Lutra canadensis* (river otter) | 1 | 0.24 | 0.22 | 1 | 3.10 | 2.3 |
| *Lynx rufus* (bobcat) | 2 | 0.50 | 0.45 | 1 | 3.10 | 2.3 |
| *Odocoileus* sp. (deer) | 4 | 0.98 | 0.90 | 1 | 3.10 | 2.3 |
| *Bison bison* (bison) | 339 | 83.30 | 76.70 | 7 | 21.90 | 15.9 |
| Subtotal | 407 | 100.00 | 92.10 | 32 | 100.00 | 72.9 |
| Grand totals | 442 | | 100.00 | 44 | | 100.0 |

**Table 14.** Summary of Cultural and Natural Characteristics Noted on Identifiable Unmodified Faunal Remains.

| Taxa | Cut marks | Chop marks | Burning | Carnivore gnawing | Rodent gnawing | Immature | Scatological |
|---|---|---|---|---|---|---|---|
| cf. Catostomidae (sucker) | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| *Castor canadensis* (beaver) | 2 | 0 | 0 | 3 | 1 | 2 | 0 |
| *Canis* sp. (dog or coyote) | 2 | 0 | 8 | 4 | 2 | 1 | 0 |
| *Mephitis mephitis* (striped skunk) | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| *Lutra canadensis* (river otter) | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Lynx rufus* (bobcat) | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Odocoileus* sp. (deer) | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| *Bison bison* (bison) | 61 | 18 | 22 | 89 | 44 | 18 | 0 |
| Totals | 69 | 18 | 33 | 97 | 47 | 22 | 1 |

combined identified unmodified fauna. Three frog or toad bones include pelvic bones that represent a minimum of two individuals. Eight species of frogs and toads are common in central Kansas (Collins 1993; Conant 1975).

Two carapace and one plastron turtle elements were recovered, representing a minimum of one individual of the family Emydidae (box or water turtle). Examples of the family in central Kansas are Chrysemys picta (western painted turtle), Chry-



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semys scripta (pond slider), and Terrapene ornate (ornate box turtle) (Collins 1993; Conant 1975).

The remainder of the amphibian and reptile sample consists of 23 snake vertebrae, representing the Colubridae (non-venomous snakes) and Crotalidae (venomous snakes) families. The remainder could not be segregated into these two major families. More than 20 species of snakes are found in central Kansas (Collins 1993; Conant 1975).

The snake and frog or toad remains are likely non-cultural. While the turtle bones have no direct evidence of cultural utilization, such as burning or cut marks, they are considered as contributing in a minor way to the Plains Woodland diet (Hoard and Bozell 2016:52).

### Bird

The only bird bone is an Aquila chrysaetos (golden eagle) tarsometatarsus. It is noteworthy that eagle bones occur in most Keith phase sites but in low frequencies. They may have ceremonial significance (Hoard and Bozell 2016:52; Kivett and Metcalf 1997:212; and Mundell 1980:167). Other Keith phase-derived bird materials include other raptors, waterfowl, turkey, grackle, and grouse or prairie chicken (Deming 1980:173).

### Small Mammal

The sample of small mammals—rabbits, moles, and small rodents—consists of 34 specimens that constitute 7.7 percent of the combined identified unmodified fauna (Table 13). Represented in the small mammalian remains are nine taxa in six families: Talpidae (mole), Leporidae (rabbit), Sciuridae (squirrel), Geomyidae (gopher), Heteromyidae (pocket mice), Cricetidae (other mice, vole and rat). None of these remains are burned or bear cut marks, and most of this material may reflect natural intrusion into the archeological deposit.

Other Keith phase sites produced small mammals. The Keith (25FT38) and Doyle (25RW28) sites in southwestern Nebraska contained prairie dog, cottontail, pocket gopher, and vole bones (Deming 1980:172–173; Kivett and Metcalf 1997:212; Mundell 1980:167). The Forrest site yielded rabbit, prairie dog, and gopher. The 14PA303 prairie dog and rabbit remains display charring and cut marks indicative of use as food (Hoard and Bozell 2016:52–57). Gophers, rabbits, and prairie dogs were used for food at other non-Keith phase central Plains Woodland sites (Falk and Semken 1990). On the Northern Plains these and even small mice and voles are suspected as occasional food items, based on burning (Bozell and Toom 2003).

### Medium-Sized Mammal

Medium-sized mammals, including beaver and carnivores, comprise 6.8 percent of the identified vertebrate materials. Three Castor canadensis (beaver) elements, representing at least two individuals, were recognized. All three beaver bones were gnawed by either carnivores or rodents, and two are from immature animals. Two also carry cut marks—clear evidence of cultural utilization. Beaver bone was present in low frequencies from other Keith phase sites (Deming 1980:173; Hoard and Bozell 2016:53; Kivett and Metcalf 1997:212; Mundell 1980:167).

The remainder of the medium-sized mammal sub-collection consists of 27 carnivore bones. These are dominated by 16 Canis sp. (dog or coyote) elements. Although a distinction could not be made between coyote or small to medium-sized dog, none of these are from large dogs or wolves. There is one element from an immature animal. Two canid elements are cut and eight are burned. Other characteristics are carnivore or rodent gnawing. The only other canid remains are two swift fox (Vulpes velox) foot bones.

Two spotted skunk (Spilogale putorius) and four striped skunk (Mephitis mephitis) bones were recovered. One of the striped skunk elements is burned, and another exhibits cut marks. Remaining carnivore materials are a river otter (Lutra canadensis) scapula with cut marks and a bobcat (Lynx rufus) foot bone and mandible. The mandible has cut marks.

Canis remains are common at the Forrest site, including an intentional burial of a large dog or wolf (Hoard and Bozell 2016:52–53), although they are very rare from other Keith phase sites. Another canid burial was uncovered at the Late Woodland Walker Gilmore site (25CC28) in eastern Nebraska (Falk and Angus 1983). In addition to the canid remains, Keith and other central Plains Woodland sites produce limited amounts of fox, rac-



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coon, badger, and skunk (Deming 1980:173; Hoard and Bozell 2016:53; Kivett and Metcalf 1997:212; Mundell 1980:167).

Large Mammal

The four deer bones consist of three foot bones and a mandible and comprise less than 1 percent of the sample. One of the foot bones is cut, and another is burned. The cut foot bone has been gnawed by a carnivore and is partially digested. Another of the foot bones is from an immature animal. It is not possible to determine if these deer bones are Odocoileus virginianus (white-tailed deer) or O. hemionus (mule deer); both species occur near the Kraus 1 site (Cockrum 1952:271–274).

The remainder of the sample is Bison bison (bison), with 339 bones representing 83.3 percent of the mammals and 76.7 percent of all identified bone. The clear majority of the 35 kg of unidentifiable bone is heavily butchered and crushed bison bone. A minimum of seven bison individuals are represented, based on proximal radii. Modifications recorded on bison remains include cut marks, chop marks, burning, carnivore gnawing, and rodent gnawing. Eighteen elements are from immature animals. Bison are found at all Keith phase sites but are far more common at L33 than other Keith components. Bison procurement and processing are treated further in the following discussion.

Discussion

The overall condition of the collection suggests that most bone was rapidly buried following disposal. The sample is generally well preserved, with most specimens displaying only minor erosion, flaking, and exfoliation. Very few specimens exhibit characteristics typical of poor preservation resulting from adverse soil conditions or weathering due to extended exposure. As the recovery involved a significant amount of fine-screening that was carried out consistently across the site, concern over within-site bias is nominal. All retrieved bone was made available for this analysis. The impact from gnawing animals (Figure 53)—particularly carnivores (dogs)—and the inherent strength and survivability of certain elements is somewhat more problematic.

About 32 percent of the identified sample has been damaged by some level of gnawing, and most of that has been inflicted on bison remains. Some elements favored by ravaging dogs and rodents certainly have been entirely consumed or damaged beyond recognition. Carnivores may have carried some elements away to the perimeter and beyond, leaving them unavailable for archeological recovery.

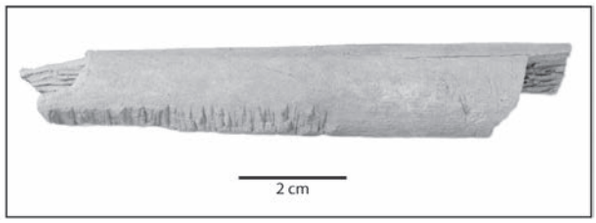


**Figure 53.** Bison rib with extensive rodent gnawing (catalog number 338-1).

The larger-bodied taxa are certainly present in the Kraus 1 collection as a direct result of subsistence activity and tool or ornament manufacture. These include bison, deer, canids and other carnivores, beaver, and possibly the eagle bone. Most of these remains either have direct evidence of cultural utilization, such as butchering damage (Figure 54)

**Figure 54.** Bison astragalus fragment with cut marks (catalog number 155-12).



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or charring, or are well documented as components of Plains Woodland subsistence practices. The rodents, mole, snakes, and frog or toad could represent natural deaths; however, rodents have been recorded as food items in Plains Woodland contexts (Falk and Semken 1990:158–162). While fish remains also could be naturally deposited as an outcome of overbank flooding, one element is charred, suggesting cultural involvement. It is important to keep in mind the significant amount of mussel shell fragments recovered from 14 L33 (see Miller herein), which almost certainly are related to Plains Woodland harvesting and consumption.

In summary, the collection is biased to some extent by natural processes, such as destruction by gnawing carnivores or rodents. However, these processes do not appear to have had a serious impact on the sample, at least not to such an extent that meaningful interpretations cannot be made. Most of the medium and larger-bodied animals and mussel shell are products of Woodland subsistence and tool or ornament raw material procurement activities. The reptiles, amphibians, small mammals, possibly the single bird element, and even the fish may be present because of natural processes

The Kraus 1 site is situated on a low terrace of Big Creek. Although it is in a riparian setting, higher elevation terraces and grassy uplands occur within 2 miles, affording residents a variety of settings within which to procure fauna. Figure 55 depicts MNI values in terms of habitat preference for taxa that are the most likely subsistence sources. The surrounding environment was divided into three

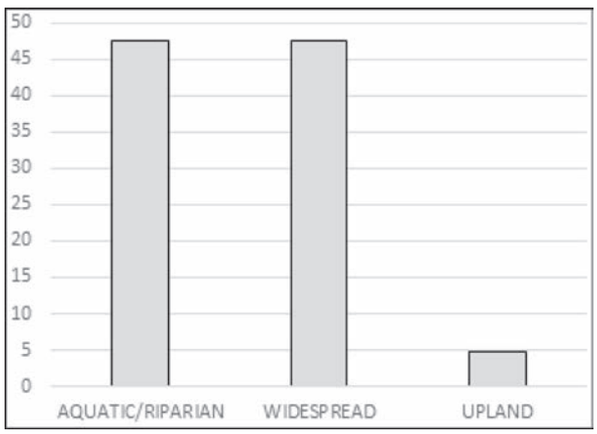


**Figure 55.** Environments exploited as percent of MNI.

very broad biotic communities: aquatic or riparian, upland, and widespread. Pertinent information regarding the natural history and habitat preferences for recovered species were obtained from Cockrum (1952), Collins (1993), and National Geographic Society (1999).

Fauna from aquatic and riparian settings account for 47.5 percent of the captured animals and include beaver, river otter, spotted skunk, bobcat, and fish. Although not tabulated here, the harvesting of mussels was a significant undertaking along the stream edge. The only animal that prefers upland settings is swift fox, which represents 5 percent of the sample. The remainder of taxa (canids, striped skunk bison, and deer) could have been procured at various locations along the broad Big Creek valley and adjacent uplands. These wide-ranging animals comprise about 47 percent of the sample. Since the focus of site activity clearly is processing bison carcasses, it is reasonable to assume that Keith phase hunting parties responsible for formation of 14 L33 killed bison as they watered along Big Creek.

In the absence of a robust assemblage of small rodents and insectivores, it is not possible to offer meaningful paleoclimatic reconstruction for the Kraus 1 occupation. The small mammals all currently occupy this portion of Kansas. The occupation took place at some point during the period 1000–1200 C.E. and probably at the early end of this span. This places the occupation at the end of the Keith phase and during the Medieval Warm Period (or Neo-Atlantic), an episode characterized by warmer and perhaps moister conditions than preceding and subsequent times. Large accumulations of climatically sensitive small mammals from water-screened central and northern Great Plains Early Plains Village pattern contexts tend to confirm warmer and moister conditions (Semken and Falk 1987:208–209). The Kraus 1 mussel fauna suggests that Big Creek had an increased flow level, indicating wetter conditions (Miller herein).

A clear and comprehensive report of seasonal variation in animal procurement by the Kraus 1 residents is not possible. The subsistence species could realistically have been procured at any time of the year, and no direct evidence, such as young deer or bison dentition or a robust sample of fish vertebrae and scales displaying annual growth rings, was found. Miller proposes that the mussels were taken



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during the summer, and this certainly may be true for the vertebrates.

Figure 56 provides data that allows clearer assessment of how residents were using bison. The information essentially compares the relative frequency of skeletal portions (% MAU) against the overall nutritional utility to learn more about site function and transportation of large mammal materials. This approach was pioneered by Binford (1978) and has been under continual use and refinement for three decades (Binford 1984; Lyman 1984; Metcalfe and Jones 1988).

Apparently bone preservation has not played a key role in the composition of the Kraus 1 bison remains, but there is some evidence of damage to the sample by gnawing carnivores and rodents. About 26 percent of the bison bones have been chewed by carnivores and 13 percent gnawed by rodents. The actions of carnivores likely resulted in some elements being gnawed to an unidentifiable state, as well as some elements being carried away to unexcavated portions of the village perimeter. The data in Figure 56 illustrate that the order in which carnivores devour carcasses is a factor in this sample.

Carcass processing also has differential impacts on various portions of the skeleton. During portion separation, certain elements (the high value proximal femur-pelvis intersection, for example) have a greater likelihood of being smashed to the point of being unidentifiable. Overall, the sample seems to be significantly impacted by bone smashing. Much of the sample is heavily crushed and unidentifiable mammal bone, presumably bison. Many elements exhibit clear chop marks and spiral fractures, indicative of intense bone processing (Figure 57). Very likely this activity was related to marrow retrieval and manufacture of bone grease (Vehik 1977).

The Kraus 1 findings are typical of a base camp, as opposed to a more permanent settlement. The highest MAU values are for some of the lowest quality portions (lower fore limb segments), and some of the highest quality elements (pelvis, upper hind limb, and certain vertebrae and ribs) are not particularly well represented. These quantities suggest that higher quality portions might have been processed, packed, and hauled away. This type of configuration is typical of hunting camps where carcasses are processed in the field for transportation to more permanent settlements.

The Kraus 1 sample is compared to the other available Keith phase faunal samples (Figure 58) to offer some preliminary statements about the temporal and spatial variation of subsistence associated with this cultural complex. The other avail-

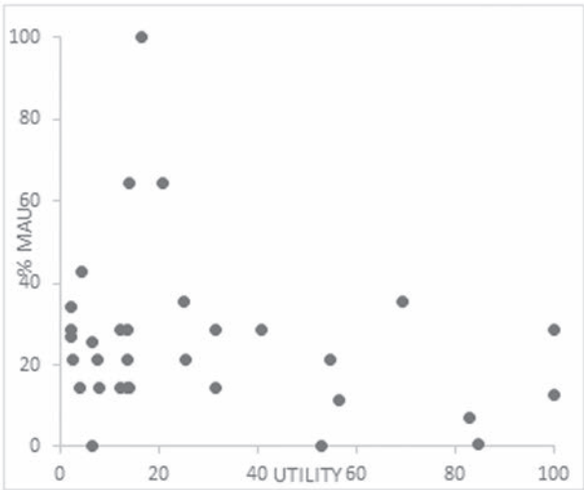


**Figure 56.** Percent MAU for bison arrayed against utility.

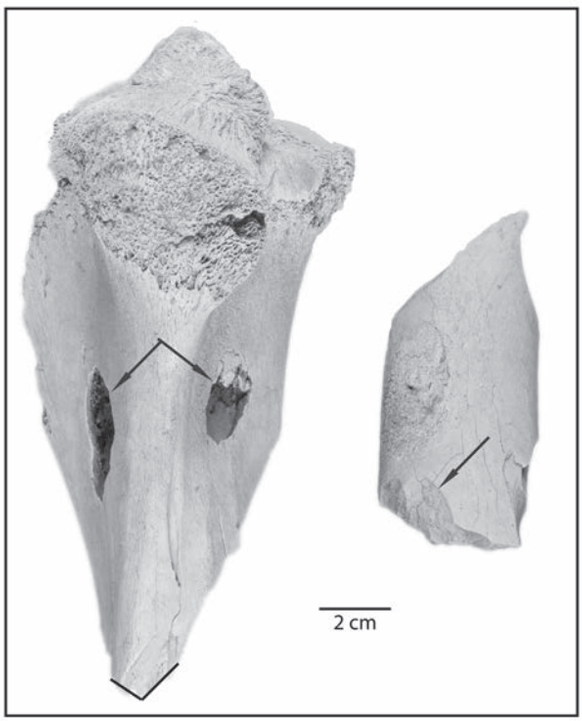


**Figure 57.** Bison tibia (left, catalog number 137-11) and humerus (catalog number 136-11) showing spiral fractures, perforations, and flake scars resulting from bone smashing.



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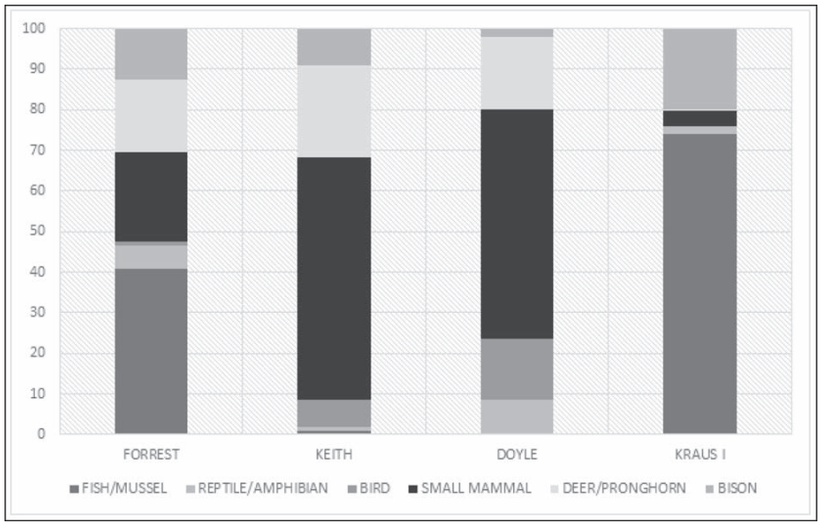


**Figure 58.** General taxonomic comparisons (percent of NISP) between Kraus 1 and select other Keith phase samples.

able Keith phase samples are from the Forrest site (Hoard and Bozell 206 4 ) about 0 km south of the Kraus 1 site and dating around 1000 C.E., the Keith site (Kivett and Metcalf 1997:212) in the Republican valley of southern Nebraska about 110 miles to the north-northwest and dating to 900 C.E., and the earlier Doyle site (Deming 1980; Grange 1980; Mundell 1980) also in the Republican valley. Doyle site dates range from 1 to 600 C..E., but it may have more than one Keith phase occupation. All three sites yielded evidence of house floors and a greater diversity of other features and material culture than did 4 L33 .

Although not illustrated in Figure 58, several other non-Keith phase central and northern Plains Woodland samples are relevant to an even broader understanding of Woodland adaptation in the region. These include the Middle Woodland Rainbow site (13PM91) in northwest Iowa (Falk and Semken 1990; Riggle and Freitag 1990), the Middle and Late Woodland Kirschenman-III site (32SN247) in eastern North Dakota (Bozell and Toom 2003), the Middle Woodland Stelzer site (39DW242) in north-central South Dakota (Neuman 1975:99–104), the late Woodland Walker Gilmore site in eastern Nebraska (Falk and Angus 1983), the Middle Woodland Wallace site in the Republican valley of south-central Nebraska (Bozell 1991), and the Late Woodland (Great Oasis) Packer site (25SM9) in the Loup basin of central Nebraska (Bozell and Rogers 1989).

These faunal assemblages demonstrate that the meat portion of Plains Woodland subsistence strategies varied considerably across time and space. In general, fishing does not seem to have been regularly and intensively practiced by Keith or other Plains Woodland groups in Kansas, Nebraska, or the Dakotas, although modest amounts of fish (generally 5 percent or less of NISP) are recovered from several sites. Five fish vertebrae represent 1.1 percent of unmodified bone from the Kraus 1 site. This is certainly in contrast to Woodland faunas of the Midwest, where fish are sometimes abundant. However, Plains Woodland populations did make regular use of mussels, both for food and as a source of raw material for making disk beads and other ornaments and cutting tools. Shell debris makes up 0 to 70 percent of the Kraus 1 and Forrest samples. Shell also was collected regularly from the Keith site, although it was not formally quantified (Kivett and Metcalf 1997:30). Turtles are typically not plentiful in Plains Woodland sites but are more common from the Forrest and Kirschenman III sites. Birds are not particularly abundant from Keith components. When they do occur, raptors and grouse or prairie chicken dominate. Birds are more common and avian assemblages more diverse (including waterfowl) in Woodland sites to the north and east of the Keith phase heartland, such as Packer, Walker Gilmore, and Rainbow.

Small and medium-sized mammals were exploited by Keith and other Plains Woodland groups to varying degrees. Beaver, canids, fur-bearers, and even rodents to some extent are represented. At some sites



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canid remains are common, a significant portion almost certainly domestic dog. Small and medium-sized mammals are fairly common at the Keith and Doyle sites but less frequent at Forrest and constitute only 4 percent of the Kraus 1 sample. They are typically more commonly exploited at components to the north and east, such as Wallace and Rainbow.

Due to the vastly larger meat package, large mammals effectively account for the major portion of the meat diet at all Plains Woodland sites. The principal prey species are deer, pronghorn, and bison, but the proportions vary from site to site. Wapiti were rarely hunted by central Plains Woodland people. With respect to the Keith phase, the Kraus 1 site had the largest proportion of bison remains. In fact, it appears to represent a bison hunting and processing base camp. No pronghorn and only four deer bones were recovered there. In contrast, the Keith site had all three of the major large mammal prey species, although pronghorn is more common than deer or bison. The Doyle site also produced those three large mammals, but deer or pronghorn are more common than bison. The Forrest site yielded roughly equal proportions of bison and deer or pronghorn.

The site has all the diagnostic features of a bison hunting base camp near one or more kill sites. The bison remains reflect all portions of the skeleton; however, lower and mid-quality portions are more common than higher-value pieces. The latter may have been transported to more permanent settlements. The site has a limited number of contained features and no obvious structures. The artifact inventory, including modified bone and shell, is not particularly rich nor diverse and is atypical of that expected for more permanent Keith settlements, like components at the Doyle, Forrest, and Keith sites.

The obvious exception to the focus on bison bone processing is the quantity of mussel shell. It is very likely that 14EL313 was established as a bison hunting and processing base camp, but certainly occupants might have taken advantage of easily captured mussels if they were available in immediately adjacent Big Creek. Similarly, occasional hunting of deer and small mammals might have been carried out on a limited basis. While the vertebrate sample does not offer any direct seasonal evidence, Miller (herein) suggests that the mussels were harvested during the warmer months. Bison hunting and processing taking place at the same time as mussel gathering is a reasonable assumption. Therefore, the Kraus 1 site adds what is likely warm season bison procurement base camp data to the existing inventory of mortuary sites and semi-sedentary hamlets already documented for the Keith phase. This study contributes to ongoing assessment and synthesis of Plains Woodland subsistence strategies (Bozell 1995; Bozell et al. 2011).

## INVERTEBRATE FAUNAL ANALYSIS

### *Unionid Analysis*

Edwin J. Miller

Bivalve mollusk (Unionidae) shell and shell fragments from the Kraus 1 site were studied to determine species present during the time of occupation, to assess size structure and probable age classes of valves and compare growth rates with extant specimens of same species from Kansas, to characterize habitats used by bivalve species and the probable aquatic habitat of Big Creek at the time of prehistoric human occupation, and to compare the past Kraus 1 assemblage of bivalves with the contemporary mussel assemblage in Big Creek. Finally, valves were inspected for possible tooling marks.

#### Methods

Relic unionid (mussel) shell remains were examined, identified, and sorted into measurable valves, identifiable fragments, and unidentifiable fragments. Valves and valve fragments were compared to voucher specimens to help verify species identification. Umbo shape, beak cavity, external sculpture, lateral and pseudocardinal teeth, and/or muscle scars were used to differentiate valves. Intact and mostly intact valves were measured. Because the posterior end of many relic shells was broken, height dimensions were more common and used for shell size comparisons to increase sample size.

Shell size comparisons were made between archeological valves and recent samples from the Verdigris River Basin in southeast Kansas when sample size of measurable archeological valves of any one species was more than or equal to six specimens. Mean size differences were compared via t-test ($\alpha = 0.05$). Any species that had a sample size greater than five was measured at winter rest lines



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2 and 3 (Figure 59). These were then compared to recently dead shells of the same species, collected from the Verdigris River basin in southeast Kansas, to compare growth rates between the archeological and modern-day samples.

Probable habitat at the time of archeological deposit was characterized using literature sources that describe where species were most commonly found. Finally, Kraus 1 shells were inspected for tooling marks, such as notching, drill marks, or drilled holes, and recorded.

## Results

Examination of specific shell attributes allowed 1,207 valves or valve fragments to be assigned to species. Eight unionid mussel species were identified (Table 15).

Two species (Wabash Pigtoe and Pondhorn) had a sample size of intact valves great enough to analyze shell size. In both cases, most measured valves were ≤ 40 mm height. Unionid species diversity at the Kraus 1 site is typical of small stream habitats in Kansas (Hoke 1997). However, current mussel diversity in Big Creek is now both less and of different species composition than that appearing in the Kraus 1 collection. Eberle et al. (1986) recognized just three unionid mussel species in Big Creek (Giant Floater, Pink Papershell, and Mapleleaf). Hoke (1997) surveyed six sites on Big Creek in 1983 and documented five live species (Paper Pondshell, Giant Floater, Mapleleaf, Pondhorn, and Pink Papershell). He did not find evidence of either of the two most common fast water species at 14 L33 (Wabash Pigtoe or White Heelsplitter).

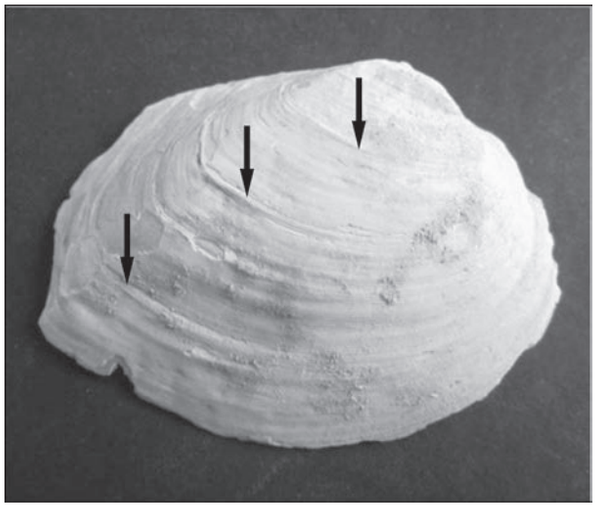

**Figure 59.** Wabash Pigtoe valve showing probable winter rest lines 2, 3, and 4.

In addition to the above-mentioned bivalves of the Unionidae Family, there was a representative of the Pisidiiae Family that is commonly referred to as fingernail clam, Sphaerium striatinum. Twenty-five of these valves were noted in the archeological collection.

Mean height of Kraus 1 Wabash Pigtoe sample is significantly smaller than a recent sample from the Verdigris River. Specifically, 94.3 percent of the archeological valves were less than or equal to 40 mm as compared to only 11.5 percent of shells from

**Table 15.** Freshwater Mussel (Unionidae) Species Valve Counts by Intact Shells, Partial Shells, and Identifiable Valve Fragments. Species are listed from most to least common.

| Species | Intact valves | Partial valves | Identifiable fragment | Total |
|---|---|---|---|---|
| Wabash Pigtoe (*Fusconaia flava*) | 54 | 149 | 753 | 956 |
| White Heelsplitter (*Lasmigona complanata*) | | | 144 | 144 |
| Pondhorn (*Uniomerus tetralasmus*) | 33 | 4 | 14 | 51 |
| Pondmussel (*Ligumia subrostrata*) | | | 31 | 31 |
| Creeper (*Strophitus undulatus*) | 1 | | 14 | 15 |
| Cylindrical Papershell (*Anodontoides ferussacianus*) | | | 7 | 7 |
| Lilliput (*Toxolasma parvus*) | 1 | | 1 | 2 |
| Giant floater (*Pyganodon grandis*) | 1 | | | 1 |
| Totals | 90 | 153 | 964 | 1,207 |



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the Verdigris River. Moreover, 92 percent of Kraus 1 Pondhorn valves were less than or equal to 40 mm shell height (Figure 60). Comparing growth or rest lines on these measurable valves, those less than or equal to 40 mm would probably be aged at ≤ 4 years for the Wabash Pigtoe and ≤ 3 years for the Pondhorn, due to differential growth rates between the two species.

The comparison of Wabash Pigtoe shell growth rates (Figure 61) between the archeological sample and the recent Verdigris River collection (Miller et al. 2014; Tomasic et al. 2012) was not significantly different.

No evidence of tooling marks was noted on the intact valves or large valve fragments. There were closely examined notches in two Wabash Pigtoe valves (4 L33- 6 ; 1 4 L33- 7 3-2) and one White Heelsplitter (4 L33- 5- 1) that probably are due to wear and erosion because they occur in the thinnest and most fragile portion of these specimens (Figure 2) .

## Discussion

The mussel assemblage from the Kraus 1 site near Big Creek is remarkable because it reveals that a dramatic change has taken place between the archeological deposition and the present day (Eberle et al. 1986; Hoke 1997). Likewise, the small size of the valves found in the site was evident and supports the hypothesis that there was a probable harvest bias.

For several reasons the archeological assemblage may not fully typify what was naturally occurring in Big Creek at the time of deposit. This could be due to the fragility of thin shells, such as the Cylindrical Papershell. Species and size bias also could result from selective harvest pressure that might favor one species or size over another.

Habitats of the unionid species, documented in the Kraus 1 mussel assemblage, vary from flowing to ponded water environs (Table 16). Half of the species are flowing water species and probably attest that Big Creek was a perennially flowing stream. Wabash Pigtoe, White Heelsplitter, Creeper, and Cylindrical Papershell all are stream species and require some permanent flow most years. Moreover, the most common shell is the Wabash Pigtoe, a pelagic spawner that releases its glochidia in flowing water during the summer and uses minnows and

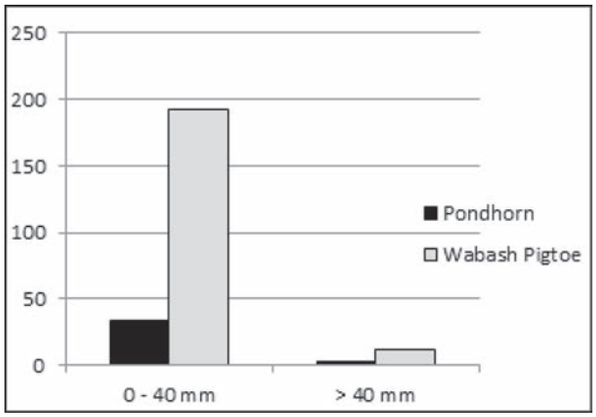


**Figure 60.** Proportion of Kraus 1 valves of Pondhorn and Wabash Pigtoe that were ≤40mm in height.

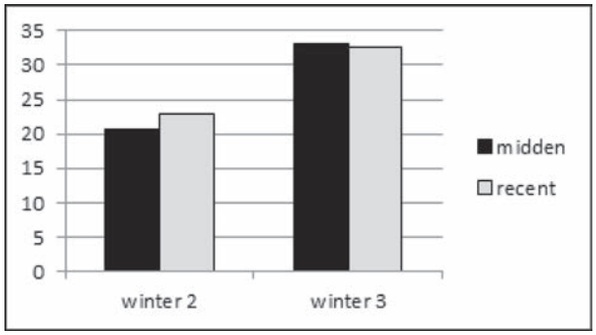


**Figure 61.** Winter rest lines of Kraus 1 and recently collected Wabash Pigtoe shells comparing shell height (mm) between relic shells from Big Creek, Ellis County, Kansas with recently collected shells from the Verdigris River, Montgomery County, Kansas.

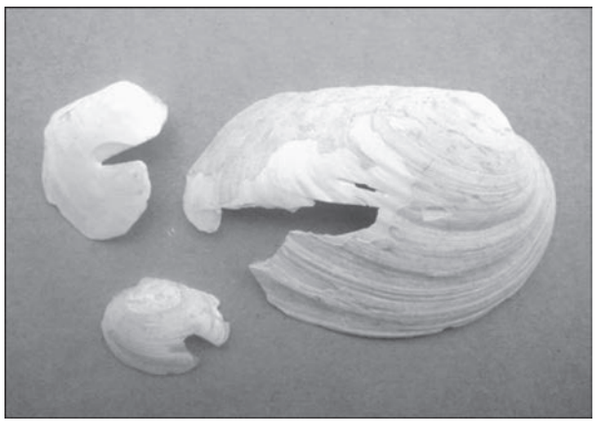

**Figure 62.** Notches examined for possible tooling are probably due to natural wear and erosion of the thinnest portion of the shell.



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**Table 16.** Aquatic Habitat Characteristics of Freshwater Mussel (Unionidae) Species Documented at the Kraus 1 Site from Most to Least Common. Habitat descriptions are from McMurray et al. (2012).

| Species | Habitat |
|---|---|
| Wabash Pigtoe (*Fusconaia flava*) | Creeks to large rivers in gravel and sand |
| White Heelsplitter (*Lasmigona complanata*) | Medium to large rivers with mud or mud-gravel substrate |
| Pondhorn (*Uniomerus tetralasmus*) | Lakes, ponds, small streams in mud; prefers still water areas |
| Pondmussel (*Ligumia subrostrata*) | Small creeks, ponds, lakes in mud |
| Creeper (*Strophitus undulatus*) | Small to large streams; prefers gravel or gravel-mud substrates |
| Cylindrical Papershell (*Anodontoides ferussacianus*) | Small streams in mud and sand |
| Lilliput (*Toxolasma parvus*) | Small to medium streams, lakes, ponds in gravel and mud |
| Giant floater (*Pyganodon grandis*) | Lakes or ponds; prefers slack water habitats with mud or gravel bottoms |

shiners as fish hosts (Miller et al. 2014). Summer is the most likely no-flow period but the presence of Wabash Pigtoe suggests that summer flow occurred at the time of the archeological deposit.

The assemblage of both lentic (standing water) and lotic (running water) mussel species characterizes Big Creek aquatic habitat as probably a series of riffles, runs, and pools. In addition, the fingernail clam signals the presence of a short-lived (2 years) species. This group of mollusks is not found in intermittent headwater streams (Mackie and Huggins 1983). Fingernail clams were well represented in the archeological sample and support the probability that Big Creek had permanent flow.

Conditions for unionid mussels evidently have changed as most of the species from the site are now extirpated from Big Creek. This stark difference in assemblage is probably attributable to loss of flow. Eberle et al. (1986) described Big Creek as an intermittent stream that during summer, fall, and early winter often was composed of isolated pools throughout most of its length. Hoke (1997) portrayed the unionid assemblage of the Upper Kansas Basin under stress from surface and subsurface water withdrawals for irrigation, reservoir construction, heavy grazing pressure along waterways, pollution, and siltation.

Wabash Pigtoes and Creeper are probably no longer extant in the Smoky Hill River basin. Within that basin the Pondhorn, Cylindrical Papershell, and White Heelsplitter are considered rare; the Giant Floater is uncommon. However, all six have a greatly reduced range (Hoke 1997; Bergman et al. 2000). Further comments regarding occurrence, shell-size, and age of the three most common Kraus 1 species follow.

Wabash Pigtoe (*Fusconaia flava*)

The high relative abundance of Wabash Pigtoe could be credited to the fact that it is probably the most robust shell at the site and, therefore, is more likely to hold its characteristics over time. Typically, Wabash Pigtoe shells from a small stream differ in shape from those in a larger river. The stream shells tend to be more flattened or compressed in shape (Baker 1928). The valves from the site supported this observation. The Kraus 1 shells are small and young as compared to the measured live Wabash Pigtoes from the Verdigris River in southeastern Kansas.

The small size of Wabash Pigtoe mussel shells found is remarkable. The fact that older, more robust shells would preserve better than small younger shells lends credence to the assumption that they were not deposited at the site. Three explanations are probable for the sparse number of large valves at the site: 1) growth rates of mussels at the time of the deposit were lower than present, 2) a high proportion of young mussels might be expected if population structure was steadier than the more sporadic episodes known to occur at present, 3) smaller shells were selected for consumption. The first explanation can be dismissed because there was no significant difference in growth rates at winter 2 and winter 3 rest lines between the Kraus 1 mussels and a recent sample from the Verdigris River. The second explanation does not seem plausible because the parental stock to produce the juveniles should



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be well represented in the archeological assemblage, and it was not.

Small size of mussel shells at archeological sites has been noted in other studies (reviewed by Peacock 2000; Miller et al. 2004). Most of the Wabash Pigtoe valves are probably under four years of age, and smaller shells likely were selected because they were more palatable.

Pondhorn (Uniomerus tetralasmus)
The Pondhorn is adapted to drought conditions and can aestivate, i.e., remain dormant, deep in the mud for up to a year without needing to siphon water (Baker 1928). A drought event would not terminate the larger individuals of this species when compared to a more lotic species, e.g., Wabash Pigtoe. Pondhorns can easily survive drought cycles, so various sizes should exist and would be expected in the archeological assemblage unless larger mussels were not harvested.

White Heelsplitter (Lasmigona complanata)
The White Heelsplitter fragments appear to be from small valves, although this mussel can grow to be nearly as large as a dinner plate. The shell has been described as thin and brittle in the young but solid in adults (Murray and Leonard 1962). The w-marked umbos were diagnostic in identifying the young shells, but no intact valves large or small were found in the archeological assemblage.

### Summary

The Kraus 1 mussel shells reveal a fauna that exemplifies a change in hydrology of Big Creek from a flowing perennial stream to the current intermittent flow. The Big Creek mussel assemblage in the Kraus 1 assemblage no longer exists there. Mussel valves were relatively small and young. These characteristics probably reflect harvest selectivity rather than a lower growth rate of mussels.

### *Gastropods*

James L. Theler

Gastropods (Figure 63) are among the faunal remains recovered using water-screening and flotation procedures. Gastropods can be a source of paleoenvironmental data, as they are very sensitive to environmental conditions (Theler 2003; Theler et al. 2004).

Excavators collected gastropod shells from a stratigraphic column in the west wall of 898N 558E. Ten sequential soil samples, taken from top to bottom in the column between depths of 10 and 120 cmbs, including soil horizons above and below the paleosol. The samples were washed in window screen to retrieve small objects, such as gastropod shells. The specimens were identified to species and counted by strata (Table 17). Nine distinct terrestrial species from seven genera and one species from three aquatic genera were enumerated. Concentrations of specimens correlate with the Buckner Creek paleosol.

## PLANT REMAINS ANALYSIS

### *Archeobotanical Analysis of Flotation Samples*

Gina S. Powell

Sediment processing by flotation had never been conducted on a Keith phase site. The presence of cultigens in sites is easily overlooked without flotation, and because the origins of domestic plant cul-

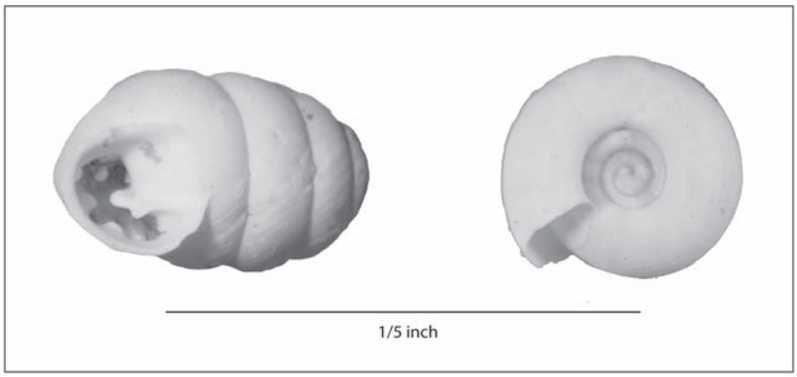


**Figure 63.** Two gastropod shells from the Kraus 1 site.



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**Table 17.** Gastropods Recovered from Soil Column in West Wall of N898 E558.

| | Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Taxon | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Terrestrial** | | | | | | | | | | |
| *Gastrocopta abbreviata* (Sterki 1909) | 0 | 0 | 2 | 10 | 12 | 5 | 7 | 1 | 4 | 0 |
| *Gastrocopta cristata* (Pilsbry and Vanatta 1900) | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Gastrocopta holzingeri* (Sterki 1889) | 0 | 0 | 0 | 3 | 0 | 0 | 2 | 0 | 0 | 1 |
| *Gastrocopta procera* (Gould 1840) | 11 | 0 | 3 | 92 | 41 | 21 | 10 | 3 (1) | 4 | 2 |
| *Pupoides albilabris* (C. B. Adams 1841) | 4 | 0 | 2 | 12 | 11 | 6 | 2 | 3 | 3 | 1 |
| *Vallonia parvula* (Sterki 1893) | 0 | 0 | 0 | 14 | 38 (3) | 112 | 64 | 12 | 11 (6) | 3 (2) |
| *Vallonia* sp. (juveniles) | 1 | 0 | 4 (2) | 66 | 109 | 109 | 71 | 25 (15) | 5 (5) | 5 (3) |
| *Vallonia* sp. (egg shells) | 0 | 0 | 0 | 1 | 0 | 5 | 3 | 0 | 0 | 0 |
| *Helicodiscus parallelus* (Say 1817) | 0 | 0 | 0 | 34 (18) | 34 (5) | 40 (10) | 26 (26) | 12 (5) | 21 (20) | 10 (9) |
| *Lucilla singleyanus* (Pilsbry 1889) | 0 | 0 | 2 (2) | 13 (2) | 23 (2) | 31 (2) | 32 (28) | 31 (21) | 37 (26) | 40 (34) |
| Succineidae | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| (*Hawaiia minuscula* (A. Binney 1841) | 3 (1) | 0 | 5 (1) | 41 (12) | 74 (14) | 56 (6) | 46 (40) | 19 (6) | 56 (26) | 32 (23) |
| Terrestrial juveniles (+ fragments)* | 5 | 0 | 10 | 80 | 216 | 176 | 222 | 46 | 89 | 51 |
| **Aquatic** | | | | | | | | | | |
| Sphaeriidae | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Physidae | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| *Gyraulus* cf. *G. circumstriatus* (Tryon 1866) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| *Gyraulus* sp. | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |
| Aquatic gastropod fragments | 0 | 0 | 0 | 0 | + | + | + | + | 0 | + |
| *Chara* sp.** | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |

0 = absent + = present (n) = unweathered, possibly modern intrusive

* unoxidized terrestrial juveniles, not counted ** Chara is aquatic microphyic algae.

tivation is a topic of substantial interest, the Kraus 1 research design required systematic flotation sample acquisition.

## Methods

### Sample Collection

*Features*

Features were bisected, and one half was excavated, bagging the sediment for water screening through 1/16-inch (1.32-mm) mesh. Ten-liter flotation samples were collected from the second half in stratigraphic zones, where they were present. In the absence of stratigraphic variation, a 10-liter sample from each 10-cm level within the feature was taken for flotation; the rest was water screened.

*Column Samples*

Flotation columns were removed as a series of 10-liter soil samples from the walls of selected units. Disturbed soils were avoided as much as possible resulting in sample columns that varied in width and depth. Each sample represents about 10 cm of vertical thickness within a single stratum to reflect cultural activities (Figure 64). Since depth of strata varied slightly from unit to unit, the samples are described by stratum rather than depth.

Each column of samples was located within the profile wall where the fewest visible animal burrows were observed. Soil was removed from the column using a trowel or small square shovel and placed into a graduated 10-liter bucket to standard-



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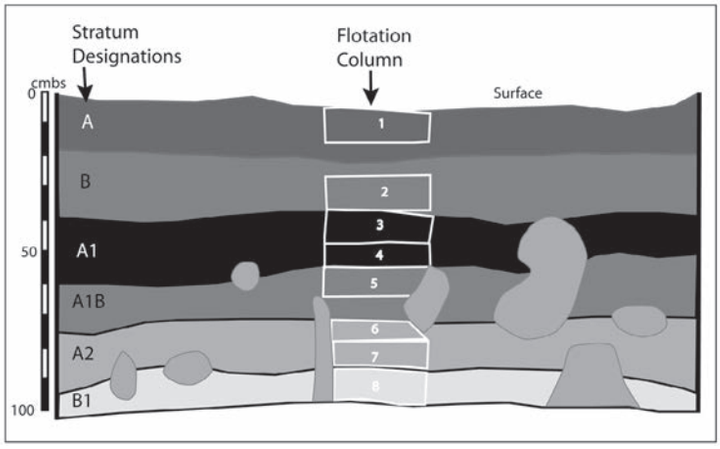


**Figure 64.** Example of the flotation sample column in the west profile wall of Unit N896 E558, designated Column 1. Irregular shapes represent animal burrows.

ize sample size (Figure 65). Samples were removed in small chunks (2–4 cm thick), because this is more likely to preserve charcoal than scraping with a trowel. Artifacts were retained within the soil sample but large rocks were removed. A summary of column samples is presented in Table 18.

Sample Processing

Each sample was re-measured prior to flotation, because some of the samples were less than 10 liters, especially those from areas with high bioturbation. A modified Shell Mound Archeological Project (SMAP) system was used to separate the heavy fraction, which sinks, and the light fraction, which floats to the top and is captured in a geological sieve. Heavy fractions were collected in ordinary fiberglass window screen with openings of approximately 1.32 mm (0.045 inches), and light fractions were caught in a No. 40 geological sieve with openings of 0.425 mm (0.016 inches). Light fractions were transferred from the sieve to sheer cloths, tied

**Figure 65.** Column sample in progress.

**Table 18.** Summary of Strata across All Four Column Samples. SNE is the seed number estimate.

| Stratum | Number of samples | Total volume (liters) | Total grams of charcoal >2 mm | Average grams of charcoal >2mm/10 liters | SNE, excluding hackberry | SNE, excluding hackberry/10 liters |
|---|---|---|---|---|---|---|
| A | 7 | 63.0 | 0.01 | t | 0 | 0 |
| B | 4 | 37.5 | 0 | 0 | 6 | 1.60 |
| A1 | 10 | 93.0 | 0.81 | 0.09 | 36 | 3.87 |
| A1B | 5 | 47.0 | 0.73 | 0.16 | 6 | 1.28 |
| A2 | 7 | 60.5 | 0.52 | 0.09 | 23 | 3.80 |
| B1 | 3 | 24.0 | 0.08 | 0.03 | 13 | 5.42 |
| Totals/averages | 36 | 325.0 | 2.15 | 0.36 | 14 | 2.66 |



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into bundles, and dried in the shade along with the heavy fractions.

### Analysis

It was not feasible to sort all 79 flotation samples, so 36 samples from four columns and from the two most distinct and diverse features were selected. All eight samples from Feature 2, an area of concentrated cultural activity, were incorporated, as were the two samples from Feature 21, an ash lens, for a total of 46 analyzed column samples.

The heavy and light fractions were treated in slightly different manners. Each heavy fraction sample was passed through a set of geological sieves with mesh openings of ¼ inch, 2 mm, 1 mm, 0.5 mm, and the bottom pan. The >¼ inch portion of each heavy fraction was sorted and cataloged by volunteers. Artifacts include identifiable bone (usually teeth, small mammal, fish, or bird), mussel shell hinges, snail shells, flakes, pottery, and debitage. Charcoal was pulled from the heavy fraction to be examined with the light fraction charcoal.

Each light fraction, along with the charcoal pulled from the heavy fraction, was passed through the same set of sieves. Using a Bausch and Lomb binocular microscope with a zoom range of 10–70X, charred botanical items from the >2-mm sieve were fully sorted into categories, such as wood, bark, stem, maize, indeterminate, etc., and then counted and weighed. Items weighing less than 0.01 g are marked on the tables as "t" for trace.

The fractions from the <2-mm sieves were inspected for seeds and seed fragments. For simplicity in this report, the word "seeds" is used as a catch-all term for grass caryopses, chenopod fruits, fruit achenes, etc. Those items usually pulled from the >2-mm fractions, such as wood, but extant only in the <2-mm fractions are marked as "p" for present on the tables. This usually occurs in samples with only a few fragments of charcoal. Seeds were tallied but not weighed except for large hackberry seeds, which were weighed to ascertain how many whole seeds are represented, here called a Seed Number Estimate (SNE). SNEs were attempted for all hackberry seeds to account for breakage. To estimate the number of whole hackberry seeds in the samples, four complete uncharred seed halves were weighed. This weight (0.13 g) divided by two (0.065 g) is an estimate of the weight of a whole hackberry seed. This number is used throughout the report to estimate SNE for hackberry.

Freshly broken fragments of wood were examined and assigned to taxon. Two reference manuals with micrographs were used for comparisons: Hoadley (1990) and Panshin and de Zeeuw (1964). The wood was identified to the lowest taxonomic level possible, either to the genus or family level, although the species can be surmised with reasonable accuracy using local floral and historical references.

## Recovered Plant Remains

Analysis focused on plant species of known economic value in the Kraus 1 samples. Table 19 provides the Latin and common names for these plants.

### Maize

Maize was introduced to the midcontinent around the onset of the Common Era but did not become abundant enough to leave visible traces until around 600 C.E. Based on stable carbon isotopes from Plains Woodland human burials, Miller and Tieszen (1992) hypothesized a shift toward maize on the Central Plains after the Plains Woodland period, which was commonly estimated as 900 C.E. Archeological visibility is shifting backwards in time with advances in analytical technology, most notably Adair's and others' study of the maize starch grains, lipids, and phytoliths on curated potsherds (Mary Adair, personal communication 2015).

The earliest directly dated maize found so far in Kansas is from the Avoca site (14JN332) in Jackson County (Table 20), which has a radiocarbon age of 1220 ± 40 B.P. (corrected) with a median probability of 799 C.E. (Adair 2006). The Avoca site is a house with associated interior and exterior pits, dating to the Grasshopper Falls phase, part of the Early Ceramic/Plains Woodland period. A directly dated maize fragment from the Middle Ceramic period Kohr village site (14SA1) in Saline County has a radiocarbon age of 926 ± 33 with a median date of 1099 C.E. (Roper and Adair 2011). Another age determination on maize from the associated Whiteford Burial Pit (14SA1) is 780 ± 40 (Roper 2006:247). A maize cupule from 14NT11, a site in Norton County with Early Ceramic Keith phase and Upper Republican Middle Ceramic compo-



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**Table 19.** Summary of Recovered Plant Species.

| Latin name | Commonname |
|---|---|
| *Amaranthus* sp. | Amaranth |
| *Celtis* sp., charred and uncharred | Hackberry |
| *Chenopodium berlandieri* | Chenopod |
| *Chenopodium* sp. | Chenopod |
| *Datura* sp. | Jimsonweed |
| *Desmodium* sp. | Ticktrefoil |
| *Euphorbia maculata* | Spurge |
| *Euphorbia* sp. | Spurge |
| *Galium aparine* | Bedstraw |
| *Hedeoma* sp. | False pennyroyal |
| *Helianthus annuus* | Sunflower |
| *Hordeum jubatum* | Squirreltail barley |
| *Hordeum pusillum* | Little barley |
| *Iva annua* | Marshelder |
| | Carpetweed |
| *Phytolacca americana* | Pokeweed |
| Poaceae | Grass family |
| Poaceae, festucoid | Grass, festucoid |
| *Polanisia graveolens* | Clammyweed |
| *Polygonum* sp. (trigonal) | Knotweed |
| *Portulaca oleracea* | Purlsane |
| *Rhynchospora* sp. | Beaksedge |
| *Rumex* sp. | Dock |
| *Scirpus* sp. | Bulrush |
| *Sida spinosa* | Prickly fanpetals |
| *Solanum ptycanthum* | Black nightshade |
| *Tribulus terrestris* | Puncturevine |
| Unknown bony seed | Possible immature or misshapen *Celtis* |
| *Vitis* spp. | Grape |
| *Zea mays* | Maize (corn) |

nents, has a radiocarbon age of 864 ± 30 B.P. with a median probability of 118 C.E. (Hoard and Bozell 2016). Current excavations at 14EL313 also recovered a maize kernel, described more fully below.

Little Barley

There is a strong case for little barley (Hordeum pusillum) domestication in the eastern U.S. (Hunter 1992), though the issue is not entirely settled. In the Southwest, however, little barley has been accepted as a domesticated plant (Bohrer 1987; Adams 2014), which is not necessarily inconsistent with the more conservative approach by Eastern archeobotanists.

From among the hundreds of charred and well-preserved little barley seeds from the Radio Lane site (14CO385), part of a Lower Walnut complex of Great Bend aspect (ancestral Wichita) sites near Arkansas City in Cowley County (Adair 2012b) (Figure 66), a sample was measured for this study as a comparison to the Kraus 1 specimens. The 32 seeds averaged 2.29 mm long (sd = 0.22) and 1.14 mm wide (sd = 0.13). Hunter (1992:Table 9) presented measurements of charred little barley seeds from sites mostly in Illinois, dating from Middle Archaic to Protohistoric times. The highest length dimensions date to the Middle Woodland (n = 379) and Late Woodland (n = 557) periods, arguably when little barley was the most widespread in the East. The mean measurements for these samples vary between 2.62 and 2.63 mm for length and 1.27 and 1.32 mm for width, which are substantially larger than those for the charred seeds for Kansas.

Both Hordeum pusillum and H. jubatum (squirreltail barley) grow naturally in western Kansas (Natural Resources Conservation Service 2016). The differences between the plants themselves are

**Table 20.** Selected Direct Dates on Maize in Kansas

| Site number | Site name | B.P. | Median date | Reference |
|---|---|---|---|---|
| 14JN332 | Avoca | 1220±40 | 799 C.E. | Adair 2006 |
| 14EL313 | Kraus 1 | 1013±24 | 1014 C.E. | herein |
| 14SA414 | Kohr | 926±33 | 1099 C.E. | Roper and Adair 2011; Roper 2006b |
| 14SA1 | Whiteford | 870±40 | 1169 C.E. | |
| 14NT11 | | 864±30 | 1181 C.E. | Hoard and Bozell 2016 |



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easy to see. Squirreltail barley seed heads have long awns, giving them a fuzzy tail-like appearance, similar to the eponymous rodent. The awns of little barley are much shorter. Both are cool-season grasses that grow and mature before summer. They thrive in disturbed places, but squirreltail barley is a perennial grass and little barley is an annual grass (Yatskievych 1999). Their weedy habits make them good candidates for garden cultivation and domestication, but little barley has an evolutionary edge because it is an annual plant and not a perennial like squirreltail.

Distinguishing the two species from charred seeds is much more difficult. According to Yatskievych (1999), little barley fruits (seeds) are 2.7–3.2 mm long, while those of squirreltail barley are 3.0–3.5 mm long. Add to this the vagaries of shrinkage or puffing during charring, and the size difference is not sufficient to discern between the two species. For this report it is assumed that the seeds in the flotation samples are little barley, Hordeum pusillum, the more commonly identified species.

### Chenopod and Amaranth

Chenopods are another documented pre-maize cultigen in the Eastern Woodlands. When chenopod seeds are well preserved, the signs of domestication include squared-off seed margins and thin seed coats. Both changes allow for an increase in edible starch inside the seed and improve simultaneous germination, which farmers would favor.

Of the 24 taxa of Chenopodium noted on the USDA PLANTS website only five species are documented near Ellis County: C. album (lambsquarters, a complicated taxon with some subspecies introduced), C. berlandieri (pitseed goosefoot, domesticated in the Eastern U.S.), C. incanum (mealy goosefoot, a western taxon), C. *pratericola* (desert goosefoot, a western taxon), and *C. simplex* (maple-leaf goosefoot, mostly in the eastern half of Kansas). All of them are prolific seed producers, and many thrive in disturbed places. The greens, as well as the seeds, are edible. The mostly likely species present at 14EL333 is *C. berlandieri* with its rough, reticulated seeds.

It can be easy to discern the difference between seeds from a domesticated chenopod plant and a wild one, but the seeds with intermediate characteristics are harder to classify. They might be from plants encouraged in gardens but not actively selected, which would decrease selective pressures, or they might exemplify an intermediate stage in the domestication process. These are the types of seeds in the Kraus 1 samples. They display rough and reticulated seed coats typical of C. berlandieri (Yatskievych 1999) but exhibit a wide variety of diameters and seed coat thicknesses. They are commonly uncharred specimens, so many of the chenopod seeds were cracked during analysis to determine if they were charred. The charred chenopod seeds may have been cultivated or encouraged plants or gathered as wild plants.

### Hackberry

The hackberry (Celtis occidentalis [common hackberry] or C. laevigata [sugarberry]) seeds are represented by uncharred, light brown specimens and charred or calcined white, black, or bluish specimens. Uncharred hackberry seeds preserve for a long time in the archeological record due to their high calcium content, which is why they, like bone, can turn blue when heated. Hackberry fruit flesh and seed kernels are desirable to animals and humans alike. Humans can eat the fruit flesh fresh or process large amounts of the whole fruits for storage by pounding and drying (Hoard 2004; Hoard et al. 2005). Larger animals eat the whole fruits, while smaller animals can hoard the fruits in burrows and eat both the flesh and kernel inside the hard seed.

## Results

Overall, the recovery of charred plant remains was meager (Table 21); less than a half gram of carbon per 10-liter sample is extremely small for a site with so many artifacts. Although many of the sampled strata were dark, they apparently were not colored by flotation-recoverable charcoal but instead by non-recoverable organic staining. Charcoal density was highest in Feature 2. The number and diversity of species is scant and is indirect evidence that cultural activity either was low in intensity or variety, was not focused on plant food exploitation, or was a brief occupation.

### Uncharred Seeds

Except for the uppermost stratum, the A horizon, the number of uncharred seeds was relatively low. The density and diversity of taxa decrease with



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**Table 21.** Summary of Charred Remains from Analyzed Samples. SNE is seed number estimate.

| | Feature 2 894N 558E | Feature 21 888N 554E | Column 1 896N 558E | Column 2 888N 554E | Column 3 898N 558E | Column 4 904N 558E | Total/ Average |
|---|---|---|---|---|---|---|---|
| Number of samples | 8 | 2 | 8 | 8 | 10 | 10 | 46 |
| Total volume in liters | 65.00 | 14.00 | 74.50 | 67.50 | 92.00 | 91.00 | 404.00 |
| Total weight of charcoal >2mm | 1.97 | 0.28 | 0.77 | 0.86 | 0.43 | 0.09 | 0.73 |
| Average weight of charcoal >2mm/10 liters | 0.30 | 0.20 | 0.10 | 0.13 | 0.05 | 0.01 | 0.13 |
| SNE per 10 liters, excluding hackberry | 4.80 | 10.00 | 3.50 | 6.10 | 1.30 | 0.70 | 4.38 |
| Weight, charred and uncharred hackberry per 10 liters | 1.60 | 0.38 | 0.26 | 0.57 | 0.27 | 0.05 | 0.52 |

**Table 22.** Presence or Absence of Uncharred Seeds in the Column Samples, Sorted by Stratum.

| Latin name | Common name | A | B | A1 | A1B | A2 | B1 |
|---|---|---|---|---|---|---|---|
| *Amaranthus* sp. | Amaranth | X | X | X | X | X | X |
| *Euphorbia maculata* | Spurge | X | | | X | X | |
| *Chenopodium berlandieri* | Chenopod | X | X | X | X | | |
| *Mollugo verticillatus* | Carpetweed | X | | X | | | |
| *Helianthus* sp. achene | Sunflower | X | X | X | | | |
| Poaceae | Grass family | X | X | X | | | |
| *Sida spinosa* | Prickly fanpetals | X | X | X | | | |
| *Datura* sp. | Jimsonweed | X | | X | | | |
| | Purlsane | | | X | | | |
| *Rhynchospora* sp. | Beaksedge | | | X | | | |
| *Phytolacca americana* | Pokeweed | | X | | | | |
| *Euphorbia* sp. | Spurge | X | | | | | |
| *Hedeoma* sp. | False pennyroyal | X | | | | | |
| *Polygonum* sp. (trigonal) | Knotweed | X | | | | | |
| *Scirpus* sp. | Bulrush | X | | | | | |
| *Solanum ptycanthum* | Black nightshade | X | | | | | |

depth in the flotation columns (Table 22). The feature samples contained about the same amounts as the column samples. Most of the recovered and identified taxa are common weedy plants that grow in disturbed places, while the sedge and rush seeds indicate that seeds from plants growing in the Big Creek valley are being introduced onto the top of the landform. However, stream downcutting is documented in the High Plains around 1000 C.E. (Hall 1988, 1990), so the Kraus 1 living surface may not have been far above Big Creek when the site was occupied. Ants are known to gather and cache seeds in their nests, and small mammals do the same. In short, uncharred seeds in the flotation samples, with the possible exception of hackberry, are assumed to be recent introductions.



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Features

*Feature 2*

Feature 2 was a shallow ashy pit above Stratum 1A in 894N 556E and 558E. Eight flotation samples, totaling 65 liters (Tables 21 and 23), were removed during the excavation and are treated as a single analysis unit. Although the number of charred items is very low, this is the most productive set of samples from the site and yielded some of the best-preserved items. A total of 171 wood fragments, the bulk of the recovered plant remains, weighed 1.61 g. Of the 124 wood fragments that were identified to taxon, about half are ash, half are elm family, and two are walnut (Table 24). These taxa would have been common in the Big Creek valley. A few fragments of bark, grass stem, twigs, and grass rhizomes are present in the >2-mm and <2-mm fractions.

The most surprising find was a whole maize kernel, missing its embryo. It is 6.8 mm wide, 6.0 mm high, and 5.3 mm thick. Remnants of the dimpled surface covering were preserved in a few places (Figure 67). This kernel was submitted for an AMS assay and produced an age of 1013 ± 24 B.P. with a median probability of 1014 C.E. (Table 21). This date is earlier than dates from Keith phase site 14NT11 and the Middle Ceramic Kohr and Whiteford sites discussed above.

The $\delta^{13}C$ value for the Kraus 1 maize kernel was measured at –8‰, which is slightly less negative than the commonly cited values of –17‰ to –9‰ (O'Leary 1981 cited in Tieszen 1991; Schoeninger 1989). Katzenberg et al. (1995:337) and Tieszen and Fagre (1993) advise that archeological materials might have to be adjusted by –1.5‰ to account for anthropogenic processes.

**Table 23.** Summary of Charred Material Larger than 2 mm from Feature 2.

| Category | Type | Count | Weight |
|---|---|---|---|
| Fuel and construction | Wood | 171 | 1.61 |
| | Bark | 5 | 0.03 |
| | Bark, not fully charred | 1 | t |
| | Twig | 2 | 0.01 |
| | Twig or vine | p | |
| | Grass stem | 1 | t |
| | Grass or herb stem | p | |
| Maize | Kernel, whole | 1 | 0.05 |
| | Kernel fragments | 4 | 0.04 |
| | Kernel fragments, possible | 3 | 0.03 |
| | Radicle, possible maize | p | |
| Other | Rhizomes | 2 | t |
| Indeterminate | Indeterminate | 31 | 0.20 |
| Totals | | 221 | 1.97 |

p = present in <2.0-mm fractions

t = trace

Kernel fragments in two samples and possible kernel fragments in two other samples were found. A radicle (embryonic root) in a sample might not be from a maize kernel. No readily visible remains from 14EL313 resemble cupule or cob parts; however, two phytoliths from a maize cob, discussed further below, were acquired from a pottery sherd.

One whole seed (Figure 68) and seven fragments of charred little barley were obtained from three samples (Table 25). A discussion of the two taxa of Hordeum was presented above, and for analysis purposes the species is presumed to be Hordeum pusillum. The whole little barley seed was submitted for a direct AMS age determination of 1016 ±

**Table 24.** Summary of Identified Wood from Features 2 and 21.

| | | Feature 2 | | Feature 21 | | Total | |
|---|---|---|---|---|---|---|---|
| Type | Common name | Count | Weight | Count | Weight | Count | Weight |
| Ring porous | | | | | | | |
| *Fraxinus* sp. | Ash | 60 | 0.43 | 16 | 0.12 | 76 | 0.55 |
| Ulmaceae | Elm family | 62 | 0.75 | 8 | 0.04 | 70 | 0.79 |
| Semi-ring porous | | | | | | | |
| *Juglans nigra* | Black walnut | 2 | 0.01 | 1 | 0.01 | 3 | 0.02 |
| Indeterminate | | | | 5 | 0.04 | 5 | 0.04 |
| Totals | | 124 | 1.19 | 30 | 0.21 | 154 | 1.40 |



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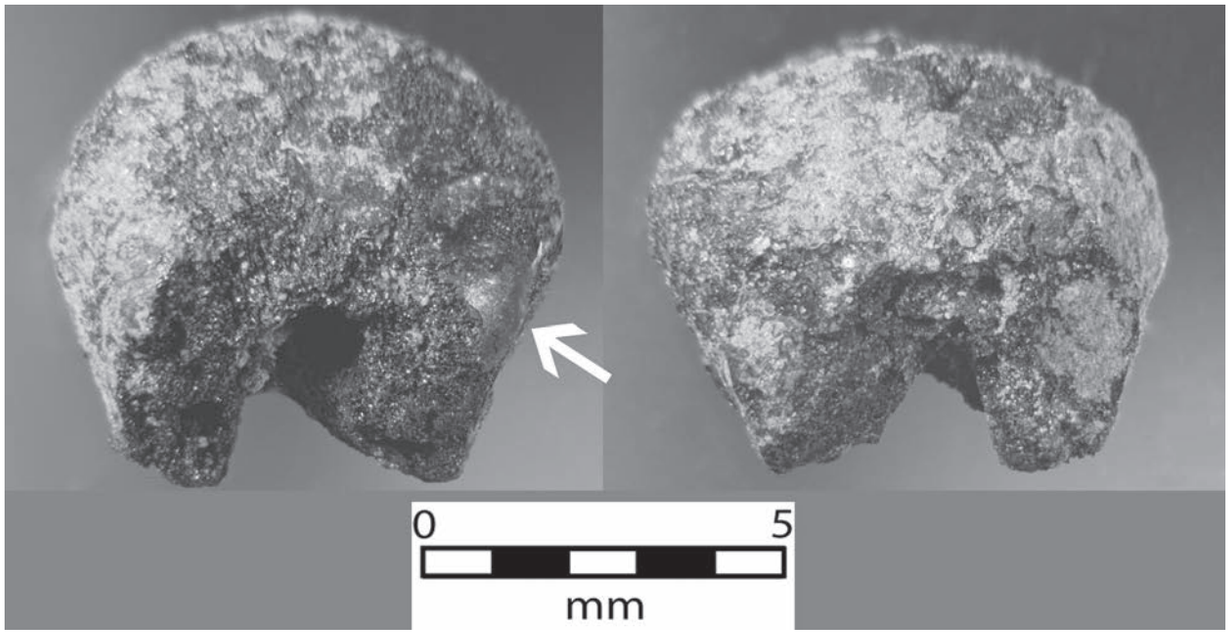


**Figure 67.** Both sides of kernel from Feature 2, catalog number 404-20, with arrow indicating preserved surface texture. This kernel was directly dated to 1014 C.E.

**Figure 68.** Both sides of a small, well-preserved little barley seed from Kraus 1, Feature 2, catalog number 400-11. This seed was directly dated to 1012 C.E.

24 B.P. with a median probability of 1012 C.E. This date is almost identical to the one from the maize kernel recovered nearby.

Four of the eight samples yielded five whole and five fragmentary chenopod seeds. The chenopod seeds from the entire site embody a variety of shapes and sizes that either were harvested from encouraged garden plants that were being grown as a source of greens or are seeds that represent naturally occurring weeds.

The uncharred hackberry specimens (9.37 g) are much more common than the charred specimens (1.05 g), but only the charred can be attributed to cultural activities.

If a cultural origin is accepted, one grape seed fragment can help ascertain the season of site occupation: late summer. A few miscellaneous seeds of spurge, grass, and bedstraw are assumed to be natural inclusions.

*Feature 21*

Feature 21 was an ash lens in 888N 554E. Two samples from it were analyzed. Only a few fragments of charcoal >2 mm were recovered: 37 wood fragments, a few small fragments of twig and similar items, and 4 indeterminate fragments. Wood and seed taxa are less numerous but similar types to those from Feature 2. Chenopod, grape, bedstraw, and hackberry seeds are represented by a few fragments each (Table 26).

Charred flesh adheres to the whole grape seed and three fragments, which means the entire fruit was exposed to fire. Possibly this fruit represents a stored dried grape in the form of a seedy raisin, but more likely the grape was part of a harvest that landed near a hearth and was burned and preserved. Grapes ripen in late summer.



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**Table 25.** Summary of Seeds from Feature 2. SNE is seed number estimate.

| Category | Latin name | Common name | Whole | Fragment | SNE |
|---|---|---|---|---|---|
| Cultigen | *Hordeum pusillum* | Little barley | 1 | 7 | 6 |
| Equivocal cultigen | *Chenopodium berlandieri* | Chenopod | 5 | 5 | 9 |
| Fleshy fruit | *Celtis* sp., charred | Hackberry | | 164 | 16 |
| | *Celtis* sp., uncharred | Hackberry | 9 | 954 | 144 |
| | *Vitis* sp. | Grape | | 1 | 1 |
| Grass | Poaceae | Grass family | | 1 | 1 |
| Miscellaneous | *Euphorbia maculata* | Spurge | 2 | | 2 |
| | *Galium aparine* | Bedstraw | 1 | | 1 |
| Indeterminate | Indeterminate | Indeterminate | | 9 | 9 |
| Unknown | Unknown bony seed | Possible misshapen *Celtis* | 1 | 5 | 2 |
| Totals | | | 19 | 1,146 | 191 |

**Table 26.** Summary of Seeds from Feature 21.

| Category | Latin name | Common name | Whole | Fragment | SNE |
|---|---|---|---|---|---|
| Equivocal cultigens | *Chenopodium berlandieri* | Chenopod | 9 | 1 | 10 |
| Fleshy fruit | *Celtis* sp., charred | Hackberry | | 11 | 1 |
| | *Celtis* sp., uncharred | Hackberry | | 54 | 7 |
| | *Vitis* sp. | Grape | 1 | 3 | 2 |
| Miscellaneous | *Galium aparine* | Bedstraw | | 1 | 1 |
| Indeterminate | Indeterminate | Indeterminate | | 1 | 1 |
| Totals | | | 10 | 71 | 22 |

Column Samples

Samples from four columns were analyzed. They are numbered in the order they were studied, which correlates with their order of priority (Table 27). Column 1 was 2 m north of Feature 2 in 896N 558E; Column 2 was in the southernmost unit, 888N 554E, which contained Feature 21; Column 3 was in 898N 558E near the center of a series of excavation units that ran north to south; and Column 4 was from 904N 558E, the northernmost unit of the north-to-south line (Figure 21). Column 1 held a moderate density of remains. Column 2 from the west wall of 888N 554E had the highest density of charred plant remains and quite a bit of mussel shell. Remains in Columns 3 and 4 decrease to the north.

Figure 69 shows how the charcoal is distributed within the strata of the columns. The greatest densities of charcoal are from either Stratum A1B or A2, depending on which column is examined. Wood is the most common charred plant residue in the column samples. Wood fragments from the Column 1 and 2 samples were identified to taxon, and, like the Feature 2 and 21 samples, half of the 124 identified fragments are ash, half are elm, and the one outlier is willow family, probably cottonwood. No unequivocal maize was recognized in any of the column samples. There are several specimens that might be maize, but their preservation was not good enough to verify.

Little barley was present in samples from Columns 2 and 3, and possible little barley was identified in samples from Columns 1 and 2 (Table 28). Remains identified as possible little barley are the correct size and texture for little barley, but the diagnostic sulcus (groove) and embryo scar are not preserved. Figure 70 shows poorly preserved but identifiable little barley, so the possible little barley seeds exhibit even worse preservation than the examples here.

A SNE of 39 of chenopod seeds came from the



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**Table 27.** Charcoal Larger than 2 mm from Column Samples.

| Column | | 1 | | 2 | | 3 | | 4 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Count | Weight | Count | Weight | Count | Weight | Count | Weight | Count | Weight |
| Volume of flotation samples (liters) | | 74.5 | | 67.5 | | 92 | | 91 | | 325 | |
| Fuel and Construction | | | | | | | | | | | |
| | Wood | 72 | 0.68 | 90 | 0.65 | 43 | 0.40 | 16 | 0.09 | 232 | 1.83 |
| | Bark | | | 2 | 0.01 | | | p | | 2 | 0.01 |
| | Stem | p | | | | | | | | p | |
| | Twig | | | | | p | | | | p | |
| | Twig or vine | | | 1 | t | | | p | | 1 | t |
| | Bud | p | | | | | | | | p | |
| | Bud, possible | | | | | p | | | | p | |
| | Fungal tissue | | | | | | | p | | p | |
| | Bark or fungus, not fully charred | 1 | 0.02 | | | | | | | 1 | 0.02 |
| Maize, possible | | | | | | | | | | | |
| | Kernel fragments | 1 | t | | | p | | p | | 1 | t |
| | Cupule fragment | | | | | | | p | | p | |
| Other | | | | | | | | | | | |
| | Rhizomes | 1 | t | 1 | t | | | p | | 2 | t |
| Indeterminate | | | | | | | | | | | |
| | Indeterminate | 13 | 0.07 | 21 | 0.20 | 5 | 0.03 | p | | 38 | 0.29 |
| Totals | | 88 | 0.77 | 115 | 0.86 | 48 | 0.43 | 16 | 0.09 | 267 | 2.15 |

p = present in <2.0-mm fractions

t = trace

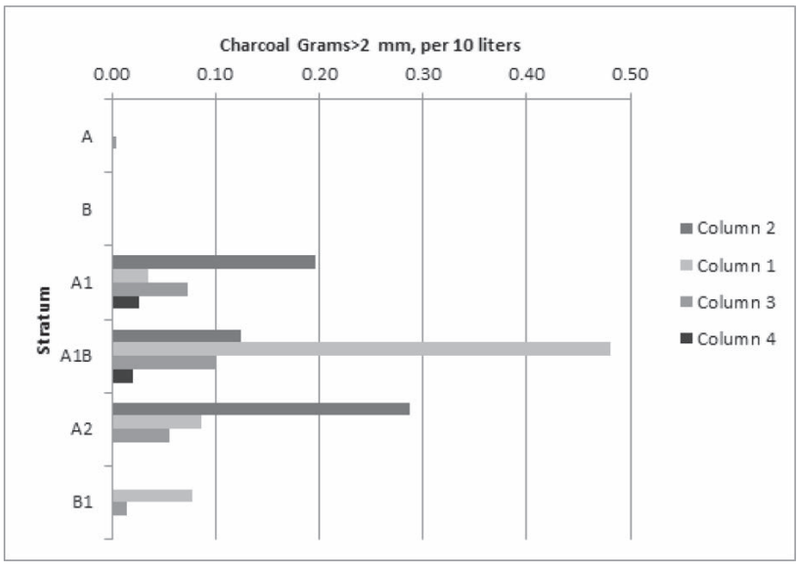


**Figure 69.** Total weight of charcoal larger than 2 mm in the column samples by stratum. The columns are presented in order from south to north.



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**Table 28.** Summary of Seed Data from the Four Column Samples.

| Column | 1 | | | 2 | | | 3 | | | 4 | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Portion | Whole | Fragment | SNE | Whole | Fragment | SNE | Whole | Fragment | SNE | Whole | Fragment | SNE | Whole | Fragment | SNE |
| Equivocal cultigens | | | | | | | | | | | | | | | |
| Little barley | | | | | 5 | 5 | | 4 | 3 | | | | | 9 | 8 |
| Little barley, possible | | 2 | 2 | | 1 | 1 | | | | | | | | 3 | 3 |
| Amaranth | | | | 1 | | 1 | | | | | | | 1 | | 1 |
| Chenopod | 18 | | 18 | 15 | 2 | 17 | 2 | | 2 | 2 | | 2 | 37 | 2 | 39 |
| Fleshy fruit | | | | | | | | | | | | | | | |
| Hackberry, charred | | 34 | 0.23 g | | 67 | 0.59 g | | 32 | 0.20 g | | 9 | 0.05 g | | 142 | 1.07 g |
| Hackberry, uncharred | | 252 | 1.68 g | | 589 | 3.29 g | | 389 | 2.30 g | | 83 | 0.38 g | | 1,313 | 7.65 g |
| Grass | | | | | | | | | | | | | | | |
| Grass family | | | | | 3 | 3 | | | | | | | | 3 | 3 |
| Grass family, festucoid | 1 | | 1 | | | | | | | | | | 1 | | 1 |
| Miscellaneous | | | | | | | | | | | | | | | |
| Spurge | | | | | | | | 1 | 1 | | | | | 1 | 1 |
| Bedstraw | | 2 | 2 | | 10 | 4 | | | | | | | | 12 | 6 |
| Dock | | | | 1 | | 1 | | 1 | 1 | | | | 1 | 1 | 2 |
| Indeterminate | | 2 | 2 | | 9 | 7 | 2 | 3 | 5 | | 1 | 1 | 2 | 15 | 15 |
| Indeterminate, possibly misshapen *Celtis* | | 1 | 1 | 1 | | 1 | | | | 3 | | 3 | 4 | 1 | 5 |
| Totals | 19 | 293 | 26 | 18 | 686 | 40 | 4 | 430 | 12 | 5 | 93 | 6 | 46 | 1,502 | 84 |

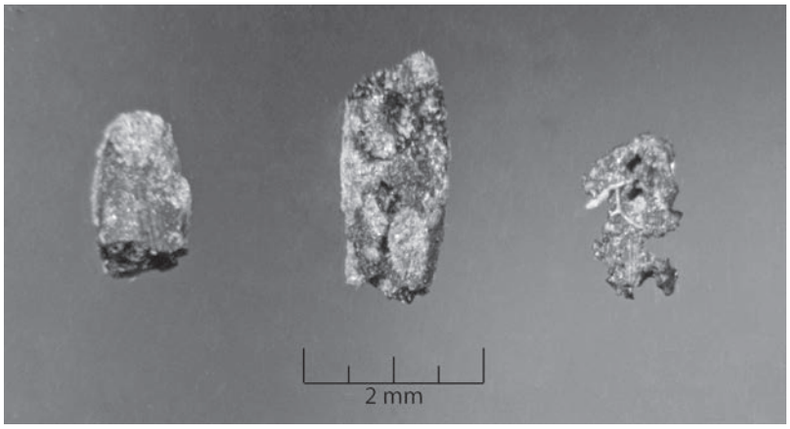


**Figure 70.** Three little barley seeds from Column 2 sample, catalog number 385, showing typical preservation.



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column samples but were most common in Columns 1 and 2. Of the miscellaneous seeds, bedstraw is the most common. Its sticky seeds attach easily to clothing, fur, and hair.

## Phytolith Analysis

Dr. Steven Bozarth (2006) of the University of Kansas determined that two maize cob phytoliths adhered to one sherd (catalog number 306) from 896N 560E at 39 cmbs. Another sherd (catalog number 318) from 900N 554E at 78 cmbs, yielded no evidence of food-producing taxa. Two scutiforms similar to little barley seed capsules were found, but no dendriforms, common to the little barley seed heads were present.

## Discussion

Fifty-six flotation samples from Feature 2, Feature 21, and four stratigraphic columns were analyzed. The amount of charcoal in the flotation samples is surprisingly sparse, given the dark color of the excavated deposits and large amounts of burned bone and burned Smoky Hill silicified chalk. Hackberry fruits and grapes were available for gathering, as were several species of weedy (if not cultivated) annual plants, such as chenopod and grasses. Wood for fuel was gathered from the creek valley in the immediate site area. About half of the wood was identified as ash and about half as elm family, which incorporates elms and until recently hackberry. A few fragments of black walnut and willow family, which includes cottonwood, were recovered.

A whole maize kernel, directly dated to 1013 ± 24 B.P. (median probability of 1014 C.E.), and one whole little barley seed, dating to 1016 ± 24 B.P. (median probability of 1012 C.E.), both from Feature 2, add new pieces of the puzzle for horticulture in the western half of Kansas. The two maize cob phytoliths, attached to a potsherd, are other, rarer pieces of the same puzzle. No identifiable farming tools were found.

Until very recently no direct evidence of domesticated plant use or cultivation has occurred in Keith phase sites (Adair and Drass 2011:311–319). Horticultural tools, such as scapula hoes and bone digging stick tips, typical of later CPt sites, generally are absent from Keith phase sites, including the Kraus 1 site. Adair (2006:57) noted the lack of agricultural tools in Middle Woodland sites farther east where horticulture has been substantiated. There are exceptions. Grange (1980:122) documented a well-polished bison scapula that he interpreted as a digging tool from the Keith phase component of the Doyle site, and Kivett and Metcalf (1997:27–30) described a modified bison scapula that may be a digging tool from the Keith site. Still, these could have been made to dig house floors, pits, and graves and may have nothing to do with cultivation.

Analysis of Kraus 1 materials provides two lines of evidence that maize was used, if not cultivated: kernel fragments and maize cob phytoliths in ceramic cooking pot residue. There also is a possible maize cupule fragment from the column samples. Blasingham (1963:27) reported at least 20 kernels of charred maize in an undisturbed midden and pits at 14NT11, a multi-component Keith phase and CPt site in Norton County, northwest Kansas. Radiocarbon assays on a maize kernel and a cupule from 30 to 45 cmbs, within the Keith phase component, produced ages of 989 ± 31 and 864 ± 30 B.P., respectively, and thus are terminal Keith phase or initial CPt (Table 1). This alone does not support an assertion for Keith phase horticulture. The low incidence of maize from High Plains Early Ceramic sites suggests that it was not a dietary staple and may only have been used socially in rituals, feasting, and similar activities before it became a subsistence crop during the Middle Ceramic (Gilmore 2008:63–65). Maize at 14EL313 and 14NT11 could have been received as trade goods. If the maize was locally grown, it was at an earlier date for maize horticulture on the High Plains than is generally accepted.

East of the Keith phase in eastern Kansas and Nebraska and western Iowa and Missouri, evidence of horticulture is recognized in Early, Middle, and Late Woodland period sites that are earlier than or contemporaneous with the Keith phase (Adair 1991, 2003, 2006:256–257; Adair and Drass 2011:Figure 12.3; Reynolds 1979). Sites in the Oklahoma panhandle and on the western edge of the Great Plains and Rocky Mountain foothills in Colorado have directly dated maize coeval with Kraus 1 specimens (McKay et al. 2004 cited in Adair and Drass 2011:311–317; Gilmore 1991:176, citing an unpublished manuscript by Short and Stravers [1981]; Gilmore 1999; Kalasz et al. 1999; Zier and Kalasz 1999; also see Hoard and Bozell 2016:73–74 for



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a discussion of this topic). Future Keith phase flotation samples and other botanical samples might recover additional proof of maize and other cultivated plants.

The low density of Kraus 1 archeobotanical remains, considered by themselves, indicate a short-term use or, more likely, repeated short-term uses of the occupants. The charred grape seed with adhering flesh minimally argues for a summer occupation where maize and other cultivated plants were used but probably not grown.

## CONCLUSIONS

### *Distribution of Cultural Material at the Kraus 1 Site*

Cultural material is most highly concentrated in the southeast corner of the site, south of 897N and west of 563E (see Figures 26, 49, and 50). This distribution is similar for bone and shell, daub, burned earth, fused silica, mud dauber nests, ground and battered stone, and all debitage and chipped stone tools except for projectile points. Several large pottery sherds from 900N 554E skew that distribution from the norm. A similar situation exists for points, which were concentrated in 898N 564E. Therefore, most activities took place on a small part of the landform, which itself is quite restricted. Hopes for indications of differential distribution of tasks or the location of a residential feature–a house–were not realized.

The vertical distribution of materials suggests mixed deposits. The relative density of all cultural material is highly correlated with the Buckner Creek paleosol, which was evident while excavating and in profiles in completed units. On the other hand, differential vertical distribution of potentially time diagnostic artifacts—one of the dart points and the side-notched points in particular—is not apparent. One dart point was found at 29 cmbs in a level with Harlan cord-roughened pottery, and above corner-notched arrow points recovered in that unit. The dart point fragment was 10–20 cm deeper, well into the Keith phase cultural layer. As noted earlier, the transition from atlatl and dart to bow and arrow occurs during the Keith phase. Finding a dart point near the top of archeological deposits could attest that deposits within the paleosol were mixed, which is likely, or that dart points persisted throughout the Keith phase, for which there is ample evidence.

Side-notched points were expected in the upper levels, if they were later than corner-notched points, but at 14EL313 they were found between 10 and 60 cmbs—throughout what is interpreted as the Keith phase occupation. The late age of the site and the presence of both corner- and side-notched arrow points signals a transition from the Early Ceramic corner-notched point style to the later side-notched arrow points, characteristic of the Middle Ceramic CPt. This may in fact be the case, but it is not supported by the provenience of the side-notched points, three of which came from between 30 and 60 cmbs. One was picked up on the ground surface. No temporal sorting of side-notched points is obvious at the Kraus 1 site.

There are six radiocarbon assays: one on charcoal acquired during auger testing, three on bone from excavation units, and two from Feature 2—one on a little barley seed and one on a maize kernel (Powell 2016b and herein). The three bone samples were selected with the intent of dating the sediments below, within, and above the Buckner Creek paleosol. The results, however, are not in orderly progression of lower samples being older and shallower samples being younger. These three median dates vary by only 32 years, and they overlap substantially at both the one sigma and two sigma ranges. This suggests that the material in the heart of the paleosol may represent either one event or a series of closely spaced events. It also may indicate that a considerable amount of sediment disturbance has occurred. Animal burrows are evident in the cut banks of the site and in unit floors and profiles, which may explain why features are so diffuse. Unfortunately, the two dates from the top of the paleosol in Feature 2 are the two oldest dates and do not overlap with the other three; instead they are significantly older (see Table 1). The determinations from Feature 2 were run on annual plant remains, and the other three dates were run on bone. This raises concerns regarding the uniformity of assays run on bone versus plant remains.

### *Past Climate*

The Scandic climatic period from 1,700 to 1,250 years ago was a period of warmer temperatures, followed by the warm, moist Neo-Atlantic period from



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1,250 to 850 years ago (Wendland 1978:281). This correlates with the greater part of the Keith phase. More recent analysis, using stable isotopes as well as archeofaunal assemblages, pollen, mollusk, and geomorphological data, provide information that a wetter climate was in place by 350 B.C.E–1000 C.E. for north-central Texas, the Osage Plains of Oklahoma, Kansas, Nebraska, and the Dakotas, then turning drier after 1000 C.E. (Dillehay 1974; Hall 1988:206–209, 1990; Hall et al. 2012; Nordt et al. 2007). Miller's unionid analysis for this study provides evidence that Big Creek was actively flowing during the summer months, indicative of more rainfall. Hall (1988, 1990; also see Boyd 1997:218, 220–223, 226–231) documents the onset of sand dune accumulation and stream valley incision after 1000 C.E. Proof of this at the Kraus 1 site is contained in a profile of the cut bank on the west side that shows an alluvial gravel layer at a depth of 210 cmbs (Figure 71). This is the depth of Soil 3 in the stratigraphic column, as displayed in the Giddings rig core, which probably is the Hackberry Creek paleosol that formed from 2,800 to 2,000 years ago (Mandel 1994:65–66). This suggests that the stream bed was much higher and much closer to the present-day surface in the relatively recent past and probably during the Kraus 1 occupation.

A cooler and moister climate may have made the High Plains more habitable overall and would have supported more plant species, especially broadleaf plants over grasses. It is plausible that plant cultivation would have been more likely to succeed in the High Plains during the Early Ceramic than it would have during the Late Archaic.

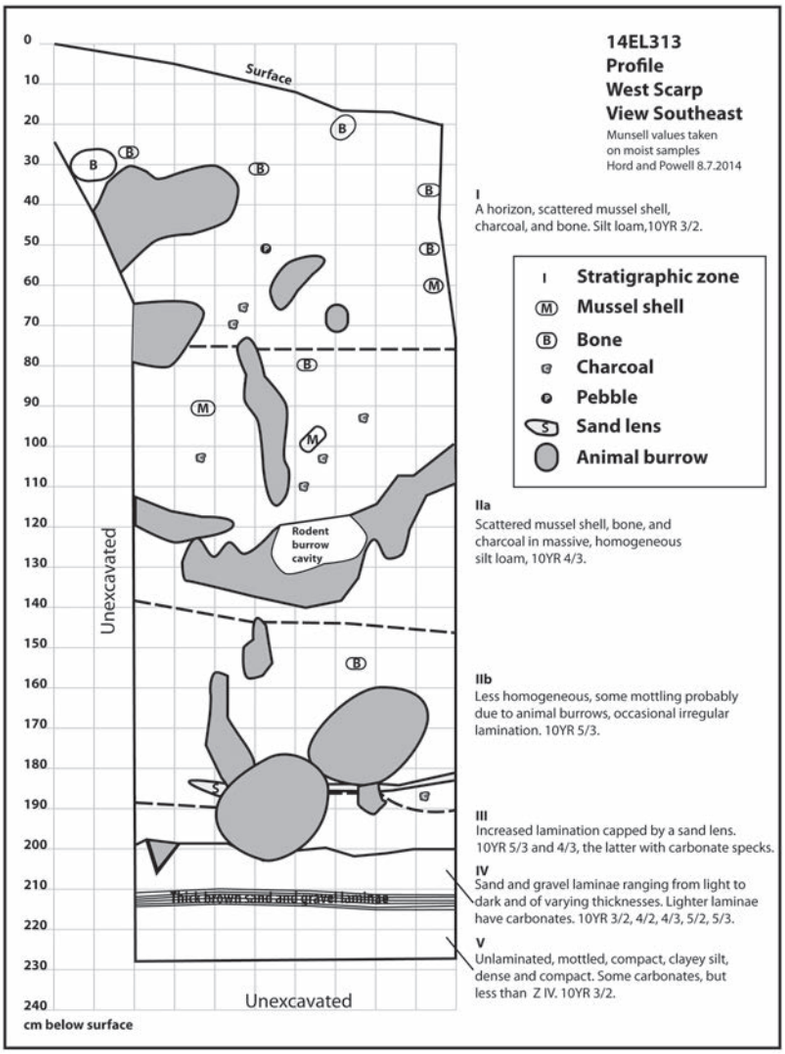


**Figure 71.** Profile of the cut bank on the west edge of Kraus 1.



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### *Horticulture*

To effectively argue that the Keith phase represents a horticultural population, direct and substantial evidence of domesticated plants and a settlement system and technological base consistent with low-level plant food production are required. In the Keith phase region, supporting data would include a climate more conducive to regional plant food production than exists today. Maize acquired so far from 14EL313 and 14NT11, dating after 1000 C.E., does not undisputedly establish that Keith phase people were raising domesticated plants, especially in the absence of clearly domesticated native plant remains. However, the analysis of Kraus 1 flotation samples is a first for the Keith phase, and phytolith analysis has been conducted on artifacts from only two Keith phase sites: 14EL313 and 14SD351 (Hoard et al. 2005). More intensive and focused efforts to address this research question are reasonable approaches.

### *Population And Site Distribution*

The number of Keith phase sites is significantly higher than Paleoindian or Archaic period sites in the Kansas and Nebraska High Plains. Data collected from site forms in 2013 from 47 counties within Keith phase boundaries in Kansas show an increase of three and one half times as many recorded sites between the Archaic and the Keith phase (Figure 72). There are 97 Archaic sites, 343 Keith phase sites, and 472 Middle Ceramic CPt sites. The increase in documented Keith phase sites is especially true of burials. Whereas Paleoindian and Archaic burials are practically unknown from the High Plains of Kansas and Nebraska (Hoard et al. 2004:730–735), there are several from the Keith phase (Hoard et al. 2005:266, 272–273), and some of these are burials of multiple individuals, representing inhumations from small habitation sites over time (see Roper 2006: 384–425 for a CPt instance of this). An example is Woodruff Ossuary about 120 km north of the Kraus 1 site, where a minimum of 54 individuals were buried in closely spaced pits. Thus, these populations were living in areas for long enough periods that many burials could accumulate. In Nebraska a number of Keith phase sites have multiple interments: 25HN1 (Marshall), 25FR2 (Dunn), 25FR9 (Holdrege 5), 25HN2 (Orleans), 25HN4 (Flag Creek), 25WT3 (Guide

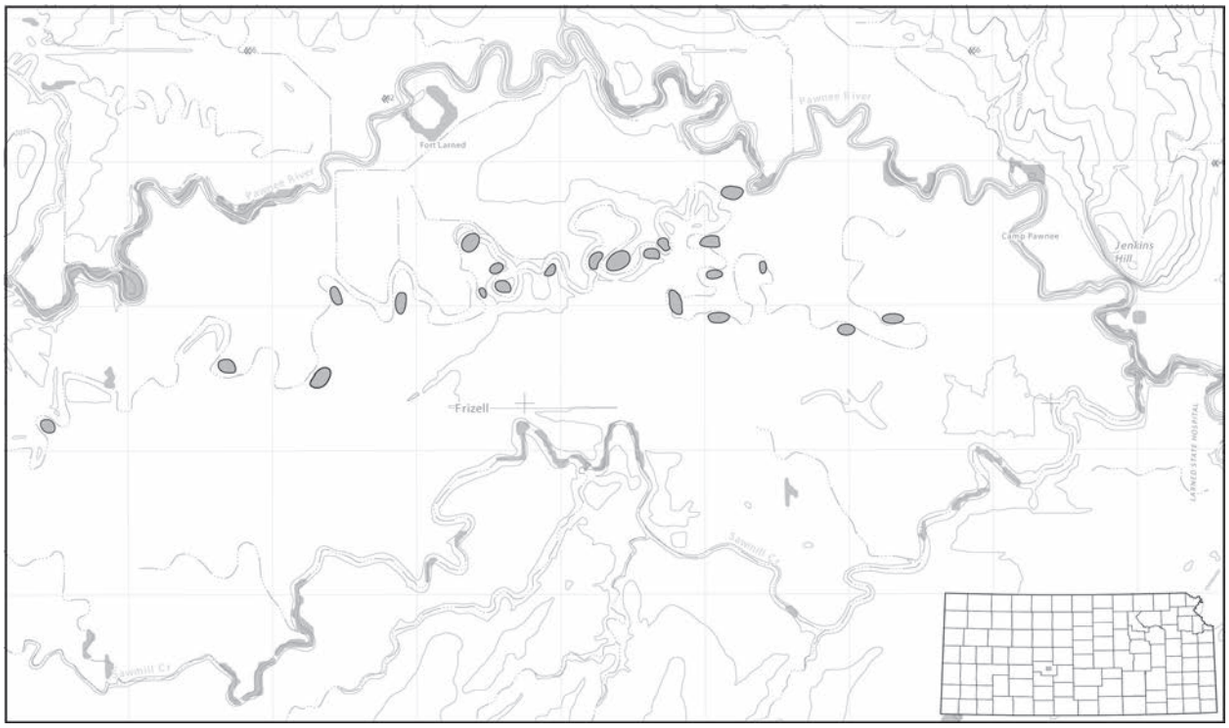


**Figure 72.** Keith phase site density in Pawnee County, Kansas.



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Rock), and 25WT4 (Robb) (Kivett 1953; Strong 1935).

The heavy utilization of mussels and other small and diverse animal species, such as birds, also may result from a more settled way of life. Use of mussel shell for ornaments became widespread during the Keith phase, as demonstrated by the thousands of mussel shell disk beads interred with burials at Woodruff Ossuary (Kivett 1953) and Marshall Ossuary (Strong 1935:116–122). Many small bird bone beads have been found in Keith phase burial sites, such as Pfaff and Young.

Finally, the increasing number of radiocarbon assays on samples from Keith phase sites shows an interesting trend: sites in Nebraska are earlier than those in Kansas (see Table 1). Only 1 of the 16 calibrated dates more recent than 1000 C.E. is from a Nebraska site; the other 15 are from Kansas. This suggests that Keith phase occupations in Kansas are later than those in Nebraska (Hoard 2016). New AMS age determinations from Nebraska sites would be useful, as most of the existing ones are the conventional type, and many are run on charcoal, while most Kansas age determinations are done on bone or annual plant seeds, employing AMS. The latter methods avoid sample problems, such as using charcoal from wood that may have rings that substantially predate the burning event (Schiffer 1986), and may be more accurate and precise.

The Kraus 1 site was occupied at a time when a foraging or possibly an incipient agricultural mode of living began to give way to one dependent on maize and intensive bison hunting. Radiocarbon ages from 14EL313, if evaluated without considering associated artifacts, could reasonably be placed in the CPt (Roper and Adair 2011), but it is not a part of that tradition. It has very little pottery, and the paste, shape, thickness, and surface treatment of that pottery are indications of the earliest potters in the region. Maize is represented but in a small way, so the occupants clearly were not dependent on it and likely were not growing it. Kraus 1 is an Early Ceramic Keith phase site.

Yet it does not fit well with coeval sites in the region. It has few of the bone and shell tools and ornaments commonly seen in the Keith phase; there are few clear features and no clear hearths, little pottery, few scrapers, and few of the chopping tools that are typical. In contrast, there are many projectile points, nearly all side- or corner-notched arrow points, that are whole, broken, or works in progress. There is much bone, most of it broken.

### *Summary Description Of The Kraus 1 Site*

Reflecting on the nature of the assemblage, the tight correlation of cultural material with the Buckner Creek paleosol, and the significant overlap of the radiocarbon ages, except for those from Feature 2, a plausible explanation is that the site represents one or possibly several kill and initial processing events. One or more of these would have been warm season events, as suggested by the selective mussel harvesting described in Miller's unionid analysis and by the findings of Powell's paleoethnobotanical analysis. This specialized focus would explain the lack of diversity of the toolkit, the absence of long occupation features, such as a well-used hearth or house, the large volume of bone and broken projectile points, and the relative absence of bison elements that constitute desirable meat packages. In this light the 14EL313 site can be viewed as a short-lived special use area, possibly visited several times over a few decades. This site possibly foreshadows the more focused bison hunting in the following Middle Ceramic period.

The Kraus 3 site (14EL315) is just upstream. This site, eroding out of the bank of Big Creek, has a hearth, a diagnostic corner-notched projectile point (Figure 73), and a radiocarbon age slightly earlier than the Kraus 1 bone dates. The hearth from this site has been excavated and awaits analysis, but 14EL315 could be a nearby example of a more typical Keith phase hamlet. Other recently discovered sites line the bank of Big Creek in both directions for more than a mile. Two of these have diagnostic Keith phase artifacts, and several others could have Keith phase components. Further investigation of these sites could provide information on semi-mobile communities in the region during a time of more prolific vegetation, a growing human population, and a rapidly changing technology.

The period of 1000–1100 C.E. lies between the central technological and behavioral tendencies of Early Ceramic or Plains Woodland period and Middle Ceramic period, as exemplified in the north-central Great Plains as part of the CPt. Before 1000 C.E. there is little reliably dated evidence of



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**Figure 73.** Projectile point from 14EL315, just upstream from Kraus 1.

earthlodge hamlets and substantial maize cultivation on the High Plains of Kansas. After 1000 C.E. maize and earthlodges are common; ceramic cooking vessels are round, have short, distinct rims, and often are decorated; and arrow points are routinely triangular and side-notched. The Kraus 1 site lies between these two technological systems. This is to be expected and typifies a period where novel trends in habitation structure and food production took place, being adopted more quickly by some people and more slowly by others.

Finally, the Keith phase may be time transgressive, developing in Nebraska and spreading south into Kansas. More radiocarbon assays can help confirm or deny this. The Kraus 1 component is securely associated with the Buckner Creek paleosol, which is indicative of a more productive biome than before and after its formation. This environment produced conditions favorable to an increase in carrying capacity for a human population, offering a possible explanation for an expansion of what is known as the Keith phase.

## ACKNOWLEDGMENTS

The Kraus family of Ellis County makes significant contributions to the understanding of the history and prehistory of the region. Their assistance was critical to this project. Special thanks to Kenneth and Dorothy Kraus, who allowed the investigation on their property and donated the collection to the Kansas Historical Society, and to Charlie Kraus, who discovered the site, helped with logistic arrangements, and provided insights on the site environment and available resources. Kansas Anthropological Association volunteers excavated the site and washed and cataloged the artifacts. Special thanks go to KAA members Deb Aaron and Nancy Arendt for organizing daily field activities, Chris Hord for logistical help and interpretive insights, Sharon Sage for coordinating water screening, and Mary Conrad for supervising initial artifact processing. Tod Bevitt alerted excavators to the fused silica at the site and to its potential significance.

Thanks are due to the Kansas Historical Society administration and staff, especially Virginia Wulfkuhle, who organized and launched the training program for more than two decades; Chris Garst, who ran the lab; Gina Powell, who provided paleoethnobotanical sampling strategies, sample collection, and analysis; and Tricia Waggoner, who guided the mapping process and conducted the total station fieldwork. Tim Weston conducted a survey along Big Creek, increasing understanding of site density in the region.

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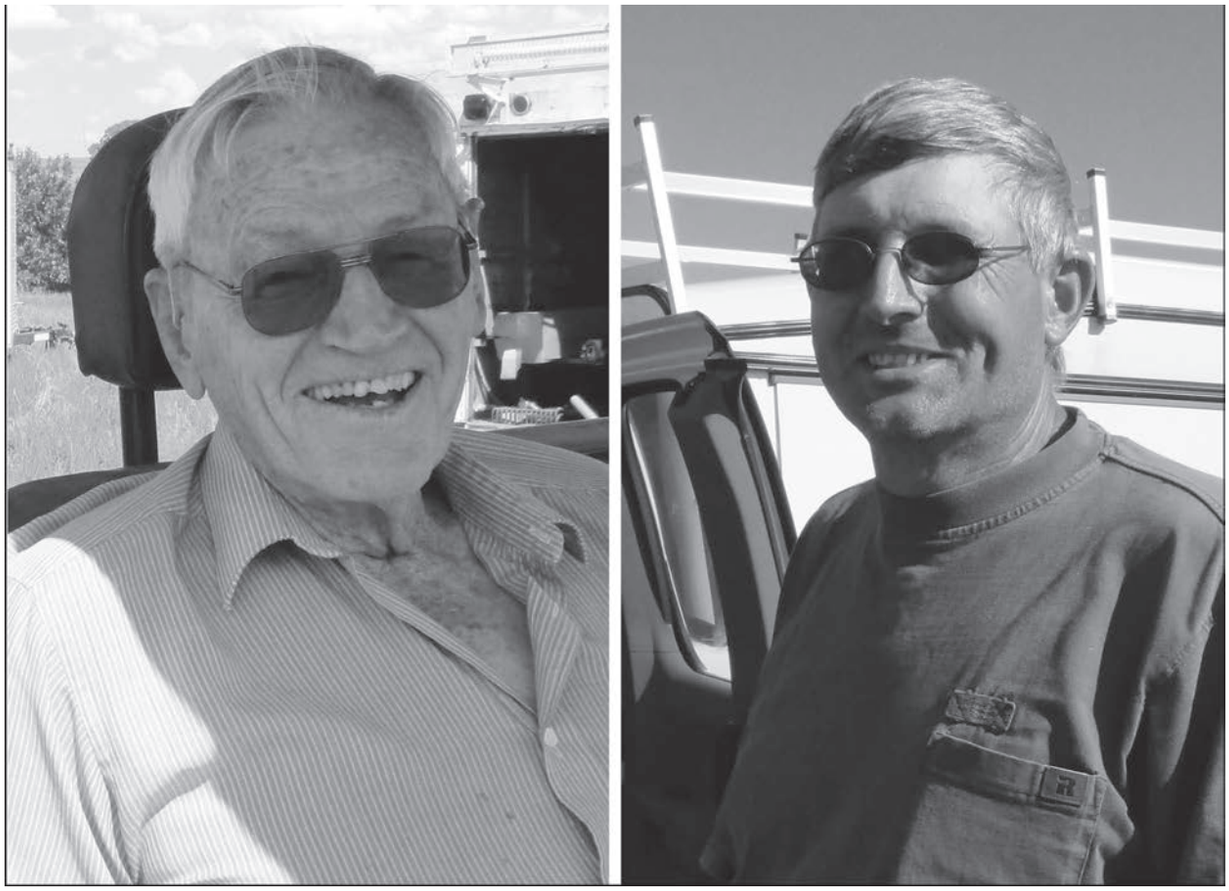

Ken Kraus (left), who allowed excavation on his property, and Charlie Kraus (right), who discovered the site and made KSHS staff aware of it.

## REFERENCES CITED


Adair, Mary J.

1991 Macrobotanical Remains from the Avoca Site: The Role of Agriculture During the Early Ceramic Period. In *The Avoca Site (14JN332): Excavation of a Grasshopper Falls Phase Structure, Jackson County, Kansas,* by Timothy G. Baugh, pp. 85–94. Contract Archeology Publication No. 8. Archeology Office, Kansas State Historical Society, Topeka.

2003 Great Plains Paleoethnobotany. In *People and Plants in Ancient Eastern North America*, edited by Paul E. Minnis, pp. 258–346. Smithsonian Books, Washington, D.C.

2006 Paleoethnobotanical Research in Kansas. In *Kansas Archaeology*, edited by Robert J. Hoard and William E. Banks, pp. 248–263. University Press of Kansas, Lawrence, and Kansas State Historical Society, Topeka.

2012a Refining Plains Woodland Chronology. *Plains Anthropologist* 57(223):213–228.

2012b Archeobotanical Analysis. In *Archeological Investigations at Arkansas City, Kansas*, edited by Robert J. Hoard, pp. 455–481. Contract Archeology Publication No. 26. Archeology Office, Kansas Historical Society, Topeka.

Adair, Mary J., and Richard R. Drass

2011 Patterns of Plant Use in the Prehistoric Central and Southern Plains. In *The Subsistence Economies of Indigenous North American Societies*, edited by Bruce D. Smith, pp. 307–352. Smithsonian Institution Scholarly Press, Washington, D.C.

Adams, Karen R.

2014 Little Barley Grass (*Hordeum pusillum* Nutt.): A Prehistoric New World Domesticate Lost to History. In *New Lives for Ancient and Extinct Crops*, edited by Paul E. Minnis, pp. 139–179. University of Arizona Press, Tucson.




KAA 38.indd 99 7/5/19 7:13 AM

Andrefsky, William
1998 *Lithics: Macroscopic Approaches to Analysis*. Cambridge University Press, Cambridge, England.

Bailey, Berkley B.
2000 *The Geoarchaeology of Day Creek Chert: Lithostratigraphy, Petrology, and the Indigenous Landscape of Northwest Oklahoma and Southwest Kansas*. Ph.D. dissertation, Department of Anthropology, University of Oklahoma, Norman.

Baker, F. C.
1928 The Freshwater Mollusca of Wisconsin, Part II. *Pelecypoda*. Bulletin No. 70. University of Wisconsin, Madison.

Baker, George
1968 Micro-Forms of Hay-Silica Glass and of Volcanic Glass. *Mineralogical Magazine* 36:1014–1023.

Baker, George, and Alfred A. Baker
1964 Hay-silica Glass from Gnarkeet, Western Victoria. *Memoirs of the National Museum Victoria* 26:245. Melbourne, Australia.

Banks, Larry D.
1990 *From Mountain Peaks to Alligator Stomachs: A Review of Lithic Sources in the Trans-Mississippi South, the Southern Plains, and Adjacent Southwest.* Memoir No. 4. Oklahoma Anthropological Society, Norman.

Bass, N. W.
1926 *Geological Investigations in Western Kansas.* Bulletin No. 11. Kansas Geological Survey, University of Kansas, Lawrence.

Bell, Robert E.
1960 *Guide to the Identification of Certain American Indian Projectile Points.* Special Bulletin No. 2. Oklahoma Anthropological Society, Norman, Oklahoma.

Bergman, S. M., M. E. Eberle, and B. K. Obermeyer
2000 Freshwater Mussels (Bivalvia: Unionoidea) in Streams of Northwestern Kansas. *The Prairie Naturalist* 32:45.

Bevitt, C. Tod, and Anne M. Bauer
2003 *Phase III Investigations at 14HO308: An Early Middle Ceramic Campsite on Buckner Creek, Hodgeman County, Kansas.* Archeology Office, Kansas Historical Society, Topeka. Submitted to Pawnee Watershed Joint District No. 81. Copy available from Historic Preservation Office, Kansas Historical Society, Topeka.

Binford, Lewis R.
1978 *Nunamuit Ethnoarchaeology.* Academic Press, New York.
1984 *Faunal Remains from Klasies River Mouth.* Academic Press, New York.

Blakeslee, Donald J.
2014 New Point Types for the State of Kansas. *The Kansas Anthropologist* 35:43.

Blakeslee, Donald J., Robert J. Hoard, Christine Garst, James O. Marshall, Martin Stein, Jan E. Mead, David Moors, Meghan Voisin, Shannon Lucas, Jessica Olson, Breanne Lasorso, Elizabeth Perez, and Sarah Kidder
2012 Stone Artifacts. In *Archeological Investigations at Arkansas City, Kansas*, edited by Robert J. Hoard, pp. 181–250. Contract Archeology Publication No. 26. Archeology Office, Kansas Historical Society, Topeka.

Blasing, Robert
1990 Mineralogical Identification of Trachyte in Trego County, Kansas. Paper presented at the 48th Plains Anthropological Conference, Oklahoma City.

Blasingham, Emily J.
1963 *Appraisal of the Archeological Resources of the Norton Reservoir, Norton County, Kansas.* A Project of the Inter-Agency Archeological and Paleontological Salvage Program. Copy available from the Midwest Archeological Center, National Park Service, Lincoln, Nebraska.

Bleed, Peter
1991 Operations Research in Archaeology. *American Antiquity* 56:19–35.

Bohrer, Vorsilla L.
1987 The Plant Remains from La Ciudad, a Hohokam Site in Phoenix. In *Specialized Studies in the Economy, Environment, and Culture of La Ciudad, Part III,* edited by Jo Ann E. Kisselburg, Glen R. Rice, and Brenda L. Shears, pp. 67–202. Anthropological Field Studies No. 20. Arizona State University, Tempe.

Bonsall, James, Robert Fry, Chris Gaffney, Ian Armit, Anthony Beck, and Vince Gaffney
2013 Assessment of the CMD Mini-Explorer, a New Low-frequency Multi-coil Electromagnetic Device for Archaeological Investigations. *Archaeological Prospection* 20:219–231.

Bowman, Peter W.
1960 *Coal-Oil Canyon (14LO1): Report on Preliminary*



KAA 38.indd 100 7/5/19 7:13 AM

*Investigations*. Bulletin No. 1. Kansas Anthropological Association, Hays.

Boyd, Douglas K.
1997 *Caprock Canyonland Archeology: A Synthesis of the Late Prehistory and History of Lake Alan Henry and the Texas Panhandle-Plains*. Prewitt and Associates, Inc. Reports of Investigations No. 110. Austin, Texas.

Bozarth, Steven
2006 Opal Phytolith Analysis of Sherd Scrapings from 14EL313. Archeological site records, Archeology Office, Kansas Historical Society, Topeka.

Bozell, John R.
1991 Faunal Remains from the Wallace Site (25GO2), Gosper County, Nebraska. Notes and identifications in possession of author.
1995 Culture, Environment, and Bison Populations on the Late Prehistoric and Early Historic Central Plains. *Plains Anthropologist* 40(153):[illegible].
2003 Faunal Remains. In The Late Woodland Component of the Stauffer Site, 23CO499. Memoir No. 35. *Plains Anthropologist* 48([illegible]):[illegible].
2006 Plains Woodland Complexes of Western Kansas and Adjacent Portions of Nebraska and Colorado. In *Kansas Archaeology*, edited by Robert J. Hoard and William E. Banks, pp. 93–104. University Press of Kansas, Lawrence, and Kansas State Historical Society, Topeka.

Bozell, John R., Carl R. Falk, and Eileen Johnson
2011 Native American Use of Animals on the North American Great Plains. In *The Subsistence Economies of Indigenous North American Societies*, edited by Bruce D. Smith, pp. 353–385. Smithsonian Institution Scholarly Press, Washington D.C.

Bozell, John R., and Mary K. Rogers
1989 A Great Oasis Fauna from Central Nebraska. *Central Plains Archaeology* 1(1):33–36.

Bozell, John R., and Dennis L. Toom
2003 Vertebrate Faunal Remains. In *Kirschenman-III Site (32SN247), 1994 Archeological Excavations, Stutsman County, North Dakota*, edited by Dennis L. Toom, pp. 9.1–9.29. Contribution No. 381. Department of Anthropology, University of North Dakota, Grand Forks. Prepared for the U.S. Bureau of Reclamation, Bismarck, North Dakota.

Bozell, John R., and James V. Winfrey
1994 A Review of Middle Woodland Archaeology in Nebraska. *Plains Anthropologist* 39(148):125–144.

Braun, David
1983 Pots as Tools. In *Archaeological Hammers and Theories*, edited by J. Moore and A. Keene, pp. 107–134. Academic Press, New York.
1987 Co-evolution of Sedentism, Pottery Technology, and Horticulture in the American Midwest, 200 B.C.- A.D. 600. In *Emerging Horticultural Economies of the Eastern Woodlands*, edited by William Keegan, pp. 153–181. Occasional Paper No. 7. Center for Archaeological Investigations, Southern Illinois University, Carbondale, Illinois.

Brown, Christopher L., and Carl E. Gustafson
1979 *A Key to Postcranial Skeletal Remains of Cattle/Bison, Elk, and Horse*. Reports of Investigations No. 57. Laboratory of Anthropology, Washington State University, Pullman.

Buchanan, Rex (editor)
2010 *Kansas Geology: An Introduction to Landscapes, Rocks, Minerals, and Fossils*. 2nd ed. Kansas Geological Survey, University of Kansas, and University Press of Kansas, Lawrence.

Clark, Anthony J.
1996 *Seeing Beneath the Soil. Prospecting Methods in Archaeology*. B. T. Batsford, Ltd., London, England.

Cockrum, E. Lendell
1952 *Mammals of Kansas*. Museum of Natural History Publications 7(1):1–303. University of Kansas, Lawrence.

Collins, Joseph T.
1993 *Amphibians and Reptiles in Kansas*. University Press of Kansas, Lawrence.

Conant, Roger
1975 *A Field Guide to the Reptiles and Amphibians of Eastern and Central North America*. Houghton Mifflin Company, Boston, Massachusetts.

Coscolluela, M. Nicole
2013 *A North American Plains Mystery: A Proposed Resolution to the Middle Missouri "Quill Flatteners."* On file, Roger Archaeology Lab. National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Crabtree, Don E.
1972 *An Introduction to Flintworking*. Occasional Papers No. 28. Idaho State University, Pocatello.



KAA 38.indd 101 7/5/19 7:13 AM

Craine, E. R.
1956 The Pfaff Site: A Preliminary Report. *Kansas Anthropological Association Newsletter* 1 1 4.

Cross, F. B., and Collins, J. T.
1995 *Fishes in Kansas*. Public Education Series No. 14. Natural History Museum, University of Kansas, Lawrence.

Dalpra, Cody L., and Bonnie L. Pitblado
2016 Discriminating Quartzite Sources Petrographically in the Upper Gunnison Basin, Colorado: Implications for Paleoamerican Lithic-Procurement Studies. *Paleo-America: A Journal of Early Human Migration and Dispersal* 2(1 :0 .

Deming, Joan
1980 Appendix 2: Additional Vertebrate Faunal Materials from Red Willow Reservoir, Nebraska. In *Sl vage Archeology in the Red Willow Reservoir, Nebraska* by Roger T. Grange, pp. 170–173. Publications in Anthropology No. 9. Nebraska State Historical Society, Lincoln.

Dillehay, Thomas D.
1974 Late Quaternary Bison Population Changes on the Southern Plains. *Plains Anthropologist* 19(65):180–196.

Duncan, Marjorie, Larry Neal, Don Shockey, Don Wyckoff, Gregory Perino, and Robert Bell
2007 *S uthern Plains Lithics: The S n all Points*. Special Bulletin No. 26. Oklahoma Anthropological Society, Norman.

Dutt, Owen Dee
1970 *Native Vegetation on Some Ellis County, Kansas Soils*. Master's thesis, Fort Hays State College, Kansas.

Ellwood, Priscilla B.
2002 *Native American Ceramics of Eastern Colorad*. Natural History Inventory of Colorado No. 21. University of Colorado Museum, Boulder.

Falk, Carl R., and Carole A. Angus
1983 A Descriptive Summary of Vertebrate Remains Recovered from the Archeological Investigation of the Walker Gilmore Site (25CC28). In *Walker Gilmore: A Stratified Woodland Period Occupation in Eastern Nebraska, A Report on the 1 Excavations* by Daniel R. Haas. Laboratory Notebook 6. Division of Archeological Research, Department of Anthropology, University of Nebraska, Lincoln.

Falk, Carl R., and Holmes A. Semken Jr.
1990 Vertebrate Paleoecology and Procurement at the Rainbow Site. In *Woodland Cultures on the Western Prairies: The Rainbw S te Investigations*, edited by David W. Benn. Report No. 18. Office of the State Archaeologist, University of Iowa, Iowa City.

Feathers, James K.
1989 Effects of Temper on Strength of Ceramics: Response to Bronitsky and Hamer. *American Antiquity* 54:579–588.

Frye, John C., and Ada Swineford
1946 *Silicified Rock in the Ogallala Formation*. Bulletin No. 64, Pt 2:33–76. Kansas Geological Survey, University of Kansas, Lawrence.

Gater, John, and Chris Gaffney
2003 *Revealing the Buried Past: Geophysics for Archaeologists*. Tempus Publishing Group, Ltd. Stroud, United Kingdom.

Getty, Robert
1975 *S sson and Grossman's Anatomy of Domestic Animals*. 2 vols. W. B. Saunders Co., Philadelphia, Pennsylvania.

Gilbert, B. Miles
1980 *Mammalian Osteology*. Modern Printing Company, Laramie, Wyoming.

Gilmore, Kevin P.
1991 *Bayou Gulch: Geoarchaeology of a Multicomponent S te in Central Colorad*. Master's thesis, Department of Anthropology, University of Colorado, Boulder.
1999 Late Prehistoric Stage (A.D. 150–1540). In *Colorad Prehistory: A Context for the Platter River Basin*, edited by Kevin P. Gilmore, Marcia Tate, Mark L. Chenault, Bonnie Clark, Terri McBride, and Margaret Wood, pp. 175–307. Colorado Council of Professional Archaeologists, Denver.
2008 *The Context of Culture Change: Environment, Population, and Prehistory Eastern Colorado, 1000 B.C. to A.D. 1540*. Ph.D. dissertation, Natural Sciences and Mathematics, University of Denver, Colorado.

Grange, Roger T.
1980 *Salvage Archeology in the Red Willow Reservoir, Neb aska*. Publications in Anthropology No. 9. Nebraska State Historical Society, Lincoln.

Grayson, Donald K.
1984 *Quantitative Zooarcheology*. Academic Press, New York.



KAA 38.indd 102 7/5/19 7:13 AM

Hall, Stephen A.
1988 Environment and Archaeology of the Central Osage Plains. *Plains Anthropologist* 33(120):203–218.
1990 Channel Trenching and Climate Change in the Southern U.S. Great Plains. *Geology* 18:324–354.

Hall, Stephen A., Thomas W. Boutton, Christopher R. Lintz, and Timothy G. Baugh
2012 New Correlation of Stable Isotopes with Changing Late-Holocene Fluvial Environments in the Trinity River Basin of Texas, USA. *The Holocene* 22:541–549.

Haury, Chérie E.
1981 Chert Types and Terminology of the Upper Walnut River Drainage. In *Prehistory and History of the El Dorado Lake Area, Kansas*. Project Report Series No. 47. Museum of Anthropology, University of Kansas, Lawrence.
1984 *Availability, Procurement, and Use of Chert Resources by Late Archaic Populations in the Southern Flint Hills of Kansas*. Master's thesis, Department of Anthropology, University of Kansas, Lawrence.

Hill, Matthew E., Jr.
1998 Spatial Analysis. In *Prehistoric Settlement of the Lower Missouri Uplands: The View from DB Ridge, Fort Leavenworth, Kansas*, edited by Brad Logan, pp. 254–300. Project Report Series No. 98. Museum of Anthropology, University of Kansas, Lawrence.

Hoadley, R. Bruce
1990 *Identifying Wood*. Taunton Press, Newtown, Connecticut.

Hoard, Robert J.
1992 *Technical Dimensions of Woodland-Period Cooking Vessels from Missouri*. Ph.D. dissertation, Department of Anthropology, University of Missouri, Columbia.
2000 Late Woodland in Central Missouri: The Boone Phase. In *Late Woodland Societies: Tradition and Transformation Across the Mid-Continent*, edited by Thomas E. Emerson, Dale L. McElrath, and Andrew C. Fortier, pp. 211–240. University of Nebraska Press, Lincoln.
2006 Appendix. In *Kansas Archaeology*, edited by Robert J. Hoard and William E. Banks, pp. 283–328. University Press of Kansas, Lawrence, and Kansas State Historical Society, Topeka.
2014 Hackberries as Food. Paper presented at the 36th Annual Flint Hills Archaeological Conference, Fort Osage, Sibley, Missouri.
2016 Western Kansas, 500–1100 C.E. Paper presented at the 74th Annual Plains Anthropological Conference, Lincoln, Nebraska.

Hoard, Robert J., and William E. Banks (editors)
2006 In *Kansas Archaeology*. University Press of Kansas, Lawrence, and the Kansas State Historical Society, Topeka.

Hoard, Robert J., William E. Banks, Rolfe D. Mandel, Michael Finnegan, and Jennifer E. Epperson
2004 A Middle Archaic Burial from East-Central Kansas. *American Antiquity* 69:717–739.

Hoard, Robert J., and John R. Bozell
2016 The Forrest Site, 14PA303: A Keith Phase Component in Pawnee County, Kansas. *Central Plains Archaeology* 15:1–8.

Hoard, Robert J., Michael Finnegan, Timothy Weston, Randall M. Thies, Steven R. Bozarth, and Don Rowlison
2005 A Keith Phase Burial on the High Plains of Kansas. *Plains Anthropologist* 50(195):265–276.

Hoard, Robert J., Danielle Montague-Judd, and Elizabeth J. Miska
2003 Ceramic Analysis. In The Late Woodland Component of the Stauffer Site, 23CO499. Memoir No. 35. *Plains Anthropologist* 48(183):455.

Hoard, Robert J., Michael J. O'Brien, M. Ghazavy Khorasgany, and Velore S. Gopalaratnam
1995 A Materials Science Approach to Understanding Limestone-Tempered Pottery from the Midwest. *Journal of Archaeological Science* 22:823–832.

Hofman, Jack L., Lawrence C. Todd, and Michael B. Collins
1991 Identification of Central Texas Edwards Chert at the Folsom and Lindenmeier Sites. *Plains Anthropologist* 36(137):297–308.

Hoke, E.
1997 The Unionid Mollusks of the Upper Kansas Basin of Northwestern Kansas and Southwestern Nebraska. *Transactions of the Nebraska Academy of Sciences* 24:3–4.

Holen, Steven R.
1983 *Lower Loup Lithic Procurement Strategy at the Gray Site, 25CX1*. Master's thesis, Department of Anthropology, University of Nebraska, Lincoln.
1991 Bison Hunting Territories and Lithic Acquisition among the Pawnee: An Ethnohistoric and Archaeological Study. In *Raw Material Economies among Prehistoric Hunters and Gatherers,* edited by Anta Montet-White and Steven Holen, pp. 399–411. Publications in Anthropology No. 19. University of Kansas, Lawrence.



KAA 38.indd 103 7/5/19 7:13 AM

2001 *Clovis Mobility and Lithic Procurement on the Central Plains of North America*. Ph.D. dissertation, Department of Anthropology, University of Kansas, Lawrence.

Holliday, Vance T.
1997 *Paleoindian Geoarchaeology of the Southern High Plains*. University of Texas Press, Austin.

Holliday, Vance T., and Curtis M. Welty
1981 Lithic Tool Resources of the Eastern Llano Estacado. *Bulletin of the Texas Archeological Society* 52:201–214.

Hughes, Richard E.
2015 Geochemical Research Laboratory Letter Report 2015–103. Manuscript on file, Archeology Office, Kansas Historical Society, Topeka.

Hunter, Andrea A.
1992 *Utilization of Hordeum pusillum (Little Barley) in the Midwest United States: Applying Rindos' Co-Evolutionary Model of Domestication*. Ph.D. dissertation, Department of Anthropology, University of Missouri, Columbia.

Hurley, William M.
1979 *Prehistoric Cordage: Identification of Impressions on Pottery.* Aldine Manuals on Archaeology. Taraxacum, Washington.

Hurst, Stance, Doug Cunningham, and Eileen Johnson
2015 Experiments in Late Archaic Methods of Heat-Treating Ogallala Formation Quartzarenite Clasts along the Southern High Plains Eastern Escarpment. *Journal of Archaeological Science: Reports* 3:207–215.

Hurst, Stance, Eileen Johnson, Zaneta Martinez McCoy, and Doug Cunningham
2010 The Lithology of Ogallala Gravels and Hunter-Gatherer Procurement Strategies along the Southern High Plains Eastern Escarpment of Texas, USA. *Geoarchaeology: An International Journal* 25:96–121.

Johnson, Alfred E.
2001 Plains Woodland Tradition. In *Plains*, edited by Raymond J. DeMallie, Pt. 1, pp. 159–172. Handbook of North American Indians, Vol. 13, William C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Johnson, Jay
2006 *Remote Sensing in Archaeology: An Explicitly North American Perspective*. University of Alabama Press, Tuscaloosa, Alabama.

Josephs, Richard L.
2010 *A Petrographic Investigation of Central Plains Ceramics from Sites in Nebraska, Kansas, and Oklahoma.* Report available from Historic Preservation Office, Kansas Historical Society, Topeka.

Justice, Noel D.
1987 *Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States: A Modern Survey and Reference.* Indiana University Press, Bloomington.

Kalasz, Stephen M., Mark Mitchell, and Christian J. Zier
1999 Late Prehistoric Stage. In *Colorado Prehistory: A Context for the Arkansas River Basin* by Christian J. Zier and Stephen M. Kalasz, pp. 141–263. Centennial Archaeology, Inc., Ft. Collins, Colorado. Submitted to Colorado Council of Professional Archaeologists, Denver.

Kansas Geological Survey
2015 Ellis County Geology. Electronic document, http://www.kgs.ku.edu/General/Geology/County/def/el/el_8_5.html, accessed April 3, 2015.

Kansas Mammal Atlas
2015 Electronic document, http://webcat.fhsu.edu/ksfauna/mammals, accessed June 29, 2015.

Katzenberg, M. Anne, Henry P. Schwarcz, Martin Knyf, and F. Jerome Melbye
1995 Stable Isotope Evidence for Maize Horticulture and Paloediet in Southern Ontario, Canada. *American Antiquity* 60: 335–350.

Kelly, Lucretia S., and Paula G. Cross
1984 Zooarchaeology. In *American Bottom Archaeology: A Summary of the FAI-270 Project Contribution to the Culture History of the Mississippi River Valley*, edited by Charles J. Bareis and James W. Porter, pp. 215–232. University of Illinois Press, Urbana.

Kivett, Marvin F.
1949 Archaeological Investigations in Medicine Creek Reservoir, Nebraska. *American Antiquity* 14: 278–288.
1952 *Woodland Sites in Nebraska.* Publications in Anthropology No. 1. Nebraska State Historical Society, Lincoln.
1953 *The Woodruff Ossuary: A Prehistoric Burial Site in Phillips County, Kansas.* River Basin Survey Papers No. 3 and Bulletin No. 154. Bureau of American Ethnology, Smithsonian Institution, Washington, D.C.
1970 Early Ceramic Environmental Adaptations. In *Pleistocene and Recent Environments of the Central Great Plains*, edited by Wakefield Dort, Jr. and J. Knox Jones Jr., pp. 93–102. University Press of Kansas, Lawrence.



KAA 38.indd 104 7/5/19 7:13 AM

Kivett, Marvin F., and George S. Metcalf
1997 *The Prehistoric People of the Medicine Creek Reservoir, Frontier County, Nebraska: An Experiment in Mechanized Archaeology (1946–1948)*. Memoir No. 30. *Plains Anthropologist* 42(148):1–228.

Koch, Amy, John R. Bozell, Carl R. Falk, and James Colburn
2010 Modified and Unmodified Faunal Remains. In *The Eagle Ridge Site and Early Eighteenth Century Indian-European Relations in Eastern Nebraska*, edited by Gayle F. Carlson and John R. Bozell. Central Plains Archaeology 12(1):149–176.

Krause, Richard A.
1995 Attributes, Modes, and Tenth Century Potting in North-Central Kansas. *Plains Anthropologist* 40(154):307–323.
2011 An Inventory and Analysis of Ceramics from Sites on the Fort Carson Military Base. *Plains Anthropologist* 56(220):303–322.

Küchler, A. W.
1974 A New Vegetation Map of Kansas. *Ecology* 55(3):586–604.

Lehmer, Donald J.
1971 *An Introduction to Middle Missouri Archeology.* Anthropological Papers No. 1. National Park Service, Washington D.C.

Logan, Brad
2006 Woodland Adaptations in Eastern Kansas. In *Kansas Archaeology*, edited by Robert J. Hoard and William E. Banks, pp. 76–92. University Press of Kansas, Lawrence, and Kansas State Historical Society, Topeka.

Long, Austin, and James E. Mielke
1966 Smithsonian Institution Radiocarbon Measurements III. *Radiocarbon* 8:341–342.

Lubinski, Patrick M., and Vicki Herren
2000 An Introduction to Pronghorn Biology, Ethnography, and Archaeology. In *Pronghorn Past and Present: Archaeology, Ethnography, and Biology*, edited by Jana V. Pastor and Patrick M. Lubinski, pp. 3–12. Memoir No. 32. *Plains Anthropologist* 45(174).

Lyman, R. Lee
1984 Bone Density of Differential Survivorship of Fossil Classes. *Journal of Anthropological Archaeology* 3:259–299.
1994 *Vertebrate Taphonomy*. Cambridge Manuals in Archeology. Cambridge University, Cambridge, England.

Mackie, G. L., and D. G. Huggins
1983 *Unionacean Clams of Kansas*. Technical Publication No. 14. State Biological Survey of Kansas, University of Kansas, Lawrence.

Maki, David, and Geoffrey Jones
2015 A Multi-Method Geophysical Investigation at 14EL331: A Keith Phase Archaeological Site Located in Ellis County, Kansas. Archaeo-Physics, LLC, Minneapolis, Minnesota. Submitted to Kansas Historical Society. Manuscript on file, Archeology Office, Kansas Historical Society, Topeka.

Mandel, Rolfe D.
1994 *Holocene Landscape Evolution in the Pawnee River Valley, Southwestern Kansas*. Bulletin No. 236. Kansas State Historical Society, Topeka, and Kansas Geological Survey, University of Kansas, Lawrence.
2006 The Effects of Late Quaternary Landscape Evolution on the Archaeological Record of Kansas. In *Kansas Archaeology*, edited by Robert J. Hoard and William E. Banks, pp. 28–45. University Press of Kansas, Lawrence, and Kansas State Historical Society, Topeka.

Mandel, Rolfe D., and E. Arthur Bettis III
2001 Use and Analysis of Soils by Archaeologists and Geoscientists: A North American Perspective. In *Earth Sciences and Archaeology*, edited by Paul Goldberg, Vance T. Holliday, and C. Reid Ferring, pp. 173–204. Kluwer Academic/Plenum Publishing, New York.

McCoy, Zaneta L.
2011 *The Distribution and Origin of Silcrete in the Ogallala Formation, Garza County, Texas*. Master's thesis, Texas Tech University, Lubbock.

McKay, Michael W., Leland C. Bement, and Richard R. Drass
2004 *Testing Results of Four Late Holocene Sites, Harper County, Oklahoma*. ARSR No. 49. Oklahoma Archeological Survey, University of Oklahoma, Norman.

McLean, Janice
2004 Six Obsidian Artifacts from the Kansas High Plains. *Current Archaeology in Kansas* 56.

McMurray, S. E., J. S. Faiman, A. Roberts, B. Simmons, and M. C. Barnhart
2012 *A Guide to Missouri's Freshwater Mussels*. Missouri Department of Conservation, Jefferson City.

Metcalfe, Duncan, and Kevin T. Jones
1988 A Reconsideration of Animal Body-Part Utility Indices. *American Antiquity* 53:486–504.



KAA 38.indd 105 7/5/19 7:13 AM

Miller, Anne, and Larry L. Tieszen
1992 When Did Maize Become a Staple in the Great Plains? Isotopic Assessment in Kansas. Manuscript on file, Archeology Office, Kansas Historical Society, Topeka.

Miller, Edwin J., John J. Tomasic, and M. C. Barnhart
2014 A Comparison of Freshwater Mussels (Unionidae) from Late Archaic Archeological Excavation with Recently Sampled Verdigris River, Kansas, Populations. *American Mid and Naturalist* 71: 46.

Miller, Malcolm E.
1962 *Guide to the Dissection of the Dog*. New York State Veterinary College, Cornell University, Ithaca.

Montet-White, Anta, and Steven Holen (editors)
1991 *Raw Material Economies among Prehistoric Hunters and Gatherers*. Publications in Anthropology No. 19. University of Kansas, Lawrence.

Mundell, Raymond
1980 Appendix 1. Vertebrate Faunal Materials from Archeological Investigations, Red Willow Reservoir, Nebraska. In *Salvage Archeology in the Red Willow Reservoir, Nebraska* by Roger T. Grange. Publications in Anthropology No. 9. Nebraska State Historical Society, Lincoln.

Murray, H. D., and A. B. Leonard
1962 *Handbook of Unioid Mussels in Kansas*. Miscellaneous Publications No. 28. Museum of Natural History, University of Kansas, Lawrence.

National Geographic Society
1999 *Field Guide to the Birds of North America*. 3rd ed. National Geographic Society, Washington, D.C.

Natural Resources Conservation Service, U.S. Department of Agriculture
2015 Web Soil Survey. Electronic document, http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx, accessed March 12, 2015.
2016 The PLANTS Database. National Plant Data Team, Greensboro, North Carolina. Electronic document, http://plants.usda.gov, accessed January 21, 2016.

Neuman, Robert W.
1975 *The Sonota Complex and Associated Sites on the Northern Great Plains*. Publications in Anthropology No. 6. Nebraska State Historical Society, Lincoln, Nebraska.

Nordt, Lee, Joseph von Fischer, and Larry Tieszen
2007 Late Quaternary Temperature Record from Buried Soils of the Northern Great Plains. *Geology* 35:159–162.

O'Brien, Michael J., Thomas D. Holland, Robert J. Hoard, and Gregory L. Fox
2003 Evolutionary Implications of Design and Performance Characteristics of Prehistoric Pottery. In *Style, Function, Transmission: Evolutionary Archaeological Perspectives*, edited by M. J. O'Brien and R. L. Lyman, pp. 199–226. University of Utah Press, Salt Lake City.

O'Leary, M.
1981 Carbon Isotope Fractionation in Plants. *Phytochemistry* 20:55.

Panshin, Alexis J., and Carl de Zeeuw
1964 *Textbook of Wood Technology*, Vol. I. McGraw Hill Book Company, New York.

Parker, Douglas R.
2002 Results of Radiographic Analysis. In *Native American Ceramics of Eastern Colorado* by Priscilla B. Ellwood, pp. 111–113. Natural History Inventory of Colorado No. 21, Appendix B. Museum of Natural History, University of Colorado, Boulder.

Pavesic, Max G.
1985 Cache Blades and Turkey Tails: Piecing Together the Western Idaho Archaic Burial Complex. In *Stone Tool Analysis: Essays in Honor of Don E. Crabtree*, edited by Mark G. Plew, James E. Woods, and Max G. Pavesic, pp. 55–90. University of New Mexico Press, Albuquerque.

Peacock, E.
2000 Assessing Bias in Shell Assemblages. *Journal of Field Archaeology* 27:183–196.

Pierce, Christopher
2005 Reverse Engineering the Ceramic Cooking Pot: Cost and Performance Properties of Plain and Textured Vessels. *Journal of Archaeological Method and Theory* 12: 175.

Pitblado, Bonnie L., Carol Dehler, Hector Neff, and Stephen T. Nelson
2008 Pilot Study Experiments Sourcing Quartzite, Gunnison Basin, Colorado. *Geoarchaeology: An International Journal* 23(6): 747–778.



KAA 38.indd 106 7/5/19 7:13 AM

Powell, Gina S.
2016a *Phase III Archeological Testing of Sites 14NT201 and 14NT367 for KDOT Project 383–69 KA-2371-01, State Highway K-383 Improvements, Norton County, Kansas*. Contract Archeology Program, Kansas Historical Society. Submitted to Kansas Department of Transportation, Topeka. Copy available from Historic Preservation Office, Kansas Historical Society, Topeka.
2016b Archeobotany at 14EL313, a Terminal Keith Phase Site in Western Kansas. Poster presented at the 74th Annual Plains Anthropological Conference, Lincoln, Nebraska.

Quigg, J. Michael, Matthew T. Boulanger, and Michael D. Glascock
2011 Geochemical Characterization of Tecovas and Alibates Source Samples. *Plains Anthropologist* 56(219):259–284.

Ray, Jack H.
2010 Lithic Analysis. In *Archaeological Investigations of the Horsethief Site (14HO308), Hodgeman County, Kansas* by Neal H. Lopinot, A. Holly Jones, Jack H. Ray, and David Byers, pp. 45–83. Research Report No. 1352, Center for Archaeological Research, Missouri State University, Springfield. Copy available from Historic Preservation Office, Kansas Historical Society, Topeka.

Reynolds, John D.
1979 *The Grasshopper Falls Phase of the Plains Woodland*. Anthropological Series No. 7. Archeology Office, Kansas State Historical Society, Topeka.

Rice, Prudence M.
1987 *Pottery Analysis: A Sourcebook*. University of Chicago Press, Chicago, Illinois.

Riggle, R. Stanley, and Thomas M. Freitag
1990 Freshwater Mussels from the Rainbow Site. In *Woodland Cultures on the Western Prairies: The Rainbow Site Investigations*, edited by David W. Benn, pp. 165–182. Report No. 18. Office of the State Archaeologist, University of Iowa, Iowa City.

Roper, Donna C.
2006a The Central Plains Tradition. In *Kansas Archaeology*, edited by Robert J. Hoard and William E. Banks, pp. 105–132. University Press of Kansas, Lawrence, and Kansas State Historical Society, Topeka.
2006b *The Whiteford Site, or Indian Burial Pit: A Smoky Hill Phase Cemetery in Saline County*. Anthropological Series No. 18. Archeology Office, Kansas State Historical Society, Topeka.

Roper, Donna C., and Mary J. Adair
2011 Interpreting AMS Radiocarbon Age Determinations from Selected Central Plains Tradition Sites. *Plains Anthropologist* 56(217):322.

Schiffer, Michael Brian
1986 Radiocarbon Dating and the "Old Wood" Problem: The Case of the Hohokam Chronology. *Journal of Archaeological Science* 13:139–150.

Schiffer, Michael Brian, James M. Skibo, Tamara C. Boelke, Mark A. Neupert, and Meredith Aronson
1994 New Perspectives on Experimental Archaeology: Surface Treatments and Thermal Response of the Clay Cooking Pot. *American Antiquity* 59:197–217.

Schoewe, W. E.
1949 The Geography of Kansas, Part II, Physical Geography. *Transactions of the Kansas Academy of Science* 52(3):261–333.

Semken, Holmes A., Jr., and Carl R. Falk
1987 Late Pleistocene/Holocene Mammalian Faunas and Environmental Change on the Northern Plains of the United States. In *Late Quaternary Mammalian Biogeography and Environment of the Great Plains and Prairies*, edited by Russell Wm. Graham, Homes A. Semken, Jr., and Mary A. Graham, pp. 176–313. Scientific Papers No. 22. Illinois State Museum, Springfield.

Shaeffer, James B.
1958 The Alibates Flint Quarry, Texas. *American Antiquity* 24:189–191.

Sherard, Jeffrey L.
2001 Burning Down the House: The Interpretation of Slag-Like Material Remains Recovered from an Earth Lodge Structure Located on Mound V at the Moundville Site. Paper presented at the 58th Annual Meeting of the Southeastern Archaeological Conference, Chattanooga, Tennessee.

Spielmann, Katherine A.
1983 Late Prehistoric Exchange Between the Southwest and Southern Plains. *Plains Anthropologist* 28(102):257–272.

Stein, Martin C.
2005 *Sources of Smoky Hill Silicified Chalk in Northwest Kansas*. Anthropological Papers No. 17. Archeology Office, Kansas State Historical Society, Topeka.
2006 Kansas Lithic Resources. In *Kansas Archaeology*, edited by Robert J. Hoard and William E. Banks, pp.



KAA 38.indd 107 7/5/19 7:13 AM

264–282. University Press of Kansas, Lawrence, and Kansas State Historical Society, Topeka.

Steinacher, Terry L.
2014 The Chadron State Park Site (25DW1), Dawes County, Nebraska. *Central Plains Archaeology* (41):1–42.

Strong, William D.
1935 *An Introduction to Nebraska Archeology*. Miscellaneous Collections 93(10). Smithsonian Institution, Washington, D.C.

Swineford, Ada, and Paul C. Franks
1959 Opal in the Ogallala Formation in Kansas. In *Silica in Sediments: A Symposium with Discussions*, edited by H. A. Ireland, pp. 111–120. Special Publication No. 7. Society of Economic Paleontologists and Mineralogists, Tulsa, Oklahoma.

Theler, James L.
2003 Paleoenvironmental Interpretation from Burnham Site Gastropods: 1989 Results. In *The Burnham Site in Northwestern Oklahoma: Glimpses Beyond Clovis?*, edited by Don G. Wyckoff, James L. Theler, and Brian J. Carter, pp. 169–189. Sam Noble Oklahoma Museum of Natural History, University of Oklahoma, Norman.

Theler, James L., Don Wyckoff, and Brian J. Carter
2004 The Southern Plains Gastropod Survey: The Distribution of Land Snail Populations in an American Grassland Environment. *American Malacological Bulletin* 18:1–20.

Thy, P., G. Willcox, G. H. Barfod, and D. Q. Fuller
2015 Anthropogenic Origin of Siliceous Scoria Droplets from Pleistocene and Holocene Archaeological Sites in Northern Syria. *Journal of Archaeological Science 54:193–209.*

Tibesar, W. L., T. K. Larson, S. Baker, K. Deunholm, and P. H. Saunders
1984 *Archeological and Osteological Analyses of Two Burial Sites along Harlan County Lake, Nebraska: Chronological and Evolutionary Implications*. Larson-Tibesar Associates, Laramie, Wyoming. Submitted to the Kansas City District, U.S. Army Corps of Engineers, Kansas City, Missouri.

Tieszen, Larry L.
1991 Natural Variation in the Carbon Isotope Values of Plants: Implications for Archaeology, Ecology, and Paleoecology. *Journal of Archaeological Science* 18:227–248.

Tieszen, Larry L., and Tim Fagre
1993 Carbon Isotopic Variation in Modern and Archeological Maize. *Journal of Archaeological Science* 20:249–64.

Tomasic, John J., Edwin J. Miller, Mark Volmut, and Andrew Wiatt
2012 The Eastep Site (14MY388): A Late Archaic/Woodland Period Site in Southeast Kansas. *The Kansas Anthropologist* 33:1–38.

U.S. Geological Survey
2015 National Water Information System: Web Interface. Electronic document, http://waterdata.usgs.gov/usa/nwis/uv?site_no=06863500, accessed April 6, 2015.

Vehik, Susan C.
1977 Bone Fragments and Bone Grease Manufacturing: A Review of their Archaeological Use and Potential. *Plains Anthropologist* 22(77):169–182.
1988 Late Prehistoric Exchange on the Southern Plains and its Periphery. *Mid-continental Journal of Archaeology* 13:1–46.
1990 Late Prehistoric Plains Trade and Economic Specialization. *Plains Anthropologist* 35(128):245–264.
2002 Conflict, Trade and Political Development on the Southern Plains. *American Antiquity* 67:374–64.

Vehik, Susan C., and Timothy G. Baugh
1994 Prehistoric Plains Trade. In *Prehistoric Exchange Systems in North America*, edited by T. G. Baugh and J. E. Ericson, pp. 249–274. Plenum Press, New York.

Wedel, Waldo R.
1959 *An Introduction to Kansas Archeology*. Bulletin No. 174. Bureau of American Ethnology, Smithsonian Institution, Washington D.C.
1986 *Central Plains Prehistory*. University of Nebraska Press, Lincoln.

Wendland, Wayne M.
1978 Holocene Man in North America: The Ecological Setting and Climatic Background. *Plains Anthropologist* 23(82):273–287.

Weston, Timothy
1986 *Acculturation in the Upper Missouri Valley as Reflected in Modified Bone Assemblages*. Ph.D. dissertation, Department of Anthropology, University of Kansas, Lawrence.

Wheeler, Richard P.
1956 "Quill Flatteners" or Pottery Modeling Tools? *Plains Anthropologist* 3(6):7–20.



KAA 38.indd 108 7/5/19 7:13 AM

Whittaker, William E.
2005 Eastern and Plains Late Woodland Transitions as Seen at the Lafayette Mound, Northwest Missouri. *Plains Anthropologist* 50(194):121–142.

Williams, Barry G.
1989 *Phase III Investigations of 14JN349 at Jackson County Project C-0612*. Copy available from Historic Preservation Office, Kansas Historical Society, Topeka.

Yatskievych, George A.
1999 *S eyermark's Flora of Missouri*, Vol. 1. 2nd ed. Missouri Department of Conservation in cooperation with Missouri Botanical Garden Press. Jefferson City, Missouri.

Zeller, D. E.
1968 *The S ratigraphic Sc cession in Kansas*. Bulletin No. 189. Kansas Geological Survey, University of Kansas, Lawrence.

Zier, Christian J., and Stephen M. Kalasz
1999 *Colorad Prehistory: A Context for the Arkansas River Basin*. Centennial Archaeology, Inc., Ft. Collins, Colorado. Submitted to Colorado Council of Professional Archaeologists, Denver.



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## APPENDIX 1: DESCRIPTION OF SOIL CORE AT 14E L33

Rolfe D. Mandel

Landform: T-1 terrace
Slope: 1%
Parent material: Alluvium
Land cover: Prairie
Remarks: Core was refused in coarse gravel at a depth of 640 cm.

| Depth (cm) | Soil Horizon | Description |
|---|---|---|
| | **SOIL 1** | |
| 0–12 | A | Dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; very friable; many very fine and fine roots; common worm casts; gradual boundary. |
| 12–35 | Bw | Brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; friable; many very fine and fine roots; common worm casts; clear boundary. |
| | **SOIL 2** | |
| 35–70 | A1b1 | Dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; friable; common very fine and fine roots; common worm casts; gradual boundary. |
| 70–90 | A2b1 | Dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak fine subangular blocky; friable; common very fine and fine roots; common worm casts; gradual boundary. |
| 90–115 | Bw1b1 | Brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to weak fine subangular blocky; friable; common very fine and fine roots; few worm casts; gradual boundary. |
| 115–160 | Bw2b1 | Pale brown (10YR 6/3) to brown (10YR 5/3) silt loam, brown (10YR 5/3 to 4/3) moist; weak medium prismatic structure parting to weak fine subangular blocky; friable; few very fine and fine roots; few worm casts; gradual boundary. |
| 160–187 | BCb1 | Pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; very weak fine subangular blocky structure; very friable; faint bedding (laminated); common laminae of very pale brown (10YR 7/3) loam and very fine sandy loam; few very fine and fine roots; abrupt boundary. |
| | **SOIL 3** | |
| 187–205 | Akb2 | Brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; weak fine prismatic structure parting to weak fine granular; friable; common grayish brown (10YR 5/2) organic coatings on ped faces; few fine threads of calcium carbonate; few very fine roots; gradual boundary. |
| 205–221 | Bkb2 | Brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to weak fine subangular blocky; friable; few fine threads of calcium carbonate; few very fine roots; gradual boundary. |
| 221–254 | BCkb2 | Laminated brown (10YR 5/3) and dark grayish brown (10YR 4/2) silt loam, brown (10YR 4/3) and very dark grayish brown (10YR 3/2) moist; very weak fine subangular blocky structure; friable; common films and threads of calcium carbonate; abrupt boundary. |



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| Depth (cm) | Soil Horizon | Description |
|---|---|---|
| | **SOIL 4** | |
| 254–275 | Ak1b3 | Dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine prismatic structure parting to moderate fine granular; friable; common very fine threads of calcium carbonate; few very fine roots; gradual boundary. |
| 275–320 | Ak2b3 | Dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine prismatic structure parting to moderate fine granular; friable; few very fine threads of calcium carbonate; gradual boundary. |
| 320–330 | ABkb3 | Dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine prismatic structure; friable; few very fine threads of calcium carbonate; gradual boundary. |
| 330–350 | Btk1b3 | Brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; weak fine prismatic structure; friable; common distinct discontinuous dark grayish brown (10YR 4/2) clay films on ped faces; very few very fine threads of calcium carbonate; gradual boundary. |
| 350–383 | Btk2b3 | Brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; weak fine prismatic structure; friable; few faint discontinuous dark grayish brown (10YR 4/2) clay films on ped faces; very few very fine threads of calcium carbonate; gradual boundary. |
| 383–430 | BCkb3 | Brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; very weak fine prismatic structure parting to very weak fine and very fine subangular blocky; very friable; faint bedding (laminated); very few very fine threads of calcium carbonate; gradual boundary. |
| 430–510 | Ckb3 | Stratified brown (10YR 5/3) silt loam, brown (10YR 4/3) moist, interbedded with dark grayish brown (10YR 4/2) light silty clay loam, very dark grayish brown (10YR 3/2) moist; massive; friable; common very fine threads of calcium carbonate in beds of silty clay loam; abrupt boundary. |
| 510–545 | 2C1b3 | Very pale brown (10YR 7/3) medium and coarse sand, pale brown (10YR 6/3) moist; single grain; loose; common lenses of granules and very fine and fine pebbles; coarsens downward; abrupt boundary. |
| 545–595 | 2C2b3 | Fine limestone gravel; single grain; loose; abrupt boundary. |
| 595–630 | 2C3b3 | Stratified dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist, interbedded with gravelly very pale brown (10YR 7/3) coarse sand, pale brown (10YR 6/3) moist; silty clay loam is massive and gravelly coarse sand is single grain; abrupt boundary. |
| 630+ | 2C4b3 | Coarse limestone gravel; single grain; loose. |



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# APPENDIX 2: PETROGRAPHIC ANALYSIS

Margaret C. Beck

All particles are randomly oriented.

| Specimen number | Inclusion group size | Percent of inclusion type | Sorted | Shape | Roundness | Lens | Max size (mm) | Modal size (mm) | Grain size | Spacing | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Category 1: Large calcite temper in fine matrix** | | | | | | | | | | | |
| **KSHS2 (14PA363-223)** | Large | 25 | Poorly | Equant-elongate | Angular | 2, 5 (20x) | 4.00 | 1.50 | Very coarse sand to granules | Close to single | Calcite |
| | Small | 5 | Well | Equant-elongate | Subangular-subround | 2, 5 (20x) | 0.25 | 0.10 | Very fine sand to fine sand | Open | Calcite, quartz (sr) |
| **KSHS4 (14PA303-134)** | Large | 30 | Poorly | Equant-elongate | Subangular | 2,5 (20x) | 3.75 | 2.25 | Granules | Close to single | Calcite, polyminerallic calcite (1 w/attached biomicrite), micritic limestone w/fossils |
| | Small | 10 | Well | Equant | Subangular -subround | 2,5 (20x) | 0.25 | 0.10 | Fine to very fine sand | Close to open | Quartz, calcite |
| **KSHS5 (14PA303-90)** | Large | 15 | Poorly | Equant-elongate | Subangular -subround | 2,5 (20x) | 3.25 | 1.00 | Very coarse sand to granules | Close to double | Calcite, polyminerallic calcite, micritic limestone w/fossils |
| | Small | 5 | Well | Equant-elongate | Subangular -subround | 10 (80x) | 0.25 | 0.06 | Fine sand to coarse silt | Double to open | Quartz, calcite, micritic limestone (?) |
| **KSHS9 (14EL313-3-1)** | Large | 25 | Poorly | Equant-elongate | Angular -subround | 2,5 (20x) | 3.00 | 1.00 | Very coarse sand to granules | Close to single | Large calcite, polyminerallic calcite, micritic limestone w/fossils |
| | Small | 5 | Poorly | Equant-elongate | Angular -round | 10 (80x) | 0.19 | 0.06 | Fine sand to coarse silt | | Angular calcite, quartz, rounded micritic limestone |
| **KSHS10 (14PA411-277)** | Large | 15 | Poorly | Equant-elongate | Angular -subround | 2,5 (20x) | 5.00 | 1.50 | Very coarse sand to granules | | Large angular to subangular calcite; occasional subrounded micritic limestone w/ fossils |

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| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Small | 5 | Poorly | Equant-elongate | Angular -round | 10 (80x) | 0.25 | 0.06 | Fine to very fine sand | | Rounded micritic limestone, angular calcite, rounded quartz |
| **Category 2: Quartz-feldspar sand temper in sandy-silty matrix** | | | | | | | | | | | |
| **KSHS (14PA363 1987.C.1129)** | Large | 10 | Poorly | Equant-elongate | Subangular -subround | 2, 5 (20x) | 3.25 | 0.25 | Medium sand to granules | | 70% quartz, 30% feldspars |
| | Small | 20 | Well | Equant-elongate | Subangular -subround | 2, 5 (20x) | 0.15 | 0.05 | Fine sand to coarse silt | | 80% quartz, 15% feldspars, 5% mica |
| **KSHS8 (14EL313-22-4)** | Large | 5 | Well | Equant-elongate | Subangular -subround | 2,5 (20x) | 2.00 | 1.00 | Very coarse sand | | Quartz, polymineralic quartz, plagioclase and other feldspar; weathering on feldspar |
| | Small | 10 | Well | Equant-elongate | Subangular -subround | 10 (80x) | 0.19 | 0.06 | Fine to very fine sand | | Mostly quartz |
| **KSHS3 (14PA303-146)** | Large | 10 | Poorly | Equant-elongate | Subangular | 2, 5 (20x) | 1.50 | 0.75 | Coarse sand to very coarse sand | | Quartz, feldspar (some heavily fractured & weathered); calcite, dark grog w/ calcite & quartz inclusions |
| | Small | 10 | Poorly | Equant-elongate | Subangular -subround | 10 (80x) | 0.38 | 0.06 | Coarse silt/ very fine sand to medium sand | | Quartz, calcite, grog |
| **Category 4: Quartz-feldspar sand with grog** | | | | | | | | | | | |
| **KSHS7 (14EL313-23-5)** | Large | 20 | Well | Equant-elongate | Subangular-round | 2,5 (20x) | 1.00 | 0.50 | Coarse sand | | Quartz, feldspar (fractured, weathered); shale or grog w/quartz inclusions |
| | Small | 10 | Well | Equant-elongate | Subangular -subround | 10 (80x) | 0.06 | 0.04 | Coarse silt | | Quartz? very small |
| **Category 5: Fossiliferous limestone temper** | | | | | | | | | | | |
| **KSHS6 (14PA303-8)** | Large | 30 | Poorly | Equant-elongate | Subangular | 2,5 (20x) | 3.25 | 1.50 | Very coarse sand to granules | | Micritic limestone w/dense fossils, some fossil shell & small calcite crystals; density of fossils is distinctive |
| | Small | 10 | Poorly | Equant-elongate | Subangular -subround | 10 (80x) | 0.31 | 0.06 | Medium sand to coarse silt | | Micritic limestone, quartz, some polymineralic quartz |

All particles are randomly oriented.



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# ARCHEOLOGICAL INVESTIGATIONS OF THE ADAIR CABIN (14MM327): RESULTS OF THE 2014 KANSAS ARCHEOLOGY TRAINING PROGRAM FIELD SCHOOL

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*Kansas Historical Society*

*In 2014 the Kansas Anthropological Association and the Kansas Historical Society conducted the Kansas Archeology Training Program field school at the Adair cabin site (14MM327) in Osawatomie, Kansas. The territorial period cabin was the home of a moderate abolitionist couple, Samuel and Florella Adair, and their children, but also was a refuge for the notorious John Brown. The structure was relocated to a city park in 1912 and remains there within a building erected to protect it. The archeological investigations focused on the cabin's original location and sought to confirm some of the area history and also to get a better understanding of the lives of an abolitionist family living in Kansas Territory during the Bleeding Kansas era. The investigation reveals a very modest life for the Adairs and provides evidence that it would have been possible to hide escaping slaves in the cabin, although this is not irrefutably verified.*

The Adair cabin, now the centerpiece of the John Brown Museum State Historic Site, has stood in John Brown Memorial Park in Osawatomie since 1912, but originally it was located at the western edge of town. The John Brown Foundation acquired the Adair property in 2009 and requested that the Kansas Historical Society (KSHS) undertake archeological exploration.

Between May 30 and June 14, 2014, the Kansas Anthropological Association (KAA) and the KSHS hosted the Kansas Archeology Training Program (KATP) field school at the Adair cabin site (14MM327). Investigations were conducted with the intent of providing new knowledge regarding the historical narrative of Bleeding Kansas. The project served to educate the public on archeological practices and techniques, while acquiring information about the Adair family. Activities consisted of fieldwork, which involved a multi-instrument geophysical survey, metal detector survey, and excavation at the original cabin site and its vicinity. It also incorporated laboratory cataloging and analysis of artifacts recovered during the fieldwork, as well as classes and presentations on a variety of topics. This report focuses on the archeological field investigations and findings.

## SITE SETTING AND HISTORICAL BACKGROUND

The Reverend Samuel Adair and his wife Florella (Figure 1) came to Kansas and settled near the town of Osawatomie, an abolitionist community and a center of conflict during the pre-Civil War period referred to as Bleeding Kansas (McFarland 1982:12). Samuel was a struggling Congregational minister in Ohio and then Michigan when he was accepted as a missionary to Kansas (Harris 1919–1922:557). His journey was supported by the Massachusetts Emigrant Aid Society (Renick 1992:7). The Adairs, Florella's half-brother John Brown, and many other northern abolitionists were active participants in the struggle during the 1850s to keep Kansas Territory free from slavery (Harris 1919–1922:557). The Adairs purchased a cabin just outside of Osawatomie in March 1855 (Figures 2 and 3). It was built in 1854 by a squatter named Samuel Glenn (Figures 4 and 5) (*Osawatomie Graphic-News (OGN)* 1938).

Within a year the Adairs were joined in the region by the five sons of John Brown and their families (Harris 1919–1922:557; McFarland 1985:147), and John Brown soon followed them (Figure 6).



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**Figure 1.** Samuel (1811–1898) and Florella (1816–1856) Adair. Courtesy of kansasmemory.org, Kansas Historical Society.

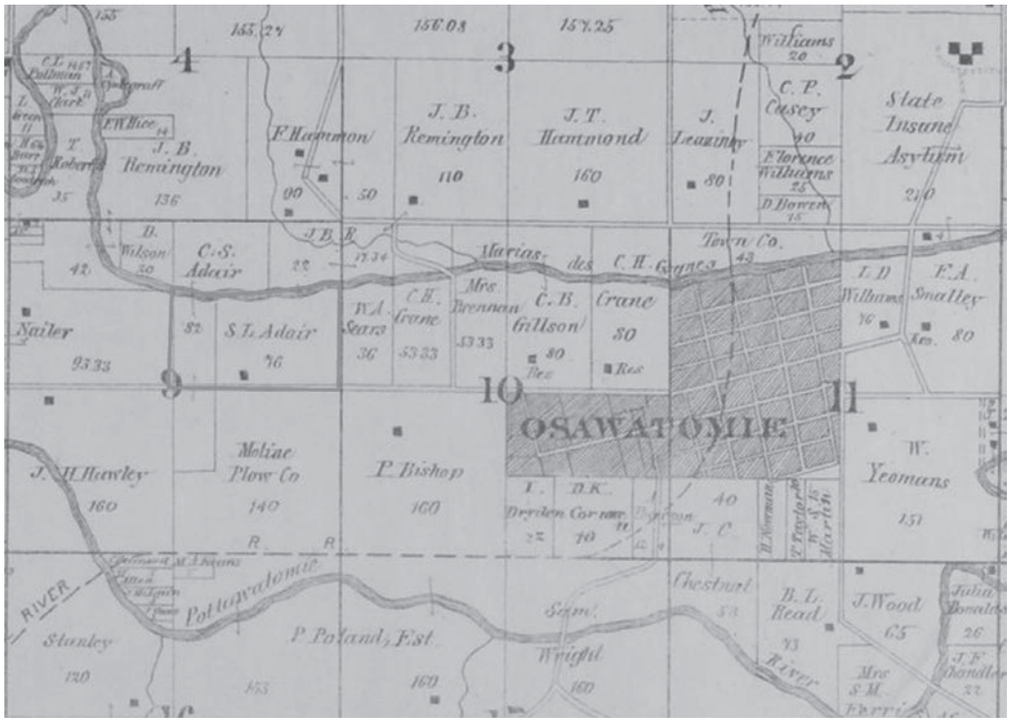


**Figure 2.** The 1878 plat map, showing the location of the Adair property (Edwards Brothers 1878:55).



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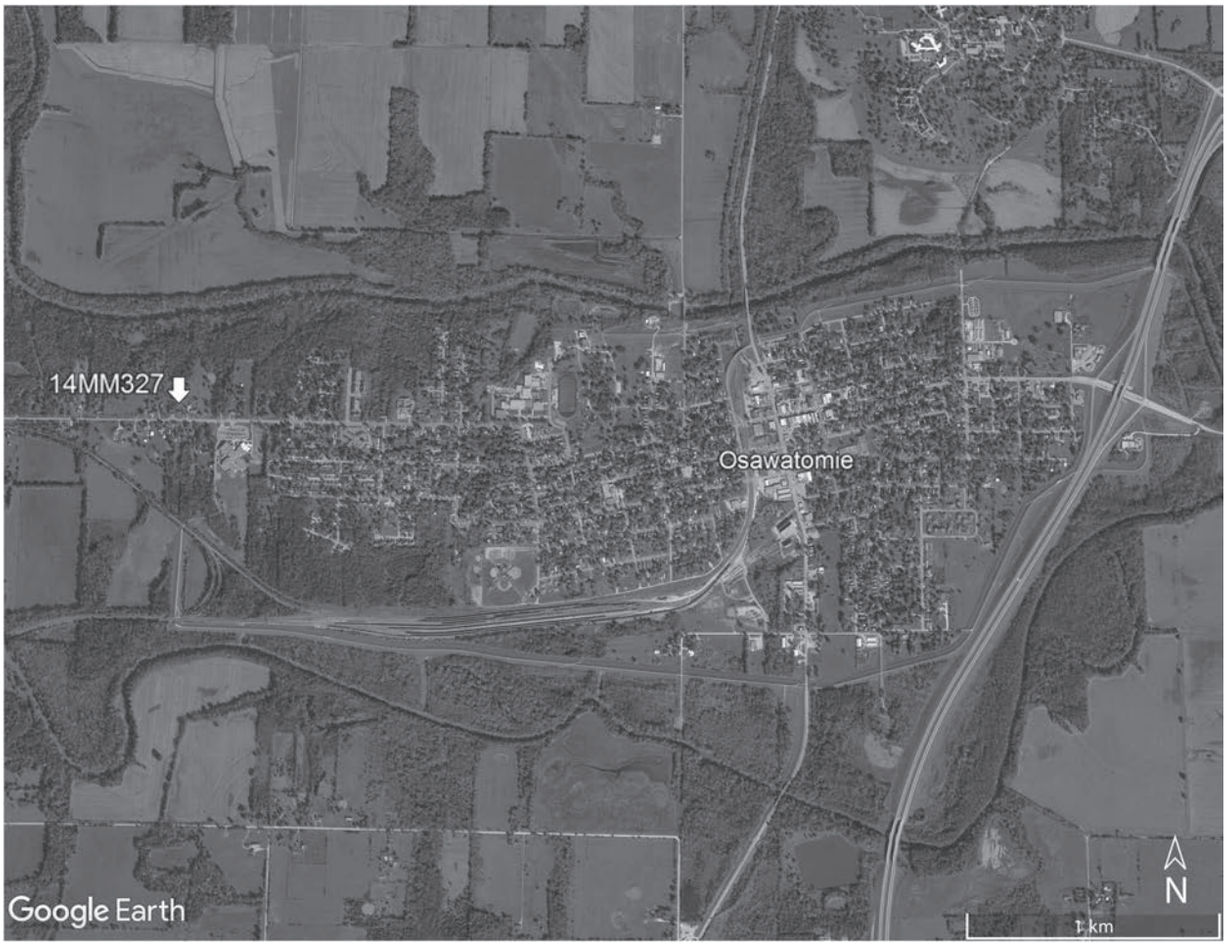


**Figure 3.** Site 14MM327, the original location of the Adair Cabin at 1926 Parker Avenue on the west edge of Osawatomie in Miami County, east-central Kansas. Modified Google Earth© image.

**Figure 4.** The Glenn cabin, purchased by Samuel Adair. Courtesy of kansasmemory.org, Kansas Historical Society.



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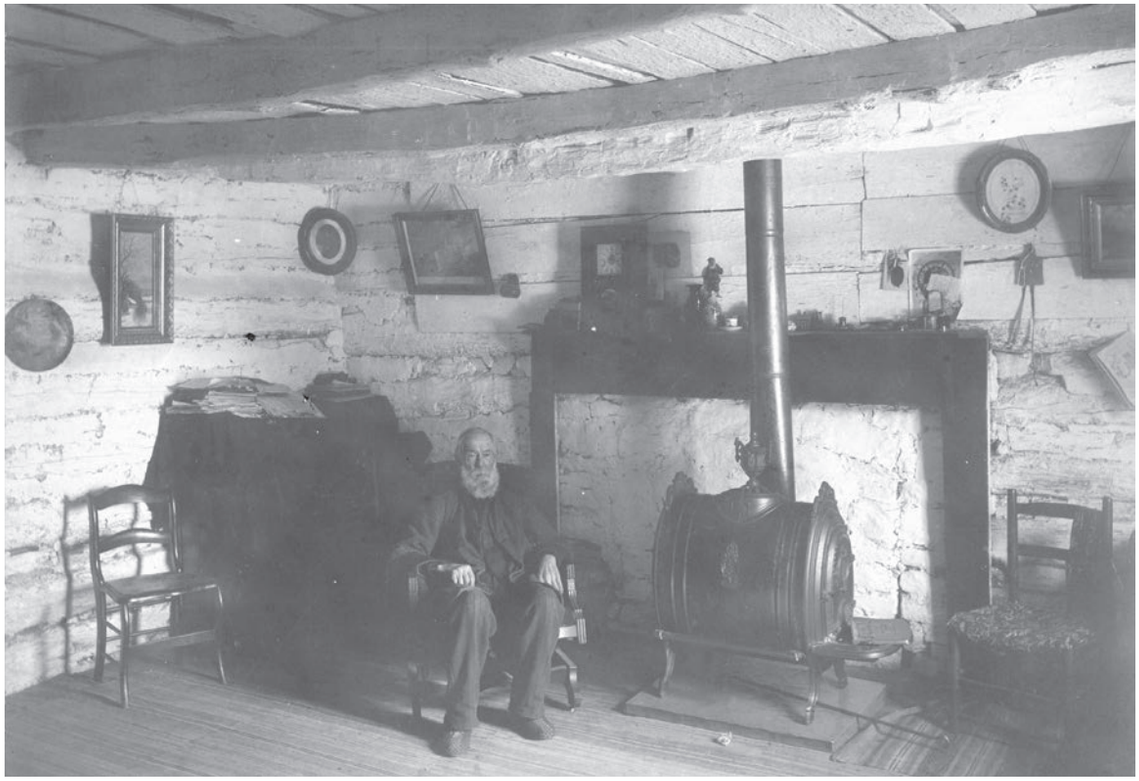

**Figure 5.** Samuel Adair in the original cabin in the mid-1890s. Courtesy of kansasmemory.org, Kansas Historical Society.

The Browns claimed land about 10 miles west of Osawatomie and called it Brownsville.

Pro-slavery immigrants and nonresidents also were active in Kansas, which led to a series of political and bloody conflicts. The locally relevant actions included the Pottawatomie Massacre, the murder of five pro-slavery men on May 24–25, 1856, likely by John Brown and his sons (Cutler 1878:31). Three months later on August 30, Missouri forces marched on Osawatomie, where they met Brown's forces at the Battle of Osawatomie in the current location of John Brown Memorial Park. Most of Osawatomie was sacked and burned that day by pro-slavery forces, except for the Adair residence (McFarland 1985:149). The pro-slavery forces did approach the home, but found only Florella, quite pregnant, who pleaded with them to take what they wanted but to leave the women and children inside unharmed. The pro-slavery men agreed

**Figure 6.** Portrait of John Brown, painted by Elden J. Woodman and photographed by Alex Hesler. Courtesy of kansasmemory.org, Kansas Historical Society.



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and left, stating that it was not their intention to harm women and children (McFarland 1982:12).

However, that morning John Brown's son Frederick had been k lled nearby (Cutler 8: 4 . A stone monument on the property on the edge of Park r Avenue ack o wledges his death (Figure 7) (McFarland 1982:12). The Adair cabin served as refuge for Johns Brown's sons after the Pottawatomie Massacre, as a center for abolitionist planning, and reportedly as a safe place on the Underground Railroad (McFarland 1985:149). During Christmas of 1858, 11 slaves brought by Brown from Missouri were concealed in the k tchen (presumably the first addition) and smuggled out the next day (*OGN* 1938; Wilson 1901:3) .

In addition to the woes of Bleeding Kansas, day-to-day life in Kansas Territory was not easy for the Reverend Adair and his wife in their 8 by 20-foot log dwelling (Figures 4 and 5), but they accepted the hardships in the name of their abolitionist cause. The Adairs were less militant abolitionists than the Brown family, who conducted raids to liberate enslaved people. While Samuel was busy building a congregation and meetinghouse— he First Congregational Church of Osawatomie, now referred to as The Old Stone Church, still standing at 311 6 h Street—Florella was keeping house and taking in sewing and laundry, something that would have been unthink ble in Ohio for a preacher's wife. They also raised their two children, Charles and Emma (Renick 1992:7).

The cabin was made of split logs that were chinked. It had two doors but initially no window and only half a floor. The east gable end was not mortared, letting in light but also winter winds (McFarland 1985:145). A stone chimney was on the east side. About two years later, John Brown, Brown's and son-in-law, and Samuel Adair built an addition on the north end that served primarily as a k tchen (Figure 8 (*OGN* 1938) .

After John Brown's departure from Kansas in December 1858, the Adairs remained in their small home in Osawatomie. In 6 Florella fell ill and died in Leavenworth, where Samuel was stationed as a military chaplain (McFarland 1982:13; Renick 1992:7). Florella was buried in the Greenwood Cemetery in Leavenworth. She was joined by her daughter Marion, who died at nine months and was reported in correspondence to have been buried beneath a tree behind the Adair residence. However, the infant's grave, marked with a stone, lies in Greenwood Cemetery with Florella, apparently moved there by Samuel when his wife died (McFarland 1982:3) . After the Civil War Samuel returned to live in the Osawatomie cabin, and in 6 he built the western addition that served as a study (Figures 9 and 10) (*OGN* 1938). The addition included a cellar and a loft, substantially increasing the size and utility of the building. Figure 11 is a plan view, showing the dimensions and construction sequence. Samuel lived there until his death in 1898, and it was occupied by unnamed parties until 1904.

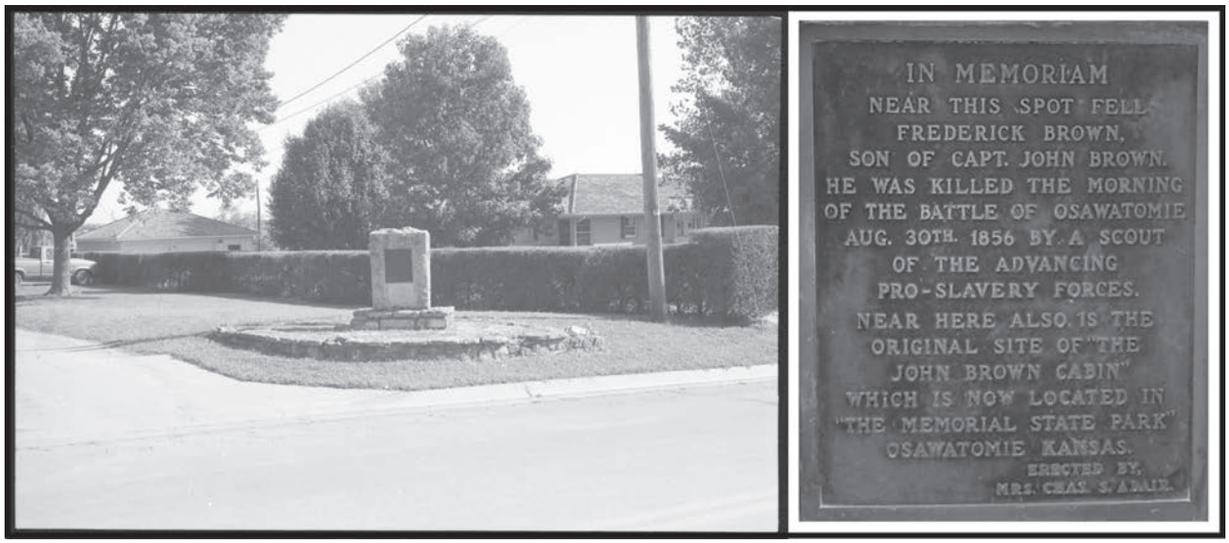


**Figure 7.** Marker at the cabin site acknowledging the shooting of Frederick Brown, son of John Brown.



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**Figure 8.** East side of the original cabin. The addition built by John Brown, his sons, his son-in-law, and Samuel Adair is the left half of the structure. Excavation units near the outbuilding in this image did not find evidence of it. Courtesy of kansasmemory.org, Kansas Historical Society.

A two-story frame house was built in 1903 just south of the cabin by Samuel and Florella's son Charles Adair, who inherited the land (Figure 12). In 1912 the cabin, which was still in good condition, was matchmarked, dismantled (Figure 13), and reassembled in its current location in the John Brown Memorial Park (*Kansas City Star* 1912). In 1928 the western addition was removed, and a stone structure was erected around the original cabin plus the 8 6 addition (Figure 14). This complex was listed on the National Register of Historic Places in 1971. The state historic site is operated in partnership by the KSHS and City of Osawatomie. More information can be found on the John Brown

**Figure 9.** Post-1866 image of the Adair cabin, view to the northwest. Courtesy of kansasmemory.org, Kansas Historical Society.



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**Figure 10.** North side of cabin, 1903–1912. The frame house immediately behind the cabin was built in 1903 by Charles Adair, son of Samuel and Florella. Courtesy of kansasmemory.org, Kansas Historical Society.

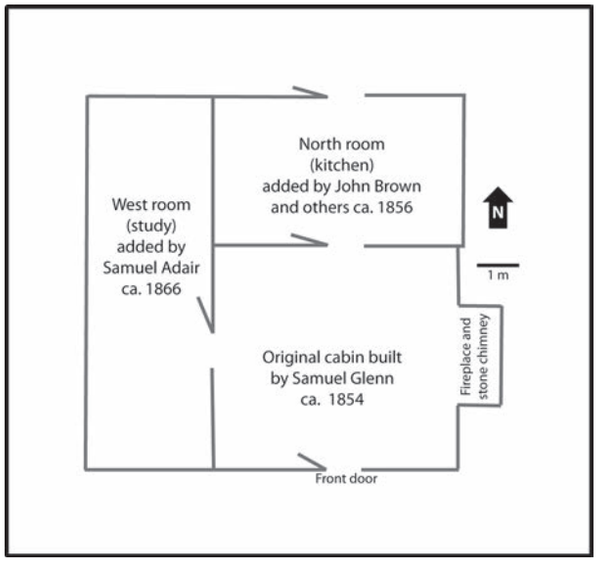


**Figure 11.** Cabin floor plan, after a measured drawing by Chris Hord in 2014. The west room was removed when the protective pergola was built in 1928. Dimensions for the western addition are based on photographs from the original location.

Museum website http://www.kshs.org/kansapedia/john-brown-museum/18 .

The John Brown Foundation acquired the Adair property in 2013 and invited the KSHS and KAA to conduct an archeological investigation of the area. The site was designated 14MM327 (Figures 3 and 5).

## RESEARCH OBJECTIVES

The objectives of the field project were developed to guide investigations and provide new facts to add to the historical narrative. A key question is how the Adair family participated in abolition, the Underground Railroad, and Free State activism. Were they covertly militant? Were they harboring escaped slaves? Attention also focused on the socio-economic status of the Adairs in comparison to other Osawatomie settlers. Finally, efforts were directed toward determining the layout of the farmstead.

## PRELIMINARY FIELDWORK

Fieldwork comprised a geophysical survey prior to the field school, a metal detector survey, intensive testing, and excavation of recognized features. Identification and interpretation of artifacts were accomplished by a processing lab, and the field school was augmented by classes and evening lectures by local and regional authorities.



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**Figure 12.** Left, south side of 1903 Adair house; right, north side of 1903 Adair house, mid-1990s. The Adair cabin footprint was partially covered by the garage, visible on the left of the north side view.

**Figure 13.** Dismantling cabin for move to park, 1911 or 1912. Courtesy of kansasmemory.org, Kansas Historical Society.



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**Figure 14.** John Brown Memorial Park stone enclosure building, 1928. Courtesy of kansasmemory.org, Kansas Historical Society.

**Figure 15.** Looking southwest across 14MM327 in April 2014. The Adair cabin, now removed, was partially beneath the garage seen in this image. The two-story house was built in 1903, and the garage was constructed in the mid-1950s.

### *Geophysical Survey*

Dustin Thompson of the Center for Archaeological Research at Missouri State University carried out a geophysical survey at 14MM327 in April 2014. Assisted by KSHS and KAA personnel, he used a magnetometer, a gradiometer, and ground penetrating radar over most of the 3,250-m$^2$ lot (Figures 16–19) (Thompson 2014).

Data post processing and interpretation resulted in three maps. Figure 17 shows the deep features below the clutter of the more recent ground surface



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**Figure 16.** Thompson conducting the magnetic field gradient survey in April 2014. View is to the northwest.

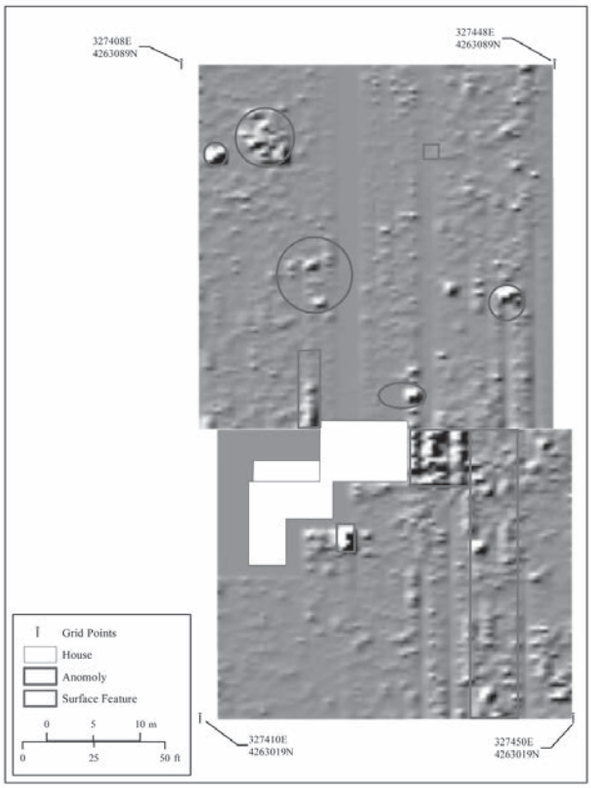


**Figure 17.** Ground penetrating radar results, showing deeper frequencies (slice 9, see Thompson 2014). Anomalies in the northwest quadrant are believed to be associated with the septic system for the frame house (from Thompson 2014).

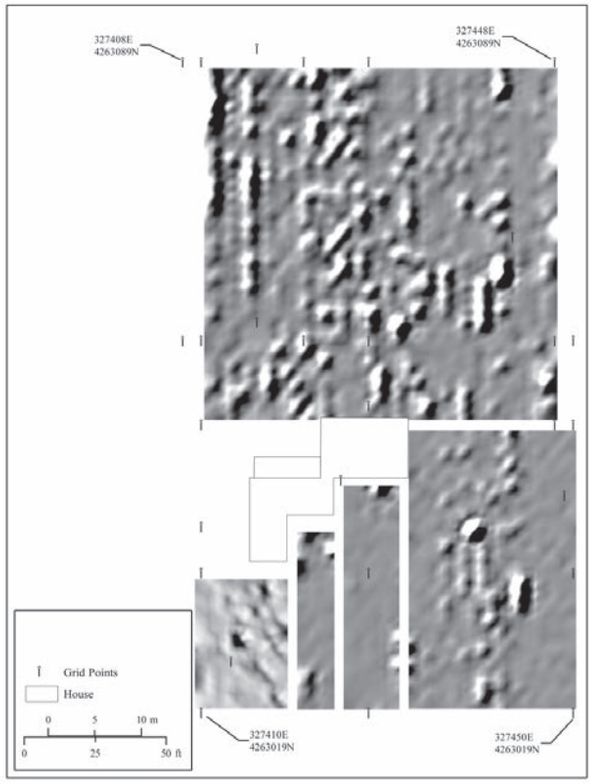


**Figure 18.** Gradiometer data (from Thompson 2014).



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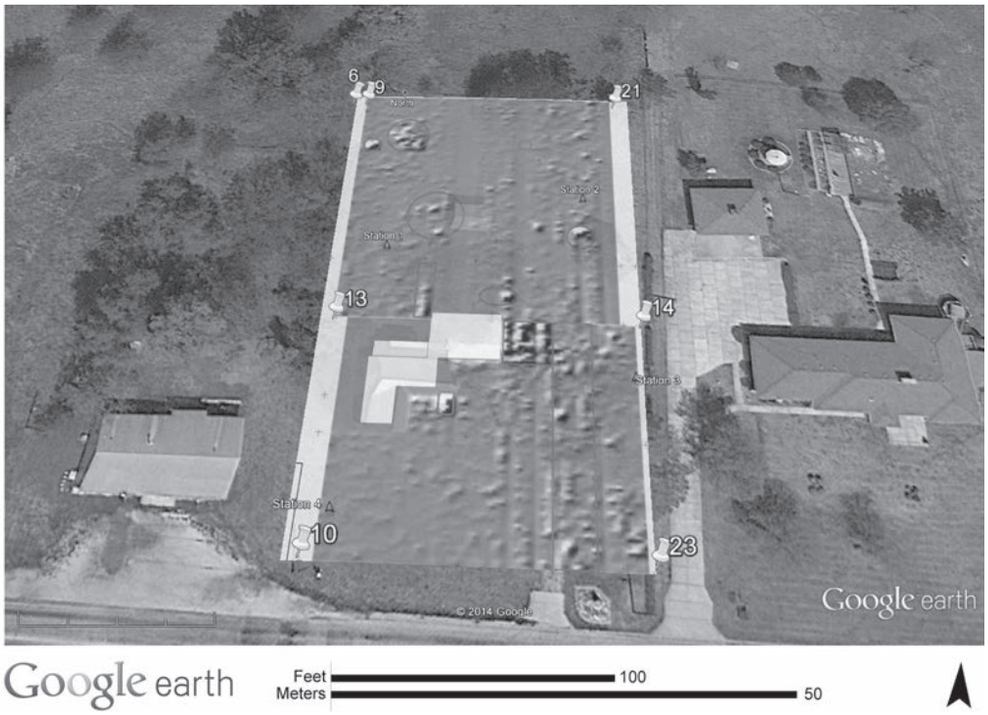


**Figure 19.** Image of the ground penetrating radar survey superimposed over a Google Earth© image of the site.

disturbance. Those outlined by rectangles, including sidewalks, concrete slab, gravel driveway, and parking area, are apparent. Outlined by circles are the anomalies that did not have surface expression. GPR anomaly 1–6 is within the cabin interior and thus was an excavation priority. Figure 18 depicts the magnetic field gradient data, which do not reveal any recognizable patterns, but probably indicate a near-surface scattering of iron objects. Figure 19 illustrates the relationship of the geophysical survey to the modern layout of the site.

### *Metal Detector Survey*

Metal detectors had been used by non-professional relic hunters at this site in the past, which is one of the reasons that the KSHS was asked to conduct a professional investigation there. Previous metal detection and artifact collection obviously diminished the effectiveness of the fieldwork reported here. In 2014 metal detector crews identified, recorded, and bagged specimens, following an established protocol. Specifically, when a metal detector operator received a signal, he or she exposed the target and recorded the location using a handheld GPS with ±3 m accuracy. Artifacts determined to be significant were photographed with a scale, their positions were recorded using the total station, and they were picked up. Large items, such as barrel bands and wheel rims, were photographed, their locations were recorded using the total station, and they were left in situ.

## EXCAVATIONS IN MAY-JUNE 2014

KATP field school took place from May 30 to June 14, 2014. Excavation at 14MM327 focused on the original cabin footprint. The boundaries were based on visible surface features, such as flat stones suggesting a walkway; known structure dimensions; historic photographs; and the geophysical survey.

### *Excavation Procedures*

Excavations were conducted within a grid of 1 m squares. A primary datum at an arbitrary 100- m elevation was established on an elevated spot north and west of the house at Universal Transverse Mercator (UTM) coordinates Zone 15 south, 327416.0 E, 4263061.0 N. Its location is designated with the last three whole digits of its coordinates with reversed cardinal direction order (N061 E416). Three secondary datum points are N070.20 E443.47 (Station 2), N042.35 E449.04 (Station 3), and N024.50



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**Figure 20.** Boundaries of 14MM327 and of Areas 141 and 142. Imagery from Google Earth©.

E3 .12 (Station 4). Two localities of interest were established early in the project and are referred to as areas. Area designations are three-digit numbers that indicate the excavation y ar (4 for the y ar 2014, for example), followed by an individual number. Two areas were established: A141 and A2 . A4 is the location of the Adair cabin; A142 was thought to be the position of an outbuilding (Figure 20).

Excavation unit corners were marked with metal spikes, and each individual unit was referred to by the grid coordinates (northing and easting) of its southwest corner spike. Workers used shovels or trowels to skim sediment in 10-cm levels and recorded precise locations of identifiable in-situ artifacts with the total station. Objects in disturbed contexts, such as rodent runs, were piece plotted with notations of their displaced circumstances. The locations and dimensions of concentrations of nondiagnostic specimens, such as bone, shell, or metal scrap, were mapped, and the materials were collected and bagged together. Excavated sediments were sifted through ¼ inch mesh screens. At the discretion of the principal investigator, 10l flotation samples were taken from features and processed at the KSHS Archeology Lab. Field school participants described, photographed, and mapped such features as foundations, walkways, and postholes. Feature fill was dry screened, with the contents saved separately rom the unit level bag.

When culturally sterile soil was encountered, the level was terminated, and soil core probes were taken from the four corners and the middle of the floor to check for deeper cultural deposits. In some cases profiles of one or more unit walls were drawn.

Investigators also dug 37 shovel tests on grid intersection points to ground-truth geophy ical data and to search for site boundaries and features. They were assigned numbers, and both the nature of sediments and types of items uncovered were noted on shovel test forms. The type and density of artifacts, as well as the absence of artifacts, were used to determine where excavation units should be placed. Shovel tests also were useful in identify ng disturbed deposits.

Twelve units were opened west of a twentieth-century sidewalk that led from the 1903 frame house to a recent shed (Figure 21). These units, excavated to find evidence of the outbuilding shown in Figures 7 and 8, quickly encountered disturbed sediments. They were abandoned when local informants shared the information that this is the lik ly location of a septic line.

Archeological testing in May and June 2014 revealed that foundation and walkway stones, as well as a cellar-lik construction associated with the cabin, are positioned from the north wall footing of the garage, extending approximately 20 feet northward. While some of the stones are exposed at



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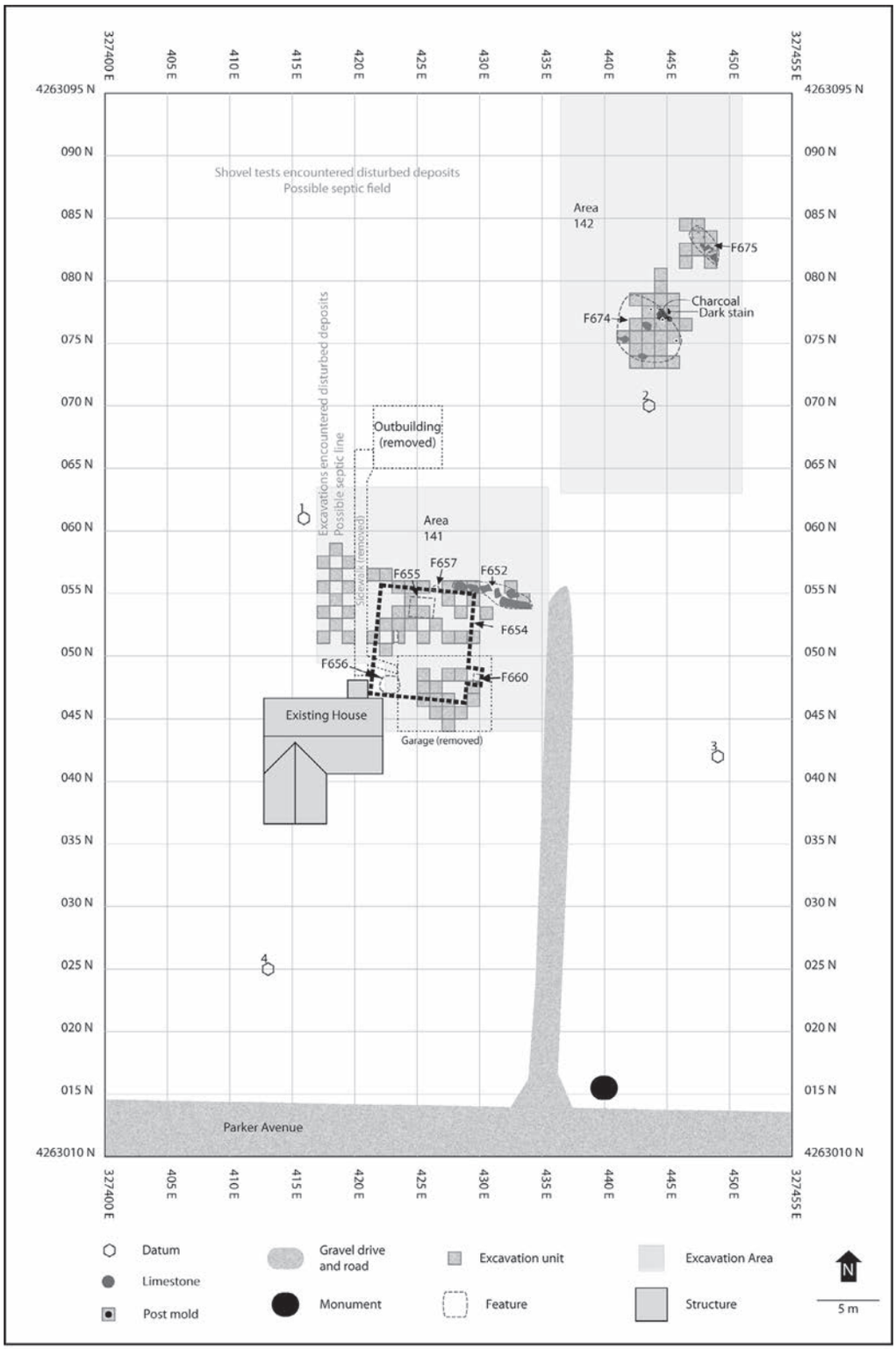


**Figure 21.** Map of 14MM327, including structures standing at the time of the excavation, excavation units, areas, and features.



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the surface, many are buried. These remains established this spot as a focus for investigation.

## ADDITIONAL EXCAVATIONS IN SEPTEMBER 2014

The May-June explorations confirmed that the circa 1955 garage was situated directly on top of much of the cabin footprint. In August 2014 the garage attached to the 1910 frame house was removed to facilitate the excavation of the entire cabin foundation and floor. Garage demolition and the removal of adjacent concrete sidewalks and trees, accomplished with heavy equipment, was monitored by a KSHS archeologist. In September 2014 a professional and volunteer crew returned to continue work in the newly uncovered portion of the foundation and floor within A141. This included F655, referred to as the cellar, found earlier.

### *Features*

Feature 652 (F652)—Stone Walkway

A series of flat stones, documented just north and east of the north cabin edge, represents a walkway, visible in an early twentieth-century image (Figure 10). Figure 22 shows one of these stones that was apparent before excavation began.

Feature 655 (F655)—The Cabin

The cabin floor was not easily distinguishable from areas outside of it. The footprint was impacted by removal of the original structure and by construction of the garage over part of it. Still, a shadow of the previous building emerged as observations during excavation were paired with information from the existing reconstruction.

There is no clear foundation. In an assessment of the circa 1830 Thomas Lincoln (father of Pres-

**Figure 22.** One of the walkway stones on the north side of the first cabin addition, part of Feature 652. It is 2 m long on its longest dimension.



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ident Abraham Lincoln) cabin in Macon County, Illinois, Mansberger (2009:1030-1034) stated that cabins of the period either had no foundations, with wall bases lying directly on the ground, or the four corners rested on piers of one or more large stones, effectively lifting the structures a small distance. Given that the Adair cabin is a vernacular dwelling and that the builder could do anything that seemed practical or desirable; all options are open. Most likely the cabin sat directly on the ground, as there is no firm evidence of a prepared surface or rock foundation that follows the outline of any or all of the three building events. However, this assumption is tempered by the fact that at least part of the third Samuel Adair addition circa 1866, which became the west side, has walls made of stone that extend up about 3 feet before continuing with vertical siding (see Figure 10). No clear remnant of that partial stone wall was visible in the excavation of the footprint. This is not surprising, as all this material likely was removed during relocation in 1912.

The reconstruction, now enclosed in a building in the John Brown Memorial Park and Museum, consists of the original cabin and the first (circa 1856) addition with dimensions of 30 by 20 feet. The chimney exterior is 7 feet wide and pushes out of the east wall about 3 feet at a point about 7 feet north of the south wall. At 14MM327 the chimney is represented by a large limestone slab that shows signs of heating, surrounded by burned earth and charcoal (F660). A post (F653) lies along the north wall, as does a walkway (F652). A cistern (F656) is in a location that was remembered by former resident Nancy Brownback as the southwest side of the cabin. Finally, a cellar (F655), described below, lies to the west within the 1856 addition, built by John Brown.

The cabin boundary, depicted in Figure 21, does not fit any one data source well. For example, the precise position of the fireplace, as manifested by the hearthstone, which presumably was in situ when discovered during excavation, is farther north and east than expected if the outline as reconstructed is laid over the excavation grid. It is possible and likely that the proportions of the reconstruction are not entirely faithful to the original and that the vague dimensions represented archeologically were diminished by the cabin removal and twentieth-century use of the property.

Feature 655 (F655) – Cellar

F655 is a deep subsurface structural feature within the foundation of the 1856 addition, erected by John Brown and others. It was identified in the ground penetrating radar survey as GPR anomaly 1-16 and was recommended for ground-truthing (Thompson 2014:13, 21). Its limestone construction, faced with mortar, is consistent with a cellar. It measures approximately 2 m east to west, 1.5 m north to south, and 1.4 m deep (Figure 23). F655 corresponds with the location of a trap door in the floor of the first addition. Reportedly this trap door was evident in the floor of the relocated cabin before it was damaged in a 1995 fire, which led to floor replacement (Wilson 1901:547). At 14MM327 the roots of a tree and fallen wall or foundation stone made thorough excavation difficult in the limited time of the field school and later fall work event. The bottom was reached only in a small portion of the southwest corner.

The floor and walls of the cellar are covered in mortar. John Speweik of Speweik Preservation Consultants, Inc. (personal communication November 3, 2014) evaluated mortar from between the stones of F655 and from the mortar overlayer on the facing of the stone to determine if they were coeval. Speweik conducted subjective tests. The sounds that mortar makes when struck is an indication of its properties. A dull sound signals a low-fired mortar, typical of older material; a brighter sound attests to more recent higher-fired mortar. The between-stones mortar had a duller ring than that of the facing mortar and likely is older. Older mortar is lighter and more water absorbent. The between-stones mortar bubbled when placed in water, demonstrating that it contains more air space. The facing mortar sank and did not bubble or absorb water, implying that it is more recent. This suggests that the stone was coated with the mortar years after the cellar was built.

Feature fill, excavated during the field school, is dominated by early twentieth-century materials, so the cavity was used as a dump after the cabin was removed. This raises a question as to whether earlier artifacts dating closer to the occupation period were more common near the bottom. Table 1 lists objects for which firm dates of manufacture can be determined. Unfortunately, based on this information, no clear chronological layering of the deposits



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**Figure 23.** Feature 655, presumably a cellar. Large roots, dense deposits, and insufficient time allowed only partial excavation of the structural feature.

**Table 1.** Artifacts with Verifiable Date Ranges Recovered from Upper and Lower Halves of Adair Cabin Cellar.

| Lower half of feature | Upper half of feature |
|---|---|
| Ridenour-Baker condiment bottle (1858–1910) | Bowl with JW Pankhurst & Co. bowl mark (1850–1852) |
| Carter's ink bottle (1858–1978) | Plate with The Potters Co–operative mark (1883–1925) |
| Bottle with P D & Co mark (1875–2007) | |
| Mason fruit jar (1885–1900) | |
| Heinz bottle (1888–present) | |
| Tea cup with Brother mark (post 1891) | |
| Baker's flavoring bottle (1892–1962) | |
| Atlas canning jar (1896–1964) | |
| Franco–American Hygienic Co. face cream jar (post 1903) | |
| Condiment jar with Economy mark (1904–1955) | |
| Plate or saucer with George mark (1904–1955) | |
| Lyric medicine bottle (1914–1929) | |



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exists. Likewise, a more subjective evaluation of all F656 specimens reveals no layering.

However, all the medicinal items—medicine cans or bottles and syringe fragments—came from the lower portion of the feature. Florella's health was not good. The winter of 1864 was particularly difficult for her, and in March 1864 she joined Samuel in Leavenworth, where she died in February 1865 (McFarland 1985:156). The concentration of health-related artifacts may be related to her illness.

Oral tradition is that a sub-floor area in the cabin was used to hide slaves escaping to freedom. The archeological excavations reported here confirm that there was a subterranean space large enough to hide several people for a short time. Presumably this space could have been concealed and thus serve as a hiding place. However, findings do not provide positive evidence that people hid in the cellar, and it is difficult to imagine exactly what that proof would be. The discovery of the cellar neither fully affirms nor refutes the folklore that escaping slaves were hidden there.

Feature 656 (F656) Cistern

A depression was visible in the corner between the 1903 frame house and the connected garage. Former resident Nancy Brownback identified the spot as the cistern or well, and photographs of the house before garage construction show what appears to be a well or cistern cap (Figure 24). F656 was partially excavated as a whole, not by units or levels. An overburden of modern trash and construction debris was removed and screened. Partially covered by the circa 1955 garage, rough limestone blocks, like those seen in images of the Adair cabin foundation, are present under the garage foundation. Beneath the layer of trash is dark gray brown clay that was saturated at the time of investigation, supporting the notion of a cistern. Digging ceased upon reaching this material and the verbal confirmation that it was

**Figure 24.** View to the southeast showing the northeast corner of the 1903 frame house. The adults are sitting on the cover over F656, the well or cistern. Image courtesy of Nancy Brownback.



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the well or cistern. A probe inserted at four locations penetrated to depths of 70–80 cmbs. This depth is more consistent with a cistern than a well.

Feature 672 (F672) – Post

F672 is a wooden post, surrounded by stabilizing stones, positioned at the outside of the cabin's north wall. The post diameter is 17 cm; it penetrated 30 cm below ground surface (cmbgs). This post would have been outside of the 1886 addition. It is in proximity to a doorway, seen in Figure 10, and may have been a load-bearing member of the door frame.

Feature 660 (F660) – Hearth

The hearth is indicated by a limestone slab that is 12 cm thick and burned earth, burned rock, and charcoal in a lens 0–20 cmbgs. Significant amounts of cultural material, both domestic (several buttons, decorative glass and ceramic tableware, a doll dish and ceramic doll hand, bone and mussel shell) and construction-related (mortar and nails) were recovered. At this point the fireplace and chimney protrude from the east wall of the cabin, and it is undoubtedly the hearth. F660 was exposed beneath the floor after the garage was removed.

Features 673, 674, and 675 (F673, F674, F675) – Outbuilding

Geophysical and metal detector surveys showed concentrated cultural activity north and west of the cabin. Workers excavated 31 units in this locality. Three areas initially were established as separate entities—F673, F674, and F675—and provide evidence of an outbuilding. This structure is characterized by flat limestone rock (F674 and F675), partially and completely burned wood, dark stains, a higher density of artifacts than the surroundings, and a line of post molds (F673). F675 is distinguished by a row of flat limestone rocks, arranged in a southeast-to-northwest-trending line. These may have been a walkway or a flat surface for a building sill. Such remnants would be expected for any farmstead of this time period and into the present. A post-1886 image (Figure 25) reveals an outbuilding in the general vicinity of F673, F674, and F675, further substantiating this interpretation.

Objects associated with F674 include the flat limestone slabs that clearly were set together (Figure 26) and level, pieces of glass, brick, and copper wire, a cup hook, bone, square nails, whiteware, a porcelain light fixture, staples, a washer, cinders, a marble, a Model T valve stem keeper, and river gravel that may have been laid down to abate mud. Finally, a cow hair ball suggests that the location was an animal pen.

## ARTIFACT ANALYSIS

Artifacts were cleaned in a manner appropriate to the specific material, such as washing or dry brushing, and cataloged by KSHS staff and KAA volunteers. Christine Garst conducted the analysis.

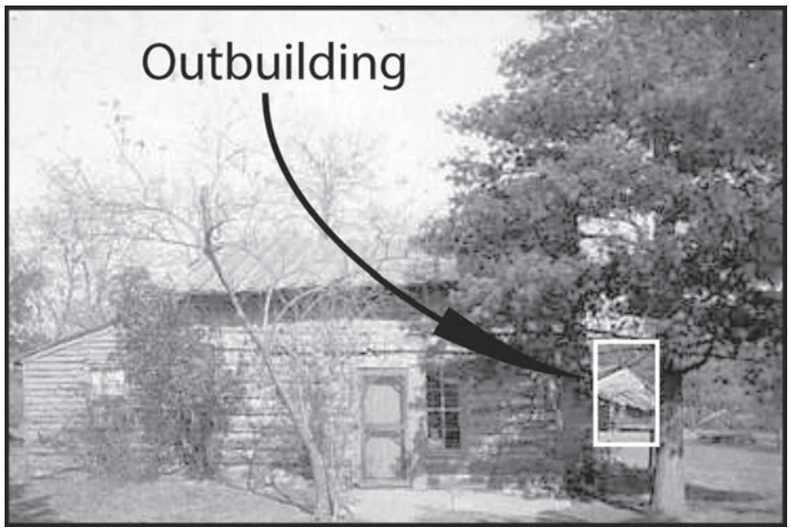


**Figure 25.** View to the north of the Adair cabin. Note the outbuilding to the northeast. Courtesy of kansasmemory.org, Kansas Historical Society.



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**Figure 26.** Documentation of flat stones that may have served as the foundation or floor of an outbuilding.

The cataloged items were entered into a Microsoft Access© database and tabulated by function, type, and subtype. The functional categories were further grouped into four categories: building-related material, domestic, work, and other. The artifact classes and subclasses, their amounts by count or weight, and a summary of specific types are presented in the Appendix.

### *Building-Related Material*

Building-related materials are those artifact categories related to the structural or foundational aspects of the Adair cabin and any other structures, past or present, on the property. Within the group are five functional categories: construction material, window glass, utilities, hardware fasteners, and miscellaneous hardware.

Construction Material

Artifacts classified as construction material are bricks, stone, cement, mortar, and wood. Twelve of the wood fragments may have come from posts, possible fence posts or support posts for a roof. One of the stones may have been a flagstone, serving as part of a walkway.

Window Glass

Most of the window glass is aqua; the rest is colorless. These two colors were available from 18 through 1912, when the cabin was moved.

Utility

The utility-related artifacts were recovered from four functional categories: electrical, heating, lighting, and plumbing. According to John Brown Museum State Historic Site administrator Grady



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Atwater (personal communication February 14, 2019), it is unlikely that the Adair cabin was connected to city water, sewer, or electricity prior being moved in 1912, although these changes to utilities occurred elsewhere in the city as early as 1909. However, the seven specimens recognized as having a plumbing function—two ceramic sewer pipe sections, two iron fittings, a single iron collar, and two pieces of a drainer—could have been part of the septic system or water pumps. The lighting category contains a prism (Figure 27), which may have come from either a lamp or a ceiling light, and 376 lamp components, among them an airplate, a thumbscrew, a wick tube, and lamp chimney and globe glass. Most of the lamp glass is clear or white, but at least one lamp is dark green on the exterior and white on the interior.

Hardware Fastener

Not surprisingly, many 14M M327 artifacts fall into the hardware fastener category. All the different types of fasteners could have been used during the period of interest into the twentieth century: bolts, a single cotter pin, fasteners, grommets, hooks, nuts, pins, rivets, screws, a single spacer, staples, washers, and nails. Most of the staples are fence staples; the others are either box staples or unidentified.

Nails are the largest functional category in hardware fasteners. Most are wrought, cut, or wire nail fragments (n = 796, 61.4 percent). The rest can be differentiated as finishing, cinch, roofing, horseshoe, and common nails. All these types could be expected at the cabin and any outbuildings.

Hardware Miscellaneous

Most of the hardware is common for the period of occupation. Fencing material is well represented with both fencing wire and barbed wire. A nose ring for an animal and chain link, swivel, and loop signify animal husbandry. Bucket bails, round bar stock, chain lengths, a ring, a spring, and strap metal were also recovered.

## *Domestic*

Domestic materials encompass those artifact categories related to the domestic or household aspects of the Adair cabin and any other past or present buildings. Within the domestic group are 10 functional categories: furniture and appliance, containers, tableware and utilitarian wares, flatware, cookware, by-products, organic, clothing, personal, toiletry, and recreation. All are consistent with a domestic structure.

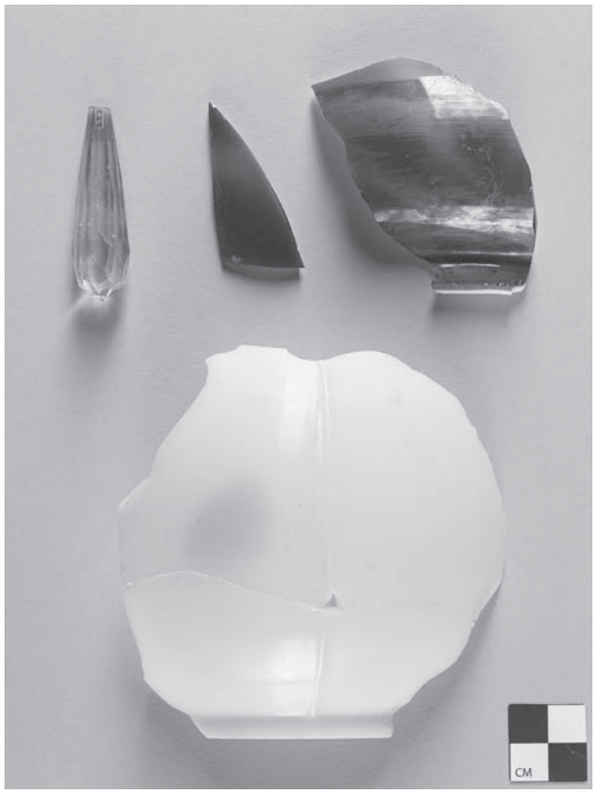


**Figure 27.** Light fixtures and a lamp prism. Courtesy of kansasmemory.org, Kansas Historical Society.

Furniture and Appliance

Many objects are classified in the furniture and appliance category. They are household utility items, such as latches, coat hooks, and window treatments. Several frosted glass sherds with a geometric pattern may have been the glass front of a fine quality cabinet, potentially an expensive purchase. Minor appliances include a sad iron, a possible crank mechanism from a coffee mill, and a clear glass dome and metal stem from a percolator. Thirteen cast iron pieces are thought to be parts of a stove for cooking, heating, or both.

Container

This category is dominated by canning jar fragments, canning lid liners, and zinc caps, dem-



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**Figure 28.** Canning jar lid liners. Courtesy of kansasmemory.org, Kansas Historical Society.

**Figure 29.** Canning jar manufactured by the Kerr Glass Manufacturing Company. Courtesy of kansasmemory .org, Kansas Historical Society.

**Figure 30.** Canning jar manufactured by the Mason Fruit Jar Company. Courtesy of kansasmemory.org, Kansas Historical Society.

onstrating that either canning or the purchase of home-canned goods was important to the household (Figure 28). One complete jar had the advertising "ECONOMY" (Figure 29) on the front, indicating that the jar was manufactured by the Kerr Glass Manufacturing Company, later known as the Alexander H. Kerr Glass Company, between 1904 and the mid-1950s (Toulouse 1971:307). Other canning jars were manufactured by the Mason Fruit Jar Company (Toulouse 1971:343–345) that was in operation from 1885 to 1900 (Figure 30). Finally, canning jars also carry the logo of the Atlas Glass Company, later known as Hazel Atlas Glass Company (Figure 31) that manufactured jars from 1896 to 1964 (Toulouse 1971:345).

One face cream jar has the lettering "FRANCO AMERICAN HYGENIC CO. CHICAGO" (Figure 32). The Franco American Hygenic Company



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**Figure 31.** Canning jar manufactured by the Atlas Glass Company. Courtesy of kansasmemory.org, Kansas Historical Society.

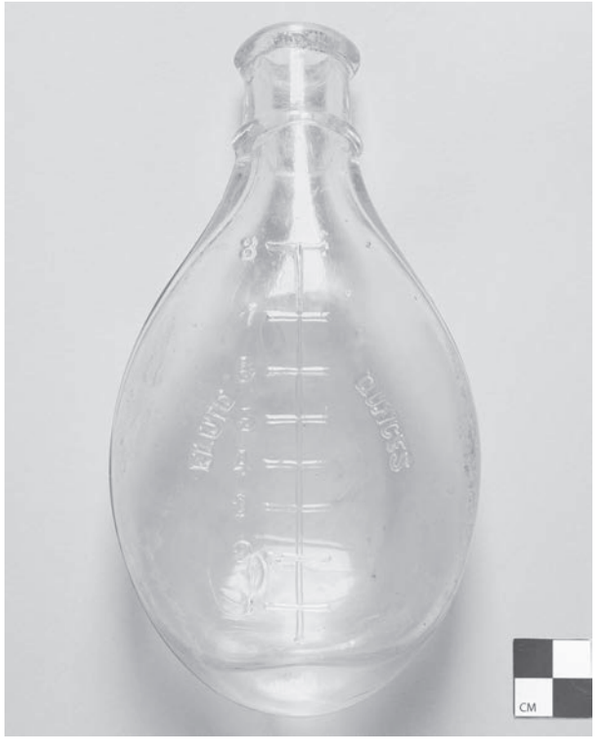


**Figure 33.** Nursing bottle with graduated lines marking fluid ounces. Courtesy of kansasmemory.org, Kansas Historical Society.

**Figure 32.** "Franco American Hygienic Co. Chicago" jar. Courtesy of kansasmemory.org, Kansas Historical Society.

may have started production of toiletries as early as 1873 (Hetherington 2017). Another bottle that may have come from the Adair occupation is a complete baby bottle (Figure 33), called a nursing bottle. The bottle has a rounded bottom, a short, tipped-up neck, and gradated lines denoting fluid ounces on the back. It was manufactured in a two-piece mold and, depending on the nipple attached, could have been used for humans or livestock. A single rim and neck of a clear milk bottle also was recovered. In the United States, the first glass milk bottle was patented in 1884 (Stanpac 2019).

Two complete ketchup bottles were found, one (Figure 34) with wording on the bottom: "H. J. HEINZ CO/162/PAT." In 1888 the successful condiment manufacturer changed its name to J. J. Heinz Company (Moloney and Cadamore 2009), a name that is retained today. The other ketchup bottle also was manufactured for Heinz, although the bottle maker's mark is a single "H." According to Toulouse (1971:417), this mark dates to post 1888. One bottle was labeled "BAKER'S STANDARD



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**Figure 34.** Bottle makers' marks for Heinz ketchup bottles. Courtesy of kansasmemory.org, Kansas Historical Society.

FLAVORING EXTRACTS" along one panel (Figure 35). The first use of the Baker's product name occurred in 1892 (Justia 2018). Another nearly complete bottle, which may have held flavoring, bears the advertising: "RIDENOUR-BAKER GROCERY CO. KANSAS CITY MO" (Figure 36). The Ridenour-Baker Grocery Company, established in 1858 in Lawrence, Kansas, subsequently moved to Kansas City, Missouri, and operated between 1858 and 1910 (University of Kansas Libraries 2001).

One of the ink bottles has the logo "CARTER'S" on the base (Figure 37). The Carter's Ink Company, of Boston, Massachusetts, operated from 18 to 1976 (Faulkner and Faulkner 2003). This is an example of a clear glass machine-made square bottle. Another chemical bottle (Figure 38) may have held polish and was labeled on two panels with "B. F. STINSON & CO. BUFFALO, N.Y. U.S.A." The bottle style may date it to the late 1800s.

**Figure 35.** Baker's Standard Flavoring bottle. Courtesy of kansasmemory.org, Kansas Historical Society.

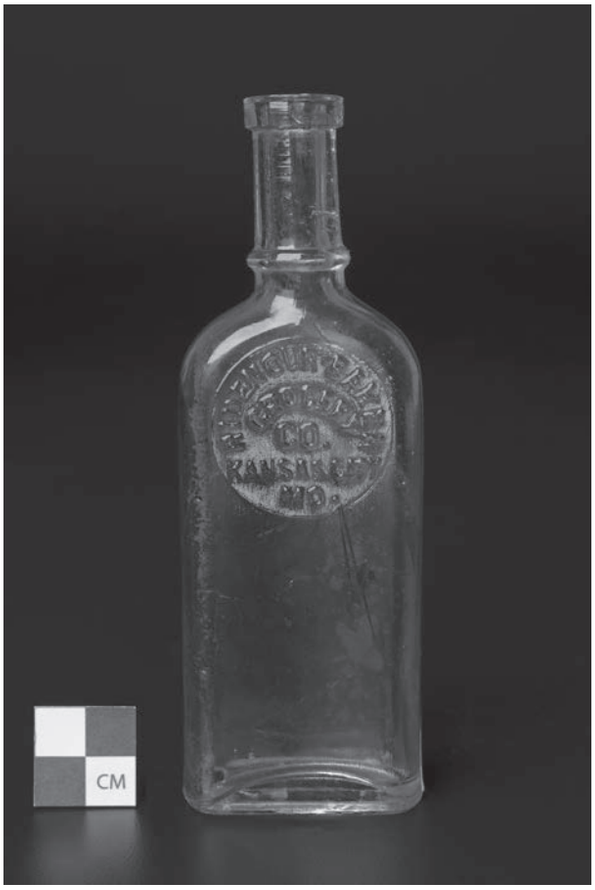


**Figure 36.** Ridenour-Baker Grocery bottle. Courtesy of kansasmemory.org, Kansas Historical Society.



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**Figure 37.** Carter's Ink bottle base. Courtesy of kansasmemory.org, Kansas Historical Society.

**Figure 38.** B. F. Stinson and Co. bottle. Courtesy of kansasmemory.org, Kansas Historical Society.

One bottle fragment has partial lettering for the word "Listerine." Listerine mouthwash was first marketed in 1879 by Dr. Joseph Lawrence (Johnson & Johnson Consumer, Inc. 2016). Several bottles and sherds are classified as either medicinal or pharmaceutical. Many are assigned as such based on the medicinal or pharmaceutical-type finish (Figure 39). One of these has "PD & CO" on the bottom (Figure 40) for the Parke, Davis and Co., makers of pharmaceuticals since 1875 (Toulouse 1971:417). Another small complete bottle has the maker's mark of "T C W CO, USA" (Figure 41). This stands for the T. C. Wheaton Company of Millville, New Jersey, and dates to post 1888 (Toulouse 1971:492). Three bottles are the cobalt blue color, typically associated with Milk of Magnesia, a product of the Phillips Company from 1873 to present day (Lockhart et al. 2018). Based on their dark brown color, five other body sherds may have held bitters, a tonic with high levels of alcohol, popular in the United States from the mid-nineteenth century through the 1910s (Lindsey 2018).

A key style can opener that used a key to roll up a scored strip on the side of the can was collected. This style was first patented on October 2, 1866 (Winfield-Chislett 2011). One silver cap, indicating a finer acquisition, appears to be for a pill case and has the lettering "Floral S/Sterling."

Table and Utilitarian Wares

One whiteware sherd has the maker's mark "MCNICOL," a reference to the D. E. McNicol Pottery Company of East Liverpool, Ohio, in operation at that location from 1892 to 1928 (Kowalsky and Kowalsky 1996:49). One cup, perhaps a gift to Samuel or Charles Adair, has "Brother" with a row of flowers above and below (Figure 42). On the base of the cup is the labeling "MADE IN GERMANY." The Tariff Act of 1891 made mandatory country-of-origin labeling in the United States, though Europe had enacted such laws in the 1880s (Stack Exchange Network 2018). A bowl rim and base sherd advertised "J. W. PANKH" of "HANLEY" with the additional notation of "STONE" (Figure 43). This was produced by the J. W. Pankhurst pottery of Hanley, England, between 1850 and 1852, when the wording "STONE CHINA" was added to the mark (Kowalsky and Kowalsky 1996:298–299).

Six refitted saucer sherds have a maker's mark



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**Figure 39.** Medical and pharmaceutical bottles. Courtesy of kansasmemory.org, Kansas Historical Society.

**Figure 40.** Parke, Davis and Company bottle. Courtesy of kansasmemory.org, Kansas Historical Society.

**Figure 41.** T. C. Wherton Company maker's mark. Courtesy of kansasmemory.org, Kansas Historical Society.



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**Figure 42.** Side and bottom views of the "Brother" cup. Courtesy of kansasmemory.org, Kansas Historical Society.

**Figure 43.** J. W. Pankhurst Pottery maker's mark. Courtesy of kansasmemory.org, Kansas Historical Society.

**Figure 44.** Dish sherd showing The Potteries Co-Operative maker's mark. Courtesy of kansasmemory.org, Kansas Historical Society.

"The Potteries Co-Operative Co." (Figure 44). The company operated in East Liverpool, Ohio, from 1882 to 1925 (Carnegie Public Library 2019). Fragments of a large soup bowl bear the maker's mark of Johnson Brothers pottery of England, used from 1891 to 1913 (Kowalsky and Kowalsky 1996:246). In addition, the pattern name "WOODLAND" appears (Figure 43).

Classified as a serving item, a small nickel-plated tray, 3 1/8" long and 2 7/16" wide, rightly might belong on a dressing table rather than a dining table. Like the silver pill case lid, this piece may show that the Adairs had a few of the finer things in life. Seven sherds of either Rockingham or Bennington may have belonged to a tea pot. Rockingham ware was produced in the United States since circa 1[illegible] (Steele 2019), and Bennington pottery began in 1[illegible]4 (Bennington Potters 2019). Utilitarian objects include a nearly complete chamber pot, which could date from the Adair occupation.



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**Figure 45.** Johnson Brothers Pottery maker's mark and pattern name. Courtesy of kansasmemory.org, Kansas Historical Society.

Flatware

One nickel silver-plated spoon has the silver maker's mark "PIX ACORN." This is a partial mark for flatware from Albert Pick and Company of Chicago, Illinois (circa 1895–1965) and Bridgeport, Connecticut (1919–1927) (Lieberman Antiques 2018). The tablespoon also has silverplate marks on the back of the handle, but wear makes it difficult to read except for a possible anchor. A silver-plated fork (Figure 46) with Florella Brown Adair's initials, "F B A" in script, on the front and "ROGERS BRO A1" on the back was recovered. This may have been manufactured by Rogers & Brothers or Roger Brothers of Waterbury, Connecticut, that operated from 8 to 8 (Davis 2001). In 8 the company name was changed to Rogers & Bros. Mfg. Co, and it operated under this name until 1898.

Cookware

Cookware comprises two handles, one ferrous and one enamelware, two sherds from a possible bean pot, a blue and white graniteware pan, and a gray graniteware pan (Figure 47). Graniteware is a type of enamelware, patterned to resemble granite.

By-product

Accumulated across 14MM327 were 2.8 kilos (6.2 pounds) of coal, clinkers, cinders, and charcoal. Additionally, four lead sprues were retrieved, suggesting that lead bullets were being cast on site.

Organic

Organic artifacts are sorted into food flora, other flora, food fauna, and other fauna. The incomplete

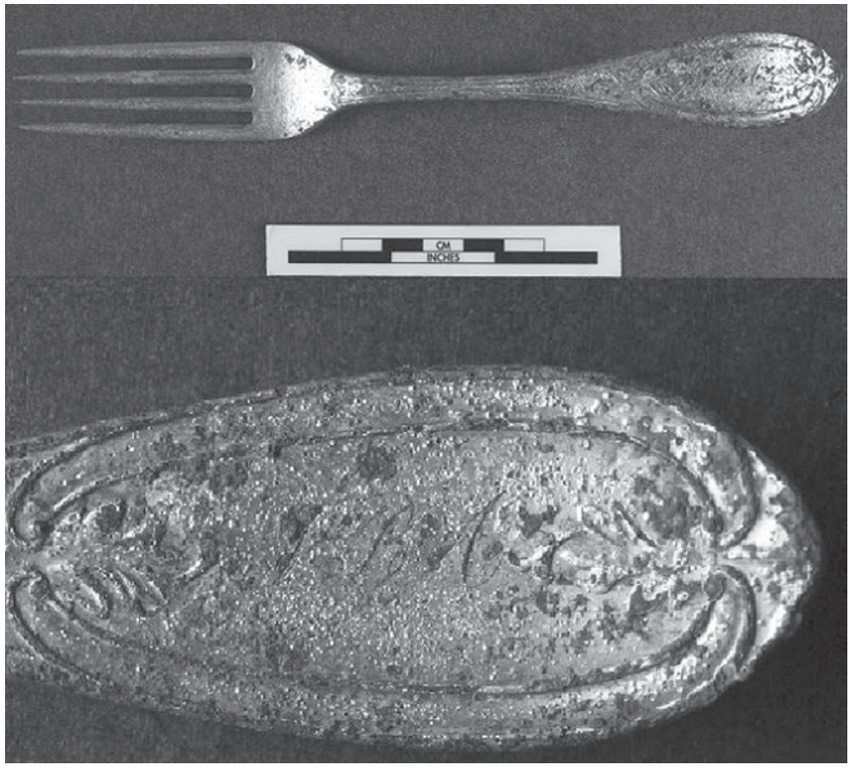


**Figure 46.** Monogrammed fork with detail view of Florella Brown Adair's initials. Courtesy of kansasmemory.org, Kansas Historical Society.



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**Figure 47.** Graniteware pans. Courtesy of kansasmemory.org, Kansas Historical Society.

condition of many organic specimens makes it difficult to decide whether to place the fauna items into the food category or the other category. If an object shows signs of butchering (cut marks) or cooking (color change), is of a large size, or comes from a mammal typically eaten (beef, pork), then it is assigned to food fauna. If the artifact does not meet any of these requirements, it is categorized as other fauna. Consequently, the organic functional category would benefit from further analysis by a zooarcheologist.

Beef is represented by various food bones: joints, ribs, steaks, stews, and roasts. In addition, there are elements not typically thought of as cuts of meat: a pelvic bone, phalanges, large pieces, and even a hair ball. Rib, ham steak, joint, blade steak, and long bones indicate pork consumption. Other porcine components are a mandible, teeth, a pelvis, a vertebra, a scapula, and fragments. A small amount of venison is identified, mostly from teeth but also ribs and long bones. Poultry remains are present in the form of eggshells, long bones, wing bones, a wishbone, ribs, and vertebra. A very few fish bones were recovered.

Bird, rodent, and small and medium-sized animal bones are considered in the other fauna category. One rabbit fibula and three turtle carapaces were collected, and, while these animals are sometimes eaten, these elements bear no signs of having been cooked. A small amount of shell is classified as other fauna. One delicate, crushed gastropod shell and mussel shell were found. Several of the mussel shells are large enough or have intact hinges and possibly could be differentiated by further analysis.

The food flora class includes an unidentified nut hull, pecan hulls, walnut hulls, a single bean, and a burned corn kernel. The other flora class contains tree parts, wood, bark, and a knot hole. The floral accumulation does not seem sufficient for a household occupied for nearly 60 years, nor is it comparable to the total weight of the faunal material. Perhaps it reflects practices or location of floral waste disposal or archeological collection methods.

Clothing

Twenty-two fragments of black lawn likely were once part of a lady's dress, as was another scrap of unidentified black material. One larger yellow or tan remnant with a red stripe appears to be from the sleeve of a man's shirt. The final clothing item is green yarn, perhaps from a knitted garment. Five attachments for bras, slips, corsets, or girdles consist of an adjustable buckle, a hook, two garter trolleys, and a garter guide, some of which may date to the Adair occupation.

Forty-nine footwear components, constructed of leather, wood, rubber, ferrous, and cuprous materials, are recognized. These include a toe plate to help prolong the life of the footwear, heels (some with pegs), soles, uppers with eyelets, eyelets, and a partial rubber boot or overshoe. Six objects have an accessory function: three belt buckles, one suspender adjustable buckle, and two suspender clips. Clothing fasteners, specifically buttons, constitute the largest number of artifacts in the clothing func-



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**Figure 48.** Bone, china, shell, and metal buttons. Courtesy of kansasmemory.org, Kansas Historical Society.

tion category. Buttons were manufactured in many styles on cuprous, ferrous, jet, bone, glass, plastic, shell, bakelite, porcelain, brass, and rubber materials (Figure 48). One button appears to be for a pair of trousers and another for a coat.

Personal

The only jewelry that appears to be time appropriate is a truncated stick pin (Figure 49). An Indian Head penny, dated 1865, has a small drilled hole and may have been used as a pendant. A complete trunk key and an incomplete pair of embroidery scissors are classified as personal artifacts, as are three straight pins, three safety pins, a sewing machine needle, a thimble fragment, and sewing machine parts. One of the sewing machine parts is a plate with the country of origin labeling "MADE IN INDONESIA KO." As with the "Brother" cup, this indicates manufacture after 1891. A pipe bowl and a bowl and stem portion were found. The final functional category is office supply, which contains two pen nibs, a slate board section, and four slate pencil segments.

Toiletry

Toiletry artifacts are sorted into two functional categories: grooming aids and haircare. Most are shards of a mirror, thought to be the small, hand-held type. The rest of the grooming aids are toothbrush heads and handles.

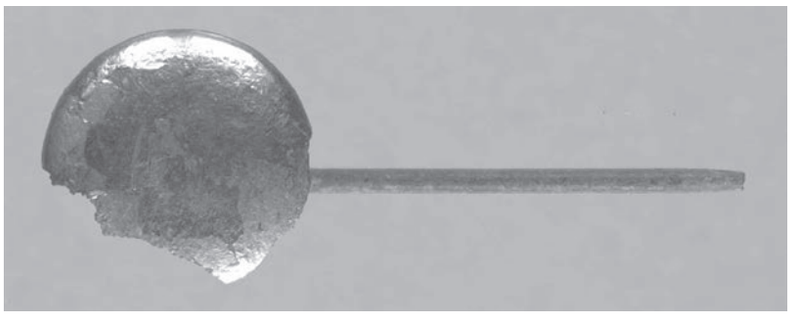

**Figure 49.** Stick pin. Courtesy of kansasmemory.org, Kansas Historical Society.



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Recreation

Musical instruments are represented by two components of a harmonica. The modern harmonica was invented in 1825, and by 1862 the United States had become the biggest customer of the largest manufacturer, then in Germany (Harmonica Tunes 2015). Other recreation items, possibly used prior to 1900, are a rubber ball, a single jack, a jacks ball, china doll fragments, and toy dishes. Glass or ceramic marbles (Figure 50) in the form of commies, puries, shooter, solids, and swirls round out the recovered evidence of fun times at the Adair cabin.

## *Work*

The work group covers those categories related to work: tools, harness hardware, automotive parts, fire arms and ammunition, and medical. Tools contain boring, cutting, fastening, measuring, masonry, holding, shaping, and smithing implements. Harness hardware consists of riding tack, shoes, and harness. Automotive parts encompass those from automobiles, farm vehicles, motorcycles, other machinery. Firearms and ammunition incorporate firearms, edged weapons, and accessories. Medical artifacts comprise devices for examination, surgery, treatment, dentistry, patient care, mobility, veterinary, and pharmacy or lab.

Tools

Many different tool types were collected, some of which likely date from the Adair occupation of the site. The specimens include three drill bits, a hex wrench, and an adjustable wrench with a two-twist handle. Additional objects are a gouge, a clamp, a ferrule from an unidentified tool, a hoof pick blade and tang, a whetstone, sections of a slim taper or square file, a flat mill file, an unspecified file, and a flat bastard file used for finishing tasks, with the lettering "MILL SMOOTH." Finally, a complete Western or Wisconsin axe head has a faint manufacturer's mark (Figure 51).

Harness Hardware

Twenty-three harness, riding tack, and shoe artifacts were recovered, all of which are pertinent to the period of interest. These consist of horseshoes with horseshoe nails, portions of bits, strap fragments, snap hooks, buckles, rivets, and a bell.

Automotive Parts

Many of the automotive parts were retrieved from F6 and represent post-1900 dumping episodes.

Firearms and Ammunition

Artifacts with an edged weapon function include three pocket knife blades. The firearms are a trigger guard from a rifle and a gunflint (Figure 52). At some point the letters "E A," followed by an unidentifiable mark, were etched onto the exterior of the guard (Figure 53). The gunflint was quarried and manufactured in France, as attested by the honey-yellow or blonde color. The square gunflint has one dorsal arris (Figure 54). The pocket knife blades may have come from the Bleeding Kansas era, while the trigger guard and gunflint most certainly did so. Four lead balls may also date to that period. One of these was a .32 caliber complete minié ball

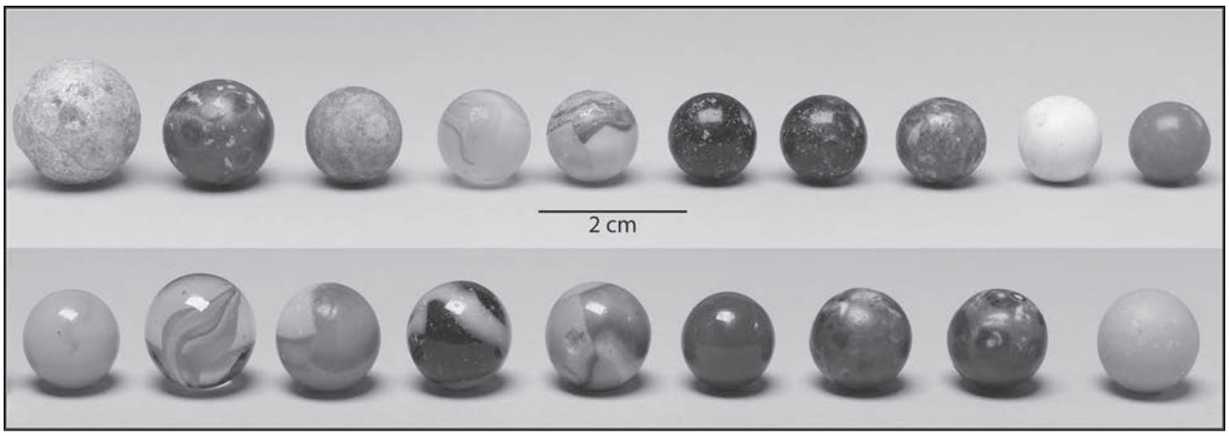


**Figure 50.** Selected marbles. Courtesy of kansasmemory.org, Kansas Historical Society.



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**Figure 51.** Western or Wisconsin style axe head. Courtesy of kansasmemory .org, Kansas Historical Society.

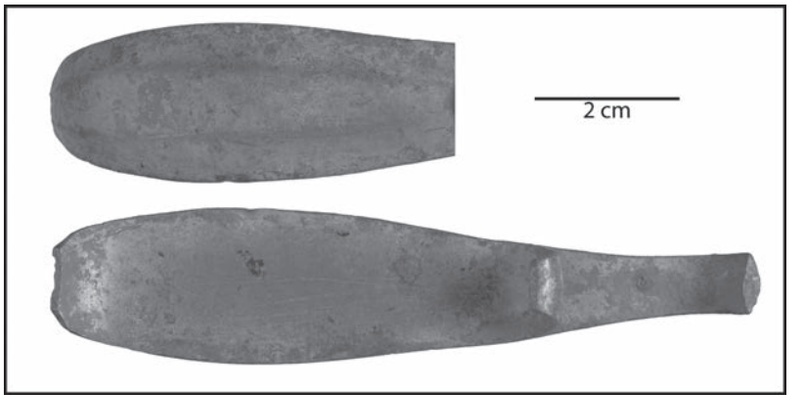


**Figure 52.** Obverse and reverse of the trigger guard. Courtesy of kansasmemory.org, Kansas Historical Society.

**Figure 53.** Trigger guard detail, showing initials. Courtesy of kansasmemory.org, Kansas Historical Society.



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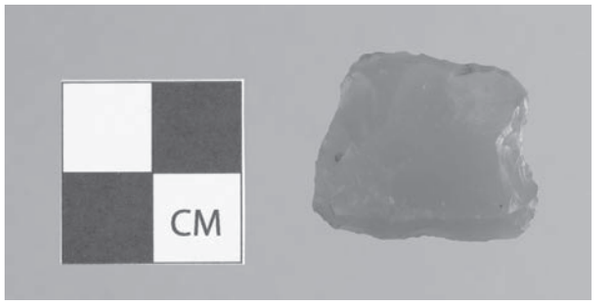


**Figure 54.** Square gunflint, quarried in France. Courtesy of kansasmemory.org, Kansas Historical Society.

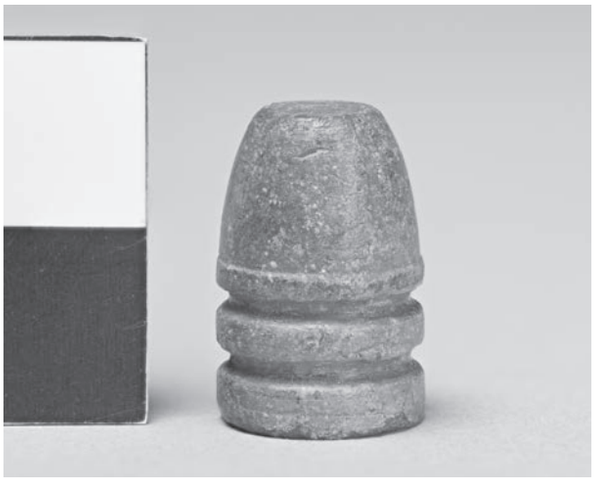

**Figure 55.** Minié ball. Courtesy of kansasmemory.org, Kansas Historical Society.

with two grease rings (Figure 55). By the mid- to late-1860s, the minié ball had been superseded by ammunition for breech-loading guns.

Some of the ammunition dates to post 1900, but others were manufactured by companies in operation prior to 1900, namely cartridges of .22 caliber (both short and long), a single .32 caliber, a single .38 caliber, and a semi-rimmed bottleneck casing and casings that had headstamps from the Union Metallic Cartridge Company (1867–1902), Remington Arms (1816-present), and Winchester (1866–present). There are shotshell bases from both Winchester and the Union Metallic Cartridge Company.

Medical

Classified as medicinal items are a segment of an oral thermometer, liquid measuring cups, a vial, and tubes. Complete or partial glass syringes, some with rubber or ferrous attachments were discovered. Whether these were for human or animal use is not known, but the use of syringes predates 1900.

### *Other*

The other group combines two categories that do not fit readily into the other three groups: prehistoric and unidentified.

Prehistoric

Twenty-three prehistoric stone artifacts were separated out during cataloging of the 14M M327 collection (Table 2). These consist of 20 pieces of debitage, a beveled knife section, a modified flake, and a graver. Although not all material was recognized, Smoky Hill silicified chalk, Florence chert, and Permian chert were noted. Five pieces are thermally altered. These specimens were concentrated within A141, but one was found south and two north of A141. The setting of the Adair cabin on a toe ridge overlooking the Marais de Cygne River and river valley would have been an attractive place for prehistoric people. The low density and diversity of the assemblage and the lack of prehistoric features suggests temporary use of the landscape by these Native American peoples.

Unidentified

Unidentified artifacts include fragments of bakelite, celluloid, ferrous, and cuprous materials. What appears to be part of an iron name plate has lettering "WEIRE PATENT 1862–6." No further information could be discovered for the object.

### *Temporally Diagnostic Artifacts*

Thirty-five items can be dated, 22 of which had both an earliest and a latest date (Table 3). Nineteen fell within the period of cabin occupation, although they could have been passed down in the family for continued use or discarded later. Samuel died in 1898, and most of the dateable artifacts (n = 22) post-date his death.



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**Table 2.** Prehistoric Artifacts from 14MM327.

| Catalog number | Count | Weight (g) | Artifact class | Raw material type | Provenience |
|---|---|---|---|---|---|
| 15-6 | 1 | 0.4 | Flake | Smoky Hill silicified chalk | N55 E417 0-10 cmbs |
| 46-12 | 1 | 0.1 | Flake | Unknown | N55 E423 10-20 cmbs |
| 51-17 | 1 | 5.2 | Flake (heat treated) | Unknown | N51 E427 10-20 cmbs |
| 54-8 | 1 | 2.2 | Flake | Florence chert | N60 E418 20-30 cmbs |
| 64-9 | 1 | 0.5 | Flake (heat treated) | Permian chert | N51 E429 0-10 cmbs |
| 67-4 | 1 | 0.3 | Flake (heat treated) | Florence chert | N54 E429 10-20 cmbs |
| 67-5 | 1 | 0.8 | Beveled knife fragment | Permian chert | N54 E429 10-20 cmbs |
| 75-13 | 1 | 0.6 | Flake | Unknown | N54 E432 20-30 cmbs |
| 79-33 | 1 | 0.2 | Flake | Unknown | N51 E429 10-20 cmbs |
| 79-34 | 1 | 05 | Modified flake (heat treated) | Permian chert | N51 E429 10-20 cmbs |
| 82-9 | 2 | 1.4 | Flake | Permian chert | N55 E432 20-30 cmbs |
| 84-8 | 1 | 5.8 | Flake | Florence chert | N54 E427 10-20 cmbs |
| 89-18 | 1 | 0.1 | Flake | Non-local chert | N53 E424 0-10 cmbs |
| 97-14 | 1 | 0.5 | Flake | Florence chert | N53 E425 0-10 cmbs |
| 106-13 | 1 | 0.8 | Flake | Smoky Hill silicified chalk | N53 E425 0-10 cmbs |
| 114-5 | 1 | 4.7 | Graver | Permian chert | N53 E425 10-20 cmbs |
| 123-10* | 1 | 0.6 | Flake | Not recorded | N49 E425 0-10 cmbs |
| 129-12* | 1 | 4.0 | Flake | Not recorded | N40 E427 10-20 cmbs |
| 141-6* | 2 | 0.8 | Flake | Not recorded | N48 E429 10-20 cmbs |
| 226-4 | 1 | 3.7 | Shatter | Permian chert | N75 E443 10-20 cmbs |
| 936-4 | 1 | 0.2 | Flake (heat treated) | Permian chert | N87 E434 10-20 cmbs |

*Artifact cannot be located.



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**Table 3.** Temporally Diagnostic Artifacts.

| Artifact | Earliest date | Latest date | Comment |
|---|---|---|---|
| Minié ball | | late 1860s | |
| Gunflint | | late 1850s | |
| Monogrammed fork | 1847 | 1855 | |
| Bitters bottle | 1850 | 1919 | |
| J. W. Pankhurst maker's mark | 1850 | 1852 | |
| Ridenour-Baker bottle | 1858 | 1910 | |
| Carter's ink bottle | 1858 | 1976 | |
| Penny | 1865 | | |
| Key style can opener | 1866 | | |
| Union Metallic Cartridge Co. | 1867 | 1902 | |
| Milk of Magnesia bottle | 1873 | | |
| P D & Co bottle | 1875 | 2007 | |
| Mason fruit jar | 1885 | 1900 | |
| Heinz bottles | 1888 | | |
| T C W Co bottle | 1888 | | |
| Made in Germany cup | 1891 | | |
| Johnson Bros. maker's mark | 1891 | 1913 | |
| Baker's Standard Flavoring bottle | 1892 | | |
| McNicol maker's mark | 1892 | 1928 | |
| Pix Acron spoon | 1895 | 1965 | |
| Atlas Glass Co jar | 1896 | 1964 | |
| "H" bottle | 1900 | 1943 | tentative |
| Ohio China Co. maker's mark | 1902 | 1912 | |
| Franco American Hygienic jar | 1903 | | |
| Crown overall button | 1903 | 1969 | |
| Economy canning jar | 1904 | 1955 | |
| W. S. George maker's mark | 1904 | 1955 | |
| Marion Bottle Co bottle | 1906 | 1922 | |
| Insulator | 1909 | | |
| Homer Laughlin maker's mark | 1912 | 1929 | |
| Pocket watch | 1912 | 1968 | |
| Lyric bottle | 1914 | 1929 | tentative |
| Pyrex | 1915 | | |
| Vaseline jar | 1918 | 1929 | |
| Penny | 1959 | | |

### *Spatial Analysis*

It was thought that the artifacts from 14M M327 might be able to address questions regarding locations of fence lines and outbuildings. The distribution of fence staples and fencing wire does not indicate where a fence line might once have been. Instead, fence-related implements are clustered around the cabin and 1903 house and a possible outbuilding (F674 and F675), proposed to be the barn or other building. Spatial arrangement of harness, tool, and hardware miscellaneous highlights a nearly identical distribution. Finally, the dispersion of construction material and nails is slightly different in that concentrations are near the cabin, 1903 house, and possible outbuilding, but also on a north-



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south 10- m strip on the east side of the property. Rather than clues to fence lines and outbuildings, the artifacts may simply reflect areas of excavation and metal detector survey.

## CONCLUSIONS

### *Research Questions*

The artifact collection from the 14M M327 should help examine some, although not all, of the research questions generated by Principal Investigator John Fox (2014).

Can any definitive Border War-era or John Brown activity be detected?

It can be difficult to distinguish those artifacts that came from the Adair cabin from those from the 1903 frame house on the same tract. The dwelling was built in 1854, and the Adairs moved in in 18 . Except for a period during the Civil War, the Adairs lived there until Samuel, a widower for more than 30 years, died in 1898. Following the 1911–1912 dismantling and removal of the cabin, the environs may have been used for trash disposal and other activities. While the cabin's dates of occupation or activity ought to be 18 54–1912, the parcel itself was occupied continuously for 10 years, as Fox (2014) noted. Nonetheless, several specimens seem to fall neatly into the 1855 to 1912 range: a minié ball, a gunflint, the monogrammed fork, the pottery bowl fragment with J. W. Pankhurst maker's mark, a Ridenour-Baker bottle, and an 1865 penny. The munitions do not necessarily relate to Border War activity, as they certainly were used for hunting. Other objects, first manufactured in this period but in use long past 1912, could date to the Adair occupation of the cabin.

What does the site's material culture say about the socio-economic status of the Adair family?

The silver-plated fork, monogrammed with Florella Brown Adair's initials, a small nickel-plated tray, and a silver-plated spoon attest to a household not barren of some finer acquisitions. Frosted glass sherds, likely from door panels in an article of furniture, may represent a more expensive piece brought from the east. Some of the tableware, now stained, but once nicely decorated, indicates a wide variety of patterns and manufacturers. The Rockingham or Bennington teapot is an example. However, most sherds are plain whiteware and may exemplify "everyday" dishes.

Skeletal remains demonstrate consumption of beef, pork, and poultry, as well as venison. The cuts of beef and pork indicate that a wide range was consumed, not trending either toward the best or worst. While the sample is insufficient to accurately characterized diet, what exists testifies to an adequate level of food security. Canning jars and tools constitute corroborating evidence that a garden was likely located on the land. Food was both purchased from a store (tin can sections) and raised on the property (canning jar fragments and food fauna remains). Taken altogether, a faint picture starts to emerge of a household or households raising some of their own food. They used many common items for the times but still had some possessions reflecting the nicer things in life.

How did the Adair family interact with the community of Osawatomie?

Nothing in the archeological assemblage could be used to examine Samuel's duties as a pastor or Florella's sewing and laundry occupations. How the Adairs interacted with the community is not disclosed in the recovered material culture.

Can the locations of outbuildings be distinguished? If so, what function did they serve?

While documented in the field as separate entities, F673, F674, and F675 collectively represent an outbuilding, visible in a photograph of the cabin (Figure 25). Artifacts suggest a barn—animal husbandry objects signify stock keeping if not farming. Structures west of the cabin, visible in photographs (Figures 8 and 9), were not found and may have been obliterated during construction of the 1903 frame house.

### *Future Work*

As with all archeological projects, time and money were limiting factors. The completed study provided the exact location of the cabin and verified the presence of one outbuilding and a cellar and cistern associated directly with it. Future work can focus on excavating more or all of the cellar and possibly the cistern. Further work also may recover evidence of outbuildings west of the cabin.



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## ACKNOWLEDGMENTS

This report is the result of many people's hard labor and kind support. John Fox, now of the Osage Nation Historic Preservation Office, Pawhaska, Oklahoma, served as principal investigator at the 2014 Kansas Archeology Training Program field school and at the follow up event, the 2014 KAA Fall Fling. Fox (2014) authored the preliminary report that appeared in *Kansas Preservation*. Grady Atwater, John Brown Museum site administrator, provided logistical direction and support, presented excellent evening programs and arranged for others, and carried out numerous other tasks to make this a successful endeavor. Gina Powell of the Kansas Historical Society provided background research and drafted Figure 19. A special thanks to the KAA volunteers for their many hours spent excavating, record keeping, cleaning, and cataloging at the 2014 KATP field school and follow-up event at 14MI327. KSHS Archeology Lab volunteers gave generously of their time after the fieldwork concluded. The John Brown Foundation and the City of Osawatomie provided for the work demolishing and removing the garage, concrete pads, and trees in addition to providing a safe cross walk from headquarters to the site. Osawatomie School District 367 provided a facility for headquarters, a location for camper showers, and waived camper fees. The City of Osawatomie, the First Presbyterian Church, and the Miami County Republic newspaper provided assistance and publicity. They, along with numerous members of the gracious host community, made the 2014 KATP field school a success.

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## REFERENCES CITED


Bennington Potters

2019 "The History Makes It Special." Electronic document, https://www.benningtonpotters.com/our_history, accessed January 4, 2019.

Carnegie Public Library

2019 Alphabetical List of Pottery Industries in the East Liverpool Area. Electronic document, https://www.carnegie.lib.oh.us/alphalist, accessed January 4, 2019.

Cutler, William G.

1883 *History of the State of Kansas*. A. T. Andreas, Chicago, Illinois.

Davis, R. E.

2010 Clearing up the Rogers Confusion: Marks and Manufacturers. Electronic document, http://silverandsilverplate.blogspot.com/2010/04/clearing-up-rogers-confusion-marks-and.html, accessed August 29, 2018.

Edwards Brothers

1878 *An Illustrated Historical Atlas, Miami County, Kansas*. Edwards Brothers, Philadelphia, Pennsylvania.

Faulkner, Ed, and Lucy Faulkner

2003 Let's Talk About Ink. Bottles and Extras 14(2):41–43. Federation of Historic Bottle Collectors, Houston, Texas. Electronic document, http://www.fohbc.org/PDF_Files/Ink_Sp2003.pdf, accessed August 22, 2018.

Fox, John

2014 Abolitionism in Territorial Kansas: Archeology Excavations at the Adair Cabin Site (14M M327). *Kansas Preservation* 36(3):013–.

Harmonica Tunes

2015 Harmonica History – From China to the Blues. Electronic document, http://harmonicatunes.com/harmonica-history/, accessed January 4, 2019.

Harris, Harry Jaspar

1919–1922 My Story. In *Collections of the Kansas State Historical Society*, edited by William E. Connelley, Vol. XV:553–572. Kansas State Printing Plant, Topeka.

Hetherington, Mike

2017 History of the Franco American Hygienic Company – Aliases and Madness. Electronic document, http://collectingvintagecompacts.blogspot.com/2016/09/history-of-franco-american-hygienic.html, accessed January 4, 2019.

Johnson & Johnson Consumer, Inc.

2016 History of Listerine®: From Surgery Antiseptic to Modern Mouthwash. Electronic document, https://www.listerine.com/about, accessed January 4, 2019.

Justia Corporate Center

2018 BAKER'S – Trademark Details. Electronic document, https://trademarks.justia.com/712/76/baker-71276826.html, accessed August 22, 2018.

Kansas City Star

1912 Moving John Brown's Cabin. 8 September. Kansas City, Missouri.

Kowalsky, Arnold A., and Dorothy E. Kowalsky

1996 *Encyclopedia of Marks*. Schiffer Publishing, Ltd., Atglen, Pennsylvania.

Lieberman Antiques

2018 Silverplate Marks. Electronic document, https://www.sterlingflatwarefashions.com/SPMfgs/1SPMfg.html, accessed August 29, 2018.

Lindsey, Bill

2018 Bottle Typing/Diagnostic Shapes Medicinal/Chemical/Druggist Bottles. Electronic document, https://sha.org/bottle/medicinal.htm#Bitters%20&%20Tonics, accessed August 22, 2018.

Lockhart, Bill, Beau Shriever, and Carol Serr

2018 The Bottles of Phillips Milk of Magnesia. Electronic document, https://sha.org/bottle/pdffiles/MilkOfMagnesia.pdf, accessed August 22, 2018.

Mansberger, Floyd

2009 An Archaeological and Architectural Assessment of the Lincoln Log Cabin, Rural Macon County, Illinois. Fever River Research, Springfield, Illinois. Submitted to City of Decatur, Illinois. Electronic document, http://illinoisarchaeology.com/IDNR/Lincoln%20Cabin%20Report.pdf, accessed February 27, 2019.

McFarland, Gerald W.

1982 John Brown's Sister Florella: Some Mysteries Solved. *Kanhistique: Kansas History and Antiques* 8(6):213–. Ellsworth, Kansas.

1985 *A Scattered People: An American Family Moves West*. Pantheon Books, New York.

Moloney, Sean, and William Cadamore

2009 Success in Every Bottle: The H. J. Heinz Company. Pennsylvania Center for the Book, University Park, Pennsylvania. Electronic document, https://pabook





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.libraries.psu.edu/literary-cultural-heritage-map-pa/feature-articles/success-every-bottle-hj-heinz-company, accessed August 22, 1028.

*Osawatomie Graphic-News (OGN)* [Osawatomie, Kansas]
1938 John Brown's Cabin. 24 February. Osawatomie, Kansas.

Renick, Andrea
1992 The Adair Cabin. In *Osawatomie and Its People*, Vol. I, pp. 7–8. Osawatomie Historical Society, Osawatomie Publishing Company, Osawatomie, Kansas.

Stack Exchange Network
2018 When were country of origin labels (e.g. Made in France) introduced? Electronic document, https://history.stackexchange.com/, accessed August 30, 2018.

Stanpac
2019 A Brief History of Home Milk Delivery Service. Electronic document, http://www.stanpacnet.com/a-brief-history-of-home-milk-delivery-service/, accessed January 4, 2019.

Steele, Lenville J.
2019 An Archaeological Guide to Historic Artifacts of the Upper Sangamon Basin, Central Illinois, USA. 1. Ceramics 3. Yellowware. Electronic document, http://virtual.parkland.edu/lstelle1/len/archguide/documents/arcguide.htm, accessed March 1, 2019.

Thompson, Dustin A.
2014 *Geophysical Survey of the Adair Cabin Site (14MM327), Osawatomie, Miami County, Kansas*. Research Report No. 1513. Center for Archaeological Research, Missouri State University, Springfield. Submitted to Kansas Historical Society, Topeka.

Toulouse, Julian Harrison
1971 *Bottle Makers and Their Marks*. Blackburn Press, New Jersey.

University of Kansas Libraries
2010 Ridenour-Baker Grocery Co. Collection, Kansas Collection, RH MS 1086. Kenneth Spencer Research Library, University of Kansas Libraries, Lawrence. Electronic document, http://hdl.handle.net/10407/7372013696, accessed August 22, 2018.

Wilson, Hill P. (compiler)
1901 *A Biographical History of Eminent Men of the State of Kansas*. Hill Lithographing Company, Topeka, Kansas.

Winfield-Chislett, Alison
2011 Patent Du Jour. Electronic document, http://patentdujour.tumblr.com/post/10925119299/2-october-1866-josterhoudt-method-of-opening, accessed September 26, 2018.

## APPENDIX: SUMMARY OF 14MM327 ARTIFACTS

| Functional class or subclass | Count and/or weight (k) | Artifacts recovered |
|---|---|---|
| **Building Related Material** | **Subtotal 3,553** | |
| Construction | 332 | 16 walkway or foundation stones |
| | | 3 linoleum pieces |
| | | 27 tar paper and slate shingle fragments |
| | | 70 plaster and paint fragments |
| | | 67 mortar and cement fragments |
| | | 12 possible wooden post fragments |
| | | 18 fragments of other wood |
| | | 2 screen fragments |
| | | 117 brick fragments |
| Window glass | 1,106 | Cylinder, plate, or machine-made window glass, mostly aqua |
| Utilities | 412 | Plumbing artifacts: 2 sewer pipe fragments, 2 iron fittings, 3 drain fragments, 1 collar |
| | | Electrical artifacts: 6 insulators, 1 conduit fragment, 1 wiring fragment, 1 fuse switch, 1 contact, 1 piece of electrical tape |
| | | Lighting artifacts: 11 light bulb fragments, 1 lamp prism, 1 light fixture cover fragment, 364 glass lamp globe and chimney fragments, 13 lamp airplate fragments, 1 thumbscrew, 1 wick tube |
| | | Heating artifacts: 1 tubing fragment |



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APPENDIX: continued

| Functional class or subclass | Count and/or weight (k) | Artifacts recovered |
|---|---|---|
| Hardware fasteners | 1,500 | 26 bolts, including carriage, wagon, countersunk, eye, hex, lag, lug |
| | | 1,310 cut and wire nails, including common, finishing, roofing, cinch, horseshoe |
| | | 20 washers, including flat, locking, ring, split lock |
| | | 30 screws, including adjusting, thumb, eye, slotted, flat, hexagonal, Phillips, lag |
| | | 53 fence staples |
| | | 11 other staples |
| | | 1 cotter pin |
| | | 1 spacer |
| | | 5 spikes |
| | | 1 bracket |
| | | 17 tacks |
| | | 9 fasteners |
| | | 3 grommets |
| | | 5 hooks |
| | | 2 pins |
| | | 6 rivets |
| Hardware miscellaneous | 203 | Animal husbandry artifacts: 1 cattle nose ring, 1 chain link, 1 swivel, 1 loop |
| | | 115 baling and common wire strands |
| | | 14 barbed wire strands |
| | | 2 bucket bails |
| | | 2 round bar stock |
| | | 10 chain lengths |
| | | 1 ring |
| | | 1 spring |
| | | 54 strap metal fragments |
| **Domestic** | **Subtotals 3,408** | |
| | **3.59 k** | |
| Furniture and appliances | 140 | Hardware and door artifacts: 1 shelf bracket, 1 spring for door closer, 1 coat hook, 2 latch hooks, 3 strap hinges, 1 butt hinge, 8 drawer pulls, 3 door knob spindles, 1 key, 3 escutcheon plates, 1 latch plate, 1 lock frame plate |
| | | Window treatment artifacts: 1 curtain hook, 1 curtain rod attachment, 2 window shade brackets |
| | | Furniture-related artifacts: 3 mirror fragments, 3 caster fragments, 70 frosted glass fragments with geometric pattern, possibly from furniture door |
| | | Minor appliances and accessories artifacts: 1 sad iron trivet, 1 sad iron, 3 crank mechanism fragments for coffee mill, 1 clear glass dome and 1 metal stem from percolator, 1 clothespin, 10 clothespin springs |
| | | Major appliances artifacts: 16 probable stove parts |
| Containers | Subtotal 1,783 | |
| Container - Barrels, cans, and closures | 349 | 2 barrel hoop fragments |
| | | Cans artifacts: 193 can fragments, 1 baking cocoa can, 12 fruit or vegetable can ends, 1 sardine can, 4 tobacco tin fragments, 1 toiletry (powder) can, 42 oil can fragments, 4 bails typical of paint cans |
| | | Closure artifacts: 1 key style can opener, 1 glass stopper, 1 seal, 1 silver pill case cap, 3 shaker type caps, 24 crown, flip off, pry off, and screw-on caps, 1 penny head "Pyrex" stopper, 10 complete and fragmented zinc canning jar lids, 47 complete and fragmented glass canning jar lid liners |



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APPENDIX: continued

| Functional class or subclass | Count and/or weight (k) | Artifacts recovered |
|---|---|---|
| Container - Bottles, jars, and packaging | 1,434 | 974 mostly nondescript sherds colored aqua, amethyst, brown, olive, green, cobalt, blue, black |
| | | 1 glass baby bottle |
| | | 1 rim and neck of clear milk bottle |
| | | 5 soda pop bottle sherds |
| | | 243 sherds likely from beer bottles |
| | | 1 nearly complete liquor bottle |
| | | 1 liquor bottle sherd |
| | | 18 wine bottle sherds |
| | | 5 bitters bottle sherds |
| | | 32 complete and fragmented medicinal or pharmaceutical bottles |
| | | 3 Milk of Magnesia bottles |
| | | 8 condiment bottles |
| | | 6 fragmented toiletry bottles |
| | | 25 complete and fragmented bottles for polish, shoe polish, and ink |
| | | Jar artifacts, manufactured of glass and milk glass: 20 non-descript sherds, 62 complete and fragmented canning jars, 1 malted milk jar with lid, 13 condiment jar sherds, 1 jelly jar, 13 complete and fragmented toiletry jars |
| | | Packaging artifacts: 1 aluminum foil fragment |
| Table and Utilitarian Wares | Subtotal 1,164 | |
| Table and utilitarian wares - Tablesetting | 971 | 50 beverage glass sherds |
| | | 25 whiteware soup or sauce bowl sherds |
| | | 42 whiteware and porcelain tea and coffee cups |
| | | 1 nearly complete cup, marked "Brother" |
| | | 409 plate and saucer sherds, some with maker's marks from Laughlin, The Potters, Pankhurst, Johnson Bros., and George potteries |
| | | 127 sherds, apparently tablesetting-related, but not further identifiable |
| | | 317 whiteware, stoneware, porcelain, milk glass, and glass sherds too fragmentary to confidently place in either tablesetting or serving categories |
| Table and utilitarian wares - Serving | 139 | 41 whiteware, earthenware, glass, milk glass, porcelain, and yellowware sherds, apparently serving-related but not further identifiable |
| | | 15 mixing bowl sherds |
| | | 9 creamer or sugar bowl sherds |
| | | 33 serving bowl and dish sherds |
| | | 9 possible stemmed glass dish sherds |
| | | 2 cut glass candy dish sherds |
| | | 2 egg cup sherds |
| | | 6 pitcher fragments |
| | | 14 platter fragments, 9 from plain ironstone platter |
| | | 7 Rockingham or Bennington-type tea pot sherds |
| | | 1 small nickel-plated tray |
| Table and utilitarian wares - Utilitarian | 54 | 7 chamber pot fragments |
| | | 1 enamelware milk pan |
| | | 5 redware flower pot fragments |
| | | 12 glass and whiteware vase fragments |
| | | 29 earthenware and redware crock fragments in assorted colors, some with salt glaze and some with Albany slip |



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APPENDIX: continued

| Functional class or subclass | Count and/or weight (k) | Artifacts recovered |
|---|---|---|
| Flatware | 14 | 1 trivet fragment |
| | | 2 enamelware ladle bowl fragments |
| | | 1 utensil spoon bowl |
| | | 1 utensil handle |
| | | 1 tablespoon |
| | | 3 teaspoons, 1 with Rogers silver mark |
| | | 2 teaspoon bowls |
| | | 2 fork fragments |
| | | 1 fork, inscribed with Florella Brown Adair's initials and Rogers and Bro. silver mark |
| Cookware | 6 | 2 handles, 1 ferrous and 1 enamelware |
| | | 2 possible bean pot sherds |
| | | 1 blue and white graniteware pan |
| | | 1 gray graniteware pan |
| By-products | .57 k | Coal, clinkers, cinders, charcoal |
| | | 4 lead sprues |
| Organic | 3.02 k | Food fauna: beef, pork, poultry, fish, possibly venison elements |
| | | Other fauna: bird, rodent, small animal elements |
| | | Food flora: 1 bean, 1 corn kernel, and walnut, pecan, and unidentified nut hulls |
| | | Other flora: wood, bark, 1 knot hole |
| Clothing | Subtotal 189 | |
| Clothing – Clothing and footwear | 74 | Clothing materials: 22 fragments of black lawn, likely from a lady's dress, 1 yellow or tan with a red stripe fragment possibly from man's shirt sleeve, 2 strands green yarn |
| | | 49 footwear fragments, including 1 toe plate, heels, soles, uppers with eyelets, 1 fragment of rubber boot or overshoe |
| Clothing – Attachments and closures | 115 | Underwear attachments: 1 buckle, 1 hook, 2 garter trolleys, 1 garter guide, all attachments for bras, slips, corsets, or girdles |
| | | Closures and fasteners: 2 steel snaps, 3 belt buckle fragments, 1 adjustable suspender buckle, 2 suspender clips, 8 metal overall fasteners |
| | | 94 buttons, made of copper or brass, iron, jet, bone, glass, plastic, shell, bakelite, porcelain, and rubber; 2-hole, 2-hole domed, 2-hole recessed, 4-hole, 4-hole piecrust, 4-hole prosser, 5-hole, cone, loop, and shank styles |
| Personal | Subtotal 44 | |
| Personal – Beads, jewelry, eyeglasses, coins | 19 | 1 glass bead |
| | | 4 wooden beads |
| | | 1 pronged setting holder |
| | | 1 glass setting |
| | | 2 chains |
| | | 1 stick pin |
| | | 1 modern wedding ring |
| | | 1 modern religious medal, called a Miraculous Medal |
| | | 3 pocket watch plates |
| | | 1 pocket watch frame |
| | | 1 eyeglasses temple and lens |
| | | 1 Lincoln Memorial penny, dating to 1959 or later |
| | | 1 Liberty Head or Indian Head penny, dating to 1865 or later, with small drilled hole |



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APPENDIX: continued

| Functional class or subclass | Count and/or weight (k) | Artifacts recovered |
|---|---|---|
| Personal – Sewing, smoking, office supplies, luggage | 25 | 1 embroidery scissors fragment |
| | | 3 straight pins |
| | | 3 safety pins |
| | | 1 thimble fragment |
| | | 1 sewing needle |
| | | 3 sewing machine parts |
| | | 1 pipe bowl |
| | | 1 pipe bowl and stem fragment |
| | | 1 slate board fragment |
| | | 1 slate pencil |
| | | 4 slate pencil fragments |
| | | 2 pen nibs |
| | | 3 graphite pencil leads |
| | | 1 trunk key |
| Toiletry | 36 | 23 glass mirror fragments, some with silver backing |
| | | 7 toothbrush fragments |
| | | 2 hairpins |
| | | 3 hair styling clip fragments |
| | | 1 comb back |
| Recreation | 41 | 2 harmonica fragments |
| | | 1 rubber ball |
| | | 1 jacks ball |
| | | 1 jack |
| | | 2 toy vehicle tires |
| | | 1 wind-up mechanism for toy vehicle |
| | | 3 china doll fragments |
| | | 5 toy dishes, including 3 cups, 1 lead or pewter plate, 1 bowl |
| | | 25 glass or ceramic marbles |
| **Work** | **Subtotal 143** | |
| Tools | 25 | 3 drill bits |
| | | 1 box knife blade |
| | | 1 Western or Wisconsin style axe head |
| | | 1 tire iron |
| | | 1 adjusting nut from a socket wrench |
| | | 1 adjustable wrench with 2-twist handle |
| | | 1 hex wrench |
| | | 1 clamp |
| | | 4 tape measure fragments |
| | | 3 protractor fragments |
| | | 1 gouge |
| | | 4 file fragments, including flat bastard, flat mill, slim taper, or square styles |
| | | 1 whetstone fragment |
| | | 1 blade and tang for hoof pick |
| | | 1 tool ferrule |
| Harness hardware | 23 | 1 horseshoe with 3 nails |
| | | 2 fragments of bits |
| | | 20 harness-related artifacts: 10 leather straps, 2 rivets, 2 hook snaps, 2 rings, 3 complete and fragmented buckles, 1 bell |



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APPENDIX: continued

| Functional class or subclass | Count and/or weight (k) | Artifacts recovered |
|---|---|---|
| Automotive | 16 | 2 possible radiator fragments |
| | | 2 spark plug fragments |
| | | 1 Model T tire inflation valve |
| | | 1 gas cap |
| | | 3 possible gas tank fragments |
| | | 3 possible engine parts |
| | | 1 tire inner tube |
| | | 1snow tire chain segment |
| | | 1 castellated nut for wheel bearings |
| | | 1 pedal |
| Firearms and ammunition | 60 | 3 pocket knife blades |
| | | 1 rifle trigger guard |
| | | 1 French gunflint |
| | | Munitions: 4 complete lead balls (including 1, .52 caliber minié ball with 2 grease rings), 8 shotshell bases (including 3 .410 gauge, 2 10 gauge, 2 12 gauge, 1 16 gauge), 43 cartridges (including .22 long and short, .38, .32, .25) |
| Medical | 19 | 1 oral thermometer fragment |
| | | 2 liquid measuring cups |
| | | 2 vials |
| | | 2 tubes |
| | | 12 complete and fragmented glass syringes, some with rubber or ferrous attachments |
| **Other** | **Subtotal 118** | |
| Prehistoric | 28 | 22 pieces of debitage |
| | | 3 modified flakes |
| | | 1 beveled knife |
| | | 1 graver |
| | | 1 core remnant |
| Unidentified | 90 | 89 bakelite, celluloid, cuprous, ferrous fragments |
| | | 1 iron fragment, likely a name plate |
| Grand totals | 7,222 counted | |
| | 3.59 k weighed only | |



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# BOOK REVIEWS

***Dry Creek: Archaeology and Paleoecology of a Late Pleistocene Alaskan Hunting Camp***. W. ROGER POWERS, R. DALE GUTHRIE, and JOHN F. HOFFECKER; edited by Ted Goebel. Peopling of the Americas Publications (sponsored by the Center for the Study of the First Americans), Texas A&M University Press, College Station, 2017. xi + 330 pp., 118 figures (mostly color), 43 tables, references cited, contributors, and index. $50.00 (cloth). ISBN: 978-1-62349-538-1. *Reviewed by* Jim D. Feagins, St. Joseph Museum.

For more than 40 years the Dry Creek site (HEA-005) has contributed to the discussion of the peopling of the New World. It generated several articles, some a bit controversial, and has been referenced many times over those decades. Now with the belated publication of *Dry Creek: Archaeology and Paleoecology of a Late Pleistocene Alaskan Hunting Camp*, the site is described thoroughly, and the information it has generated now rests on "firmer ground" (pun intended). In addition, the second section of the book covers new research from a 2011 excavation. Clearly, this report is well worth the wait.

HEA-005, a well stratified archeological site in central Alaska, was discovered in 1973. It was excavated from 1974 through 1977 by the University of Alaska-Fairbanks under the direction of W. Roger Powers. The late Pleistocene-age site has repeated short-term human occupations, some of which are associated with the now-extinct steppe bison (*Bison priscus*), one of the mega-mammals of Beringia. Various strata contain a chronological record of stone tools, cores, and debitage from a series of repeatedly but intermittently used hunting camps at this locality. The site is situated on an exposed elevation, overlooking the Dry Creek and Nenana River valleys. While it would have provided a good warm weather spot for sighting game, it would have been a horrible place to ride out winter storms.

Until the Dry Creek discovery no sites were known in eastern Beringia that were as old or older than the Clovis sites found much farther south in the more temperate areas of the continent. Because of its position along the proposed migration route from Asia to America, many scholars considered it a missing link. Thus, the site was especially big news back in the 1970s and after. Whether or not it is still thought to be a portion of that migration route, its early cultural and environmental record makes HEA-005 one of the most important archeological sites in Beringia. Cultural differences among strata indicate considerable variability in early lithic technology in that region of Alaska. Much remains to be understood about how some of the stone tools were manufactured and used.

Unfortunately, a final manuscript was not published. Roger Powers wrote a draft that was peer reviewed and revised. However, Powers was involved in investigating other sites, and he died before the final Dry Creek submission was completed. Recently some of his former students brought that study to fruition. Part I presents the information much as Powers intended.

Part II updates the original work, describing the 2011 excavation. As stated in the volume, much of Chapter 8 was previously presented in an *American Antiquity* article (Graf et al. 2015). This multidisciplinary research, led by Kelly E. Graf, now with the Center for the Study of the First Americans at Texas A&M University, focused on the geoarcheology and geochronology. It reaffirmed most of what Powers' team had accomplished decades earlier, but also added important new facts, especially in the field of geochronology. For example, Graf's limited 10-m$^2$ excavation exposed additional hearth features for the two late Pleistocene cultural components and supplied charcoal for accelerator radiocarbon dates. The chapter authors discuss in detail lithic artifacts collected in 2011, placing them in the following categories: cores (flake, bipolar, and microblade); debitage (angular shatter, cortical spalls, flakes, blade-like flakes, bipolar flakes, resharpening chips, biface thinning flakes, burin spalls, microblades, microblade technical spalls, and blade technical spalls); and tools (side scrapers, end scrapers, angle burins, retouched blades, retouched microblades, retouched flakes, bifaces, choppers, and hammerstones). Also the toolstones were sourced, and the faunal remains were ana-



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lyzed. Apparently Dall sheep were the primary game sought.

The final chapter outlines discoveries made at other late Pleistocene archeological sites in the nearby Nenana Valley and adjacent Teklanika Valley since the original HEA-005 excavations. The conclusions resulting from all the work conducted from 1974 through 2011 are succinctly summarized. Component I is firmly dated at 13,600–13,300 cal B.P. It contains an assemblage of small triangular bifacial points that now are known to be unique to foothill sites of similar age in central Alaska. These pre-13,000 B.P. sites belong to what is called the Nenana complex. Component 2 with an average date of 10,700 cal B.P. contains a classic microblade technology and a lanceolate point type. The authors briefly compare the Dry Creek lithic assemblage with those of nearby sites, as well as more distant locations in North America and Siberia. Although the lowest cultural components at HEA-005 date at and near the age of Clovis in the southern half of North America, the artifact assemblage is different from Clovis.

In sum, the Dry Creek site served as a repeatedly used, short-term hunting camp during late glacial times. Its strata contain identifiable large mammal remains, cultural features, and many thousands of lithic artifacts. Students of lithic technology will find much of interest in this study.

*Dry Creek: Archaeology and Paleoecology of a Late Pleistocene Alaskan Hunting Camp* is written for the professional archeologist and those in related fields. It is well written and edited and is presented in a large-formatted, slick-paper volume with excellent illustrations. Readers who are newly introduced to archeology or related sciences may grapple a little with some of the terms and a few of the concepts. However, if they stick with the report, much can be learned. It can be obtained from the Texas A&M University Press, phone at 800-826-8911 or online at www.tamupress.com. Current members of the Center for the Study of the First Americans can supply their code to the press and receive a 20 percent discount.

## REFERENCE CITED

Graf, Kelly E., Lyndsay M. DiPietro, Kathryn E. Krasinski, Angela K. Gore, Heather L. Smith, Brendan J. Culleton, Douglas J. Kennett, and David Rhode

2015 Dry Creek Revisited: New Excavations, Radiocarbon Dates, and Site Formation Information Inform on the Peopling of Eastern Beringia. *American Antiquity* 80(4):671–694.



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*The Archaeological Guide to Iowa*. WILLIAM E. WHITTAKER, LYNN M. ALEX, and MARY C. DE LA GARZA. University of Iowa Press, Iowa City, 2015. xi + 271 pp., including 94 figures, 47 color plates, 37 maps, index. $29.95 (paper or e-book). ISBN: 978-1-60938-337-4 (pbk) or ISBN: 978-1-60938-338-1 (ebk). *Reviewed by* Jim D. Feagins, St. Joseph Museum.

*The Archaeological Guide to Iowa* is the type of archeological tour guide that every state should publish. The volume presents a short introduction before the reader enters the heart of the guide in which many individual sites scattered across the state are described. The sites are numbered in sequences going from east to west and north to south, all the while following certain important river systems: Missouri, Little Sioux, Des Moines, Iowa, Cedar, Turkey, Mississippi, and others. This is a handy reference for cross-country travelers, whether they are wondering about what sites exist along their driving route or are planning a trip solely around the state's archeology. The state map and site names on pages 8–9 will prove useful in plotting an itinerary.

The introduction also summarizes the cultural periods in Iowa archeology: Paleoindian (13,500–10,500 years ago), Archaic (10,500–2,800 years ago), Woodland (800 B.C.-A.D. 1250), Late Prehistoric (A.D. 900–1600), Protohistoric (A.D. 1600–1800), and Historic (post A.D. 1800). There are some variations in names and dates for these periods in different states, but in general Iowa follows a somewhat standard chronology.

The sites discussed in individual chapters are only a very small sample (68) of the more than 27,000 sites recorded in Iowa. The majority of these 68 are protected on public lands, such as state parks or national monuments, and open to viewing and/or have exhibits nearby. A few are on secluded private property and cannot be visited. Some have been destroyed, but one can stand at their former locations and envision what the sites might have been like by way of various displays. All the sites are important and interesting, and many have unique stories.

A selection of the chapter titles demonstrates the wide range of sites described in the volume: 2) Blood Run/Rock Island: A National Historic Landmark without Equal, 4) The Cowan Site and the Origins of the Middle Missouri Tradition, 5) Sergeant Floyd's Grave—America's First National Monument, 6) Double Ditch: Uncovering a 12th-Century Iowa Community with 21st –Century Technology, 12) The Earthlodge Beneath Your Feet: Davis-Oriole, 15) The Hitchcock House—A Stop on the Underground Railroad, 18) Mounds, Gravestones, and Murders: Vegors Cemetery, 24) The Palace Site: Did People Live in Basin Houses 7,000 Years Ago?, 30) Enigmatic Alignments at the Folkert Mound Group, 31) Wanampito: A Possible Ioway Site from the 1600s, 33) Was There a Walled Prehistoric Village along the Cedar Valley Nature Trail?, 45) Nine Hundred Mounds Gone: The Great Harpers Ferry Mound Group Disappears, 46) Paint Rock and the Lost Monolith, 47) The Beauty of Effigy Mounds, 50) Dragoon Life at Fort Atkinson, 58) Hadfields Cave: Refuge inside the Cliffs, 65) Toolesboro Mounds National Historic Landmark, and 67) Is There an Adena or Hopewell Ring Enclosure at the Poisel Mounds? Each chapter presents references for more information and supplies directions on how to get to the sites. Enough sites are listed to keep travelers busy for quite some time.

This well written and authoritative guide book provides a great opportunity for the public, lay archeologists, and professionals to experience in print or in person many of Iowa's most important sites. Public etiquette or viewing guidelines are given for on-site visitors. *The Archaeological Guide to Iowa* can be obtained from the University of Iowa Press by writing to 119 W. Park Road, 100 Kuhl House, Iowa City, IA 52242-1000 or by calling 800-621-2736. The press can be found online at uipress@uiowa.edu.



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Barbara Crable earned B.A. and M.A. degrees from the University of Kansas. Her interests include Central Plains archeology, zooarcheology and taphonomy, and the ethics of archeology. In the summer of 2014, she participated in the Kansas Archeology Training Program field school in Osawatomie and the KU field school at the Pawnee Indian Museum State Historic Site, where her passion for fieldwork began. She looks forward to a third year with the Greybull River Sustainable Landscape Ecology Project in the Absaroka Mountains in summer 2019. She works for R. C. Goodwin and Associates in Lawrence as an administrative coordinator/archeologist.

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Jim Feagins is a retired private archeological consultant who still serves as part of the adjunct archeological staff for the St. Joseph Museum. He received an A.A. degree from Graceland University in Iowa, a B.S. degree from Pittsburg State University and a M.N.S. degree from the University of Oklahoma. After 30 years as a science instructor for Consolidated School District No. 4, Grandview, Missouri, he retired in 1995. Active in promoting archeological education, he is president emeritus of the Missouri Archaeological Society. He also served as president of the Kansas City Archaeological Society and as a vice-president of the Missouri Association of Professional Archaeologists and the Kansas Anthropological Association. He is a life member of the KAA.

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Jack Hofman taught archeology in the Department of Anthropology at the University of Kansas from 1991 until 2019. His research interests include lithic technology, zooarchaeology, early prehistoric hunters, large-scale land use practices, and studies of technological change and cultural contact. He has been involved in archeological research in the Great Plains region from Texas to Wyoming, beginning in Oklahoma in 1971. During the past few years he has also been working on historic and Pawnee Nation archeology. The article in this issue is derived from ongoing research with sites and collections in the High Plains region of western Kansas.

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| CHAPMAN | DEAN E | 2127 DARTMOUTH GATE CT | WILDWOOD | MO | 63011-5436 |
| CHENEY | NADINE | RT 1 BOX 105 | TRIBUNE | KS | 67879-9757 |
| CHIN | LAILIN A | 777 G RD | CEDAR POINT | KS | 66843-9520 |
| CHRISTENSEN | MARK | 504 SELBY AVE APT 9 | ST PAUL | MN | 55102-4542 |
| CLARKE | MIKE & DRU | 7810 HOPKINS CREEK RD | ST GEORGE | KS | 66535-9805 |
| CLAYTON | DAWN | 21013 W 81ST TER | LENEXA | KS | 66220-2586 |
| COLGROVE | ARRON & TRICIA | 586 S WALNUT ST | GARDNER | KS | 66030-9261 |
| COLLE | BRITT & LINDA | 724 PENN DR | MCPHERSON | KS | 67460-1718 |
| COLYER | JEFFREY & RUTH | 13825 HORTON DR | OVERLAND PARK | KS | 66223-2977 |
| CONRAD | MARY | 3900 NEARMAN DR | KANSAS CITY | KS | 66104-1230 |
| COOK | EVA C LORD | 21903 W 57TH TER | SHAWNEE | KS | 66226-8200 |
| DAHN | MARY | 1541 SYCAMORE ST | EUDORA | KS | 66025-8903 |
| DALE | FRANK | 1630 AVE L | COLDWATER | KS | 67029-5641 |
| DALTON | DEBORAH | 2433 SW 24TH ST | TOPEKA | KS | 66611-1514 |
| DANIELS & A LUDLUM | JESSICA | 1914 SW WARNER CT | TOPEKA | KS | 66604-3267 |
| DEINES | WILLIAM | 23033 T RD | WAKEENEY | KS | 67672-2759 |
| DRESBACH | RUSSELL | 250 E DANIEL ST | COLUMBIA | MO | 65202-0096 |
| DYE | NORMAN & NANCY | 19014 R RD | MEADE | KS | 67864-9513 |
| EDENS | JACK | 101 S 7TH ST | FREDONIA | KS | 66736-1819 |
| EINSEL | EUGENE | 15424 I ST | GREENSBURG | KS | 67054-6723 |
| ELLISON | KATE BUREAU OF REC | 5924 NW 2ND ST STE 200 | OKLAHOMA CITY | OK | 73127-6514 |
| ENGQUIST | BARB | 3901 LAKE ST | LINCOLN | NE | 68506-2446 |
| FEAGINS | JIM D | 800 SUNSET LN | BELTON | MO | 64012-4922 |
| FINCH & M S MILLER | STEVEN | PO BOX 52 | PATAGONIA | AZ | 85624-0052 |
| FINKE | JERRY & MARILYN | 835 NORTHPARK RDG | NEW BRAUNFELS | TX | 78130-8319 |
| FLOYD | MORRIS | 813 E HEMPHILL AVE | HAYSVILLE | KS | 67060-1823 |
| FOSHA | MICHAEL | 3710 W SAINT LOUIS ST | RAPID CITY | SD | 57702-2141 |
| FOX | JOHN | 619A PRUDOM AVE APT A | PAWHUSKA | OK | 74056-4230 |
| FRANK | ANITA | 6362 SW 10TH AVE | TOPEKA | KS | 66615-3807 |
| GARST | CHRISTINE | 4304 SW 23RD ST | TOPEKA | KS | 66614-1160 |
| GELDHOF | GORDON | 7916 HASKINS ST | LENEXA | KS | 66215-2521 |
| GENTINE | LYNN, MICHAELA & JESSICA | 2961 SW TUTBURY TOWN RD | TOPEKA | KS | 66614-4415 |



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|---|---|---|---|---|---|
| GEORGE | F SUSAN | 2309 PLUM ST | HAYS | KS | 67601-3034 |
| GIPSON | TAMMY | 915 S ELM ST | MCPHERSON | KS | 67460-5738 |
| GOEBEL | PAUL | 414N JOHN DOY CT | LAWRENCE | KS | 66049-4257 |
| GOERING | MARK & SHEILA | 57 OLD POST LN PO BOX 3012 | ENID | OK | 73702-3012 |
| GOOD | ELIZABETH | 4414 UNITY AVE N | ROBBINSDALE | MN | 55422-1146 |
| HAAS | JAMES | 3501 STOVER ST APT 195 | FORT COLLINS | CO | 80525-4528 |
| HAND | DAVID | 316 S ILLINOIS ST | KANOPOLIS | KS | 67454-9553 |
| HANNA | CASSIE | 10413 NOEL AVE | CUPERTINO | CA | 95214-1250 |
| HARRIS | PAUL | 1315 SW PIN OAK PKWY PO BOX 67304 | TOPEKA | KS | 66667-0304 |
| HARRIS & J M VINCENT | ELIZABETH | 112 E 16TH ST | HAYS | KS | 67601-3635 |
| HEASTY | DON & CAMILLA | 237 RAINBOW DR #13791 | LIVINGSTON | TX | 77399-2037 |
| HEATH & H COVEY | TARYN | 7338 GODDARD DR | SHAWNEE | KS | 66203-4476 |
| HERRICH | KATIE | 11503 S RD H | JOHNSON | KS | 67855-9020 |
| HICKS | GARY & LOUISE | 12105 WESTGATE ST | OVERLAND PARK | KS | 66213-2268 |
| HINTZ | PAULINE | 211 SHORELINE DR | LOUISBURG | KS | 66053-6431 |
| HOARD | ROBERT | 6425 SW 6TH AVE | TOPEKA | KS | 66615-1099 |
| HOFMAN | JACK | PO BOX 3453 | LAWRENCE | KS | 66046-0453 |
| HOLTHAUS | DAVE & JEAN | 3636 SW STONYBROOK DR | TOPEKA | KS | 66614-5100 |
| HOPE | JOHN | 425 STONERIDGE TER | DEFOREST | WI | 53532-1151 |
| HORD | CHRIS | 413 SE BROWNFIELD DR | LEE'S SUMMIT | MO | 64063-6020 |
| HOWELL | JEAN & BILL | H-BAR RANCH 90244 SW 130TH AVE | COATS | KS | 67028-9441 |
| HOYT | CRAIG | 3350 RD 77 | BREWSTER | KS | 67732-8912 |
| HUBER | DON | THE COURTS 302 CEDARS DR | MCPHERSON | KS | 67460-1910 |
| HUENERGARDE | JIM | 108 BIRCH ST | LIEBENTHAL | KS | 67553-5321 |
| HUTSON | RUTH | 108 N ST PO BOX 248 | WESTMORELAND | KS | 66549-0248 |
| JACKSON | DESTRY | 817 N JOYCE ST | ULYSSES | KS | 67880-8406 |
| JOHNSON | PAUL & ROBIN | 2567 23RD AVE | GYPSUM | KS | 67448-9022 |
| JOHNSON CO LIB | ACQUISITIONS | PO BOX 2901 | SHAWNEE MISSION | KS | 66201-1301 |
| KANSAS CITY PUBLIC LIB | MAIN LIB SERIALS DEPT | 625 MINNESOTA AVE | KANSAS CITY | KS | 66101-2805 |
| KANSAS HERITAGE CNTR | 1000 N 2ND AVE | PO BOX 1207 | DODGE CITY | KS | 67801-1207 |
| KANSAS HIST SOC | PERIODICALS | 6425 SW 6TH AVE | TOPEKA | KS | 66615-1099 |
| KANSAS STATE UNIV | HALE LIB TECH SERV | 1117 MID-CAMPUS DR N | MANHATTAN | KS | 66506-0110 |
| KAUL-HURST | LUCY | 1795 E 400TH RD | LAWRENCE | KS | 66049-9102 |
| KECK | DICK & CYNTHIA | 2709 W 74TH ST | PRAIRIE VILLAGE | KS | 66208-3222 |
| KECK | SETH | 7396 FLUSH RD | SAINT GEORGE | KS | 66535-9405 |
| KECKLER-ALEXANDER | KRISTIN | ADDRESS UNKNOWN | | | |
| KENNEDY | CRYSTAL & SAM | 6528 SE CALIFORNIA AVE | BERRYTON | KS | 66409-9772 |
| KEPKA | JESSICA | 9347 BALES AVE APT 2108 | KANSAS CITY | MO | 64132-4317 |
| KETCHUM | TONYA | 24960 HOLLINGSWORTH RD | MCLOUTH | KS | 66054-3117 |
| KING | MARSHA | 2525 SW BELLE AVE | TOPEKA | KS | 66614-1752 |
| KINSEY | KAROLYN | 333 N LOGAN AVE PO BOX 143 | UTICA | KS | 67584-0143 |
| KRAMER | ROBBIE | 1019 S 3100 RD | HERINGTON | KS | 67449-4600 |
| KRAUS | HAROLD & VIRGINIA | 1303 E 33RD ST #16 | HAYS | KS | 67601-9637 |
| KREISSLER | ALICE | 6709 W O'NEIL ST | WICHITA | KS | 67212-6332 |
| KURTZ | CHRIS | 5508-C POMPANO DR | MINNETONKA | MN | 55343-8910 |
| LASHELLE | JOHN | 214 S LINCOLN ST | ARLINGTON | KS | 67514-0304 |
| LATHAM | MARK | 8401 TRIPP RD PO BOX 134 | PITTSFORD | MI | 49271-0134 |
| LEDEBOER | MOLLY | 1505 WILLOW ST | VALLEY FALLS | KS | 66088-9740 |
| LIFE | MICHAEL | 3746 S HWY K-57 | JUNCTION CITY | KS | 66441-8256 |
| LINCK | RANDY | 700 W 10TH ST PO BOX 264 | HORTON | KS | 66439-0264 |
| LINDSTROM | JASON | 1102 BARBERRY DR | HUTCHINSON | KS | 67502-3365 |
| LINTZ | CHRISTOPHER | 14909 DORIA DR | AUSTIN | TX | 78728-4460 |
| LOGAN & L RITTERBUSH | BRAD | 3331 NEWBURY ST | MANHATTAN | KS | 66503-0303 |
| LOISELLE | BARBARA & DAVE | 1494 NE 400 HWY | CHEROKEE | KS | 66724-9600 |
| LUNDEEN | GAIL | 604 NE SHORELINE DR | LEE'S SUMMIT | MO | 64064-1382 |
| MADDEN | LOU | PO BOX 12354 4333 W 44TH AVE APT 2 | DENVER | CO | 80212-2360 |
| MALCOM | BARRY | 4748 N WYNDAM CIR | PARK CITY | KS | 67219-5513 |
| MALLOUF | ROBERT J | 5 SIERRA VISTA RD | ALPINE | TX | 79830-1012 |
| MASTERS | JUDY | 10583 W 181ST ST | BURLINGAME | KS | 66413-8672 |
| MATHIEU | RICK & TANYA | 204 N CHURCH ST | OLATHE | KS | 66061-3524 |
| MAXWELL | MARY ELLEN & DONALD RAY | 25094 160TH CT | LEAVENWORTH | KS | 66048-8369 |
| MCCHESNEY | KAROL | 2220 FIR RD | MUNDEN | KS | 66959-0098 |
| MCCLENAHAN | JULIE | 1298 N 550 RD | BALDWIN CITY | KS | 66006-7254 |
| MCCULLOUGH-CANTRELL | WENDY | 1911 RHODE ISLAND ST | LAWRENCE | KS | 66046-2961 |
| MCGILL | LLOYD T & JUNE | 1403 TELFORD DR | LIBERTY | MO | 64068-1269 |
| MCILRATH | SARAH | 2719 SW HUNTOON ST | TOPEKA | KS | 66604-1531 |
| MCKINNEY | SHARON | 3451 SW BRIARWOOD LN | TOPEKA | KS | 66611-1832 |
| MCMILLON | DAVID & PEGGY | 36 NW 48 RD | GREAT BEND | KS | 67530-9087 |
| MELTON | BETTY & DON | 815 N INDEPENDENCE AVE | BELOIT | KS | 67420-1639 |
| MIDWEST ARCH CNTR | FED BLDG RM 474 | 100 CENTENNIAL MALL N | LINCOLN | NE | 68508-3859 |
| MILES | ANTHONY | 6325 W 73RD TER | OVERLAND PARK | KS | 66204-2032 |



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|---|---|---|---|---|---|
| MINER & R AIKEN | ANN | 1835 HARVEY AVE | COLBY | KS | 67701-1551 |
| MISSOURI ARCH SOC | MSU | 901 S NATIONAL AVE | SPRINGFIELD | MO | 65897-0027 |
| MOORE | MARGARET | 221 N CAMPBELL AVE | BELOIT | KS | 67420-2427 |
| MOSIER | JOSEPH | 1904 TULIP TER | MANHATTAN | KS | 66502-4958 |
| MULDER | CLEVE | 721 UNIVERSITY PL | SALINA | KS | 67401-2574 |
| MURPHY | LAURA | 333 SW QUINTON AVE | TOPEKA | KS | 66606-1179 |
| MURRAY | KENT & GLENNA | 29146 NE 1830 RD | GARNETT | KS | 66032-8344 |
| MYERS | CARL | 1902 N SEDGWICK ST | WICHITA | KS | 67203-1530 |
| NADEN | MELANIE R | 4272 EAGLE LAKE CT | BEL AIRE | KS | 67220-1719 |
| NANCE | ZACHARY | 217 MILL ST | HARTFORD | KS | 66854-9418 |
| NICHOLAS | JOE, ADAM & ZACK | 10344 CHEROKEE LN | LEAWOOD | KS | 66206-2511 |
| NICKEL | CHRISTINE | 3638 COUNTRY CLUB PL | WICHITA | KS | 67208-3036 |
| NIOCE | MARVIN & BECKY | 4023 SW DRURY LN | TOPEKA | KS | 66604-2414 |
| NOVAK | KIRSTIN | 14006 BOND ST | OVERLAND PARK | KS | 66221-2802 |
| O'BRIEN | DR PATRICIA J | DECEASED | | | |
| O'HARA | LINDA | 2523 US 24 HWY | BELOIT | KS | 67420-3024 |
| OLIVA | BONITA | 3095 F RD | WOODSTON | KS | 67675-9004 |
| OLSON | BILL & BETH | 203 W COLUMBUS ST | LINDSBORG | KS | 67456-1527 |
| OLSON & J GRUBER | GREG | 609 W MAIN ST | BELOIT | KS | 67420-3012 |
| OSAGE NATION HPO | DR ANDREA HUNTER | 627 GRANDVIEW AVE | PAWHUSKA | OK | 74056-4141 |
| OVERMYER | NANCY | PO BOX 1213 | TOPEKA | KS | 66601-1213 |
| PEARSON | GAIL | 501 N WESTERN AVE | BELOIT | KS | 67420-1849 |
| PETZ | AL | 819 BANNOCK BURN RD | HUTCHINSON | KS | 67502-2033 |
| PITTSBURG STATE UNIV | AXE LIB | 1701 S BROADWAY ST | PITTSBURG | KS | 66762-5856 |
| POLSON | DAVID | 15890 GARDNER PL | GARDNER | KS | 66030-9669 |
| POWELL | JARED | 2500 W 6TH ST APT 523 | LAWRENCE | KS | 66049-2435 |
| POWELL & T MEADE | GINA | 4025 HOLMES ST | KANSAS CITY | MO | 64110-1125 |
| PURVIS | REBEKAH | 302 E NORTH ST | WESTMORLAND | KS | 66549-0000 |
| RACK | KIM, JAKE & MASON | 5113 KINGSMILL RD | LAWRENCE | KS | 66047-1897 |
| RALSTON | JAMES | 15603 W 81ST ST | LENEXA | KS | 66219-1831 |
| RECTOR | STEVE | 702 N 3RD ST | LAWRENCE | KS | 66044-1417 |
| REED | EVELYN | PO BOX 1068 | NEWTON | KS | 67114-1068 |
| REED | MARGIE | 2635 DEBORAH DR | SALINA | KS | 67401-3567 |
| REED | TERRY, TYTUS & TAYTUM | 403 S CORONADO AVE | LINDSBORG | KS | 67456-2736 |
| REXROAD | VIRGINIA | 3712 ALDERSGATE APT B | HUTCHINSON | KS | 67502-2367 |
| RICHARDS | WHTNEY | 519 N WESTWOOD DR | INDEPENDENCE | MO | 64058-3240 |
| RIGGS | JOE & LAVEDA | 214 E GRAND ST | LACYGNE | KS | 66040-0127 |
| RIVES | TIMOTHY | 612 NW 3RD ST | ABILENE | KS | 67410-2732 |
| ROBERTS | JAMES | 1036 ARROWHEAD RDG | INDEPENDENCE | MO | 64056-1179 |
| ROBERTS | PAUL | PO BOX 201 | DENTON | KS | 66017-0201 |
| ROECKERS | HENRY | 106 PARK PLAZA N | GARNETT | KS | 66032-2303 |
| ROECKERS | RICHARD & SHIRLEY | 224 E 2ND AVE | GARNETT | KS | 66032-1204 |
| ROWLINSON | DANIEL & JIMMETTE | 2911 SW WHITNEY LN | TOPEKA | KS | 66614-4814 |
| ROWLISON | DON | RT 1 BOX 57M | STUDLEY | KS | 67759-9326 |
| ROYCE | CLARE H | 8837 LONG BEACH CIR | ATLANTA | GA | 30350-2208 |
| RUDKIN | JANN & TOM | 15000 BLACKBERRY HILL RD | LOS GATOS | CA | 95030-7504 |
| RUIZ | CHRISTINA | 310 FUNSTEN AVE | LAWRENCE | KS | 66044-1440 |
| RUSSELL-IVERSON & W IVERSON | NATASHA | 4300 PIN OAK RD | HUTCHINSON | KS | 67502-4620 |
| RYAN | SHANNON | 2715 PONDEROSA DR | LAWRENCE | KS | 66046-5157 |
| SAGE | SHARON | 9130 SW 97TH ST | AUBURN | KS | 66402-9610 |
| SALLEE | KENT | 109 E GORDON ST PO BOX 592 | INMAN | KS | 67546-0592 |
| SCHMIDT | JANIE & REX | 14026 U ST | WILMORE | KS | 67155-9508 |
| SHERIDAN | ALAN | 656 OLD HWY 40 | WILSON | KS | 67490-8777 |
| SHIVELY | BARON | 823 N ELM ST | MCPHERSON | KS | 67460-2813 |
| SICHTER | JAMES | 10809 W 123RD ST | OVERLAND PARK | KS | 66213-1957 |
| SLOCUM | DUSTI | 3805 SE QUINCY ST | TOPEKA | KS | 66609-1464 |
| SMITH | STACY | ADDRESS UNKNOWN | | | |
| SMITH | SUSAN | 232 SUMMERTREE LN | LAWRENCE | KS | 66049-1830 |
| SMITH | SUZANNE | 8392 LOWER MCDOWELL RD | ALTA VISTA | KS | 66834-9293 |
| SMOKY HILL TRAIL ASSN | | PO BOX 978 | HAYS | KS | 67601-0978 |
| SNELL | ERIC & ELLEN | 13910 W 48TH ST | SHAWNEE | KS | 66216-1106 |
| SNYDER | JUSTIN | 925 SE 44TH TER | TOPEKA | KS | 66609-1674 |
| SNYDER-TORR | KATHY | 3317 L RD | BELOIT | KS | 67420-3090 |
| SPILLER | JACK & GAYNELL | 1601 WATSON ST | EMPORIA | KS | 66801-5211 |
| ST HIST SOC WISCONSIN | LIB ACQUISITIONS SEC | 816 STATE ST | MADISON | WI | 53706-1417 |
| STEIN | MARTIN | 4399 OGAN MESA LOOP | LAS CRUCES | NM | 88011-8373 |
| STELLWAGON | KIEFER | 915 W 29TH ST | LAWRENCE | KS | 66046-4635 |
| STEVENSON | JENEIZE | 305 W WAVERLY ST | NORTON | KS | 67654-1731 |
| STEWART | CARRIE | 7516 W BLANCHARD AVE | HUTCHINSON | KS | 67501-9110 |
| STIPPICH | JULIE A | 1556 N DELLROSE ST | WICHITA | KS | 67208-2219 |
| STITES | DEAN & VALORIE | 405 W BUFFALO ST | GIRARD | KS | 66743-1407 |



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|---|---|---|---|---|---|
| STRICKLER | BRENDA | ADDRESS UNKNOWN | | | |
| STROM | BYRON | 632 E DOUGLAS AVE | DES MOINES | IA | 50313-4567 |
| STRUKEL | WENDY | 602 N LEONARD ST | GIRARD | KS | 66743-1033 |
| STUBBS | MICHAEL | 23320 ROCKTON RD | ESKRIDGE | KS | 66423-9010 |
| SUDBURY | BRYON | PO BOX 2282 | PONCA CITY | OK | 74602-2282 |
| SULLIVAN | MELONIE | 1720 PRESTWICK CIR | LAWRENCE | KS | 66047-2086 |
| SWANEK | ED | 12779 HEADWATERS RD | HARVEYVIILLE | KS | 66431-9319 |
| TAYLOR | DOUGLAS | 308 N BIRCH ST | HILLSBORO | KS | 67063-1135 |
| TESKE | JEANNIE | ADDRESS UNKNOWN | | | |
| THURMOND | J PETER | RT 1 BOX 62B | CHEYENNE | OK | 73628-9729 |
| TITUS | REV MARY AL | 700 MONTEREY PL APT 506 | HUTCHINSON | KS | 67502-2248 |
| TUCKER | VITA | 7015 W 133RD ST | BURLINGAME | KS | 66413-8778 |
| UNIV OF KANSAS | WATSON LIB RETRIEVAL | 1425 JAYHAWK BLVD R 210S | LAWRENCE | KS | 66045-7594 |
| UNIV OF OKLAHOMA | BIZZELL MEMORIAL LIB SERIALS | 401 W BROOKS ST | NORMAN | OK | 73019-0528 |
| VANCE | FRED | 5808 SW 27TH ST | TOPEKA | KS | 66614-2011 |
| VEHIK | DR SUSAN | 2622 S PICKARD AVE | NORMAN | OK | 73072-6922 |
| VOGELSANG | ANDREW & CHRISTA | 8011 N HOPE AVE | KANSAS CITY | MO | 64151-3749 |
| WALKER | DANNY | 1687 COUGHLIN ST | LARAMIE | WY | 82072-2321 |
| WALLACE | DENISE | 1418 S CEDAR AVE | INDEPENDENCE | MO | 64052-2139 |
| WALLEN | ANNE | 1720 W 22ND ST | LAWRENCE | KS | 66046-2724 |
| WALLEN | MIRIAM | 1829 2ND ST APT 4 | SAN RAFAEL | CA | 95901-2656 |
| WALLEN | ROSE MARIE & MIKE | 116 E MILL ST | LINDSBORG | KS | 67456-2815 |
| WARD | ROGER | 828 AUDREY DR | EL DORADO | KS | 67042-2220 |
| WECKER | SERENA | 1274 SW GARFIELD AVE | TOPEKA | KS | 66604-1327 |
| WEDEL | DALE | 2675 MONROE ST | LARAMIE | WY | 82070-6551 |
| WELSH | DIANNA | 7593 162ND ST | VALLEY FALLS | KS | 66088-5174 |
| WERDER | DOLORES & FRANK | 16645 KING RD | VALLEY FALLS | KS | 66088-5046 |
| WERNER | NORBERT | 2302 POST AVE | DODGE CITY | KS | 67801-2556 |
| WESTON | TIM KSHPO | 6425 SW 6TH AVE | TOPEKA | KS | 66615-1099 |
| WHITE | AMY | 920 SW WOODBRIDGE CT | TOPEKA | KS | 66606-4600 |
| WIECHERT | ALLEN & SANDRA | 1501 INVERNESS APT 330 | LAWRENCE | KS | 66047-2063 |
| WILDGEN | MIKE | 801 LOUISIANA ST | LAWRENCE | KS | 66044-2649 |
| WILLIAMS | BARRY & HEDY | 1720 N CENTER VALLEY RD | SANDPOINT | ID | 83864-7154 |
| WING | EUGENE | 9751 PINE KNOLL RD | MOBILE | AL | 36608-9239 |
| WITTY | THOMAS | DECEASED | | | |
| WORKMAN | FRANK | 304 MERCURY ST | SILVER LAKE | KS | 66539-9607 |
| WROBLEWSKI & A VOGELSANG | CHRISTA | 8011 N HOPE AVE | KANSAS CITY | MO | 64141-3749 |
| WULFKUHLE | VIRGINIA | 840 N 1500 RD | LAWRENCE | KS | 66049-9195 |
| YARMER | ROBERT E | 506 W 5TH ST PO BOX 158 | ELLINWOOD | KS | 67526-0158 |
| YOUNG | A L | PO BOX 467 | BELOIT | KS | 67420-0467 |
| ZANE | KRISTEN | 10218 BRIAR DR | SHAWNEE MISSION | KS | 66207-3418 |



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