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The Quarry Creek site is a well preserved occupation of the Kansas City Hopewell variant of the Middle Woodland period (ca.A.D. 1-750). It has been protected by virtue and fortuity of its location on the Fort Leavenworth military reservation. The site was discovered in 1970 and, following discovery of limited damage to the site by tree transplanting activities, it was placed on the National Register in 1973. In response to discovery of vandalism at the site, the Historic Preservation Department, Kansas State Historical Society, called for its protection through increased patrols and removal of heavy wooded vegetation. The need for more information about the site led to its excavation for a six-week period in the summer of 1991 by the Kansas Archaeological Field School (KAFS), a joint endeavor of the University of Kansas and Kansas State University.

The report is a comprehensive account of the investigations of the KAFS. It provides information on the horizontal and vertical extent of cultural deposits and the nature of them. The application and results of a proton magnetometer survey of the site are presented.

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19. A total of 33 square meters of the ca. 8,400 square meter site area was excavated, including an exploratory trench through the center of one of four low relief mounds. The mounds are interpreted as middens, below which six trash-filled pits were revealed. Cultural material at the site includes an abundance of ceramic and lithic artifacts and well preserved animal and carbonized plant remains. This material and its context are described and analyzed.

Relative dating of the site through ceramic and lithic seriations in conjunction with absolute dating through four radiocarbon dates from as many pit features indicates the Hopewell occupation spanned at least three hundred years, ca.A.D. 210-540. The research value of the site is discussed in terms of its potential for addressing problems in Hopewellian culture history, dynamics, and environment. These problems include examination and interpretation of site structure and formation processes; environmental reconstruction and geo-archaeological investigation of the Quarry Creek-Missouri River locality and the site proper; settlement-subsistence patterns; external relationships of the Kansas City Hopewell with Hopewell of the Eastern Woodlands; chronology, including refinement of the temporal placement of the Kansas City Hopewell variant and review of the temporal and cultural relationship between it and Plains Woodland cultures of the Lower Missouri and Kansas Rivers.

The continued management and protection of the site is discussed. The previous management recommendations of the Kansas SHPO are endorsed and recommendations are made for further survey of the Quarry Creek locality.

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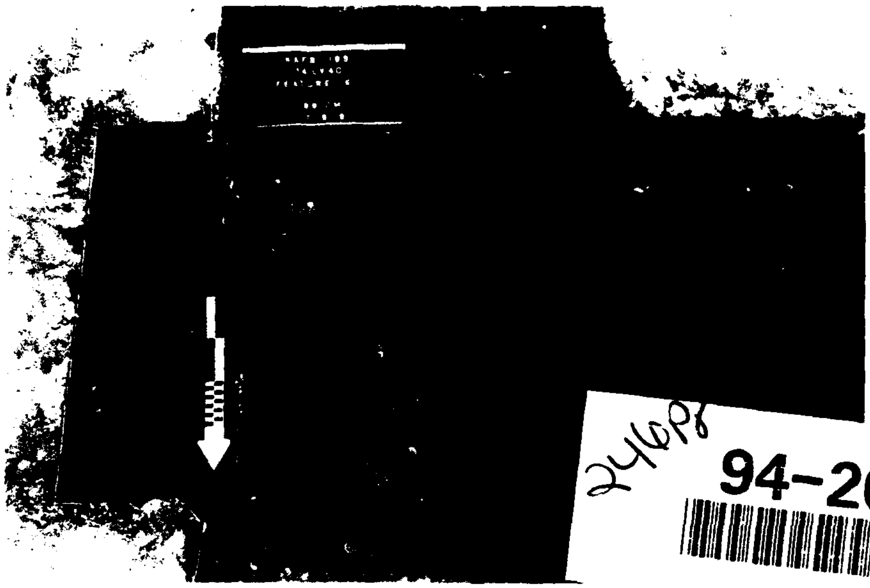
Edited by
Brad Logan



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Edited by
Brad Logan

With Contributions by

Mary J. Adair
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Submitted to:

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Kansas City, Missouri

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66045

Brad Logan, Principal Investigator

June 1993

ABSTRACT

The Quarry Creek site is a well preserved occupation of the Kansas City Hopewell variant of the Middle Woodland period (ca. A.D. 1-750). It has been protected by virtue and fortuity of its location on the Fort Leavenworth military reservation. The site was discovered in 1970 and, following discovery of limited damage to the site by tree transplanting activities, it was placed on the National Register in 1973. In response to discovery of vandalism at the site, the Historic Preservation Department, Kansas State Historical Society, called for its protection through increased patrols and removal of heavy wooded vegetation. The need for more information about the site led to its excavation for a six weeks period in the summer of 1991 by the Kansas Archaeological Field School (KAFS), a joint endeavor of the University of Kansas and Kansas State University.

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ACKNOWLEDGMENTS

Thanks are due to many people for the success of the Kansas Archaeological Field School (KAFS) investigation of the Quarry Creek site. I am grateful to Mr. Martin Stein, Archeologist, Historic Preservation Department, Kansas State Historical Society, for bringing the site to my attention and suggesting it as a candidate for the KAFS. Mr. Ramon Powers, State Historic Preservation Officer and Director, KSHS, endorsed our work at this remarkable site. Ms. Camille Lechliter, Archeologist, Kansas City District, U.S. Army Corps of Engineers, helped us obtain the permit required to conduct the field school and later played a significant role in obtaining the grant, named below, which made much of the analysis in this report possible.

At Fort Leavenworth, Mr. Matt Nowak, Forester, provided invaluable logistical support and demonstrated zeal in the continued protection of the site. Mr. Gerald Morgan, Historical Architect, Department of Egineering and Housing, Fort Leavenworth, also provided logistical support and, during his frequent visits to the site at the time of our excavation, displayed much enthusiasm for the project. Gerald pursued funding for follow-up research of data we recovered and routed our proposal for such to the Legacy Resource Management Program of the Department of Defense. A grant from that program made this report and much of the work behind it possible. We are also grateful to Prof. Alfred E. Johnson, who shared with us his considerable knowledge about the Kansas City Hopewell culture.

Behind all the information in this report is the crew of the KAFS-1991. With the unstinting support of my assistant Mr. John Hedden, then an M.A. graduate student at KU, the following persons brought the data from the ground up: Ronald Brubaker, Kent Fritz, Ken Lawrence, Chris Lewis, Sandy Marvel, Noah Pollack, Chris Raymond, Robert Rothman, Jason Rutherford, David Schmidt, David Schneider, Christy Slaughter, Sherry Sperman, Adrienne Sturbois, and Beth Watson. Robert and Christy deserve thanks for devoting a full month after the field school to flotation of about 200 of the soil samples recovered from the site.

Between the fieldwork and Legacy funded research there was a semester of laboratory preparation and preliminary analyses, which were directed by the editor as a course in Archaeological Laboratory Methods. During that course, the following students, in an atmosphere of great fun, identified, sorted and researched thousands of artifacts from the site: Nicolle Antonopoulos, Pam Blackburn, Terry Blackburn, Peter Churchill, Dawn Kothen, Chris Lewis, Robert Rothman, David Schneider, Hedy Seitter, Rodney Staab, Carla Wardlow, and Beth Watson.

With the support of the Legacy grant, the following people completed the identification, cataloging, sorting, curation and of Quarry Creek material: Robert Rothman, Chris Raymond, Jack Romine, Ken Lawrence, and Judi Banks. Robert deserves particular recognition as a participant in every phase of the Quarry Creek project. Some students expressed interest in working with the data as part of independent research projects and I appreciate their sharing the results of their work, some of which is included here: Eva Lord Cook, Will Banks, Shaun Bitikofer, and Jack Romine.

To all these people, my many thanks. And to Lauren Ritterbush and Elias Logan, who tolerated my absence during the field school at the beginning and the several "all-nighters" it took to produce this report at the end, my gratitude and affection.

Brad Logan, Principal Investigator
Associate Curator
Museum of Anthropology
University of Kansas

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Chapter 1

INTRODUCTION

Brad Logan

From June 3 to July 12, 1991 the Kansas Archaeological Field School (KAFS) conducted an archaeological investigation of the Quarry Creek site (14LV401), on the Fort Leavenworth military reservation, in Leavenworth County, northeastern Kansas. The field school is a cooperative research and educational program of the University of Kansas and Kansas State University. During the 1991 season, the field school included 15 students under the direction of the author and Mr. John Hedden, graduate student teaching assistant. This is a report of the investigation. It includes a detailed description of a magnetometer survey of the site, extensive test excavations of the field school, and the cultural material and features discovered. It also presents discussions of the recovered artifact, floral and faunal assemblages and preliminary interpretations of the nature, extent and research potential of the site. The report provides recommendations for the preservation of the site and for future research about it.

Site Discovery and Previous Investigations

The Quarry Creek site is located on wooded, relatively unused terrain on the reservation at the confluence of two intermittant feeder streams that form Quarry Creek, a west-bank tributary of the Missouri River (Fig. 1.1). It is bounded on the south and east by a branch of Quarry Creek and on the north by an east-southeast draining ravine (Fig. 1.2). The western limits of the site, according to the results of our excavations, are now marked by a large bur oak tree. A permanent datum of PVC plastic tubing was established a few meters south of this tree as a reference for our investigations (Fig. 1.3). The site extends approximately 140 m along the east-southeasterly sloping grade of a terrace and about 60 m perpendicular to that axis between the stream and ravine. As defined, the site covers an area of about 8,400 m^2.

The McPherson site (14LV357) is located just opposite the stream from 14LV401 (Figs. 1.1-2). Test excavations at that site in 1988 indicated it covers an area of at least 8,500 m^2 (Wagner et al. 1989:161-162). (Note: This source gives dimensions for the site of 170 m east-west by 50 m north-south, which I believe to be accurate. These are wrongly multiplied as 42,500 m^2 on page 162 of that reference. The scale provided in the site map

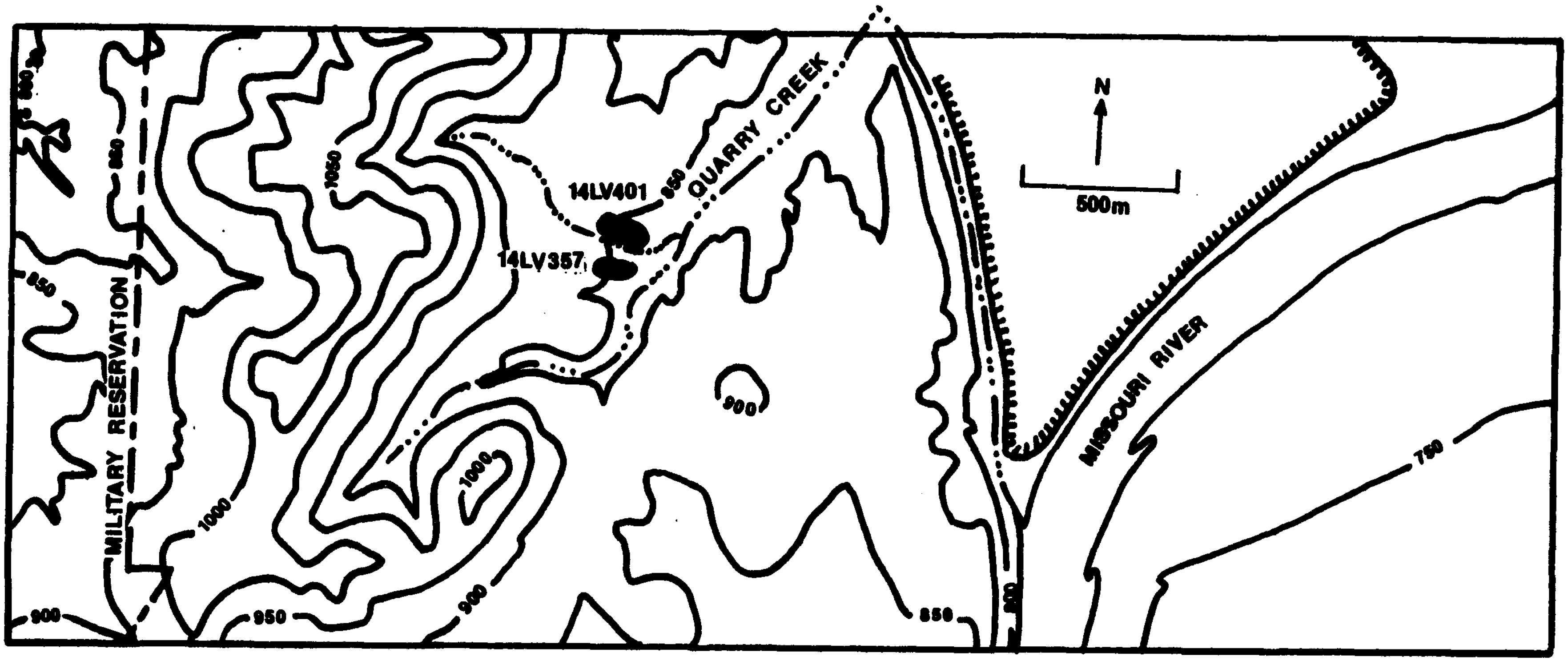


Figure 1.1 Location of Quarry Creek (14LV401) and McPherson (14LV357) Sites in the Quarry Creek Locality. Adapted from U.S.G.S. Leavenworth, Kansas Quadrangle (elevation in fifty feet contour intervals).

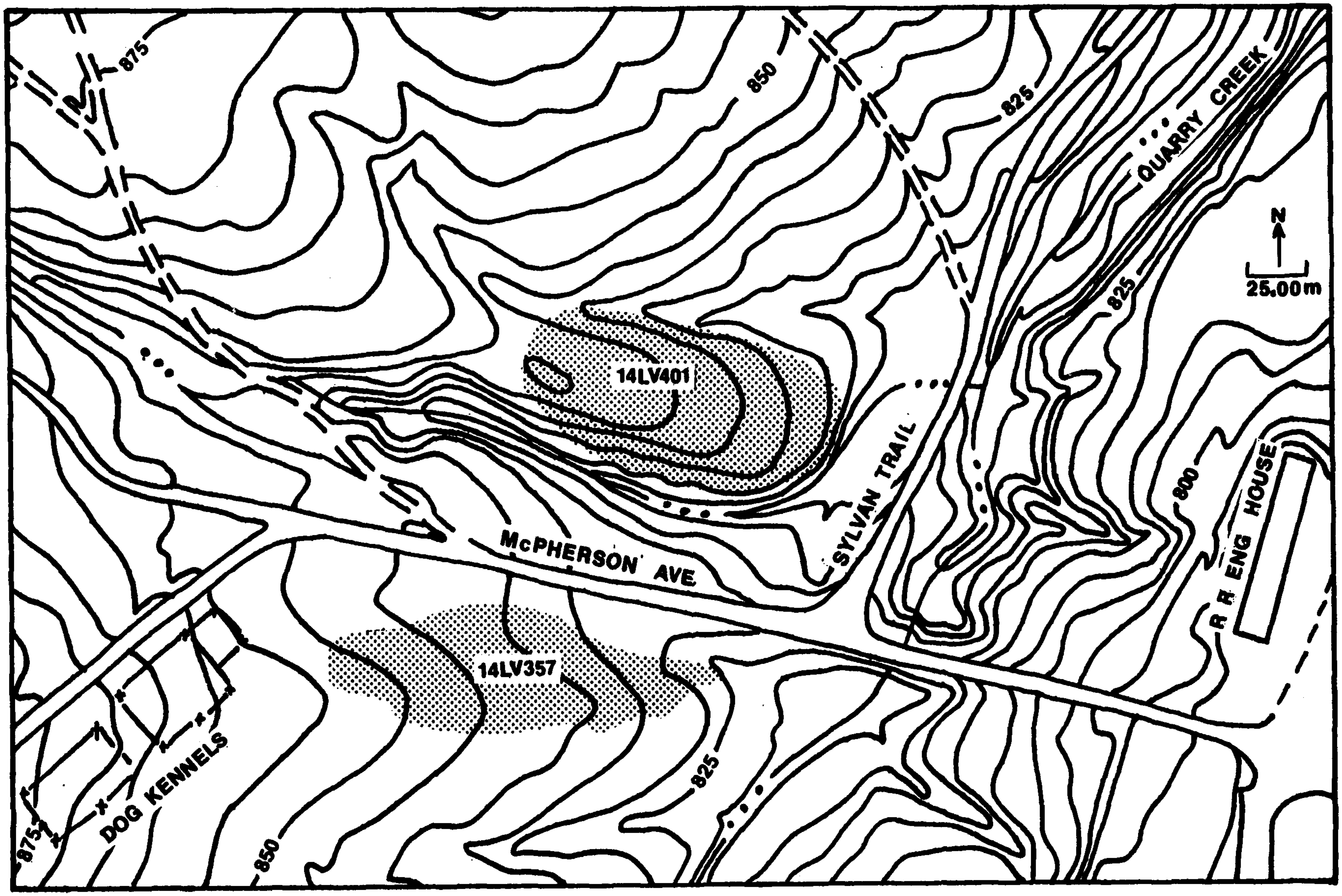


Figure 1.2 Quarry Creek-McPherson Site Area (elevation in five feet contour intervals).

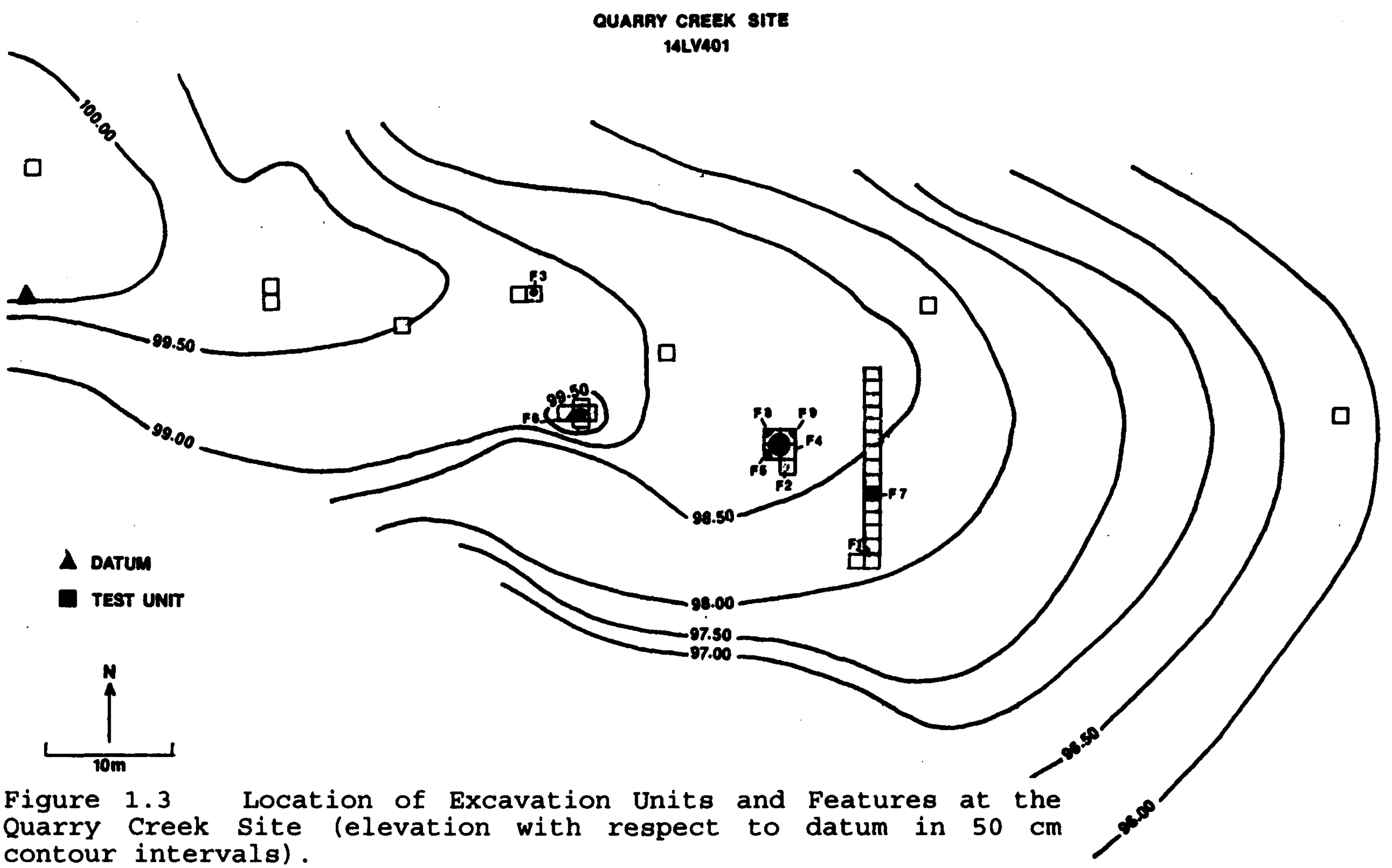


Figure 1.3 Location of Excavation Units and Features at the Quarry Creek Site (elevation with respect to datum in 50 cm contour intervals).

shown on page 161 of the reference is also in error. It should be a twenty meter scale, not ten.) It is possible that the two sites, recorded separately with unique site numbers, are one Hopewellian occupation that covered an area of about 40,000 m^2, which includes the as yet untested area between them along McPherson Avenue.

Both the Quarry Creek and McPherson sites have primary components of the Kansas City Hopewell culture (A.D. 1-750), a regional variant of the Middle Woodland period. The Quarry Creek site was first reported to professional archaeologists and recorded by Mr. Les Hixon, a local amateur archaeologist, for the Kansas State Historical Society in 1970. Hixon excavated an area three by five ft to a depth of nine inches and discovered lithic debris, ceramic sherds, some charcoal, bone, and "daub". According to the site form, and to a later report (see below), his excavation was on the northeastern periphery of the site at the edge of the wooded portion of the terrace some 30-50 ft west of Sylvan Trail. Hixon noted that one officer at the Fort had a small collection ("shoebox") of lithics and ceramics that had been given to him by "the son of [an] army officer who attended [the] 1969-1970 CGSC course". How extensively the site had been collected prior to Hixon's investigation is unknown.

In May 1972, Thomas Witty, Kansas State Archeologist, inspected the site area in response to a call from Fort personnel (Kansas State Historical Society 1972). Attempts to transplant trees from the eastern edge of the site had created about 20 holes ca. five to six ft^2 and one to 1.5 ft deep. These had revealed cultural material. Witty noted the area of Hixon's excavations "right at the edge or nose of the ridge", examined the profiles of some of the holes, and found cultural debris within a dark, humic horizon about 18 inches thick. On the basis of this examination, Witty nominated the site for inclusion on the National Register of Historic Places (Kansas State Historical Society 1973). In the spring of 1974, Witty submitted a cost estimate to the curator of the "Fort Leavenworth Museum" (now the Frontier Army Museum) for archaeological excavation of the site (Kansas State Historical Society 1974). No action was taken on this proposal.

An archaeological assessment of 5,000 acres of the military reservation was completed by Tom Barr and Don Rowlison of the Kansas State Historical Society in 1977. This project led to the discovery and recording of the McPherson site, one of only eight prehistoric sites recorded at that time (161 historic sites were recorded as a result of the project). No subsurface investigation of that site or the Quarry Creek site was attempted during this survey (Barr and Rowlison 1977).

From May 18-22, 1988, as part of a larger survey and testing project for the Fort and the Kansas City District, U.S. Army Corps of Engineers, American Resources Group, Carbondale, Illinois investigated the McPherson site in order to determine its National Register eligibility (Wagner et al 1989). The site limits were mapped and seven test units, each one m^2, were excavated. Lithic and ceramic artifacts indicative of a Kansas City Hopewell occupation, as well as a more transitory Plains Village/Protohistoric occupation, were recovered. Three features were recorded in these units, including a horizontally truncated cache pit, a concentration of over 30 pieces of burned limestone, and a cache of two unfinished celts. These excavations demonstrated the site area had been adversely affected by slope erosion aggravated by the overgrazing of horses corraled there. However, significant cultural deposits still existed within a thin (ca. five-ten cm) midden below the disturbed deposits and the presence of the cache pit pointed to the potential for other similar features. On the basis of these findings, the site was recommended for NRHP listing.

In the spring of 1989, in response to the discovery of evidence that the site was being vandalized and at the request of Fort personnel, Witty and Martin Stein, Archeologist, Historic Preservation Department, Kansas State Historical Society, visited the site (Kansas State Historical Society 1989a). Witty noted a pothole "somewhat larger than a square meter with irregular edges" with a small trench extending from it some 30 cm wide and of roughly equal depth. Artifacts were noted in the backdirt pile near the pit. The vandal's screen was nearby. This pothole and screen were still visible during our investigations (Fig. 1.4). The vandal's excavation eventually proved to be within 50 cm horizontally and about 20 cm vertically of Feature 6, one of the trash-filled storage pits discovered during the course of our work. Witty also noted four mounds along the terrace in the site area and speculated that these might be "house mounds". He suggested that the mounds and the intervening areas should be tested "to see if ... the thick cultural mix does show a differentiation of depth to demonstrate the actual presence of the mound or whether it is a natural indulation".

In response to evidence of vandalism at the site, Mr. Ramon Powers, Kansas State Historic Preservation Officer, contacted the Director of the Department of Engineering and Housing at Fort Leavenworth about protecting the site from further disturbance (Kansas State Historical Society 1989b). He suggested that trees, which had obviously provided the vandal[s] some camoflauge during their pothunting, be removed from the site and that it be replanted in native grass. Not only would this reduce the shielding vegetative cover, the grass would prove less disturbing to the cultural deposits than tree roots.

Figure 1.4 Above- View West Across Sylvan Trail of the Quarry Creek Site; Below- Vandals Pot Hole, Back-Dirt and Screen in Feature 6 Area.

On May 2, 1989 the site was visited again by Witty. He cored the area with an Oakfield sampling tool and traced the extent of the dark, humic cultural horizon. He suggested the site extended along the ridge for a distance of about 400 ft from the large bur oak mentioned above to the grassy slope east of the timber (Kansas State Historical Society 1989c).

In the winter of 1990, Stein contacted the author about the possibility of conducting archaeological investigations at the site sufficient to obtain information about the nature and extent of its cultural deposits. These investigations might also provide data which could be used to address significant research questions about the Kansas City Hopewell culture. Such information is now required for all sites listed on the National Register of Historic Places. I visited the site with Stein and Mr. Matt Nowak, Fort Leavenworth Forester, at that time and agreed to undertake such an investigation (Kansas State Historical Society, letter to Lt. Col. C.D. Knowlton from Mr. Ramon Powers and Mr. Richard Pankratz, Historic Preservation Department, February 13, 1990). A permit to conduct this work was requested in December 1990 and obtained the following spring from the Fort and Kansas City District Corps officials. The project was then scheduled for the summer of 1991.

The report is organized as follows: chapter two presents the environmental setting of the Quarry Creek locality; chapter three provides background information about the Kansas City Hopewell culture; chapter four presents the methods of field investigation; in chapter five, John Weymouth, University of Nebraska, Lincoln, describes and interprets a proton magnetometer survey of the site completed as part of our investigation; chapter six is a discussion of the excavation, including descriptions of the cultural deposits and their geomorphic context, and of nine features defined during our work. Chapter seven of the report presents analyses of the recovered assemblages, including ceramics, lithic debris, chipped stone tools, groundstone tools, exotic artifacts, and modified bone. Samples of the faunal and floral remains are described in chapter eight. Analyses of biological data are not comprehensive due to the limited funds for this aspect of the research project.

In chapter nine, the findings of the KAFS investigation are interpreted with respect to five broad problem domains: site structure and formation, environmental reconstruction, settlement-subsistence patterns, external relationships of the Kansas City Hopewell, and chronology. Specific research problems that can be addressed during future research at the site include: midden and site formation processes and post-depositional disturbances; geoarchaeology of the Quarry Creek drainage and of the site proper; identification of microhabitats at the Quarry Creek site through floral and faunal analyses; settlement-subsistence patterns, including determination of seasonality of site occupation, and interpretation of evidence for gardening; and chronological placement of Hopewellian activities in the Quarry Creek locality within the tripartite framework provided by Johnson (in press).

Management and preservation of the site are also presented in chapter nine. Requirements for site protection vis-a-vis vegetative cover and security are discussed. Recommendations for better definition of the extent and nature of Hopewell and other prehistoric activities in the Quarry Creek drainage area are also presented.

Chapter 2

THE ENVIRONMENTAL SETTING

Brad Logan

Introduction

The environmental setting of the Quarry Creek site, on both the regional and local scales, was richly varied with respect to a variety of resources essential to the Woodland adaptation of its Hopewellian occupants. Within the immediate vicinity of the site were sources of cherts and quartzites for chipped-stone and groundstone implements and limestone for hearths. A mosiac of grassland and woodland communities and their varied topographic contexts provided habitats for a diverse faunal assemblage. The background for interpreting the settlement-subsistence activities of the Quarry Creek site occupants is presented in this chapter.

Physiography

Quarry Creek is located in the glaciated region of northeastern Kansas, part of the Dissected Till Plains physiographic province of the Central Lowlands that includes adjacent portions of Nebraska, Iowa, and Missouri (Fenneman 1938; Schoewe 1949). The bedrock topography of this region is like that of the cuesta terrain of the Osage Plains south of the Kansas River. An example of that topography can be seen in the study area in the Oread escarpment between Lawrence and Tonganoxie (Schoewe 1949: 284). However, most of the bedrock topography in northeastern Kansas has been modified by Pleistocene glaciation.

During the Kansan and, perhaps, the Nebraskan episodes of the classic glacial chronology, portions of northeastern Kansas were covered with glacial ice. Drift deposited during those times now conceals much of the underlying cuesta topography. The topography of the glaciated region was also affected by subsequent glacial episodes. Wind-born silt (loess) from the outwash plains of Illinoian and Wisconsinan ice sheets, which never extended as far south as the earlier glacial masses, was deposited throughout the region. In extreme northeastern Kansas the loess mantle is thick enough (as much as 59 m but generally less than 8 m) to produce a distinctive topographic region (Caspall 1970:46), but the loess accumulation thins into a veneer over Kansan till south towards the Kansas River (Frye and Leonard 1952:208-210). Erosion of the loess-till deposits in northeastern Kansas has resulted in the undulating, hilly terrain of the uplands. In the study area, the land near divides is fairly smooth, with rounded hills and shallow swales. Near the main stream the land is broken and steeply dissected. Deepening of valleys has exposed Pennsylvanian bedrock. Elevation on the military reservation ranges from 740 ft at low water on the Missouri River to 1,083 ft on Government Hill (Brumwell 1941:3). The elevation of the sloped terrace on which the site is located is from 825 to 845 ft amsl (Fig. 1.2).

Structural Geology

A description of the exposed bedrock formations in the study area is necessary since local lithic materials, including limestone, sandstone, till, ferrous oxides (hematite and limonite), and, especially, chert, were utilized by the inhabitants of the Quarry Creek site. The site is in the Forest City Basin, a midcontinental structural feature that was a shallow sea during Upper Pennsylvanian time (Moore et al. 1944). This sea was subject to a series of transgressive and regressive episodes, or cyclothems, that resulted in the deposition of materials that appear today as alternating beds of limestones and shales. Groups of these alternating beds are assigned to two stages, Missourian and Virgilian, of the Upper Pennsylvanian Epoch. At least twelve of the separate limestone beds of these groups contain cherts (Reid 1979), the raw material most frequently utilized by the stone-age populations of the central Plains.

The bedrock formations in the Fort Leavenworth vicinity have been variously assigned by different researchers. Brumwell (1941:3) describes them, from the footslopes along the Missouri River westward, as the Weston shale, Lawrence shale and Oread limestone (Brumwell 1941:3). Only the last of these formations, which is part of the Shawnee group of the Virgilian Stage, includes chert-bearing limestones. These are the Toronto and Plattsmouth limestones, members separated by two shales (Snyderville and Heebner). Of the cherty limestones, Plattsmouth is richer in that regard and its cherts are more frequently described in the geological literature.

The Plattsmouth limestone, at five to ten meters, is the thickest and most extensive limestone member of the Oread formation. It outcrops from Osage County, Kansas to Cass County, Iowa in a rough arch along the northern and western margins of the Forest City Basin (Reid 1979:121). It is composed of light-gray to nearly white, wavy-bedded limestone that weathers to light gray or light tan. Plattsmouth cherts are light to dark gray in color and highly fossiliferous. Fossils include fusulinids, crinoids, brachiopods, mollusks, corals, and algae (O'Connor 1960:41). Morphology of the chert fragments is both tabular and nodular.

The Toronto limestone averages three meters in thickness. It is light yellow brown or light gray on breakage, but weathers to a deep yellow brown. It is massive in appearance but breaks into slabs and irregular fragments on weathering. Locally "flinty" limestone occurs in the upper part of the member (Moore et al. 1944:182). Fossils commonly include fusulinids and crinoids, with locally abundant bryzoans, horn corals, brachiopods, mollusks, and algae. This limestone is not as extensive as the Plattsmouth and does not occur in southern Douglas County. The upper part of the limestone includes nodules of chert that weather to a yellow-brown color (O'Connor 1960:38). The cherts range from fine-grained white to coarse-grained buff or tan, are generally homogeneous, and nearly fossil-free (Logan 1988).

During their survey of selected tracts of the Fort, personnel of the American Resources Groups, Ltd. collected samples of a gray, fossilerous chert that occurred as a blocky residuum on ridges and toeslopes within 500 to 1000 meters of the Quarry Creek site (Wagner et al. 1989:180). Given Brumwell's geological information, these could be examples of Plattsmouth chert. However, another geological study of the Pennsylvanian system of Kansas has assigned the formations in part of the Fort Leavenworth area to the Lansing group, the uppermost unit of the Missourian Stage formations in the area. This group underlies the Douglas group, a chert-free series of limestones, shales and sandstones, which is in turn stratigraphically lower than the Shawnee group.

The Lansing group includes one of four local chert-bearing limestones of the Missourian Stage. This limestone member, Spring Hill, contains cherts that are light to dark gray in color with abundant silicified fossils, especially fusulinids (Reid 1980a). As such, these cherts are difficult to distinguish macroscopically from those of the Plattsmouth limestone, which like the Spring Hill limestone, was deposited as a "far shore" sediment during the Pennsylvanian Epoch (Logan 1988). Given the problems inherent in identifying these cherts and the fact that the occupants of the Quarry Creek site could have obtained cherts from either limestone member within either the immediate area or a short distance of it, I have decided to refer to all gray, fossiliferous cherts from the site according to those characteristics, rather than in terms of their geological source (see chapter seven, lithic sections).

Chert-bearing members of other Missourian Stage formations occur a short distance south and southeast of Fort Leavenworth and in northwestern Missouri (Reid 1980a:130-131). These include, in ascending order, Winterset, Westerville, and Argentine limestones of the Kansas City group. Chert gravels of the Winterset limestone occur in bars in the lower Kansas River valley (Holien 1982) and artifacts of this distinctive chert have been identified, in low frequency, in the chipped-stone tool assemblage of the Quarry Creek site (see chapter seven). Winterset cherts are light to dark gray and are readily distinguished by abundant veins of white calcite. Westerville cherts range in color from light gray to pale brown and yellowish brown and fossil inclusions occur in low frequency. They are not unlike cherts of the Toronto limestone, but the appearance of layering in Westerville cherts is more frequent. However, given the difficulty in distinguishing the cherts from these two limestones, both of which were deposited as "near shore" sediments (Logan 1988), I have decided to refer to brown-buff cherts in the Quarry Creek lithic assemblage by their color rather than by their geological source. Argentine cherts are pale brown, dark reddish gray, or light gray in color and contain abundant silicified fossil crinoids (Reid 1980a).

Other sources of cherts occur in the vicinity of the Fort Leavenworth area in the form of extensive gravel mantles that cap the highest hills and ridges along the northern side of the Kansas River floodplain (Todd 1918:38; Honderich 1970). These high level chert gravels are believed to represent pre-Kansan, Tertiary drainage channels (Dufford 1958:19-20). Honderich (1970) examined one such source six km west of Linwood, Kansas. He describes the cherts in that deposit as "highly oxidized, uncemented, and [varying] in color from tan to dark brown ... subangular, tan to medium gray in internal color and dominantly tabular in shape"; most of these cherts had developed a "moderate to well developed brown alteration mantle which gives the faces a glossy appearance" (Honderich 1970:27-29). Other such high level chert deposits occur south and north of Atchison at a height of 24 m above the Missouri River floodplain (Todd 1918:38). It is possible that these high level chert sources were exploited by the prehistoric inhabitants of the study area.

Fluvial Geomorphology

Quarry Creek is tributary to the Missouri River, which courses south 30 degrees east with a gradient of 15 cm per km (0.8 ft per mile) (Brumwell 1941:4). The river along the northeastern Kansas border generally flows close to its western (right) bank. However, in the Quarry Creek locality it meanders eastward in a conspicuous loop 1.0 to 1.3 km (1.25 to 1.5 mi) wide (Fig. 1.1). The floodplain within this loop has been modified by the construction of Sherman Air Base on the floodplain and the rechanneling of Quarry Creek along the western bluffs. However, prior to this modification, the terrain was low and poorly drained. A map of Fort Leavenworth made about 1875 shows marshy terrain drained by distributaries of Quarry Creek (Hunt and Lorence 1937:126). The eastward meander in the Salt Creek-Quarry Creek area and the presence of Kickapoo Island just upstream from the confluence of the former with the Missouri River are also recorded on survey plat maps done by the Rev. Isaac McCoy and his son John C. McCoy in 1830 and 1854. The former was completed during the survey of the reservation for the Delaware, an eastern immigrant group. The latter survey was undertaken to officially register the boundaries of the Fort Leavenworth reservation (Hunt and Lorence 1937:85-87).

In the Kansas City area, the river has been described as a fast-flowing stream with a steep gradient, unstable bottom and highly sinuous course. Natural levees are poorly developed and discontinuous; channels are subject to abrupt changes with rarely straight reaches (Reid 1980b:32). Reid (1980b) has suggested these attributes prevented the development of riverine biomass sufficient for reliable subsistence by Hopewellians. However, the maps mentioned above demonstrate the general stability of the river meander in the Quarry Creek locality from ca. 1830 to the post-World War II river stabilization projects. If this recent history is a proper model for the prehistoric past, it suggests that the Missouri River may well have provided sufficient aquatic/flood-plain resources for the Hopewell. The resource potential of such a habitat is discussed in later sections of this chapter and its implications are explored in chapter nine.

Prior to dam and levee construction, the floodplain of the Missouri River was subject to severe floods. Even if these had not altered the course of the meander described above, such floods would have discouraged lowland settlement. Poor drainage and attendant infestation by mosquitoes would have had a similar effect on potential floodplain occupation. These factors may explain the location of the Quarry Creek site in an upland setting more than 30 m (100 ft) above the Missouri River valley.

Quarry Creek is a second order stream according to the Strahler method as shown on the 7.5 minute U.S.G.S. quadrangle. The site is situated at the confluence of two first order streams. The entire drainage is mapped as intermittant. The stream nearest the site is flowing in alluvium. At and beyond the confluence mentioned above, it flows on a bed of limestone. The channel is narrow. It was successfully bridged during our work by a few lashed trees less than four meters in length. At the time of our work, the stream was less than 50 cm deep.

The dissected ridge on which the site is located is an alluvial terrace subject to redeposition from loess upslope. The alluvial/colluvial nature of the terrace fill was briefly explored in our deepest (ca. 80 cm) test unit (99N/172E) by Prof. Curtis Sorenson, Department of Geography, University of Kansas. According to Sorenson (personal communication, June 25, 1991), the profile exhibited was that of a Judson soil, which occurs on nearly level surfaces of low terraces adjacent to uplands. The soil possessed a thick, cumulic A horizon (to 26 cm) of dark grayish brown, loose (granular) silt loam; a thick AB horizon (to ca. 55 cm) of lighter brown and more clay-enriched silt; and a Bt horizon some 70 cm thick (determined by coring with an Oakfield sampling tool), which was a brown to yellowish brown silty clay with block, subangular structure. A silty clay (loess) was discerned at a depth of 125 cm. The SCS has mapped the soil of the site area as Knox silty loam, which is characterized by a considerably thinner (ca. 15 cm) A horizon (Zavesky and Boatright

1977). This soil was discovered in cores extracted ten to 20 m west of the datum and immediately upslope from the site proper.

Climate

The climate of northeastern Kansas is continental and is characterized by large diurnal and annual variations in temperature. The climate of this region is described as moist subhumid (Thornthwaite 1941). Precipitation, which occurs most frequently during the period from April to September in the form of intermittant showers and convective thunderstorms, often exceeds evapotranspiration with the surplus either running off or soaking into the soil and replenishing ground water (Dickey et al. 1977:61; Corps of Engineers 1981:19). The clash of warm, moist air masses from the Gulf of Mexico and cold, dry, polar air sometimes results in high intensity, flood-producing storms (Soil Conservation Service 1959:2). Temperatures range from average lows of ca. 20 degrees F. and highs in the 40s during the winter months to lows of ca. 60 degrees F. and highs in the 90s during the summer months. Precipitation ranges from less than four inches throughout the winter to 12-15 inches during the spring, 12 inches during the summer, and less than six inches during the autumn (Zavesky and Boatright 1977:76). Table 2.1 provides data on total precipitation at six stations in or near the study area. The variations from one station to another during the year given (1978) illustrate the importance of local convectional storms in determining local moisture availability (Corps of Engineers 1981:21).

Table 2.1 Total Precipitation Recorded at Stations in Northeastern Kansas (1978).

Station	AT	EF	LV	OS	TO	VF	MEAN
January	0.40	0.54	0.32	0.23	0.35	0.41	0.38
February	1.13	1.55	0.98	1.46	0.87	1.32	1.22
March	1.93	2.29	1.42	2.31	1.98	1.75	1.95
April	5.72	4.31	6.14	3.93	4.33	4.90	4.89
May	4.32	3.73	5.04	3.07	3.33	3.25	3.79
June	3.63	3.59	1.99	5.05	2.22	4.29	3.46
July	3.38	3.57	5.18	4.74	3.11	4.13	4.02
August	4.70	2.90	3.33	4.59	2.15	5.22	3.82
Sept.	6.90	7.06	4.20	5.98	4.34	5.59	5.68
October	1.02	0.81	0.38	0.45	0.15	0.66	0.58
November	3.78	2.79	4.41	3.67	3.72	2.21	3.43
December	0.45	0.90	1.90	0.47	0.28	1.14	0.86
Annual	37.4	34.0	35.3	35.9	26.8	34.9	34.1

Modified from Corps of Engineers 1981:Table IX. AT= Atchison; EF= Effingham; LV= Leavenworth; OS=Oskaloosa; TO= Tonganoxie; VF= Valley Falls.

Artz (1983; Artz and Reid 1984) has suggested that convectional storms did not always dominate the precipitation pattern in the central Plains during the time of prehistoric occupation (cf. Knox 1983). Geomorphic evidence from the lower Walnut River valley in the Flint Hills of east-central Kansas and Cotton Creek valley on the border between the Flint Hills and Cherokee Prairie in northern Oklahoma demonstrates the prevalence of frontal storms from 4500 until 2000 BP in the former area and 1300 BP in the latter area. Similar shifts from frontal to convectional storm dominance may also have occurred in northeastern Kansas. The prevalence of either storm regime during the Hopewell occupation of the Quarry Creek locality and the implications thereof have yet to be determined.

Vegetation

On a regional scale, the Quarry Creek locality is within the northeastern oak-hickory forest defined by Kuchler (1974). This community consists of a medium tall, multilayered, broadleaf deciduous forest with the following dominant species: bitternut hickory (*Carya coriformis*); shagbark hickory (*Carya ovata*); white oak (*Quercus alba*); red oak (*Quercus borealis*); and black oak (*Quercus velutina*). Fortuitously, through its inclusion on the Fort Leavenworth reservation, much of the wooded land in the the Quarry Creek locality retains a native, presettlement character. Some of the wooded terrain on the reservation has been documented as remnant eastern upland forest (Dr. Craig Freeman, Biological Survey, University of Kansas, personal communication). It consists of old and second growth oak-hickory forest, particularly on moderate to steep east- northeast facing sides and upper slopes along the Missouri River bluffs. Canopy dominants of this forest include sugar maple, basswood, walnut, and red and black oak. The floodplain vegetation within the broad meander of the Missouri River at Quarry Creek not only includes a remnant of the floodplain oak-hickory forest now largely lost to Euroamerican clearing, but areas of the more typical floodplain softwoods (elm and cottonwood) and of floodplain savannah (sedge and willow) (Brumwell 1941).

The uplands of the reservation, as described by Brumwell (1941), include both grassland and woodland communities. These communities form an ecotone, the vegetation established in northeastern Kansas after the Altithermal (post-Pleistocene climatic maximum; Antevs 1955) about 5,000 years ago (Gruger 1973). This modern ecotone is transitional from the oak-hickory forest of eastern North America to the tallgrass prairie of the Interior Plains and forms one of the most "conspicuous and important" examples of the ecotone concept (King and Graham 1981:131). It extends some 1,920 kilometers from 30 degrees to 45 degrees N. Lat. and ranges from east to west in the case of some species, such as bur oak, as much as 1,600 kilometers wide.

Shelford (1963:306-307) estimates that within the region of at least 932,400 km^2 that contains interspersed climax forest and climax prairie, approximately four million hectares are covered by forest-edge vegetation. Prairie-forest ecotone occurs in limited areas of Minnesota, Michigan, Ohio, and Indiana and in more extensive areas of Iowa, Illinois, eastern Nebraska, eastern Kansas, northern Missouri, and eastern Oklahoma (Transeau 1935; Shelford 1963; Kuchler 1964).

The pre-settlement ecotone in northeastern Kansas was a mosaic of both prairie and woodland communities and, according to Kuchler (1974:588),

> the species of one type are not mixed with those of the other, and each of the two vegetation types involved retains its discrete character. The oak-hickory forest does not gradually open up into a savanna but keeps its identity; the bluestem prairie does likewise. Therefore, in eastern-most Kansas, forests with islands of prairie gradually change westward into a forest-prairie mosaic and finally into prairie with forest islands.

Table 2.2 is a list of the dominant species of the two plant communities that compose the ecotone in northeastern Kansas.

Table 2.2. Dominant Plant Species in NE Kansas Ecotone.

Common Name	Scientific Name
	Bluestem Prairie
Big Bluestem	*Andropogon gerardi*
Little Bluestem	*Andropogon scoparius*
Switchgrass	*Panicum virgatum*
Indian grass	*Sorghastrum nutans*
	Oak-Hickory Forest
Bitternut Hickory	*Carya cordiformis*
Shagbark Hickory	*Carya ovata*
White Oak	*Quercus alba*
Red Oak	*Quercus borealis* var. *maxima*
Black Oak	*Quercus velutina*

A prairie-woodland ecotone is a tension zone sensitive to climatic fluctuations. The relative distribution of its major components of a prairie-woodland ecotone is affected by changes in the amount of precipitation of significant duration. Shelford (1963:317) describes this dynamic process:

> Dry and rainy periods of longer or shorter duration have alternated over thousands of years. During long, wet periods, forests expand from groves and stream-skirting strips to take possession of prairie areas... During long, dry periods the process has been reversed. Grasses invade wooded areas and kill the shrubs and trees probably by monopolizing the water supply through a superior system of deep roots. Most of this competition between forest and prairie communities goes on in the shrubby edge that separates them.

It has been demonstrated that globally synchronous climatic shifts occurred throughout the Holocene (Bryson et al. 1970) and that these may have correlated with cultural adaptations in North America in general and the Great Plains in particular (Wendland and Bryson 1974; Lehmer 1970; Wedel 1970). Evidence of forest invasion onto prairie soils during the Neo-Boreal climatic episode (ca. A.D. 1550-1830) has been found in Platte and Boone counties, Missouri (Logan 1979; Howell and Kucera 1956; Reeder et al. 1983) and in Iowa (Dick-Peddie 1952; Loomis and McComb 1944). Given the evidence of past climatic fluctuations in the Midwest ecotone region, we can believe that similar periods of forest recession have occurred in the Leavenworth area in the past.

Testimony of the long history of the ecotone in the Fort Leavenworth area is found in the distribution of soils therein. Soils record in their profiles the kind of vegetation underwhich they developed. Within the immediate vicinity of the Quarry Creek site are Marshall-Sharpsburg soils, which developed under prairie vegetation, and Gosport-Sogn and Knox-Ladoga soils, which developed under either forest or a mixture of forest and prairie vegetation (Zavesky and Boatright 1977; Logan 1985:78).

A reliable analog of the ecotone that was home to the Hopewell of the Quarry Creek locality is provided by Brumwell's (1941:pocket insert) map of the woody plant associations of Fort Leavenworth. A copy of this map is presented here as Figure 2.1. The map can also be adopted as a representation of the Quarry Creek site catchment, or that area within which the site's occupants carried out most of their resource procurement activities. Indeed, site catchments are generally circumscribed over radii nearly twice that shown in Brumwell's map (cf. Roper 1979). Yet expansion of this figure is not required to increase the diversity of vegetational communities within easy reach of the Quarry Creek site occupants. The richness of the Fort Leavenworth ecotone during modern time is documented by Brumwell (1941), who lists 53 species of reeds, grasses and sedges; 79 species of trees, shrubs and vines; and 223 species of herbaceous plants. While some of these species are historical Old World invaders, the list reflects the diversity of plants that would have been available to the Kansas City Hopewell.

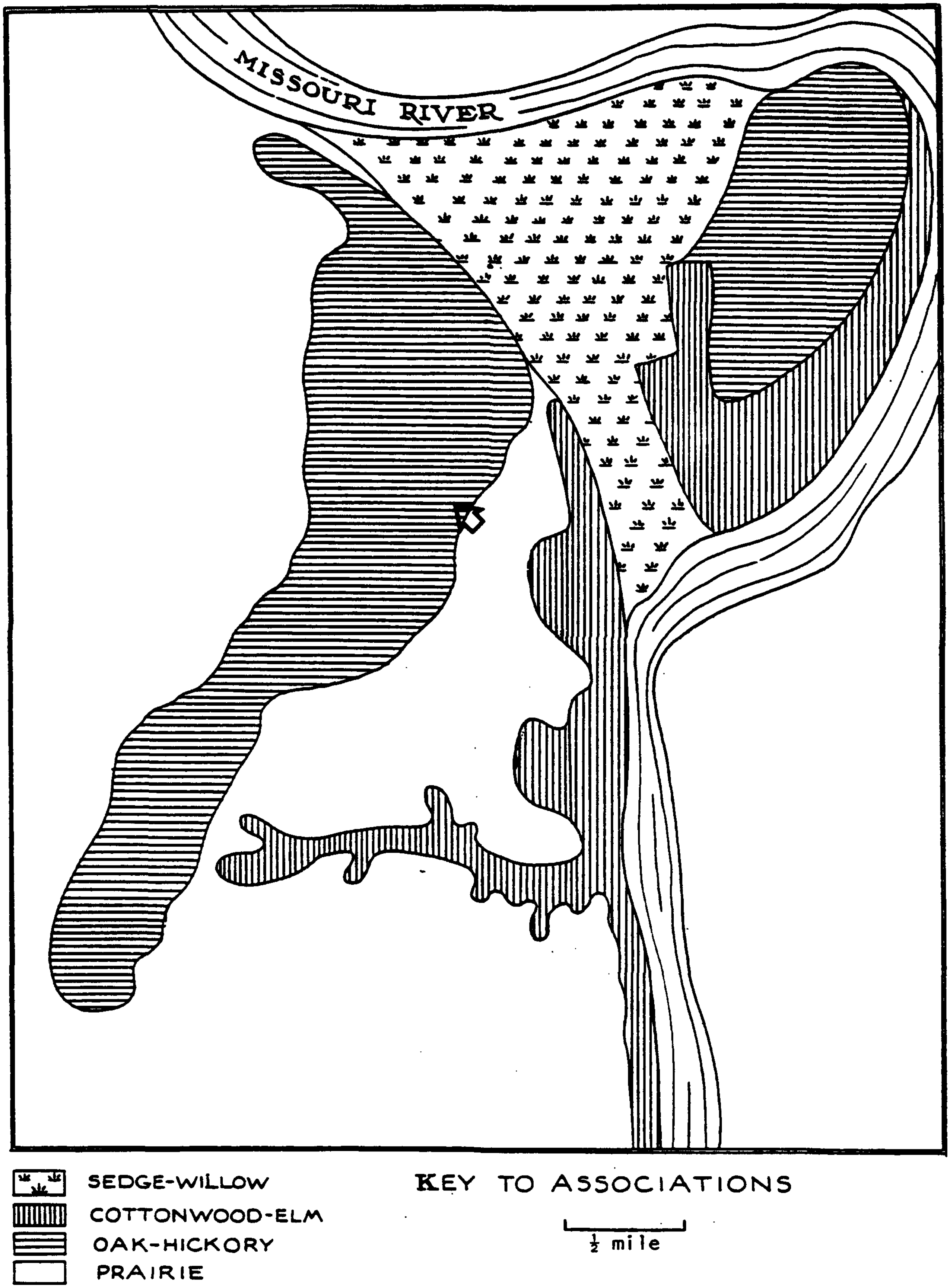


Figure 2.1 Vegetational Associations of the Quarry Creek Site Catchment. Site is at arrow tip. Modified from Brumwell 1941.

Fauna

The plant communities described above provided habitat for a wide array of animal species. Brumwell (1941) provides an inventory of the modern animals of Fort Leavenworth. He lists 12 species of amphibians, 36 species of reptiles, and 37 species of mammals in his inventory. The list, of course, does not include some species recorded in the region during the early historic period that have since been extirpated (e.g., bison, elk, grizzly and black bear, mountain lion, gray wolf, otter).

A more accurate reflection of the woodland-prairie-riverine environment of the Lower Missouri River valley in terms of its exploitation by the Kansas City Hopewell is provided by the faunal remains from excavated sites, including Renner, Young, Trowbridge, and Aker. Animals identified at these sites are presented in Table 2.3.

Table 2.3. Animals Identified in Faunal Assemblages from Kansas City Hopewell Sites.

Species	Common Name	Renner[1]	Young[2]	Trowbridge[3]	Aker[4]
MAMMALIA					
Bison bison	Bison	x	x		x
Cervus canadensis	Wapiti	x	x	x	x
Odocoileus virginianus	White-tailed deer	x	x	x	x
Procyon lotor	Raccoon	x	x	x	x
Castor canadensis	Beaver	x	x	x	x
Ursus americanus	Black bear	x			
Canis sp.	Wolf/coyote/dog	x	x	x	x
Vulpes fulva	Red fox	x			x
Urocyon cinereoargenteus	Gray fox			x	
Lynx rufus	Bobcat	x	x		x
Sciurus niger	Fox squirrel	x		x	

Table 2.3 (continued)

Species	Common Name	Renner	Young	Trowbridge	Aker
Sylvilagus floridanus	Cottontail		x	x	x
Mephitis mephitis	Striped skunk		x		x
Ondatra zibethicus	Muskrat				x
Marmota monax	Woodchuck		x		x
Geomys bursarius	Plains pocket gopher		x	x	
Scalopus aquaticus	Eastern mole		x		
Oryzomys palustris	Rice rat		x	x	
Neotoma floridana	Woodrat			x	
Perognathus hispidus	Pocket mouse			x	
AVES					
Meleagris gallopavo	Turkey	x	x	x	x
Tympanuchus cupido	Grouse			x	x
Branta canadensis	Canada goose	x			
Buteo jamaicensis	Red-tailed hawk	x			
Anas playyrhynchos	Mallard				x
Grus americana	Whooping crane				x

Table 2.3 (continued)

Species	Common Name	Renner	Young	Trowbridge	Aker
PISCES					
Lepisosteus osseus	Gar		x	x	x
Ictalurus punctatus	Channel catfish		x	x	x
Pylodictus olivaris	Flathead			x	x
Aplodinotus grunniens	Drum		x		
Ictiobus sp.	Buffalofish	x		x	
REPTILIA					
Trionyx sp.	Soft-shell turtle	x		x	
Graptemys sp.	Map turtle		x		x
Pseudemys sp.	Slider turtle	x			
Terrapene ornata	Box turtle		x		
Sternotherus odoratus	Musk turtle			x	
Crotalus sp.	Rattlesnake		x	x	
Colubrid	colubrid snake			x	
Thamnophis sp.	Garter snake		x		
AMPHIBIA					
Ambystoma sp.	Salamander		x		

1) Wedel 1943:27-28
2) Adair 1977:17
3) Johnson 1972:11-13
4) Brown n.d.

The number of species of some animals increases along a tallgrass-oak/hickory forest edge. Moreover, the population density of some animals also rises above that of adjacent communities (Odum 1971:157-159; Bee et al. 1981:9). This "edge effect" may have played an important role in the settlement and subsistence activities of prehistoric peoples who are known to have depended to a significant extent on such forest edge game as white-tailed deer. In the Lower Missouri River valley, this animal was consistently favored over such prairie game as elk and bison from at least the Late Archaic period (e.g., Adair 1977; Artz 1978; Johnson 1972; Wedel 1943:27, 72-73 and 1959:664). As noted in chapter eight of the report, the faunal remains from the Quarry Creek site are also dominated by deer.

The bias toward deer may have reflected the relatively low population density of bison in the tallgrass community of northeastern Kansas during the Late Holocene. Skeletal remains of Early Holocene bison are found much more frequently in alluvial deposits of the Kansas River than those of Late Holocene bison. This contrast may be attributable to the prairie expansion that occurred during the Altithermal (Rogers and Martin 1983). The low density of modern bison in northeastern Kansas is also reflected in the absence of any mention of bison in the region by early Euro-American explorers and settlers (Logan 1985).

The white-tailed deer population in northeastern Kansas is monitored and controlled today by the Kansas Wildlife Commission. Most of the study area falls within a section of the state that has a medium distribution and density of deer. Some areas of northeastern Kansas are known to support a high density and distribution of deer, according to the Kansas State Cooperative Extension Service (cited in Corps of Engineers 1981:77). The Missouri River in the Fort Leavenworth area supported a larger population of deer and other woodland edge game during pre-settlement time. Based on the accounts of Lewis and Clark, who reported seeing large numbers of deer on the prairie-forest edges along the river in the summer of 1804, Shelford (1963:314) suggests their population at that time may have been as high as 20 deer per km^2 of river-skirting forest. Climatic fluctuations, such as the Altithermal, that resulted in the expansion of prairie at the expense of woodland would have reduced the deer population and also affected its density and distribution. However, we can hypothesize that the density of deer in the Quarry Creek area during the Hopewell occupation, which occurred during the Atlantic climatic episode, was more like those of the Lewis and Clark era or the present time than that of the Altithermal.

Chapter 3

KANSAS CITY HOPEWELL
AN OVERVIEW

Brad Logan

Kansas City Hopewell is a regional variant of the Hopewell archaeological complex that extended throughout much of the eastern woodlands of North America during the Middle Woodland period (Griffin 1967; Fig. 3.1). Centered at the confluence of the Kansas and Missouri Rivers and located within a radius of 60 km of that point, it is the westernmost variant of the Hopewell complex. The distribution of major Kansas City Hopewell sites in the core area is shown in Figure 3.2. These sites fall into three categories recognized by Johnson (1979:87; in press): villages, such as Renner (14PL1), Trowbridge (14WY1) and Young (14PL4); camps, such as Deister (14PL2), Neiman (23PL51), Iatan (14PL53) and Kelley (14DP11); and burial mounds. Given Johnson's areal criteria, the Quarry Creek-McPherson locality is, at 4.0 ha, a village. If each of the sites were considered separately, however, their currently known extents would classify them as camps.

The relations of Kansas City Hopewell with contemporary Woodland cultures beyond the periphery of the core area are as yet poorly understood. Some evidence of Hopewell contact or influence has been documented at both habitation and burial sites as far west as the Manhattan, Kansas area (Schultz and Spaulding 1948; O'Brien et al. 1979). Reid (1976) has demonstrated, through analysis of exotic chert bladelets, that a trade relationship existed between the Kansas City Hopewell and Hopewell populations in the Big Bend area of central Missouri 160 km east of Kansas City. Johnson and Kay (1977) note the presence of Hopewell groups at the Fisher-Gabert site (14SA128), in this eastern area but suggest that sufficient differences exist to preclude its assignment to the Kansas City Hopewell variant. Fisher-Gabert may be evidence of a Hopewell complex ancestral to the Kansas City variant (Johnson 1976a). The northernmost Hopewell site along the Missouri River valley is the Kelley site, a habitation located on Squaw Creek in Doniphan County, Kansas (P. Katz 1969). The nature or extent of any relationship between the Cooper variant of northeastern Oklahoma (cf. Cuesta phase of southeastern Kansas; Marshall 1972, Brogan 1981), which has a strong Hopewellian cast (Johnson in press), and Kansas City Hopewell is as yet unknown.

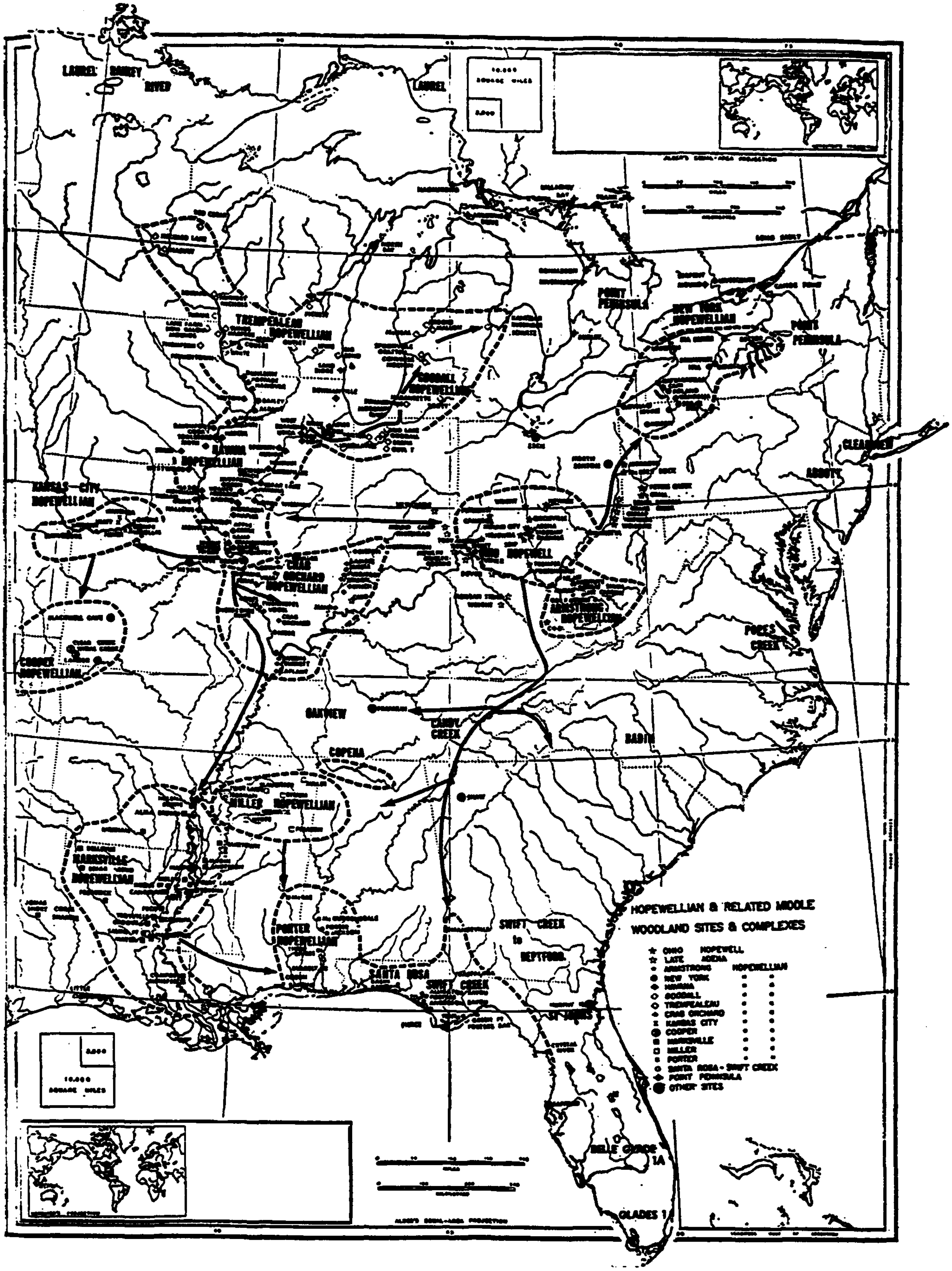


Figure 3.1 Location of Regional Variants and Major Sites of the Hopewell Culture in the Eastern United States. From Griffin 1967.

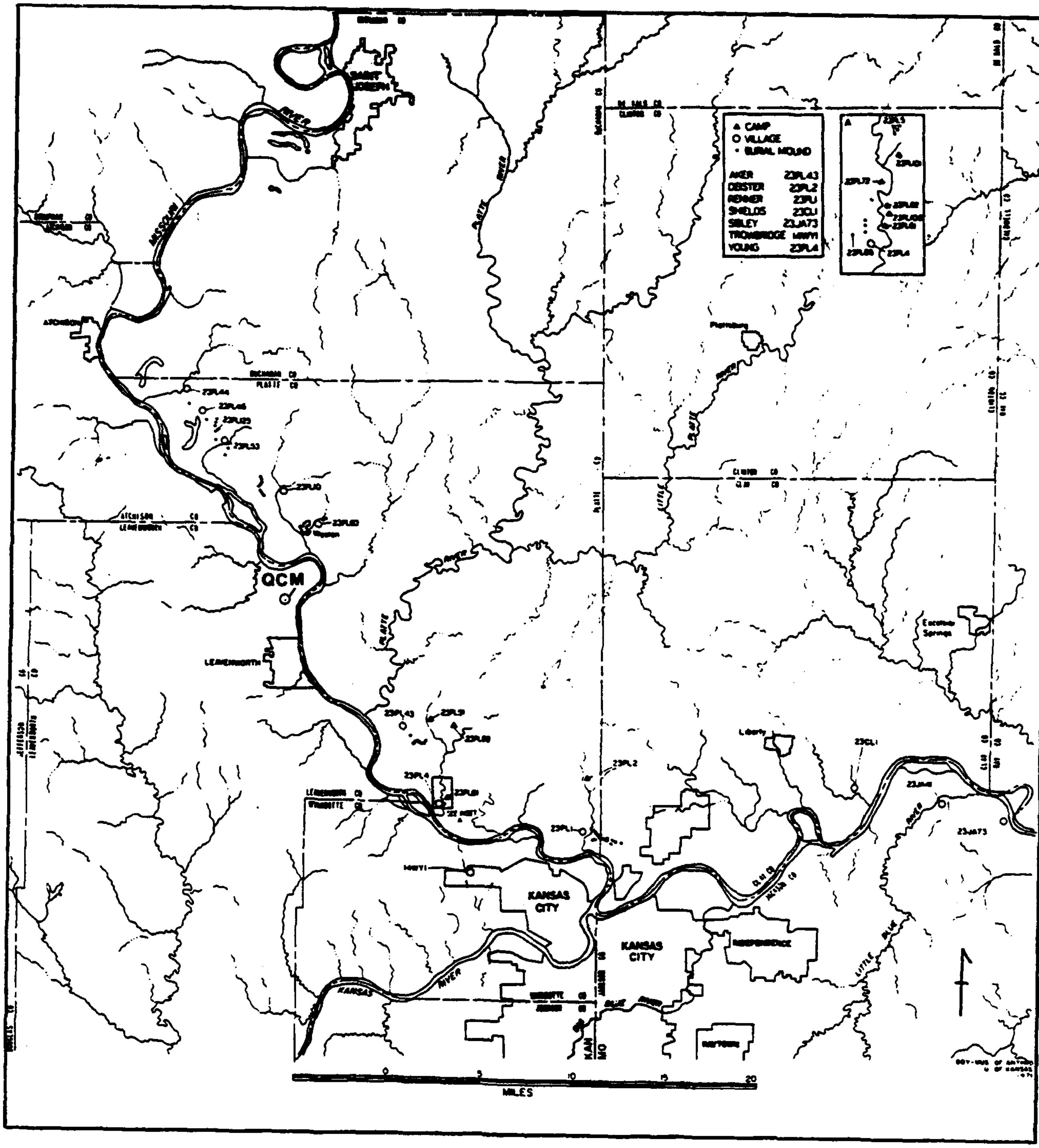


Figure 3.2 Location of Major Sites of the Kansas City Hopewell Variant, Including Quarry Creek-McPherson (QCM). Modified from Johnson 1976a.

Temporally, Kansas City Hopewell is divided into three phases on the basis of variations in ceramic and lithic artifacts (Johnson, in press). Radiocarbon dates, in conjunction with seriations of rim sherd designs and projectile point styles, have indicated that these phases span roughly equal periods. The Trowbridge phase (A.D. 1-250) is characterized by denatate-stamped and punch-and-boss decorations on vessel rims and broad-bladed (Snyders type) projectile points. The Kansas City phase is distinquished by incised cross-hatched lines and punctate motifs on rims and subtriangular, contracting-stemmed or corner-notched (Gary, Dickson, or Steuben types) projectile points. The Edwardsville phase is characterized by rim designs with little (e.g., punctates or lip crenations) or no decoration and the appearance of corner-notched arrow points (Scallorn type) in addition to the presence of medium-sized corner-notched projectile points (Johnson, in press).

In addition to changes in ceramic and lithic styles or technologies, changes in settlement-subsistence patterns characterize each phase. Evidence for maize horticulture is unknown in the Trowbridge phase and present, though of limited importance, in the Kansas City phase (Johnson 1979). Its importance to the subsistence economy of the Edwardsville phase Hopewell is believed to have increased (Johnson 1983). Settlement patterns developed from early camps scattered along riverine-tributary habitats to large, permanent villages associated with ancillary camps during the Trowbridge and Kansas City phases. The late Hopewell, or Edwardsville, phase saw a shift toward less nucleated settlements, perhaps in response to demographic pressures and/or resource depletion (Johnson 1976b). A process that entailed village/camp fissioning or "budding off" and the establishment of daughter sites in a northerly direction throughout the Kansas City Hopewell phases has also been posited (Johnson 1976b, 1979).

The origins of the Kansas City Hopewell variant are as yet poorly understood. There is some evidence of a preceeding Early Woodland (ca. 500 B.C.-A.D. 1) occupation of the Kansas City locality. Only in recent years have archaeologists discovered evidence of such occupation in northwestern Missouri paralleling that of the Morton complex of the lower Illinois River valley. In conjunction with the apparent relationship between the earlier Nebo Hill phase and its contemporary, the Titterington focus, of the lower Illinois valley (Reid 1980a) and that between the later Kansas City Hopewell culture and its contemporary Middle Woodland populations in the latter region, the evidence of an Early Woodland occupation suggests that there was a continuous exchange of ideas and culture traits between these regions from the Late Archaic through the Middle Woodland periods (Reid 1984:93-94).

What little is known about the Early Woodland occupation of the lower Missouri River region is based primarily on data from three sites in the Little Blue River valley. Wright (1980) has compared the ceramic and lithic artifacts from the Traff site (23JA36) to those of the Morton complex of western Illinois. Radiocarbon dates from the Traff site are 505±80 B.C. and 395±70 B.C. (UGa-2404, 2535; Wright 1980). Early Woodland occupation of the Little Blue valley is also indicated by ceramics from 23JA36 (Brown and Ziegler 1979:193). These consist of two rim sherds from the surface of the site that bear similarities to Morton complex ceramics. Although any temporal placement of surface finds is rightfully considered suspect, an Early Woodland occupation of the site is indicated by a radiocarbon date of 450±85 B.C. (UGa-1873) from a subsurface hearth (Ziegler 1985a:194). A radiocarbon date of 350±100 B.C. (UGa-2351) from a hearth excavated at 23JA40, in the Little Blue valley, also supports an Early Woodland occupation (Ziegler 1985b).

Recent excavations by the Kansas Archaeological Field School at 14JO46, a campsite on Cedar Creek, a tributary of the Kansas River in Johnson County, have yielded additional evidence of an Early Woodland period occupation. A radiocarbon date on a sample of burned wood from one of three distinct components at the site (the others date to the Plains Woodland and Plains Village periods) is 390±60 B.C. (Beta-38587; Logan and Hedden 1990). Though little cultural material, other than some debitage, burned earth and hearthstone debris, was associated with the burned wood on which this date was obtained, excavation of the Plains Village component of 14JO46 by the Iowa State University Field School in 1972 penetrated this lower component and yielded projectile points indicative of a Woodland occupation (John Reynolds, personal communication). More recently, Johnson (1992) has reviewed artifacts from 14BN26 in the light of the above information and suggested that there is sufficient evidence of an Early Woodland occupation of the Kansas City locality to recognize precursors (ancestors?) to the Hopewell in that area.

About 2,000 years ago, groups of hunter-gatherers, whose origin was the Illinois River valley, arrived in the present Kansas City locality. Although there is little evidence of this movement, it has been suggested that such a migration accounts for the appearance of a Hopewell manifestation in that locality that is comparable to the Middle Woodland, Havana Tradition (Bedford, Ogden and Utica phases) of the lower Illinois valley (Wedel 1943; Johnson, in press). Given the evidence of an Early Woodland occupation in the Kansas City locality, an <u>in situ</u> development of Woodland groups into Kansas City Hopewell under the influence of continued contact with groups in the lower Illinois valley must be considered a viable alternative to the migration hypothesis (Reid 1984). Future investigations must delimit the relationship between the Hopewell of the Kansas City locality and the indigenous Early Woodland population.

The Kansas City Hopewell differed in several dramatic respects from their Late Archaic and Early Woodland predecessors in the area. Apparently, the former were so proficient in exploiting the resources of the oak-hickory forest community that they were able to occupy village settlements on a permanent basis. These village sites are generally situated near the mouths of tributaries to the Missouri River. Smaller, short-term camps, probably ancillary to the village, are located in its vicinity (Johnson 1976b). These apparently functioned as resource procurement camps, strategically located satellites from which the Hopewell harvested wild plants, hunted forest and forest-edge game, and processed these foodstuffs for the occupants of the village. For example, the Neiman site in Brush Creek valley and Deister site in Line Creek valley are believed to have served this role for the inhabitants of the Young and Renner sites respectively (Johnson 1976b).

Long considered to have been hunter-gatherers little dependent on agriculture, the Hopewell of Eastern North America have recently been reviewed as the earliest farmers of that region (Smith 1992). Relying on the cultivation of small gardens of indigenous plants such as sunflower (Helianthus annuus), squash (Curcurbita pepo), goosefoot (Chenopodium berlandieri), and marshelder (Iva annua), the Hopewell in this scenario are believed to have thus supplemented their foraging of wild plant and animal foods without significant reliance on the tropical crops (e.g., corn [Zea maize] and beans [Paseolus vulgaris]) that were so important to later Mississippian cultures. To date, this revisionist perspective has yet to be applied to the Kansas City Hopewell (cf. Adair 1988). Systematically recovered flotation samples from the Quarry Creek site may provide the data essential for such interpretation (see Adair, chapter eight)

Artifacts diagnostic of Kansas City Hopewell include large, sack-like, stone (grit or sand) tempered ceramic jars. These vessels have a wide mouth and rounded, or sub-conical, base. Exterior surfaces are plain, and rims are decorated with a variety of designs including cross-hatched incisions, rocker-stamped marks, hemiconoid punctates, or lip notches (Wedel 1943; Chapman 1980). As noted above, these designs varied through time and have been seriated chronologically (Johnson and Johnson 1975). Hopewell ceramics thus provide a good means of both cultural and temporal identification in the lower Missouri region.

Distinctive lithic artifacts of the Kansas City Hopewell include broad-bladed, corner-notched dart points and sub-triangular, contracting-stemmed points. Similar forms occur in the Havana Tradition of the lower Illinois River valley and in that region provide another means of temporal control (Montet-White 1968). A similar seriation has been applied to projectile points from the Trowbridge site (Bell 1976). Other artifacts in the lithic assemblage include blocky end scrapers, drills, gouges, chipped-stone and groundstone celts and axes, and utilized bladelets driven from a prepared core (Wedel 1943; Chapman 1980; Reid 1976). Faunal remains, such as turkey bones and deer metapodials and antlers, were also modified for use as awls, punches, beamers, and flaking tools. External relationships, such as participation in the wide-spread Hopewell Interaction Sphere (Caldwell 1964; Struever 1964), were of marginal significance, as indicated by the fact that interaction sphere-like artifacts in the Kansas City locality were few in number and of local manufacture (Johnson 1979).

Sedentary occupation of Kansas City Hopewell sites is suggested by the presence of trash-filled storage pits and thick midden deposits. A well-developed ceramic technology is also indicative of increased sedentism. Another indication of either permanent occupation or continued reoccupation of villages is the occurrence of stone-lined, earth-covered burial mounds on bluff tops near some of the larger Hopewell settlements (Wedel 1943; Shippee 1967; Larsen and O'Brien 1973; Tjaden 1974).

The Kansas City Hopewell variant was first recognized as a focus, in the old Midwestern Taxonomic System, by Wedel (1938, 1939, 1940) after his direction of extensive excavations by the Smithsonian Institution at the Renner site and a series of burial mounds in 1937-1938 (Wedel 1943). These investigations were spurred by his correspondence with J. Mett Shippee, a noted avocational archaeologist and Kansas City resident. Shippee continued to explore this complex following Wedel's work. His interpretations of data collected at sites including Renner, Trowbridge, Deister, Shields (14CL1), and Aker (14PL43), among others, is presented in a monograph on the Woodland occupations of the Kansas City area (Shippee 1967). In addition to the work of Shippee and Wedel, investigations at the Renner site were undertaken by the Kansas City Archaeological Society (Roedl and Howard 1957) and, more recently, by its current owner, an avocational archaeologist and member of the Kansas City Archaeological Society (Brenner 1986, 1990).

The University of Kansas initiated what was to become a long term exploration of the Kansas City Hopewell complex when Robert Squier directed salvage excavations at the Trowbridge site during the fall semesters of 1963-1964 (Johnson 1976a). These excavations were done as a field course which was then taken over by Alfred E. Johnson from 1965-1966. Concurrent with Johnson's work, Ronald Manion, an amateur archaeologist, salvaged the contents of a number of trash-filled storage pits at the site. His collection was donated to the University of Kansas in 1972. At the time of the KU fieldwork, the Trowbridge site was endangered by expanding residential development. This development has subsequently destroyed much of this extensive village. A considerable amount of unpublished data concerning this site is also preserved in the Harry M. Trowbridge Collection at the Wyandotte County Museum. The Trowbridge site is comparable to the Quarry Creek-McPherson locality in that it too is located on the Kansas side of the Missouri River valley in an upland setting near an intermittant water supply. The loss of the Trowbridge site for further research enhances the value of the Quarry Creek-McPherson locality.

The University of Kansas continued its research into the Hopewell complex under Johnson's (1976a) direction from 1967-1976 at a number of sites in the Lower Missouri River valley. In 1967 and 1968 and under the auspices of a joint field school with Kansas State University, excavations were completed at the Kelley site (14DP11; P. Katz 1969). Field school investigations were conducted at the Deister site and Iatan sites in 1969 and again at Deister in the autumn of 1970 (S. Katz 1974). Deister, like the Quarry Creek and McPherson sites, is one of the few Hopewell sites in the Kansas City area that has been preserved for future research. It is protected by virtue of its inclusion in Line Creek Park, which is maintained by the Kansas City Park and Recreation Department. The summer field school of 1970 focused on the Fisher-Gabert site, mentioned above (Kay 1975; Robinson 1976; Reid 1976). Survey of Brush Creek valley, a tributary of the Missouri River in Platte County, Missouri, was carried out in 1971 in conjunction with a project funded by the Missouri Highway Department. Johnson (1974) describes the results of this survey, including the 13 Hopewell sites (eight habitations and five burial mounds) then recorded. Investigations in 1971 also included excavation of Cochran Mound (23PL86) and the Neiman site (23PL51), a Hopewell camp, in Brush Creek valley (Johnson 1976a). Results of work at the former site are in a report by Larsen and O'Brien (1973). Cogan Mounds, two additional burial sites of the Hopewell complex on a Missouri River blufftop, were also excavated in 1973 (Tjaden 1974). The Young site, a large village located at the mouth of Brush Creek, was investigated as part of that project in the same year and mitigation work was undertaken in 1973, 1974 and 1975. The results of this work are presented in a number of research reports, theses, and dissertations (i.e., Johnson 1976b; Brockington 1976, 1980; Adair 1977; Brown 1976; Zabel 1976).

Kansas City Hopewell sites have also been recorded in the Kansas River drainage, though in considerably lower numbers than the Lower Missouri River basin. The Wichman site (14DO1), was excavated by a field class from the University of Kansas in 1974. Results of this investigation are as yet unpublished. The Perry site (14JF301), an extensive site on a remnant of the Newman Terrace in the Kansas River valley near the town from which it takes its name, has been collected by parties from both KU and the Kansas State Historical Society. However, the only available studies concerning any of these collections is a research paper by Ritterbush and Kost (1983). Extensive, and unfortunately poorly controlled, excavations were undertaken at the Miller site, type site of the Edwardsville phase (Johnson 1983), by members of the Kansas City Archaeological Society from 1986 to 1992. These investigations were carried out while the site was being quarried for loess by its owners. Much of the terrace on which the site was located has now been destroyed by this activity.

Surveys in Stranger Creek basin, the last major tributary of the Kansas River, discovered only six Hopewell camp sites (Logan 1981, 1985). The low frequency and relatively small size of these sites, and their contrast to the greater number of Plains Woodland and Plains Village sites in that drainage suggest it was on the fringe of the Kansas City Hopewell core area. No identifiable Hopewell sites have been recorded, despite extensive surveys and excavations, in adjacent drainages such as Wolf Creek (Logan 1987b), the Delaware River (e.g., Schmits 1987; Logan 1990a), and the Wakarusa River (Chambers et al. 1977; Nathan 1980; Logan 1987a).

Chapter 4

ARCHAEOLOGICAL INVESTIGATION OF THE QUARRY CREEK SITE STRATEGY AND METHODS

Brad Logan

Introduction

At the time of the KAFS investigation, the Quarry Creek site was still concealed in woods (Fig. 1.4). Some thinning of the larger trees had been accomplished, under the direction of Mr. Matt Nowak, Fort Leavenworth Forester, by a local Boy Scout group. However, much undergrowth and several saplings remained. Therefore, prior to undertaking any survey or excavations, the site area was cleared of this vegetation by the crew and a bat-wing brush hog. Although this made the site more accessible, more easily gridded, and facilitated its excavation, ground cover still precluded surface survey. Without the ability to define artifact concentrations and their possible indication of activity areas or features, our placement of any excavation units would have been a hit-or-miss proposition. Given the relatively undisturbed nature of the site and its National Register status, such an approach was considered unwise. Consequently, we needed a remote sensing method to guide, at least in part, our unit placement. For this reason, the KAFS contracted with Professor John W. Weymouth, Department of Physics and Astronomy, University of Nebraska, Lincoln for a proton magnetometer survey of most of the suspected site area (i.e., that area defined by Witty). Weymouth is well known throughout the United States, indeed internationally, for the development and application of this method to archaeology (e.g., Weymouth 1986; Tarling 1990). His report of the survey is presented in chapter five.

Strategy: Unit Placement

Our placement of excavation units at the site was not determined solely by the findings of the magnetometer survey. In order to find the horizontal limits of the site, we dug test units and/or extracted soil probes with an Oakfield coring tool, in other areas as well. The units excavated by the KAFS are shown in Figure 1.3. Their reference point is a datum of white PVC tubing placed in the ground, at the western edge of the site, to a depth of about 70 cm and a comparable height. The datum coordinates were defined as 100N/100E, elevation 100 m.

No excavations were undertaken in the grassy area south of the stream that borders the site and north of McPherson Avenue. However, I suspect that area contains some evidence of occupation, if only because it is difficult to imagine how Hopewellians, who obviously occupied the Quarry Creek site proper and that portion of the McPherson site tested by American Resources Group, Ltd. for a considerable length of time, could have avoided the unexplored area in between. I also probed the ridge to the north of the ravine that borders the Quarry Creek site and failed to detect any evidence of human activity there.

Probes were extracted along an east-west transect beyond the large oak tree near our datum and they revealed a very shallow (less than ten cm) A horizon above a silty clay (loess-derived) B horizon. A probe at the datum revealed the A-B interface at a depth of 25-30 cm. Ten m west of the datum, the A horizon was only 15 cm thick and another ten m beyond that it was only ten cm thick. This suggests the area upslope, a Knox soil, has either been considerably more eroded than that east of the datum or that the thickness of the A horizon in the latter direction has been influenced (if not artificially thickened) by the prehistoric occupation. Excavation of a unit ten m north of the datum indicated cultural deposits there were very shallow and sparse.

Other units were dug without reference to magnetic anomalies. These include units 90N/205E and 99N/172E, which were dug in areas believed to be on the periphery of the site. The former was near the edge of the treeline where some years before, Mr. Les Hixon had dug a test pit. It yielded a considerably lower amount of cultural material than all but the westernmost unit and proved to be riddled with tree roots. This unit also was located within the much cratered portion of the site disturbed by the tree transplanting activities which led to its discovery in the early 1970s (see chapter one). Unit 99N/172 was located nearer the ravine than any other pit. However, it contained a considerable amount of material that extended to a depth of more than 60 cm, deeper than all other units at the site that were not above a pit feature. The cultural deposits in this area of the site probably extend to the edge of the ravine. It is even possible that the ravine itself might contain artifacts. One can imagine that such a surface feature might have been used as a natural trash area or "land-fill". Archaeologists may want to explore that possibility during any future work at the site.

Unit 97N/130E was located in an open area between two of the midden mounds. We believed that the best opportunity for finding traces of a Hopewell house structure would be in that area. Though the unit yielded a fair amount of cultural material, including several diagnostic ceramic and lithic artifacts, no structural features were found. However, the unit was too small to be considered sufficient for encountering such diffuse house remains as postmolds. This area should be explored more extensively during any future investigation.

A trench one meter wide and 15 meters long was excavated through the center of one of the better defined mounds. This trench extended from 79N to 93N at 168E of datum. Placement of the transect was not random. Magnetic anomalies (see following chapter) were detected at or very near its southern and northern ends. Feature 1 was found to correlate with the former anomaly (see chapter six). The purpose of this trench was to reveal the internal structure of the midden and to determine, through controlled excavation, if there was any significant variation in the horizontal or vertical distribution of its cultural deposits.

All other units were placed with respect to magnetic anomalies. The correlation of these units and anomalies is described in the following chapter. Some units failed to reveal any features, such as pits or hearths. Others encountered features that were probably recorded as anomalies. These units are briefly summarized below, from west to east across the site.

Units 99-100N/119E were dug to explore anomaly 20. No material that might have registered the anomaly was found. Units 100N/139-140E were excavated at anomaly 15. Feature 3 was found in this area. Though it may have registered the anomaly, it was of no archaeological value (see chapter six). Units 90N/143-144E and smaller units contiguous to the latter were dug to explore what proved to be a mistaken anomaly. Fortuitously, Feature 6, a trash-filled pit, was discovered there. Unit 95N/151E was dug to explore a strong, complex anomaly. The recovery of 585 gms of historic wire nails indicated this anomaly was of no prehistoric significance. Five contiguous units at 87-88N/160E and 86-88N/161E were opened to reveal a cluster of pit features (4, 5, 8 and 9) that correspond to anomaly 8. Feature 2, a concentration of relatively large body sherds, in levels 3-4 of 86N/161E, would not have registered as a magnetic anomaly. Finally, Feature 7 was encountered in unit 84N/168E of the exploratory trench. As Weymouth relates, this pit was too deeply buried to register a strong anomaly, though further post-excavation analysis of the magnetic data did reveal a weak signal that correlates with it.

Field Methods

The basic excavation unit was one meter square. Only in the case of the expansion of subunits contiguous to 90N/144E in order to reveal Feature 6 were smaller areas opened. The largest areas opened by contiguous units were the feature cluster (dubbed "Pit City" during its exploration) and the exploratory trench. All units were dug in ten cm levels and elevations of all four corners of each level were recorded with respect to datum. Level depths (i.e., 10 cm, 20 cm, 30 cm, etc.) were measured with respect to each unit's southwest corner.

Units were excavated by shovel skimming and troweling. Artifacts equal to or larger than "the size of a quarter" (ca. one inch or 2.5 cm) were piece plotted with respect to datum and assigned a unique field number (which later was replaced with a unique catalog number). All piece-plotted artifacts were also drawn on a unit plan view. Initially, these included all burned limestone. However, after two week's work, it became apparent that this material was ubiquitous and not worth the time invested in field numbering. Thus, no field numbers were assigned to limestone after June 17. However, we continued to plan-view this material in order document its density. Features were excavated with trowels and smaller tools. Pit features, with the exception of Feature 7, were excavated without horizontal control (beyond piece plotting of artifacts of the specified size). Feature 7 was excavated by ten cm levels.

All fill, other than flotation samples, was screened through 1/4" mesh hardware cloth and all cultural material was retained. Flotation samples consisting of a level 1/2 bushel of soil were collected from the southwestern quadrant of each level of all but the three partial units contiguous to 90N/144E beginning with level 2. Level 1 of all units was not sampled as it contained much recent woody detritus, seeds, animal casts, and recent humus. The few historic artifacts recovered generally came from the first level as well. All flotation samples were assigned a unique number. All fill from pit features was retained for flotation. Table 4.1 presents the totals of flotation samples for each level of the combined units and for all features. Feature totals do not necessarily equal the number of half-bushels since the final sample from each pit (or each level in Feature 7) did not always yield a full measure. Samples from the features may be taken as a <u>comparative</u> measure of their volumes, though not necessarily as an <u>accurate</u> measure of such since troweled fill in a flotation basket is not the same as fill that had been compressed within a pit for at least 1,500 years.

<u>Table 4.1. Number of Flotation Samples from Unit Levels/Features.</u>

	Unit Levels						Feature No.								
	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9
No. of Samples	32	32	32	25	8	1	1	3	1	70	5	49	50	3	5

Total Levels	Total Features
130	187

Grand Total = 317

Laboratory Methods

Some of the sorting and identifaction of artifacts and flotation of fill samples was conducted by the KAFS. However, the abundance of material recovered during the field school was too great to be processed (beyond the washing of artifacts) at that time. Two members of the field school were hired by the Department of Anthropology during August 1991 to complete flotation of all samples. The author directed a laboratory course (Anthro 401) at the University of Kansas during the spring semester of 1992 for the express purpose of completing the processing of all data and conducting preliminary analyses. Fifteen students, including four who had participated in the KAFS, completed this course. Final cataloging, checking of artifact identifications, sorting of all flotation heavy fractions and a sample of the light fractions, and curation of all materials was accomplished by volunteers and students hired by the Museum of Anthropology with support from a Legacy Resource Grant from the Department of Defense. Some of these students also conducted analyses of artifact assemblages.

The data from the Quarry Creek site also were selected by a number of undergraduate and graduate students at the University of Kansas for research in various courses. Two undergraduates, Mr. Shaun Bitikofer and Mr. Michael Haley, produced statistical analyses of the distribution of screened and piece plotted artifacts in the exploratory trench as part of a course in Archaeological Statistics directed by Dr. John Hoopes. Another undergraduate, Mr. John Romine, sorted selected light fractions of flotation samples and produced a brief descriptive analysis of them and heavy fractions from features as part of an independent research course under the author's direction. Mr. William E. Banks, M.A. graduate student in anthropology, identified a sample of the faunal remains from the site as part of a course in Mammalian Bone Identification directed by Prof. Larry Martin, Curator of Vertebrate Paleontology, Museum of Natural History at KU. Ms. Eva Cook, M.A. graduate student in anthropology, analyzed a sample of the ceramics as part of an independent research course under the author's direction. Some of the results of these research projects are included in this report.

Artifacts from the site were sorted according to categories that are defined in the appropriate sections of this report (e.g., chapter seven). A complete catalog with provenience (northing, easting, elevation, level), counts, weights, artifact category, field numbers, excavators and date of recovery, is on computer file at KUMA and a hard copy and disk will be submitted to the Kansas City District, U.S. Army Corps of Engineers. By agreement with the Frontier Army Museum, Fort Leavenworth, all prehistoric material will be curated at KUMA and all historic material will be curated by FAM. Artifacts at KUMA are stored in zip-lock bags with museum labels that provide the project name, provenience information, catalog number, counts and weights of artifacts, excavator initials, date of recovery, and description.

As previously mentioned, all flotation heavy fractions have been sorted. Categories recognized include the following: ceramics, lithics, burned bone, unburned bone, burned earth, charcoal, shell, limestone, sandstone, quartzite, mineral (e.g., ferrous oxide), and caliche. All samples were subjected to the following process: fractions that still contained large or numerous pieces of soil after water flotation were "melted" in a solution of water and sodium hexametaphosphate, which effectively removed all soil; samples were then dried and sifted through nested geological sieves of two mm, one mm, and 500 micron mesh; the latter portions were scanned for any seeds or microfaunal remains and stored in zip lock bags with provenience information; the two mm portions were picked for no more than one hour and sorted into the above categories; each category was weighed and stored in zip-lock bags with a label that provides all provenience information, weight sample number, etc.; the two mm sample that remained was also retained in a zip-lock bag. The weight of each category for all flotation heavy fractions is presented in Appendix 1.

Only 40 of the 317 light fractions have been sorted at this time. These samples were picked through for no more than 20 minutes and all burned plant material and gastropods were bagged. The residual material, less any obvious rootlets, was retained. Both light fractions and selected "charcoal" (carbonized plant material) samples from the heavy fractions were inspected by Dr. Mary Adair, KUMA. Her ethnobotanical analysis is presented in chapter eight of this report.

Charcoal samples from Features 4, 5, 6, and 7 were submitted to Beta Analytic Laboratory, Coral Gables, Florida for radiocarbon analysis. The laboratory dates and calibrations thereof are presented in Appendix 2 and discussed in chapter nine of the report. Calibrations are based on Stuiver and Pearson (1993) and were generated by the Calib (Rev 3.0.3) computer program by Stuiver and Reimer (1993).

Chapter 5

A MAGNETOMETER STUDY OF THE QUARRY CREEK SITE

John W. Weymouth

Introduction

The Kansas Archaeological Field School carried out an investigation of the Quarry Creek site in the summer of 1991. As part of the project, a magnetic survey of the site was done on June 4 and 5. The survey covered 1500 m^2 of the area. The site is on a remnant terrace that drops off south into one of the principal tributary streams of Quarry Creek and north into a ravine. The A and AB horizons were from 40 to 60 cm thick. Four low mounds, interpreted to be trash middens, were observed at the site. Three of these were tested. There were trees on the site, but the number was not great enough to cause much trouble in carrying out the magnetic survey.

Method

On June 4, two 20m by 20m blocks were surveyed and on June 5 an additional 1 3/4 blocks were covered for a total area of 1500 m^2. The layout of the blocks is shown in Figure 5.1. Excavation units are also outlined on this map for subsequent discussion.

All total field magnetic measurements were made with two Geometric G816 proton magnetometers, one operated as a reference and the other taking readings on grid points spaced a meter apart. The reference magnetometer was fired simultaneously with the moving magnetometer and the values were subsequently subtracted from the moving values to correct for the variations in time of the earth's magnetic field. During part of the survey days, the earth's magnetic field was "stormy" with sizeable variations in the background strength. The proper use of the reference readings removed possible problems that might have been caused by the stormy conditions. This is discussed in more detail in Appendix 3.

The magnetometers were operated with a sensitivity of 1/4 nT (nanotesla: a unit of magnetic anomaly magnitude, equivalent to one gamma). The sensor of the moving magnetometer was kept at 40 cm above the surface. All values were hand recorded (no memories in the magnetometers). The values were entered into a computer program and preliminary maps were produced at the end of each of day. Anomaly lists were provided soon after the survey. Subsequently, grey-scale and line-contour maps were produced. Also, because of the strong trend caused by the sharp drop-off to the stream on the south side of the site, it was necessary to filter out the long range trends of some of the maps.

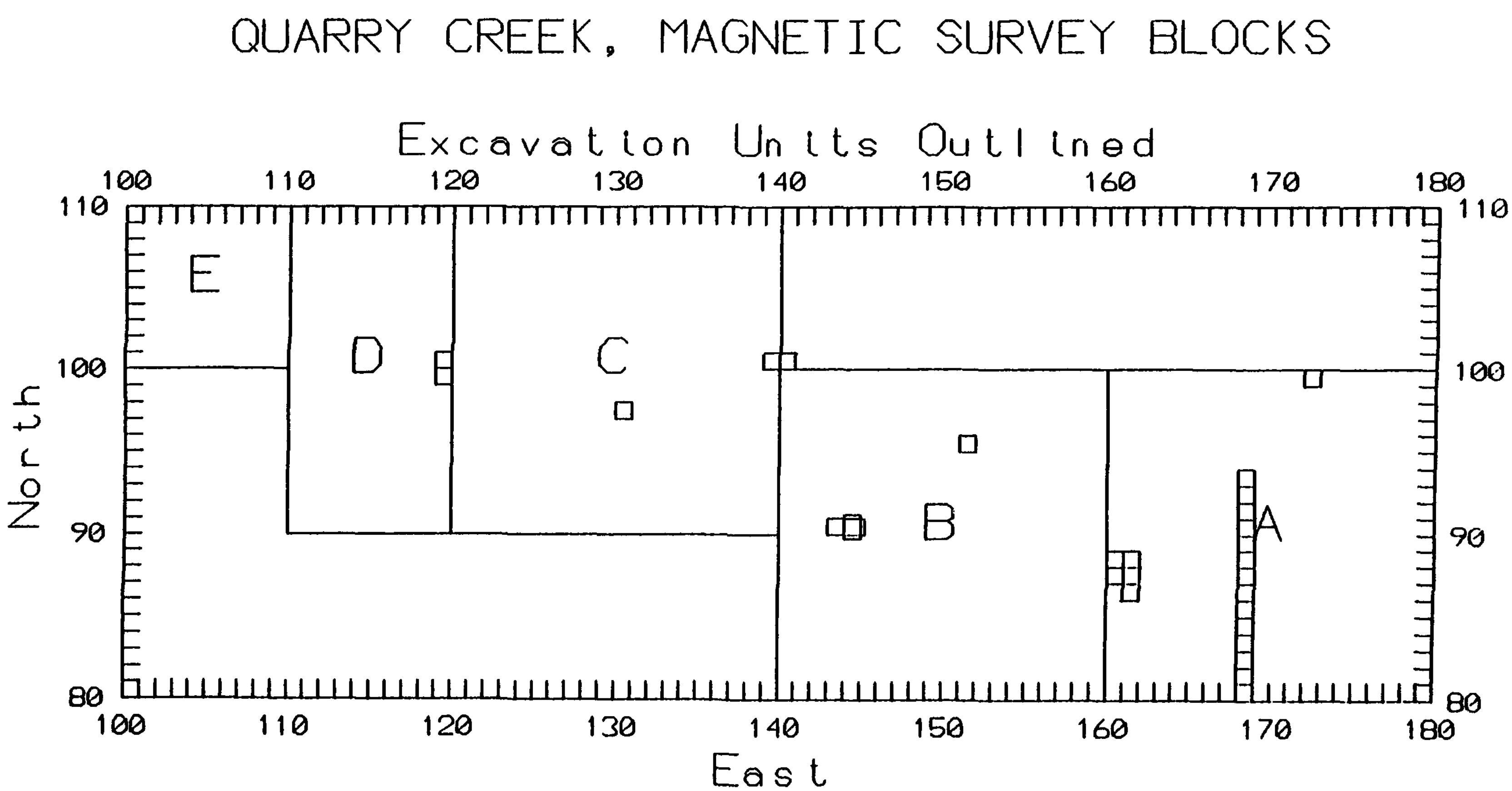


Figure 5.1 Magnetic Survey Blocks, Quarry Creek, With Excavation Units in Outline.

Results

Figure 5.2 is a grey-scale map of the original data and Figure 5.3 is a grey-scale map of the data after submitting it to a "high-pass" filter. This operation removes the longer range trends, leaving just the short range features. The contour intervals on these maps are narrow in the mid-values and broader at the extreme values in order to emphasize the small anomalies near the average background. The mid-range interval for Figure 5.2 is 4 nT (1/4 x 16) and the mid-range interval for Figure 5.3 is 2.5 nT. Figures 5.4 and 5.5 are maps of the same data done in line-contour mode with contour intervals of 10 nT and 5 nT respectively.

There are two obvious features on these maps. One is the distortion at the southern edge caused by the slope to the stream. This distortion of the magnetic field is so strong it is only partially removed by the filtering. The other feature is the strong collection of anomalies in the vicinity of unit 95N/ 153E. Testing demonstrated this was caused by a concentration of recent historic debris, including a large number of nails.

The anomalies of possible interest are indicated in the next two maps in which the survey region is divided into two parts. Figure 5.6 is a line-contour map of Blocks A and B with anomalies marked and numbered. Figure 5.7 is the same thing for Blocks C and D. Figure 5.8 and 5.9 are maps of the same regions as Figure 5.6 and 5.7 but filtered. Table 5.1 lists anomalies with comments and an indication of those most likely to be of archaeological significance. The table also indicates which anomalies were tested with comments on where archaeological features were observed.

Testing of Anomalies

As indicated in Table 5.1, six anomalies were tested with one or more excavation units. The main part of anomaly 5 turned out to be just south of Feature 7. This feature was a slightly bell shaped pit starting at about 55 cm below surface and ending at about 126 cm below surface (see chapter six). It contained sherds, lithics, bone, limestone and charcoal. This area was re-examined with trend removed and a narrow contour interval of 2.5 nT as shown in Figure 5.10. There is a slight inflection of the contour here. Another map was produced with filtered data and a very narrow interval of 0.5 nT, shown in Figure 5.11. It can be seen that there is an anomaly here, but it is too small to be visible in the larger maps. The fact that Feature 7 only appeared at 55 cm below surface may explain why the anomaly was so small.

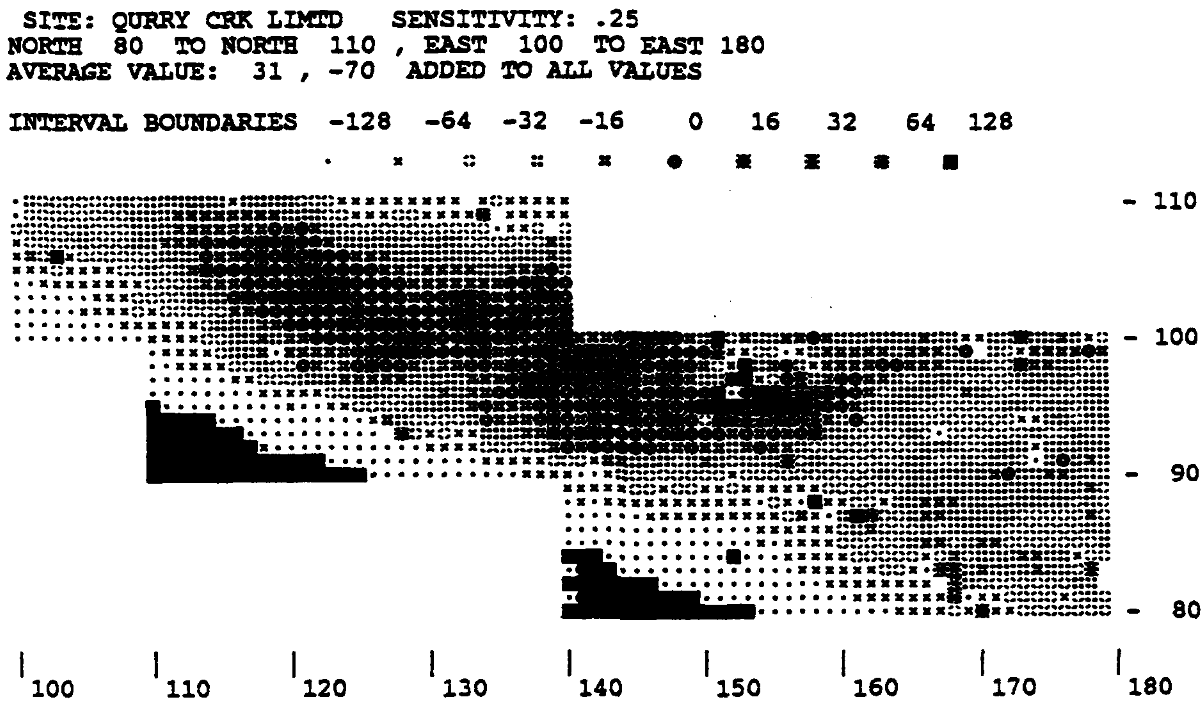


Figure 5.2 Grey-Scale Magnetic Map of All Blocks, Original Data, Contour Interval of 4 nT With No Interpolation Between Values.

SITE: QUAR LIM FILTRD   SENSITIVITY: .25
NORTH 80 TO NORTH 110 , EAST 100 TO EAST 180
AVERAGE VALUE: 0 , 0 ADDED TO ALL VALUES

INTERVAL BOUNDARIES   -80   -40   -20   -10   0   10   20   40   80

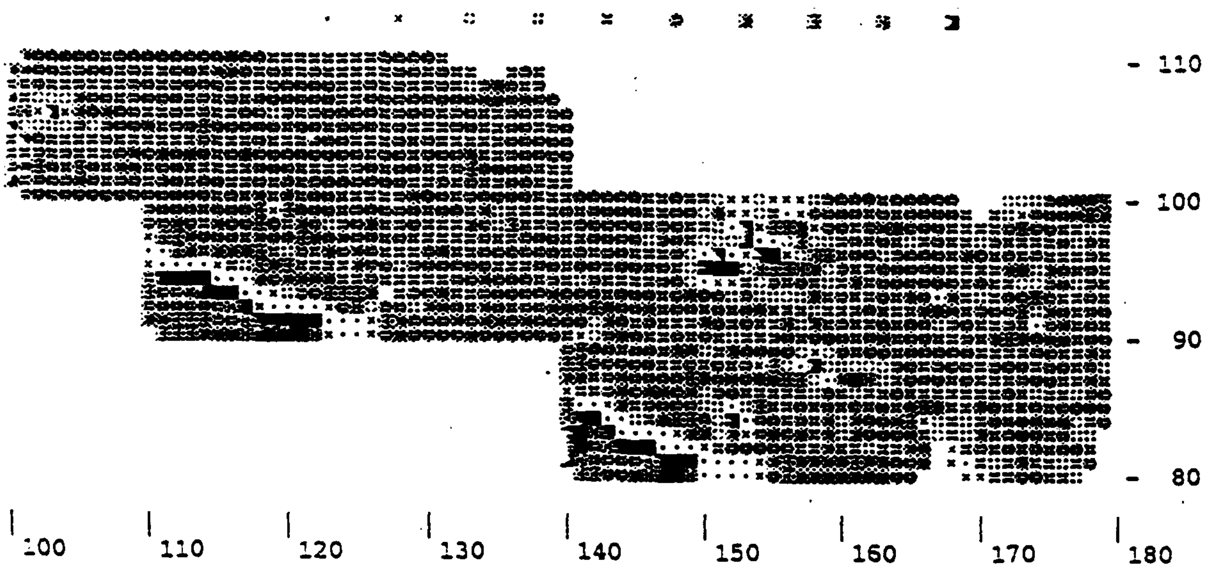


Figure 5.3   Grey-Scale Magnetic Map of All Blocks, High Pass Filtered Data, Contour Interval of 2.5 nT With No Interpolation Between Values.

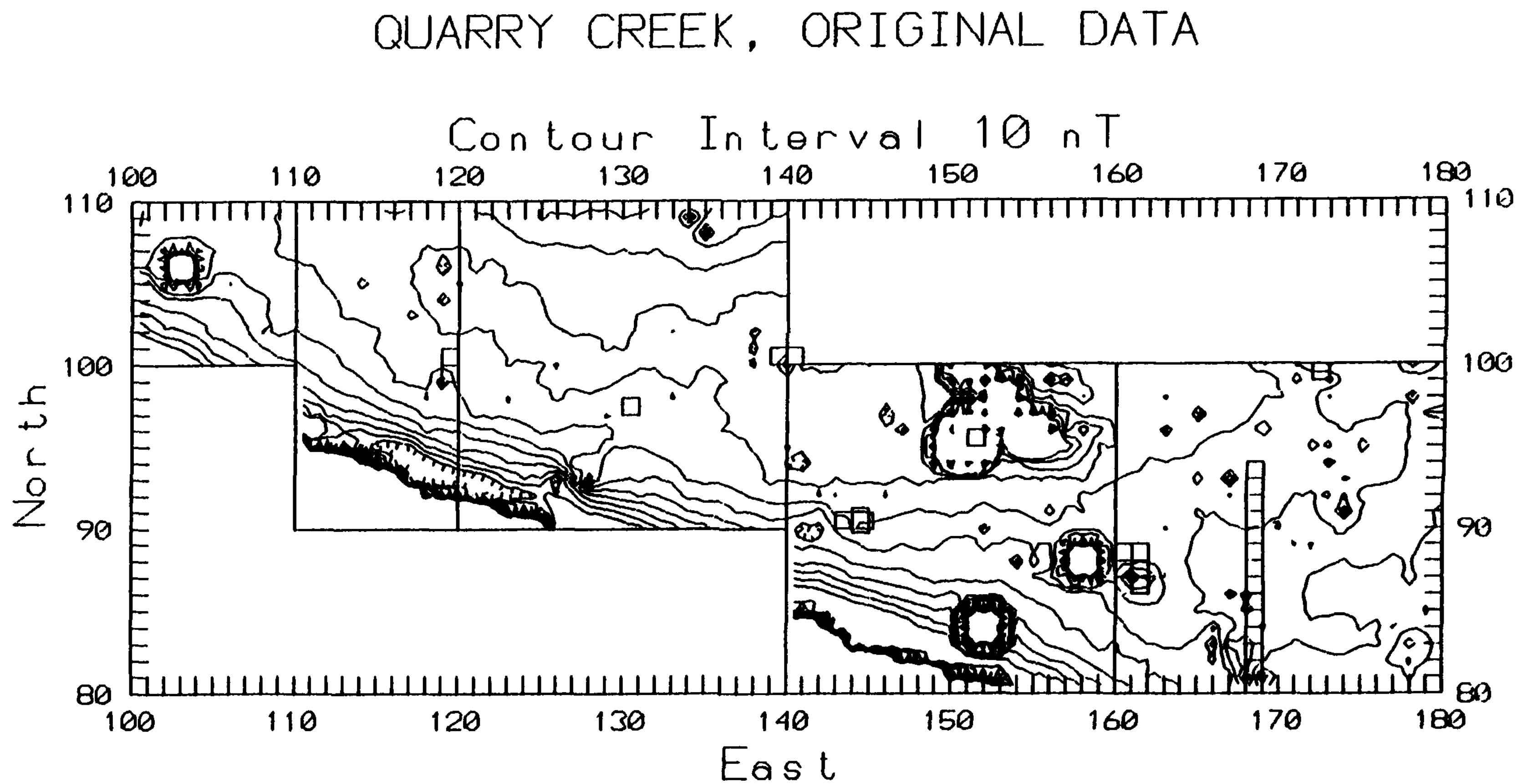


Figure 5.4 Magnetic Map of All Blocks, Original Data, Contour Interval of 10 nT.

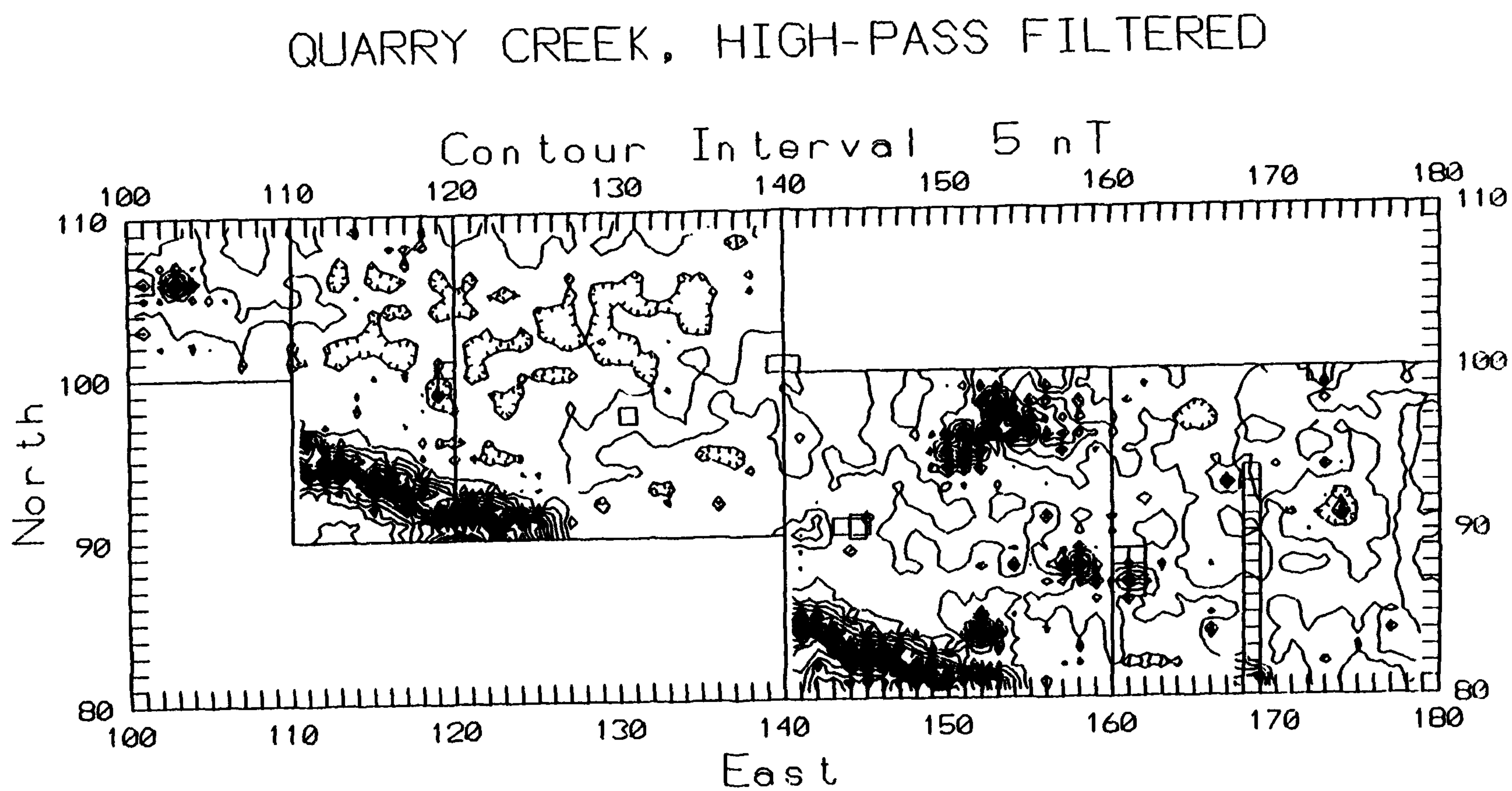


Figure 5.5 Magnetic Map of All Blocks, High-Pass Filtered Data, Contour Interval of 5 nT.

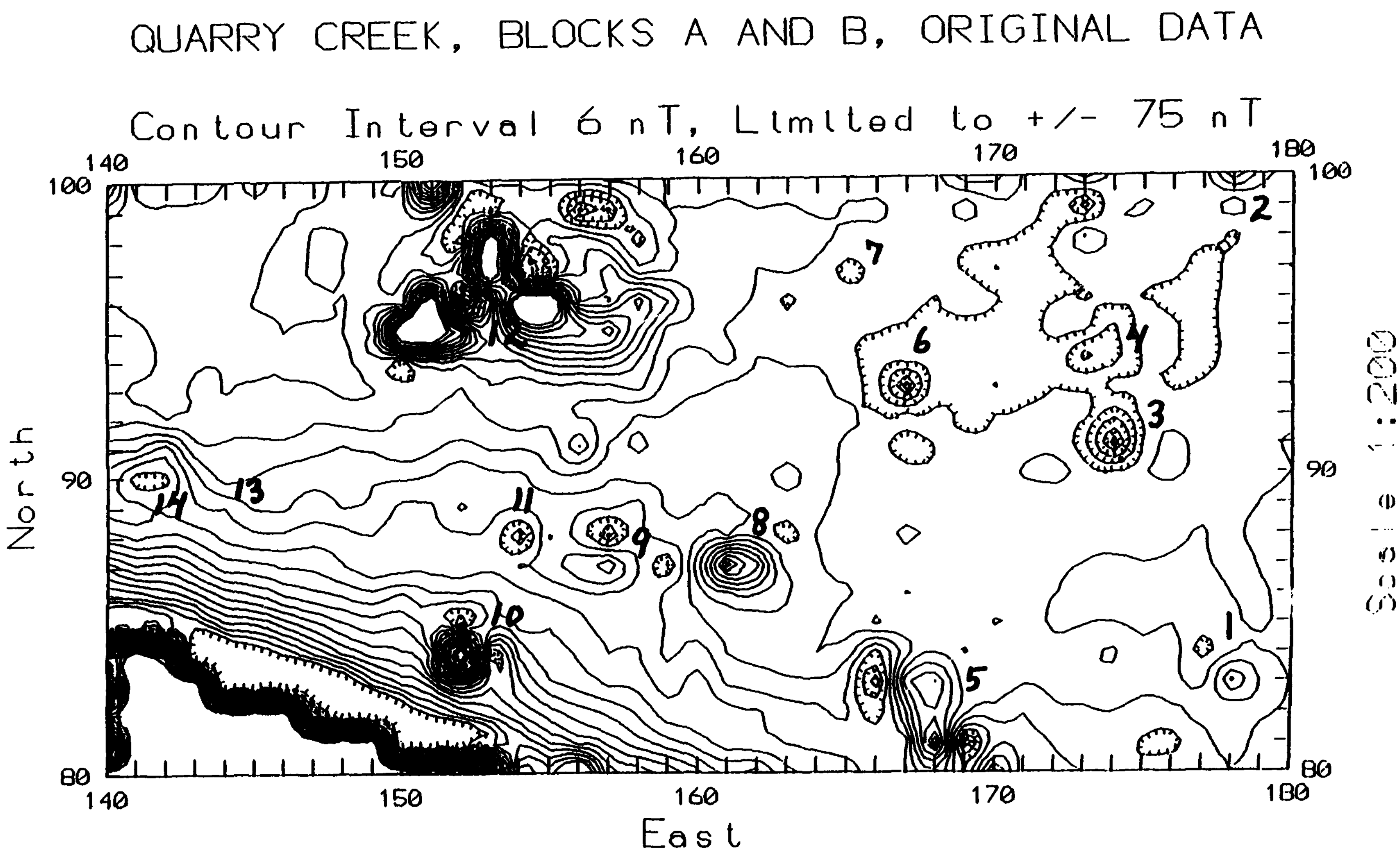


Figure 5.6 Magnetic Map of Blocks A and B, Original Data, With Anomalies Marked, Contour Interval of 6 nT, High and Low Values Cut Off at +/- 75 nT.

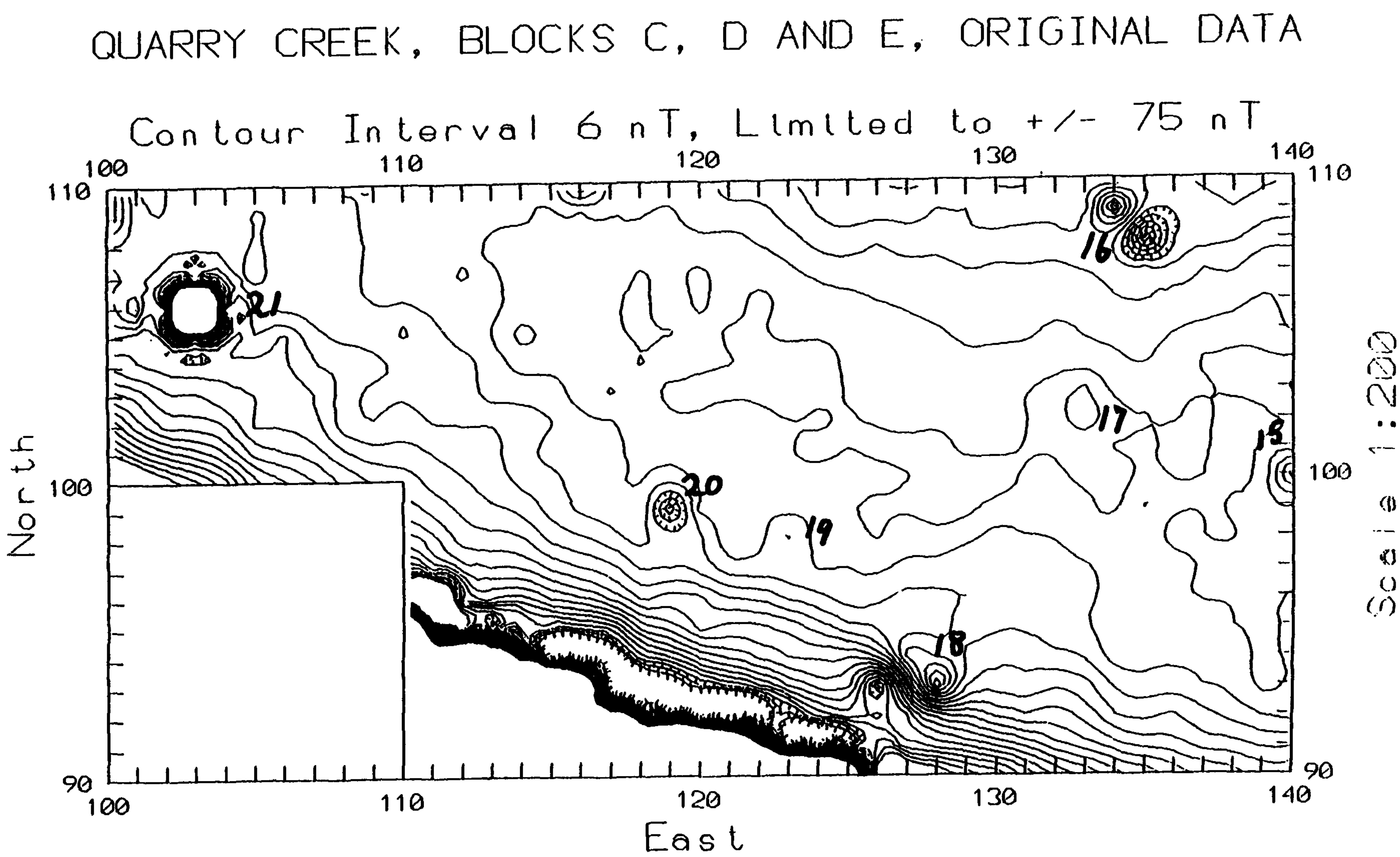


Figure 5.7 Magnetic Map of Blocks C, D, and E, Original Data, With Anomalies Marked, Contour Interval of 6 nT, High and Low Vlues Cut Off at +/- 75 nT.

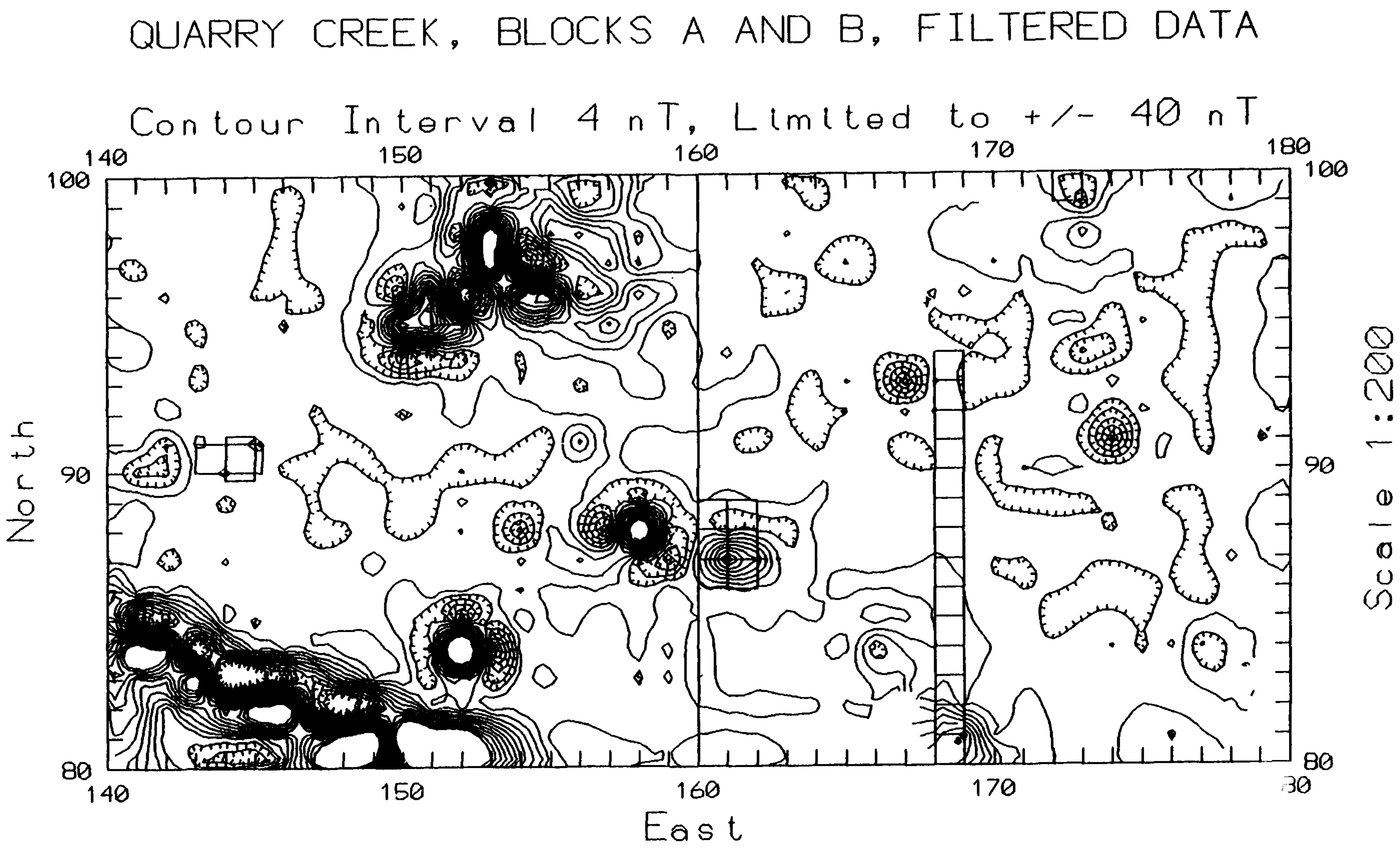


Figure 5.8 Magnetic Map of Blocks A and B, High-Pass Filtered Data, With Excavation Units Outlined, Contour Interval of 4 nT With High and Low Values Cut Off at +/- 40 nT.

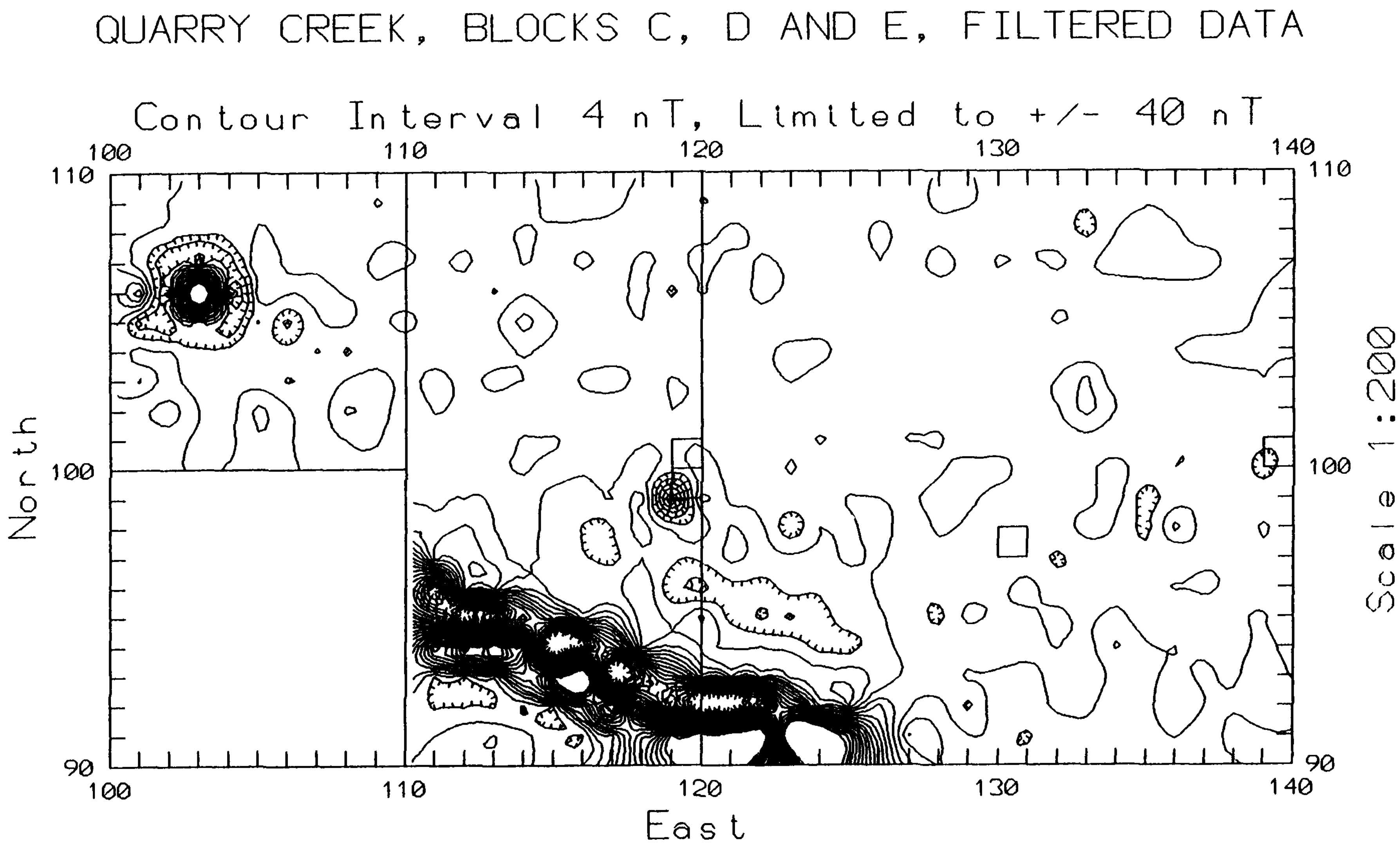


Figure 5.9 Magnetic Map of Blocks C, D, and E, High-Pass Filtered Data, With Excavation Units Outlined, Contour Interval of 4 nT, High and Low Values Limited to +/- 40 nT.

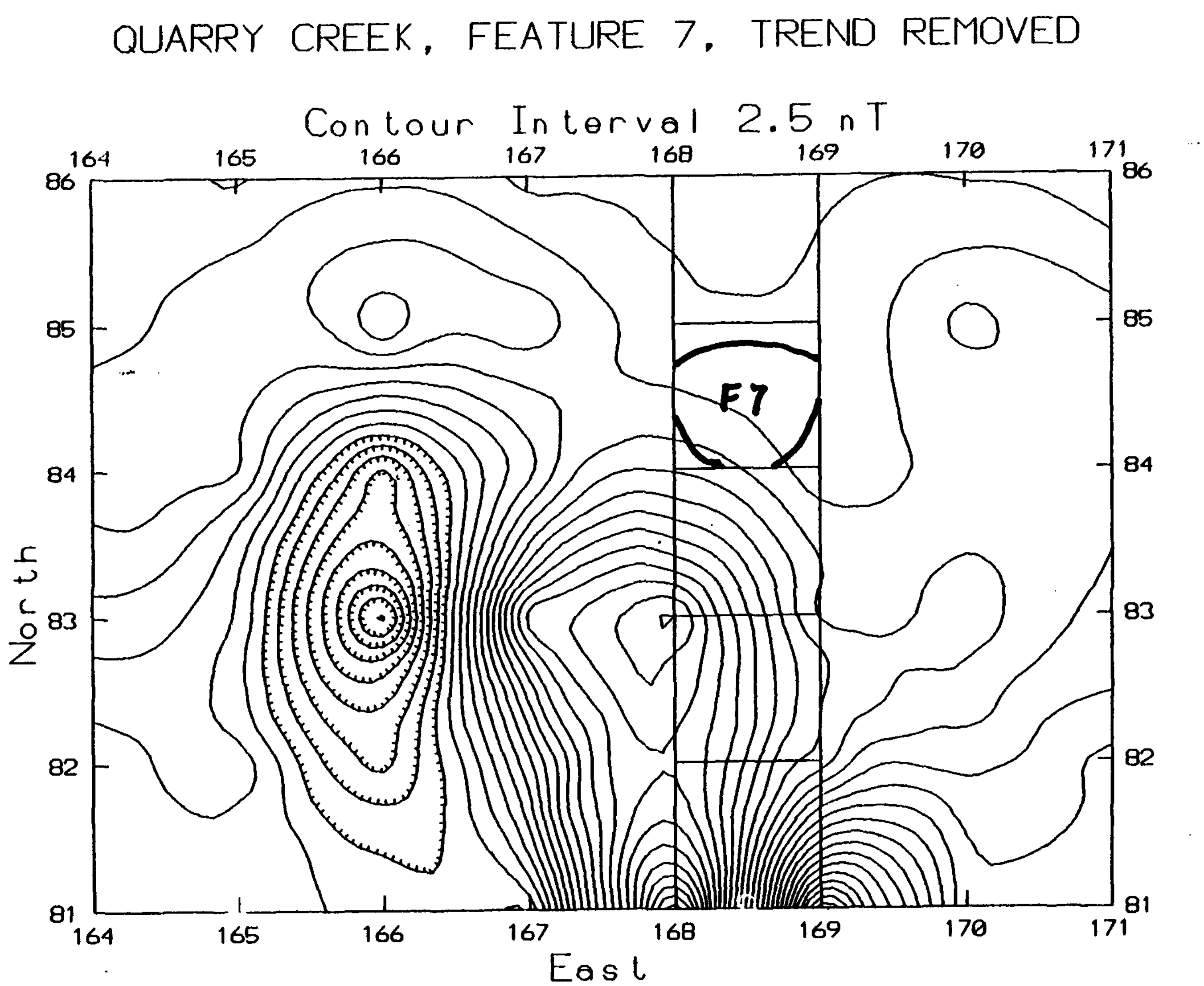


Figure 5.10 Magnetic Map of Region Around Feature 7 With Trend Removed, Contour Interval of 2.5 nT.

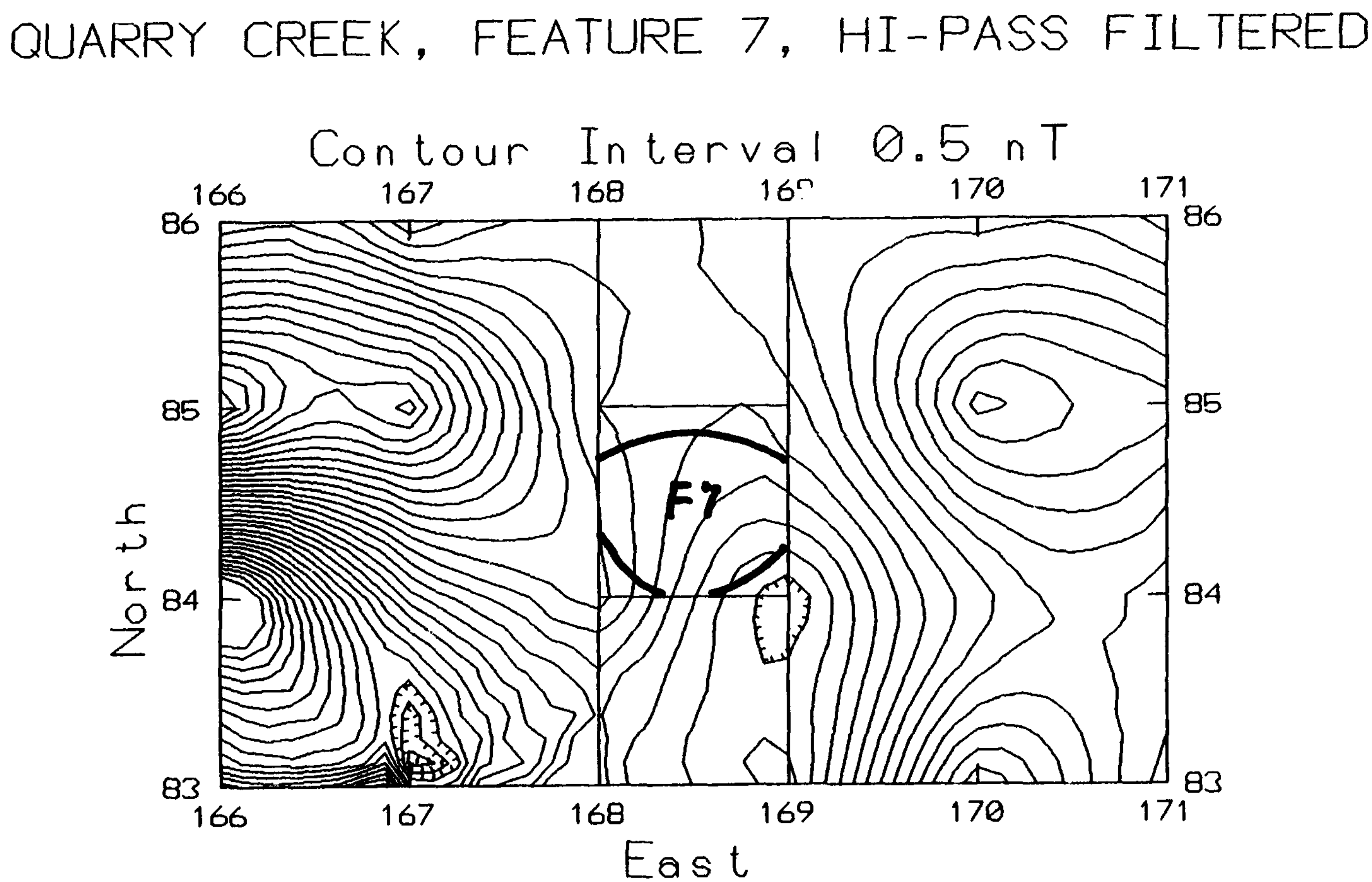


Figure 5.11 Magnetic Map of Region Around Feature 7 High-Pass Filtered, Contour Interval of 0.5 nT.

Table 5.1. Magnetic Anomalies at the Quarry Creek Site.

List of magnetic anomalies with comments and priority. Anomalies marked "*" most likely of archaeological signficance with priority number 1-highest to 3-lowest. T indicates tested anomaly.

Block	Anomaly	North	East	Comments
A	1	83	178	Small, metal?
	2	100	178	Negative, on edge of Block.
	3 *3	91	174	Negative, hole near.
	4	94	173	Negative, small, hole near.
	5 T	81-83	166-69	Complex, large, wire at 80N/169E, tree hole at 83-84N/165-67E. Note 1
	6 *3	93	167	Negative.
	7	97	165	Negative, weak.
	8 *1 T	87	161	Positive, on a least 6 points, maximum 50 nT. Note 2.
B	9	88	158	Strong, iron, maximum 660 nT.
	10	84	152	Iron near surface, maximum 1300 nT
	11	88	155	Small, iron?
	12 T	95-100	150-58	Large complex area, several pieces of iron, hole at 96N/154E.
	13 T	90	144	Positive, very weak. Note 3.
	14	90	141.5	Negative, potter's hole.
C	15 *3 T	100	140	Positive, on NW corner of Block B Note 4.
	16	108	135	Non-normal dipole, iron near surface.
	17 *2	102	133	Positive, broad, on 6 points, 10 nT.
	18	93	128	Positive, on sloping field.
	19 *3	97	123	Negative, weak.
D	20 *3 T	99	119	Negative. Note 5.
E	21	106	103	Spurious?

Note 1: Feature 1 here; Feature 7 just north of this anomaly.
Note 2: Features 2, 4, 5, 8, and 9 here.
Note 3: Feature 6 here.
Note 4: Feature 3 here at 37 cm to 50 cm b.s., probably natural.
Note 5: Historic brick at 10-20 cm b.s.

Anomaly 8 was the most straightforward archaeological anomaly on the site. It was on top of a cluster of five features, four of which were trash-filled storage pits. Figure 5.12 is a map of this area with trend removed and a contour interval of 5 nT. The central feature, number 4, was a pit starting at about 55 cm and ending at 112 cm b.s. and over 1.5 m in diameter. Besides limestone, sherds, bone, and lithics it contained hematite and a minature copper "celt".

Anomaly 13 was originally identified because of two errors in data entry which produced a false negative anomaly. After correction the anomaly pretty much disappeared, although leaving a very slight positive point. But excavation at that location before the data were corrected revealed Feature 6, an oval shaped pit 110 cm deep starting at about 50 cm b.s. and 170 cm at is widest. It contained ceramics, lithics, burned and unburned bone, limestone and charcoal. A re-examination of the data, with trend removed, revealed an anomaly at Feature 6 as shown in Figure 5.13, with a contour interval of 1.5 nT.

Anomalies 15 and 20 did not seem to be associated with anything of much archaeological signficance.

Soil Magnetic Susceptibilities

Soil samples were obtained from all six pit features. The magnetic susceptibilities of these samples were measured and are listed in Table 5.2. Figure 5.14 is a graphical presentation of these results. In general, these values represent moderately strong values typical of black top soils. Such soils in pits that penetrate the B horizon and lower horizons can give observable magnetic anomalies.

Table 5.2. Magnetic Susceptibilities of Feature Soils.

Magnetic susceptibilities were measured at a frequency of 1 Kz and are in units of 10^-6 emu/gm.

Feature	Sample #	North	East	Depth	Value	Stan Dev
4	116	88	160	57 cm	160.5	+/- 1.8
5	266	87	160	60 cm	148.1	+/- 4.3
6	145	90	143-4	65-70cm	160.5	+/- 7.2
7	135	84	168	65-75cm	144.9	+/- 7.2
8	265	88	160	70 cm	118.7	+/- 12.5
9	260	88	161	55-60cm	141.8	+/- 4.1

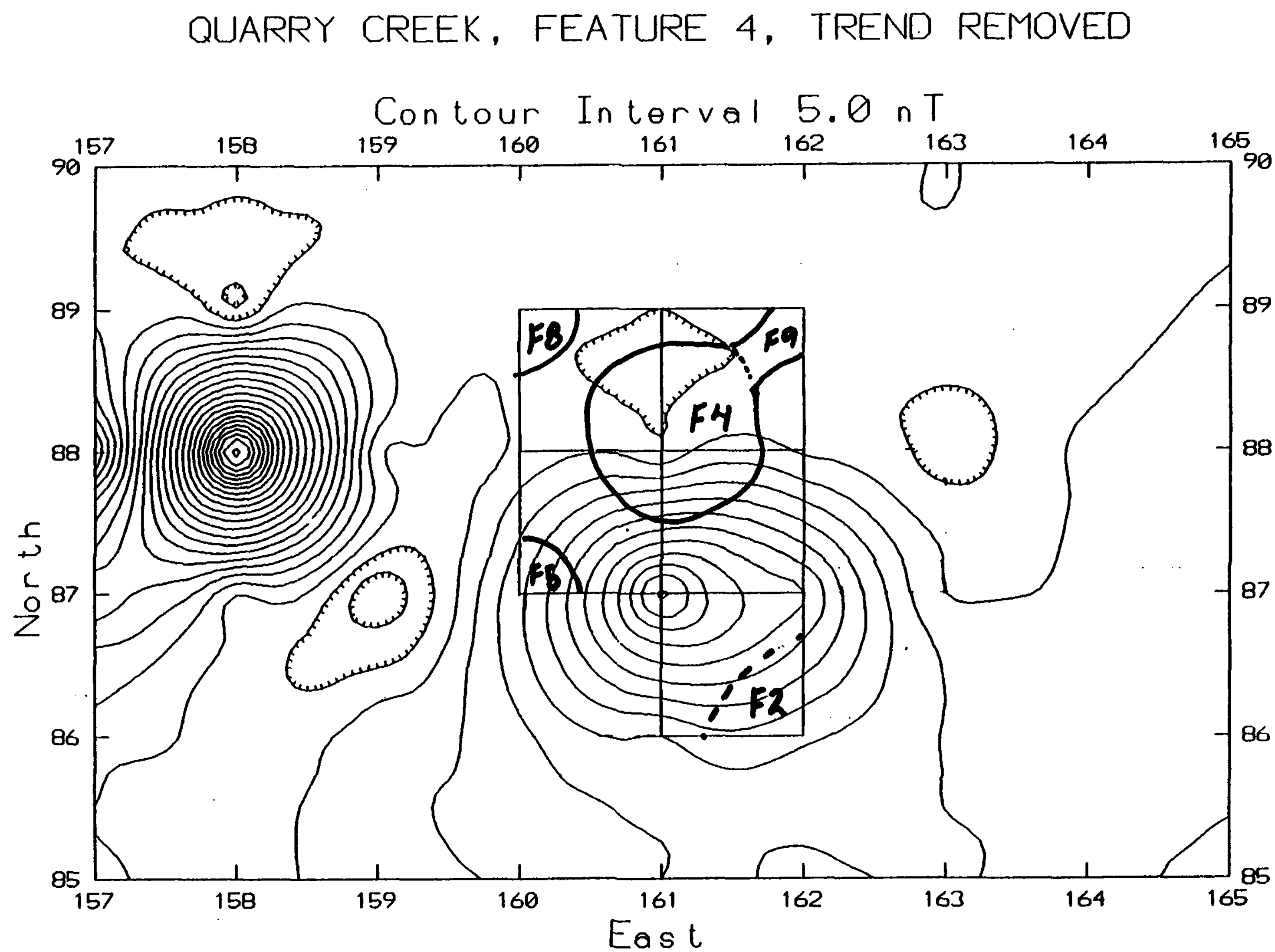


Figure 5.12 Magnetic Map of Region Around Features 2, 4, 5, 8 and 9 With Trend Removed, Contour Interval of 5.0 nT.

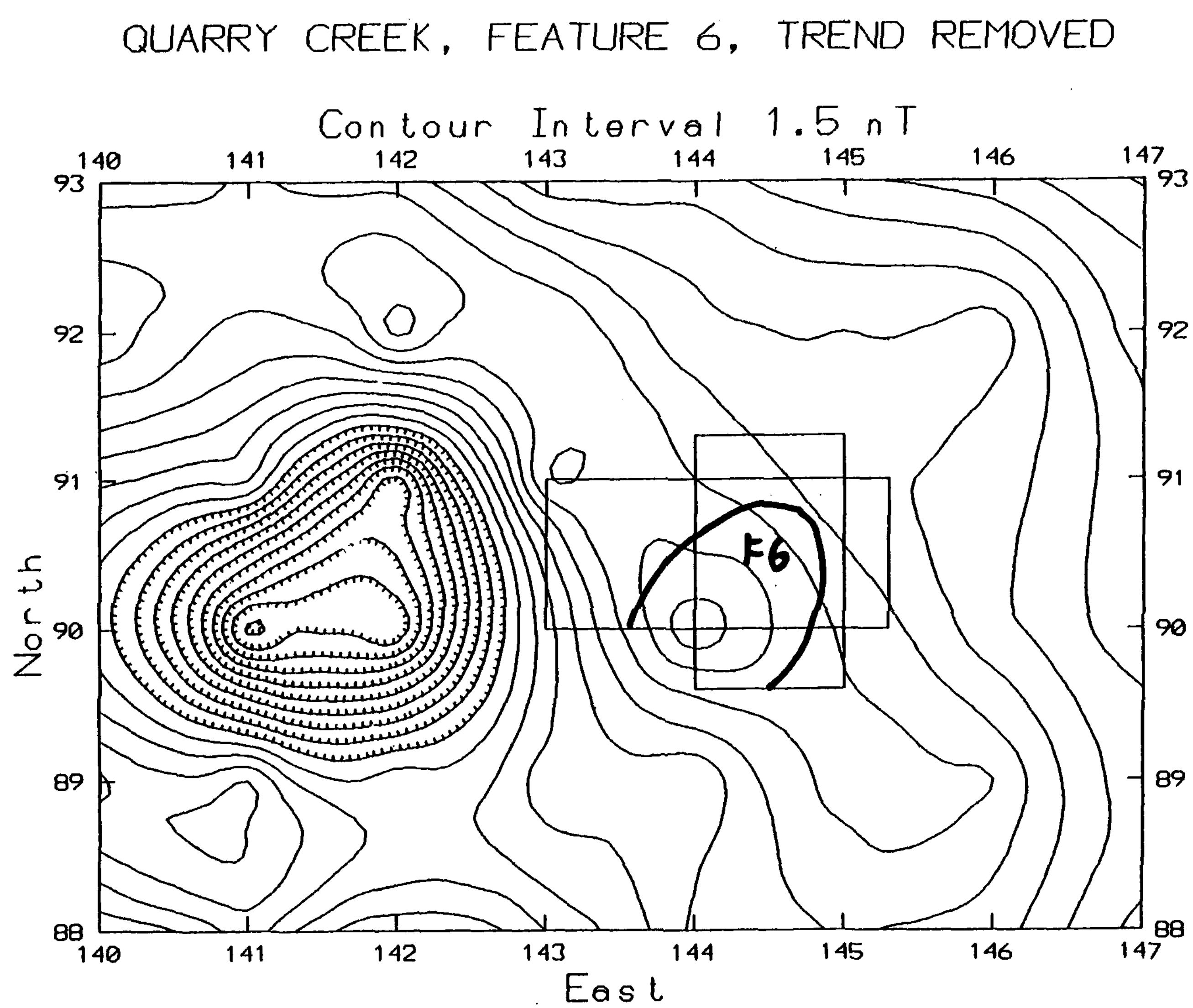


Figure 5.13 Magnetic Map of Region Around Feature 6 With Trend Removed, Contour Interval of 1.5 nT.

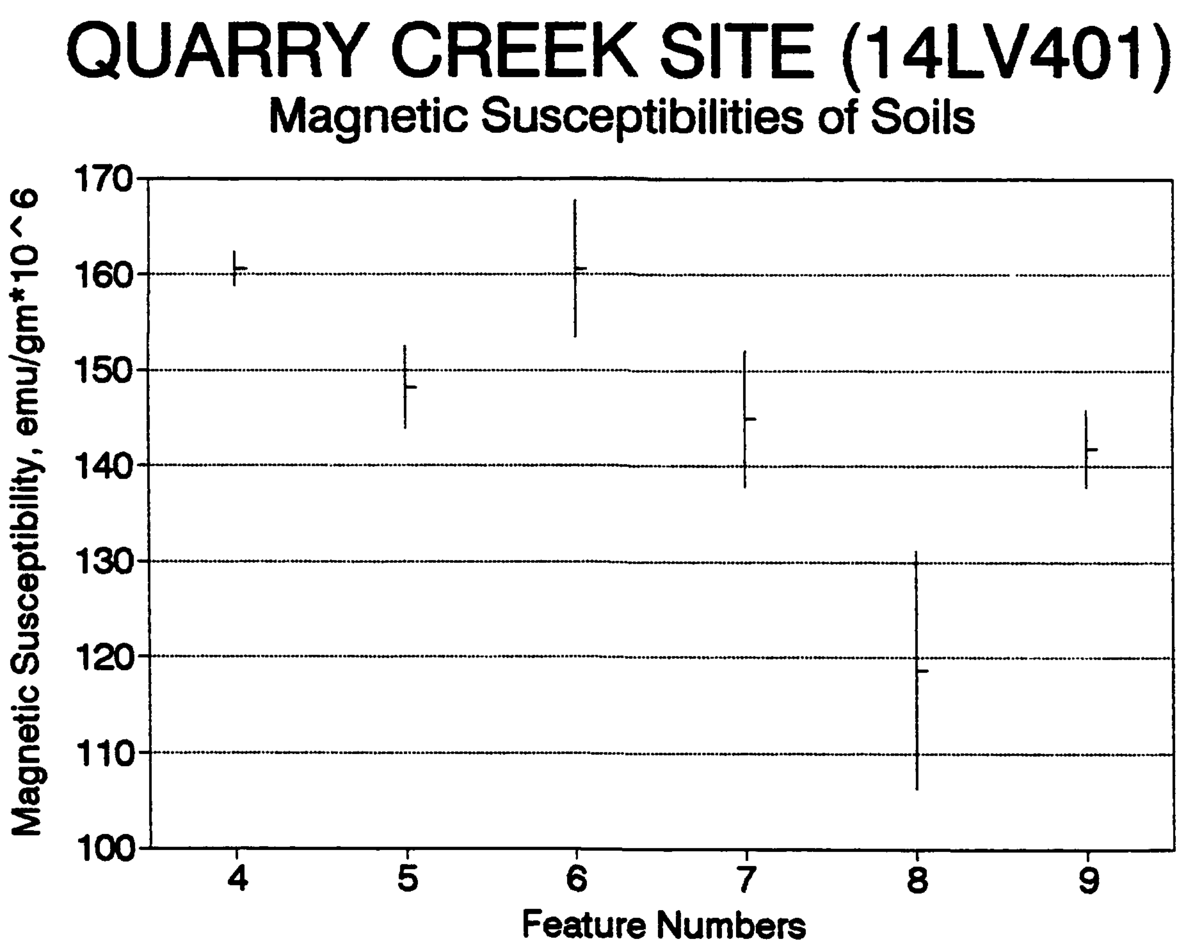


Figure 5.14 Graph of Magnetic Susceptibilities, With Error Bars, of Soils from Quarry Creek Features.

Summary and Conclusions

Quarry Creek, a Kansas City Hopewell site, was surveyed with two proton magnetometers in the difference mode. An area of 1500 square meters was covered in two days. A list was compiled of 21 anomalies. Six of these were tested with one or more one meter square excavation units. Eight features were identified, most being prehistoric pits. One anomaly was associated with a group of five features.

Observations of the reference readings during the survey indicated that sometimes the magnetic field was changing rapidly. This was subsequently verified as caused by a magnetic storm. This is discussed in Appendix 3. Close control of the reference readings eliminated errors due to the storm, which points up the value of such control.

After the initial analysis of the data it became apparent that some significant features produced very weak anomalies. This shows the need for two things. One, it would have been preferable to use magnetometers with a 0.2 nT, or even a 0.1 nT, sensitivity. Two, a grid unit of 0.5 m would have been desirable. The drawback to this is that the survey time would have quadrupled. However, with the use of memory magnetometers the added time burden would have been reduced somewhat and the turnaround time of the data analysis would have been much more rapid. At a 0.5 m interval the area could have been surveyed in four or five days.

Even at a 1.0 m interval, a sensitivity of 0.25 nT and hand recording the data, the survey enabled the excavations to focus on six significant prehistoric features.

Chapter 6

EXCAVATION OF THE QUARRY CREEK SITE

Brad Logan

Introduction

A total of 33 m^2 was excavated at the Quarry Creek site, consisting of 32 standard units and three partial units which equaled one m^2. These units were dug to varying depths, though all penetrated the A and AB horizons, which contained the cultural deposits. The upper few cm of the B horizon in several units was tested and found to be sterile, or nearly so. The depths of each unit are presented in Table 6.1 below. The mean depth of all units was 48 cm with a range from 35 to 62 cm.

Table 6.1. Depths of Excavation Units at the Quarry Creek Site.

Unit	Depth (cm)	Unit	Depth (cm)
110N/100E	35	79N/167E	40
99N/119E	40	79N/168E	50
100N/119E	45	80N/168E	46
97N/130E	40	81N/168E	45
100N/139E	40	82N/168E	45
100N/140E	45	83N/168E	50
90N/143E	48	84N/168E	65
89.6-90N/144E	45	85N/168E	40
90N/144E	45	86N/168E	50
91-91.3N/144E	50	87N/168E	43
90N/145-145.3E	40	88N/168E	50
95N/151E	45	89N/168E	50
87N/160E	55	90N/168E	50
88N/160E	57	91N/168E	50
86N/161E	50	92N/168E	50
87N/161E	55	93N/168E	60
88N/161E	60	99N/172E	62
		90N/205E	45

The stratigraphy in all units was similar, though as noted in chapter four, the thickness of the A horizon decreased westward from units 99-100N/119E. The thickness of the cultural horizon varied from about 40 to 60 cm with the deeper deposits above the trash-filled pits. Indeed, it is probable that the upper portions of the pits were not recognized in the dark grayish brown to dark brown (10YR3/2-3) lower A or AB horizons and that the lowest levels of those units (other than 99N/172E) that extended to depths greater than 50 cm were actually the upper part of pits. Features were only designated when they could be distinguished from the surrounding matrix of yellowish brown (10YR4/4) silty clay (B horizon).

Middens

The units dug into the low relief mounds first noted by Witty (see chapter one) all revealed deposits that consisted of a mixture of burned limestone and other redeposited hearth debris, ceramic and lithic artifacts, and well preserved animal bone. Mussel shell, when encountered, was generally in a poor state of preservation. The random location of this material suggested the mounds were accumulations of trash, rather than the locations of specific tasks such as hide preparation, food cooking, etc. During the excavation we noticed that the density of burned limestone in all areas was greatest at depths of about 30-45 cm, suggesting (if this one item can be taken as representative of all other debris) that the most intense occupation of the site occurred during the earliest deposition of trash. The quantified data for burned limestone (Table 6.2) support this observation. Conversely, the Hopewell occupation appears to have tapered off either in duration or intensity during deposition of the upper 30 cm of midden debris. Table 6.2 presents the total weight and frequency of burned limestone for each level at the site.

Table 6.2. Weight of Burned Limestone Per Level.

Level	Weight (gms)	Percent
1	9,530	4.28
2	11,754	5.28
3	42,929	19.30
4	91,739	41.25
5	53,927	24.25
6	11,891	5.35
7	509	0.23
8	138	0.06
Total	222,417	100.00

Interpretation of the middens at the Quarry Creek site is best obtained from the cross-section provided by the exploratory trench. As described in chapter four, the trench was excavated through the center of one of the larger mounds, though not all the way to its northern edge. The stratigraphy revealed on the western wall of the trench is attached to the end of this report (end page). Note that the relative thickness of the A horizon varies along the trench but that the elevation of the B horizon surface increases in near parallel to that of the ground surface. This suggests that while the mound is composed of an accumulation of cultural debris, it caps a natural rise of similar conformation (at least along this transect).

A comparison of the mean mass (t-test) of certain artifact categories along the exploratory trench by Bitikofer (1993) indicates a significant difference in their vertical distribution (see chapter seven, part 2). The middle levels (20-40 cm) often differed from the upper (level 2, 10-20 cm) and lower (level 5, 40-50 cm) levels with repect to the mean mass of chipped stone tools, lithic debitage (flakes, chips and shatter) and faunal remains. Figures 6.1-4 present the quantity and weight of these categories for each unit/level along the trench. Tables 6.3-6 are the t-values obtained by Bitikofer (1993). In this analysis, a comparison of means indicates a signicant difference between levels if the t-score is $\geq$1.701. The letter S in the lower left half of the tables indicates a significant difference and the letter N indicates no significant difference. The most frequently obtained difference is between levels 2 and 5, which is like the distinction between the upper and lower levels as compared to the middle levels with respect to the relative mass of burned limestone described above for all units. This also supports the inference that the period of greatest activity at the site occurred during the deposition of the lower levels.

Table 6.3. T-test for Ceramics Between Levels.[1]

Level	1	2	3	4	5
1	0	-.88	-1.16	-.58	.48
2	N	O	-.58	.11	1.01
3	N	N	O	.59	1.25
4	N	N	N	O	.84
5	N	N	N	N	O

1 Tables 6.3-6 are from Bitikofer 1993

Table 6.4. T-test for Lithic Tools Between Levels.

Level	1	2	3	4	5
1	O	1.84	.63	-.90	-1.04
2	S	O	-.64	-1.10	-1.56
3	N	N	O	.	-1.46
4	N	N	.	O	.67
5	N	N	N	N	O

POTTERY SHERDS — TRENCH 168E — QUANTITY/WEIGHT GMS

Level	79N	80N	81N	82N	83N	84N	85N	86N	87N	88N	89N	90N	91N	92N	93N
1	128/152	67/92	141/159	87/91	9/16	11/14	32/37	84/102	61/54	99/86	44/114	42/76	68/90	49/54	55/144
2	72/91	53/62	61/95	100/123	69/106	86/72	35/79	49/71	75/105	30/40	34/105	36/88	103/125	47/113	84/208
3	116/182	55/134	29/49	53/72	68/76	57/96	38/106	41/59	12/52	39/87	47/95	55/82	41/89	123/146	124/347
4	54/98	78/164	10/81	57/140	39/69	7/48	38/115	19/47	15/44	34/74	15/41	19/72	23/64	29/124	108/271
5	10/49	8/21	4/15	8/35	12/17	28/76		8/14	6/17	17/47	15/40	2/11	42/113	41/316	57/244
6						24/44									13/67
7						7/14									
8						11/30									
Feature 7						49/551									

Figure 6.1 Distribution of Quantity/Weight of Ceramics by Unit and Level in Trench. From Bitikofer 1993.

LITHIC TOOLS

TRENCH 168E

QUANTITY/WEIGHT GMS

Level	79N	80N	81N	82N	83N	84N	85N	86N	87N	88N	89N	90N	91N	92N	93N
1	2/3	11/29	3/14	/	1/1	1/18	6/7	/	1/10	5/6	/	/	1/1	/	17/22
2	3/2	/	2/3	1/2	/	4/8	3/6	3/13	7/12	5/3	5/4	1/5	6/3	3/7	4/7
3	3/1	3/3	1/5	6/8	1/1	2/2	11/47	2/1	2/1	2/1	7/2	1/13	1/7	5/24	10/4
4	5/6	1/1	3/974	3/31	/	2/12	3/3	5/2	1/13	8/12	4/28	4/1	2/24	/	2/35
5	1/4	1/1	/	5/104	3/5	2/154		2/1	1/2	/	1/1	/	1/10	1/10	/
6						2/2									/
7						5/14									
8						2/12									
Feature 7						54/529									

Figure 6.2 Distribution of Quantity/Weight of Lithic Tools by Unit and Level in Trench. From Bitikofer 1993.

LITHIC DEBITAGE* | TRENCH 168E | QUANTITY/WEIGHT GMS

Level	79N	80N	81N	82N	83N	84N	85N	86N	87N	88N	89N	90N	91N	92N	93N
1	464/206	177/108	260/165	175/113	47/26	26/17	59/40	145/85	117/94	129/71	173/89	129/98	89/49	188/114	142/104
2	111/66	121/87	219/138	183/160	161/98	133/96	125/94	117/68	155/106	85/67	96/54	174/124	228/179	209/179	179/114
3	197/105	189/82	124/74	130/104	138/90	104/91	70/64	90/56	36/22	101/115	95/46	206/143	122/62	190/83	208/144
4	139/86	188/102	82/26	138/120	108/76	7/28	84/72	49/43	28/28	64/41	77/55	76/65	68/60	118/97	243/187
5	19/46	24/18	6/4	27/28	43/26	81/107		19/12	14/17	26/21	37/43	77/69	61/41	144/94	136/90
6						60/43									15/38
7						25/9									
8						13/27									
Feature 7						173/484									

*Flakes, Chips and Shatter

Figure 6.3 Distribution of Quantity/Weight of Lithic Debris by Unit and Level in Trench. From Bitikofer 1993.

FAUNAL REMAINS — TRENCH 168E — WEIGHT IN GMS

Level	79N	80N	81N	82N	83N	84N	85N	86N	87N	88N	89N	90N	91N	92N	93N
1	28	38	44	29	15	3	13	17	22	29	32	8	24	28	26
2	34	31	56	43	23	20	30	35	43	25	17	48	39	40	41
3	135	54	52	24	26	29	20	31	33	43	38	54	39	70	44
4	77	141	105	40	32	7	41	33	11	37	41	74	64	103	108
5	27	10	4	49	20	47		8	23	103	64	77	85	123	203
Level 6						44									30
7						47									
8						9									
Feature 7						838									

Figure 6.4 Distribution of Weight of Faunal Remains by Unit and Level in Trench. From Bitikofer 1993.

Table 6.5. T-test for Flakes Between Levels.

Level	1	2	3	4	5
1	O	-1.01	.42	1.15	3.03
2	N	O	1.71	2.39	4.70
3	N	S	O	.93	3.33
4	N	S	N	O	1.99
5	S	S	S	S	O

Table 6.6. T-test for Faunal Remains Between Levels.

Level	1	2	3	4	5
1	O	-2.82	-2.87	-3.53	-2.50
2	S	O	-1.43	-2.46	-1.73
3	S	N	O	-1.19	-.87
4	S	S	N	O	.04
5	S	S	N	N	O

It is unlikely that post-depositional disturbance processes account for the vertical differences in artifact densities along the trench. The middens have been disturbed by root growth, as illustrated by the upper photograph in Figure 6.5. We attempted to document the extent of post-depositional disturbance by recording the inclination of piece-plotted artifacts (i.e., whether they were found horizontal, vertical, or inclined along their major axis). Unfortunately, the inclination of artifacts appears to have been random, which is what one might expect in a trash mound where containers of debris might have been unceremoniously dumped and their contents come to rest in a random manner and subsequently suffered trampling and scuffling. However, the root disturbance was equally pervasive throughout the unit levels. Thus, it does not appear that this process could account for the gross vertical differences in the distribution of limestone, ceramics, lithics and faunal remains.

Bitikofer (1993) also found a consistently significant difference horizontally along the trench between the relative mean mass of material in units at the northern end as compared to all others. The t-values for the comparison of means of the four

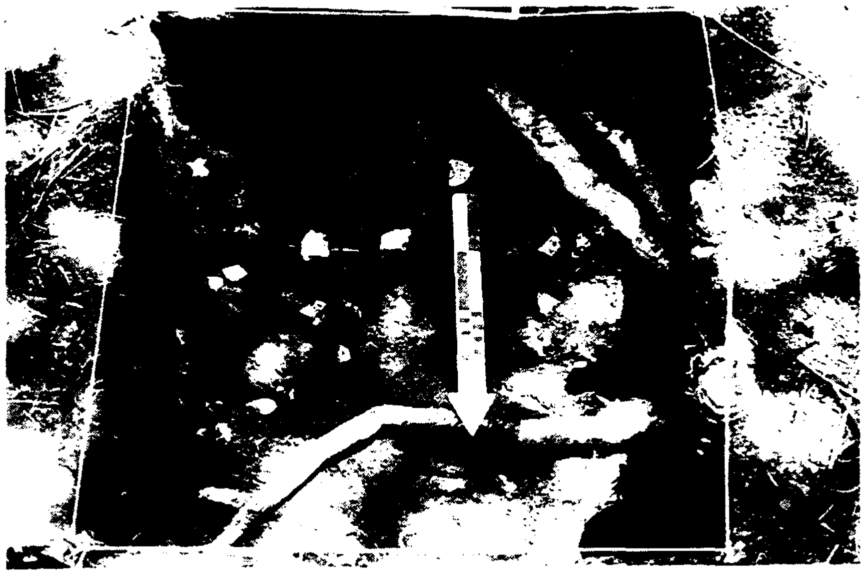


Figure 6.5 Above- Unit 90N/205E, 45 cm b.s., Showing Root Disturbance; Below- Feature 1 (arrow) in West Profile Unit 80N/168E, 40 cm b.s.

artifact categories are presented in Tables 6.7-10. With the exception of lithic tools, the mean mass of material in units 92-93N/168E differs significantly from all others, particularly the units from 83N to 88N. When contiguous units were compared in this manner, the only significant difference was between units 89N and 90N. One interpretation of the contrast in distribution along the trench is that the midden developed differently in two areas that can be distinguished at 90N/168E. The rates of accumulation of debris may have differed in the two areas. Another interpretation is that the activities that resulted in the deposition of material at the northern end of the trench were more intense than those that occurred at the southern end. It is worth noting here that a magnetic anomaly was detected in the vicinity of 93N/168E (see Weymouth herein) and that that unit extended to a greater depth than any others along the trench. Further exploration of the area around that unit should be one of the goals of future archaeological research.

Features

Nine features were defined during the KAFS investigation (Figure 1.3; page 4). One of these was a mass of burned earth (Feature 1). A second (Feature 2) was a concentration of relatively large body sherds. The third was a soil stain that may have been of natural origin. Six of the features (Features 4-9) proved to be trash filled pits that presumably first served for storage of foodstuffs or other commodities. Such features are common at sites of the Kansas City Hopewell variant. Twenty-nine pits were found at the Young site during excavations from 1971 to 1975 (Adair 1977:13). Forty-five pits were recorded at the Trowbridge site (Bell 1976:20). Wedel (1943:24-25) defined 36 pits as a result of excavations at the Renner site in the 1930s and even more have been found there during recent excavations (Brenner 1986, 1990). Given the small surface area exposed at the Quarry Creek site and the number of pits found, the density of its features is comparable to that at these other sites. The features are described below in terms of their dimensions, form, flotation sample yield (as a measure of volume), and cultural material content.

Feature 1: This feature consisted of a mass of burned earth encountered in the southwestern quadrant of unit 80N/168E. In that area it covered about 0.4 m^2. It extended into the unit adjacent to the west, though it was not traced in that direction. Figure 6.5 (lower) shows the mass in profile and its location in the trench is shown in Figure 6.6 (upper). It also appears schematically on the trench profile (end page). It extended slightly into units 79N/167-168E. It appeared at a depth of 22 cm and extended to a depth of 42 cm. The mass was floated as a single sample, which yielded 374 gms of burned earth. Other material recovered from the heavy fraction includes ceramics (28 gms), lithic debris (6.5 gms), burned bone (4.9 gms), bone (4

Table 6.7 T-test table for Pottery Sherds between units [1]

Unit	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
79	0	.57	-1.03	.74	1.96	1.94	.98	2.04	2.18	1.87	1.24	1.78	.71	-.72	-3.13
80	N	0	.42	.08	1.23	1.15	.32	1.25	1.38	1.03	.52	.99	-.05	-1.10	-3.52
81	N	N	0	-.41	.77	.67	-.14	:77	.91	.50	.03	.50	-.62	-1.41	-3.94
82	N	N	N	0	1.38	1.33	.30	1.44	1.61	1.21	.54	1.14	-.18	-1.22	-3.92
83	S	N	N	N	0	-.20	-1.09	-.07	.11	-.49	-.93	-.40	-1.91	-1.98	-4.90
84	S	N	N	N	N	0	-1.04	.14	.34	-.32	-.84	-.23	-1.98	-1.93	-4.98
85	N	N	N	N	N	N	0	1.16	1.34	.92	.22	.84	-.61	-1.27	-3.86
86	S	N	N	N	N	N	N	0	.19	-.48	-.96	-.37	-2.12	-1.99	-5.05
87	S	N	N	N	N	N	N	N	0	-.71	-1.15	-.57	-2.35	-2.08	-5.16
88	S	N	N	N	N	N	N	N	N	0	-.65	.05	-2.03	-1.86	-5.02
89	N	N	N	N	N	N	N	N	N	N	0	.62	-.89	-1.53	-4.40
90	N	N	N	N	N	N	N	N	N	N	N	0	-1.73	-1.83	-4.86
91	N	N	N	N	S	S	N	S	S	S	N	N	0	-1.20	-4.16
92	N	N	N	N	S	S	N	S	S	S	N	N	N	0	-1.66
93	S	S	S	S	S	S	S	S	S	S	S	S	S	N	0

1. Tables 6.7-10 are from Bitikofer 1993.

Table 6.8 T-test table for Lithic Tools between units

Unit	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
79	0	-.87	-1.16	-1.60	.58	-1.23	-1.36	-.25	-1.60	-.92	-.94	-1.02	-1.45	-2.62	-2.17
80	N	0	-.99	-1.14	.75	-.91	-.58	.62	.18	.45	-.01	.27	.24	-.56	-.85
81	N	N	0	.88	.86	.98	.96	1.01	1.14	1.01	.99	.85	1.14	.82	.96
82	N	N	N	0	1.22	-.07	.80	1.37	1.39	1.32	1.14	1.08	1.41	.80	.79
83	N	N	N	N	0	-.95	-1.08	-.43	-1.47	-1.00	-.81	-.99	-1.36	-2.10	-1.72
84	N	N	N	N	N	0	.68	1.06	1.09	1.02	.91	.84	1.10	.65	.66
85	N	N	N	N	N	N	0	1.09	.88	.98	.58	.75	.92	.16	-.09
86	N	N	N	N	N	N	N	0	-.91	-.37	-.67	-.50	-.86	-1.76	-1.70
87	N	N	N	N	N	N	N	N	0	.61	-.21	.27	.12	-1.27	-1.41
88	N	N	N	N	N	N	N	N	N	0	-.49	-.22	-.49	-1.64	-1.56
89	N	N	N	N	N	N	N	N	N	N	0	.30	.27	-.57	-.86
90	N	N	N	N	N	N	N	N	N	N	N	0	-.18	-1.17	-1.20
91	N	N	N	N	N	N	N	N	N	N	N	N	0	-1.35	-1.47
92	S	N	N	N	S	N	N	N	N	N	N	N	N	0	-.34
93	S	N	N	N	N	N	N	N	N	N	N	N	N	N	0

Table 6.9 T-test table for Lithic Flakes between units

Unit	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
79	0	.70	.49	-.09	1.21	1.01	1.04	1.61	1.44	1.21	1.53	.06	.63	-.35	-.79
80	N	0	-.06	-.95	.72	.47	.58	1.32	1.05	.73	1.22	-.92	.04	-1.45	-2.05
81	N	N	0	-.62	.52	.37	.38	.86	.77	.53	.75	-.53	.08	-.90	-1.30
82	N	N	N	0	1.57	1.30	1.43	2.11	1.80	1.57	2.07	.20	.81	-.31	-.82
83	N	N	N	N	0	-.19	-.21	.53	.40	.01	.33	-1.68	-.50	-2.17	-2.77
84	N	N	N	N	N	0	.01	.67	.54	.20	.51	-1.33	-.33	-1.79	-2.35
85	N	N	N	N	N	N	0	.86	.60	.22	.75	-1.63	-.35	-2.11	-2.74
86	N	N	N	S	N	N	N	0	-.02	-.51	-.32	-2.40	-.90	-2.87	-3.52
87	N	N	N	N	N	N	N	N	0	-.39	-.20	-1.90	-.78	-2.34	-2.88
88	N	N	N	N	N	N	N	N	N	0	.31	-1.68	-.51	-2.16	-2.76
89	N	N	N	S	N	N	N	N	N	N	0	-2.45	-.77	-2.95	-3.67
90	N	N	N	N	N	N	N	S	S	N	S	0	.73	-.59	-1.21
91	N	N	N	N	N	N	N	N	N	N	N	N	0	-1.15	-1.61
92	N	N	N	N	S	N	S	S	S	S	S	N	N	0	-.59
93	N	S	N	N	S	S	S	S	S	S	S	N	N	N	0

Table 6.10 T-test table for Faunal Remains between units

Unit	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
79	0	.18	.30	1.09	1.76	1.75	1.41	1.65	1.57	.51	.99	.33	.43	-.46	-.62
80	N	0	.09	.77	1.38	1.40	1.10	1.30	1.22	.28	.69	.10	.19	-.62	-.74
81	N	N	0	.91	1.77	1.73	1.38	1.63	1.52	.23	.78	.00	.11	-.85	-.88
82	N	N	N	0	2.55	1.72	1.47	1.77	1.50	-.68	-.15	-1.15	-1.12	-1.92	-1.43
83	N	N	N	S	0	.24	-.45	-.23	-.51	-1.65	-1.85	-2.28	-2.41	-2.71	-1.85
84	N	N	N	N	N	0	-.46	-.36	-.53	-1.59	-1.55	-2.11	-2.16	-2.62	-1.87
85	N	N	N	N	N	N	0	.17	-.04	-1.24	-1.21	-1.74	-1.81	-2.21	-1.55
86	N	N	N	N	N	N	N	0	-.23	-1.48	-1.47	-2.05	-2.12	-2.56	-1.79
87	N	N	N	N	N	N	N	N	0	-1.37	-1.28	-1.92	-1.97	-2.46	-1.74
88	N	N	N	N	N	N	N	N	N	0	.55	-.27	-.16	-1.11	-1.04
89	N	N	N	N	N	N	N	N	N	N	0	-.96	-.89	-1.76	-1.36
90	N	N	N	N	S	S	N	S	S	N	N	0	.13	-.94	-.91
91	N	N	N	N	S	S	N	S	S	N	N	N	0	-1.08	-.99
92	N	N	N	S	S	S	S	S	S	N	N	N	N	0	-.31
93	N	N	N	N	N	S	S	N	N	N	N	N	N	N	0

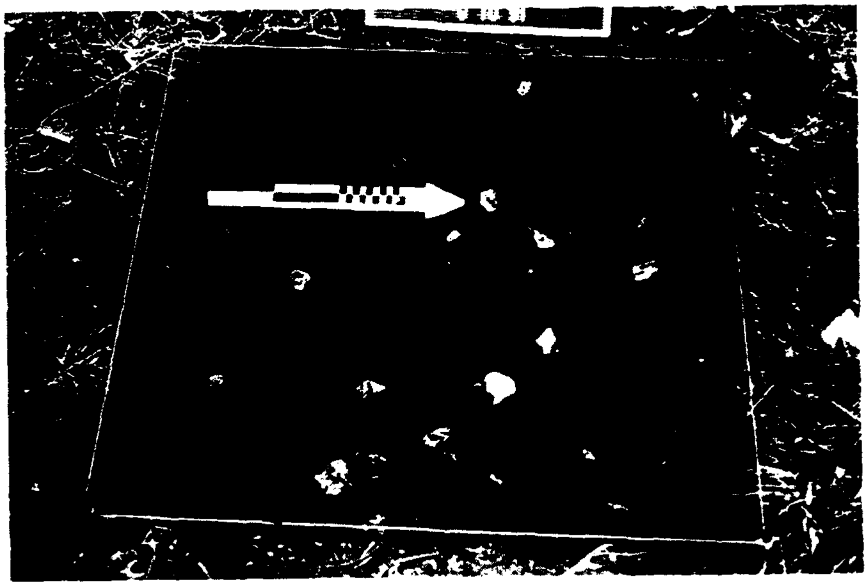


Figure 6.6 Above- Trench 168E, View North. Note Features 1 (Lower Arrow) and 7 (Upper Arrow); Below- Feature 2, Sherd Concentration, Unit 86N/161E, 30 cm b.s.

gms), limestone (5.5 gms), charcoal (1.5 gms), and sandstone (7 gms). It is uncertain if the burned mass registered magnetic anomaly number five, though it occurred in the same area. It did not appear as if the burning of this earth was <u>in situ</u>, rather a more likely inter-pretation is that it represents part of a load of other debris dumped in the midden area.

<u>Feature 2</u>: A concentration of 20 relatively large sherds, including three rims and 17 body sherds, of Hopewell ware was recorded at a depth of 26-33 cm in the center of unit 86N/161E as Feature 2 (Figure 6.6, lower). Cross mending of these sherds has not yet been attempted, though it is believed that some (if not all) represent the same vessel. The sherds weighed a total of 919 gms, of which total the rims account for 127 gms. The rims are the plain type characteristic of the Edwardsville phase. One with lip notching is shown in Figure 7.6c.

Three flotation samples from the matrix around these sherds (in addition to several plotted pieces of burned limestone and lithic debris) were collected. These yielded the following amounts of material: ceramic (25.7 gms), lithics (51 gms), burned bone (23 gms), bone (32.4 gms), burned earth (42.1 gms), limestone (68.1 gms), charcoal (1.3 gms), sandstone (12.8 gms), mineral (2.3 gms), shell (7.8 gms).

<u>Feature 3</u>: This feature appeared in unit 100N/140E at a depth of 37 cm as an irregular, dark soil stain (10YR2/1) against a background of dark brown silty clay (10YR3/3). Its maximum dimension was 28 cm (southeast-north-west). Two small pieces of burned limestone were found on its northern and western perimeters. The feature was cross-sectioned and found to extend to a depth of 41 cm below surface. No significant artifacts were recovered during the coring of the stain, although a bifacial scraper was recovered at the same depth as its surface and at a distance of 30 cm horizontally (Fig. 7.15c). The feature's form suggested it was of natural origin. Flotation of the soil yielded only minute amounts of cultural material including: ceramics (1.1 gm), lithics (1.6 gm), burned bone (.5 gm), bone (.4 gm), burned earth (1.2 gm), limestone (4.4 gms), charcoal (.1 gm), and mineral (.5 gm). The outline of the feature is shown in Figure 6.7.

<u>Feature 4</u>: Feature 4 as the largest trash-filled pit dug at at the site. Complete excavation required the opening of four contiguous units, 87-88N/160-161E, and it was during this operation that three other pits (Features 5, 8 and 9) were discovered (Figure 6.8-9). This cluster of features registered as magnetic anomaly 8 during the magnetometer survey (see Weymouth herein). Feature 4 was first defined at a depth of 55 cm in unit 87N/161E, though its orifice probably began at a higher elevation. The sterility of the unit to its south

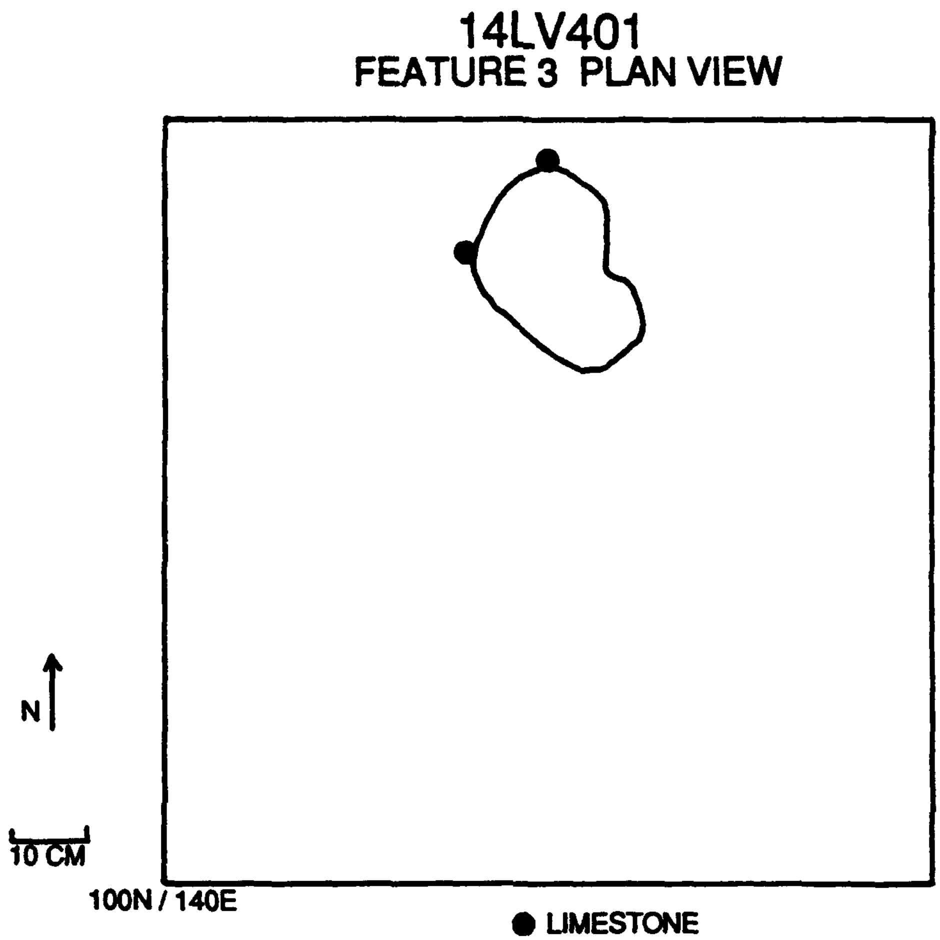
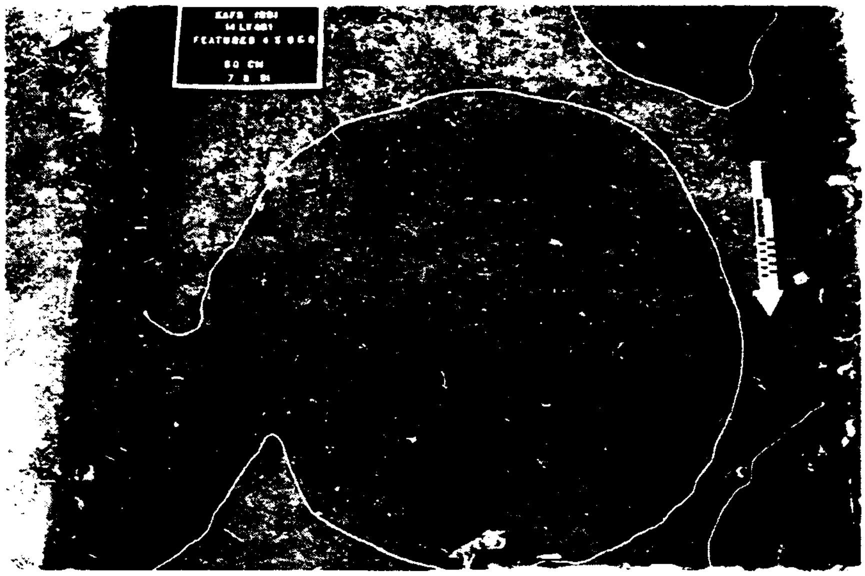


Figure 6.7 Plan View of Feature 3 (Soil Stain).



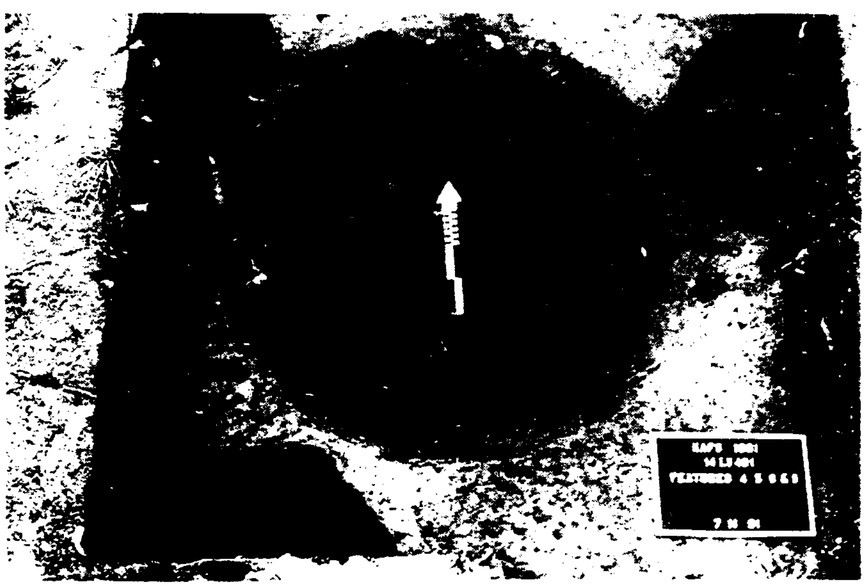


Figure 6.8 Above- Features 4, 5, 8, and 9, Before Excavation, 60 cm b.s.; Below- Features 4, 5, 8, and 9, After Excavation.

14LV401
PLAN VIEW FEATURES 4, 5, 8, 9

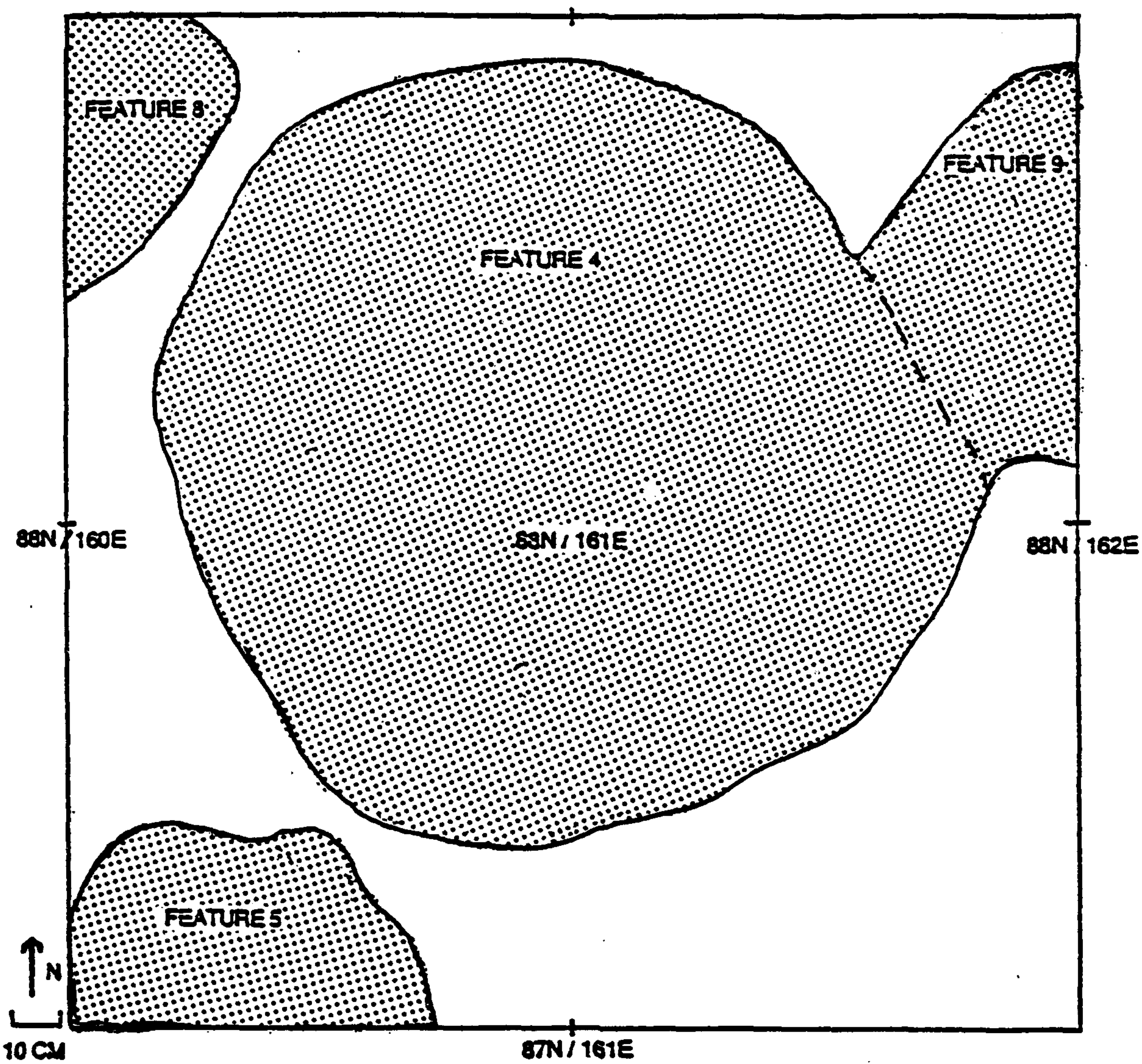


Figure 6.9 Plan View of Features 4, 5, 8, and 9 at 60 cm b.s.

(86N/161E) at 50 cm below surface suggests the top of the pit was at about that depth. A profile of the north wall of unit 87N/160-162E at a depth of 65 cm shows the edges of the pit and the transition from an A horizon to the AB horizon fill of the feature (Fig. 6.10). The pit had a roughly circular mouth 1.5 m in diameter. Its walls tapered slightly to the base, which was relatively flat and 1.0 m below surface. The feature had a small expansion on the southern perimeter near the base which gave it a maximum diameter at that point of 117 cm (Figure. 6.11).

Feature 4 yielded 70 flotation samples (ca. 35 bushels) and 42 piece-plotted artifacts. The latter included six rim sherds, eight body sherds, one projectile point, two bifaces, three scrapers, one flake, one chunk, two large pieces of daub, eight pieces of bone, two modified pieces of bone, one piece of antler, one tooth, a piece of hematite, a minature copper celt, two pieces of burned limestone, one piece of sandstone, and one piece of mussel shell. Other artifacts removed during the excavation but which lack point provenience are two bodysherds, one blade, one abrader, one piece of quartzite (847 gms), and 830 gms of limestone. The heavy fractions of the flotation samples yielded the following amounts of material: ceramic (774.5 gms), lithics (905.4 gms), burned bone (571.4 gms), bone (904.6 gms), burned earth (1,167.9 gms), limestone (19,851.5 gms), charcoal (116.2 gms), sandstone (252.3 gms), mineral (30.7 gms), caliche (161.6 gms), shell (12.9 gms), and quartzite (3.6 gms).

A sample of charcoal from the pit weighing 14 gms was submitted for radiocarbon dating. The date obtained is 1590±90 B.P.: A.D. 360 (Beta-47827). The calibration (Appendix 2) and interpretation of this assay are presented in chapter nine.

Feature 5: This feature was discovered in the southern portion of 87N/160E during the expansion of the area around Feature 4 and was only partially excavated (Fig. 6.9-10). The pit extends well into the three contiguous, unexcavated units, particularly 86N/160E. It was first defined at a depth of 58 cm and extended to a depth of 98 cm. At these depths it is comparable to Feature 4, which was less than ten cm to its northeast. Its full dimensions or form could not be determined. Its maximum diameter as exposed was 75 cm. As it appeared on the south profile of 87N/160E, the upper part 10-12 cm of the pit was lipped. The lip was undercut from about 12-32 cm (Fig. 6.12). Its form as seen on the west profile of 87N/160E shows a broad orifice that tapered to a narrow platform at 12 cm below the top of the B horizon. From the 15 cm wide platform, the pit tapered slightly to a depth of 38 cm below the B horizon and then more sharply to a depth of 40 cm below that surface (Fig. 6.13). The floor of the pit was an irregular plane 77 cm in maximum length as exposed in the unit.

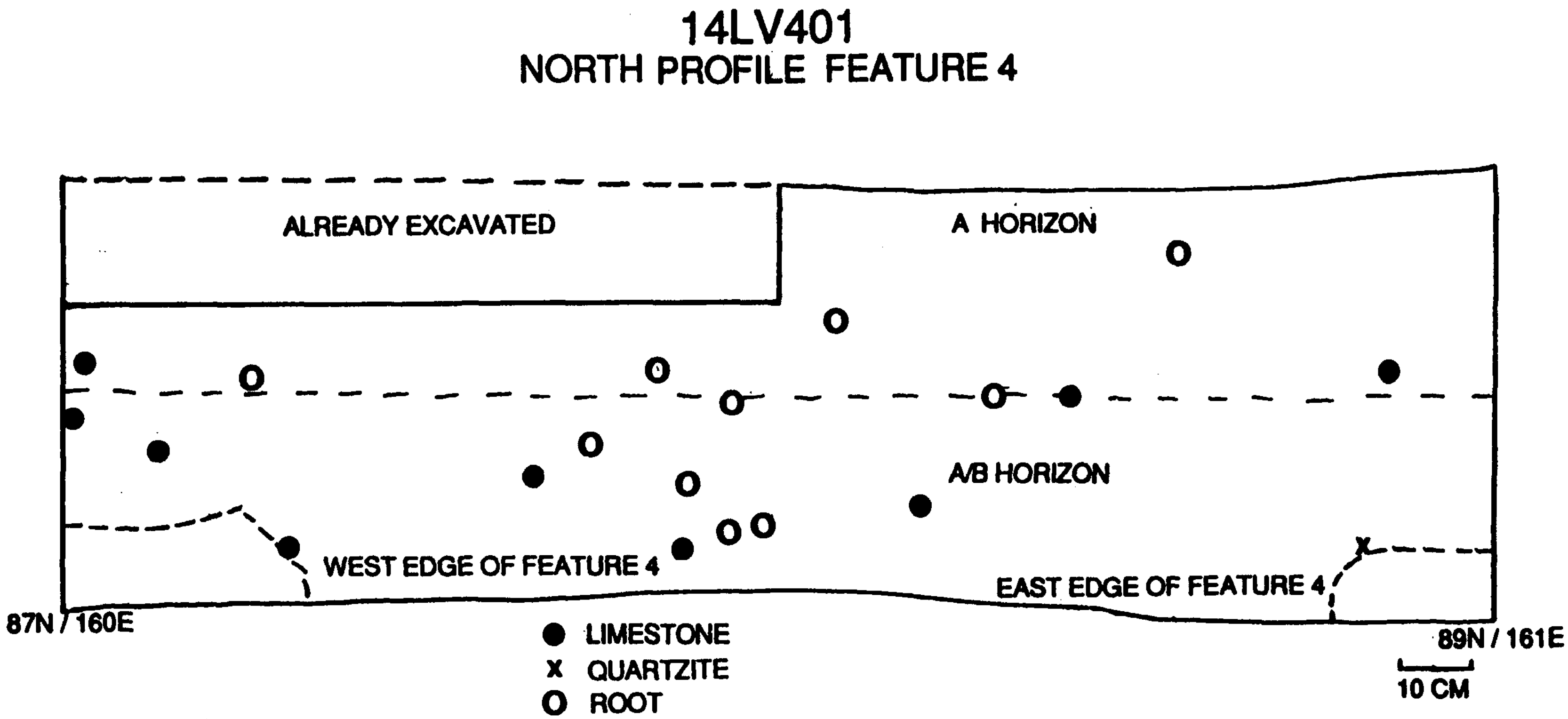


Figure 6.10 North Profile of 87N/160-161E Showing Upper Portion of Feature 4.

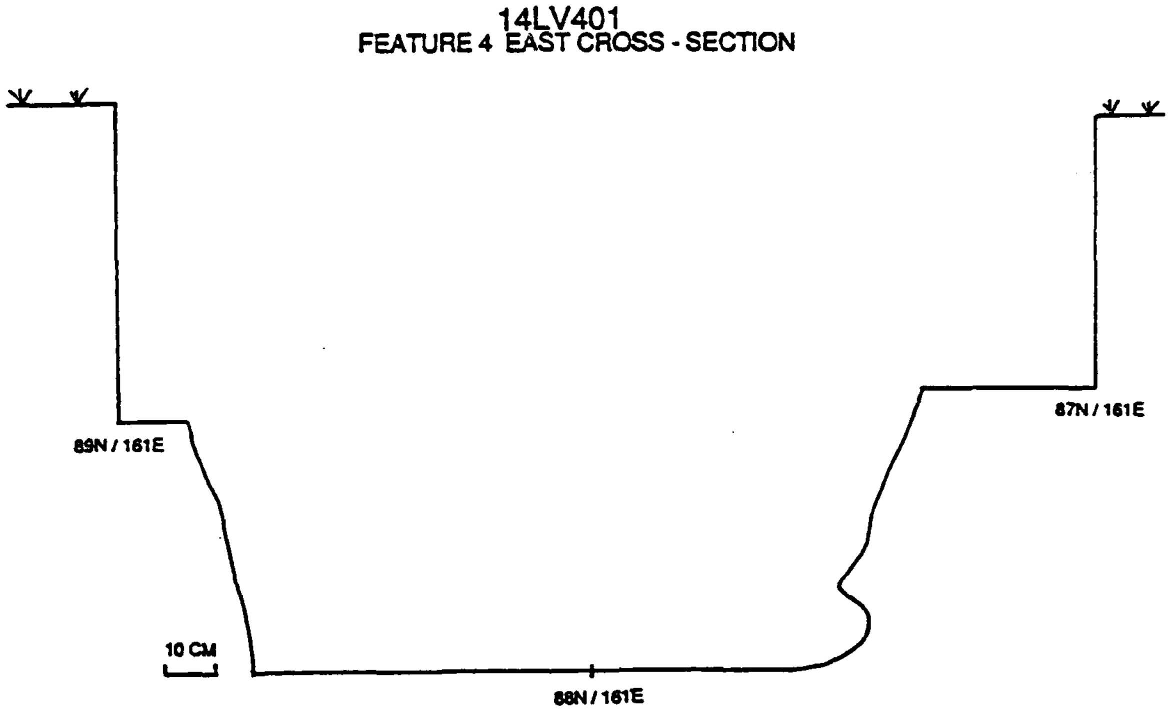


Figure 6.11 East Cross-Section of Feature 4.

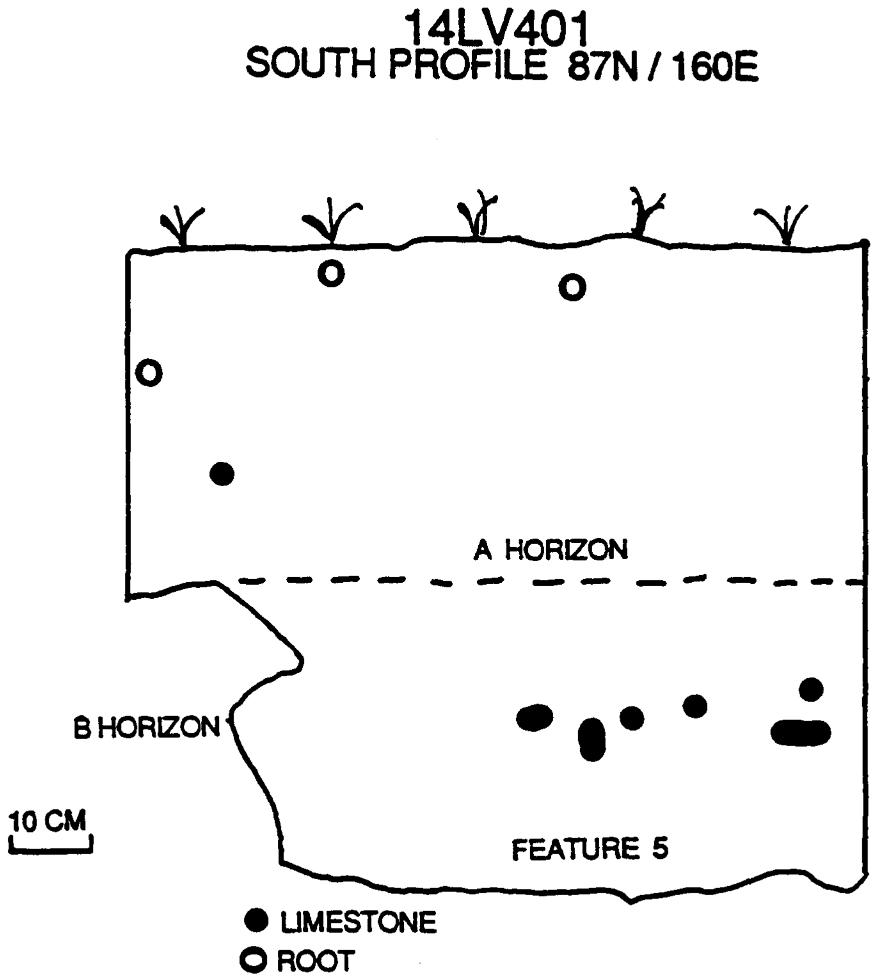


Figure 6.12 South Profile of 87N/160E Showing Feature 5 in Cross-Section.

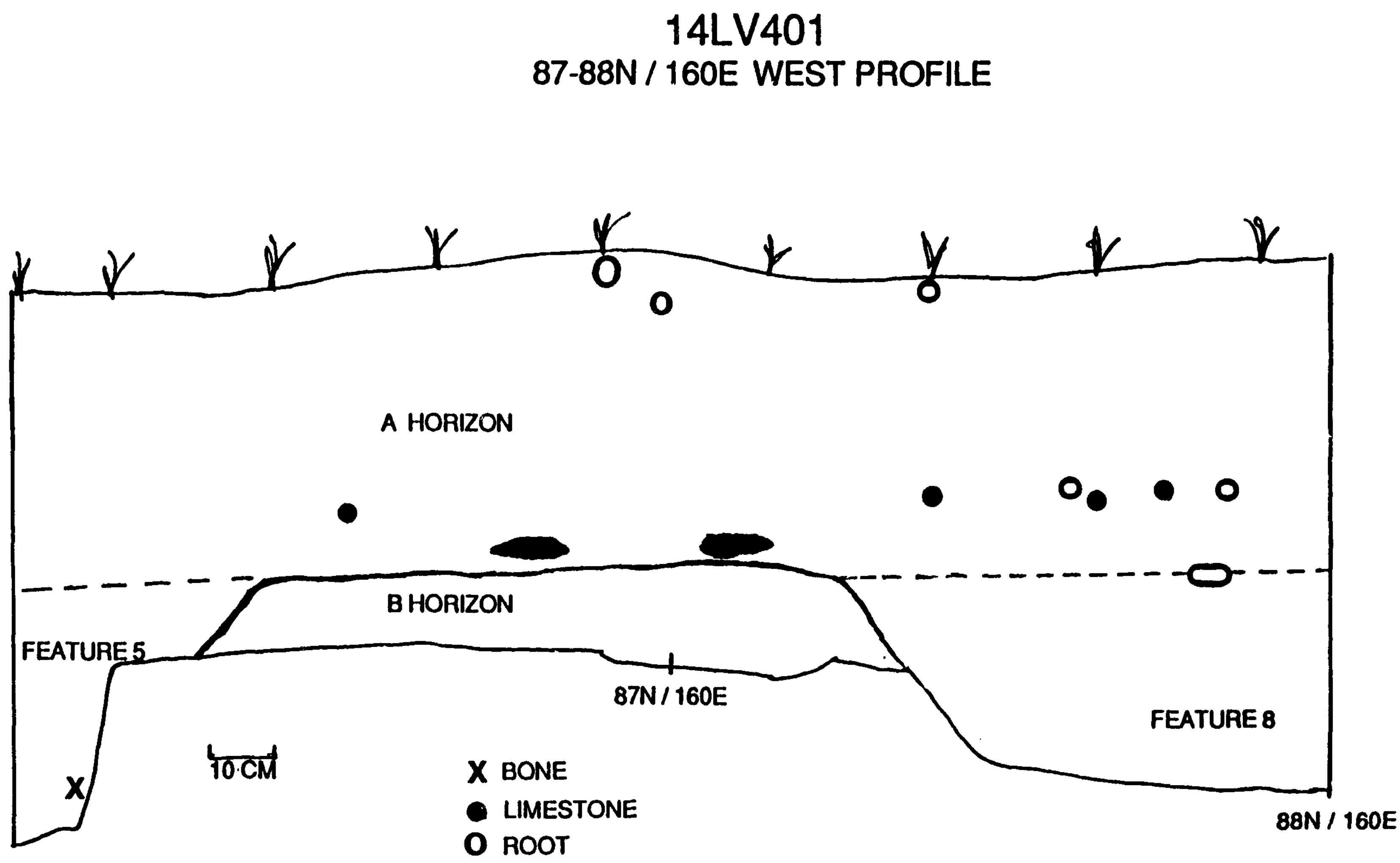


Figure 6.13 West Profile of 87-88N/160E Showing Features 5 and 8 (in part) in Profile.

That portion of the pit removed, estimated to be less than half of its volume, yielded five flotation samples (ca. 2.5 bushels) and 26 piece plotted artifacts. The latter are four rimsherds, four body sherds, one projectile point, one biface fragment, two flakes, nine bones, one piece of antler, two mussel shells (one complete valve was found on the floor of the pit), one piece of quartzite, and one piece of mineral. Other material removed but not plotted includes one piece of quartzite (548 gms) and 1,508 gms of limestone. The density of plottable artifacts was noticeably greater in this smaller pit than in Feature 4.

The heavy fraction of the flotation samples yielded the following amounts of material: ceramics (139.5 gms), lithics (137 gms), burned bone (28.8 gms), bone (60.6 gms), burned earth (94.1 gms), limestone (937.4 gms), charcoal (10 gms), sandstone (0.9 gms), mineral (9.9 gms), and shell (0.4 gms).

Charcoal (23 gms) picked from the pit during excavation was submitted for radiocarbon dating. The date obtained is 1650±80 B.P.: A.D. 300 (Beta-47828). The calibration (Appendix 2) and interpretation of this assay is presented in chapter nine.

Feature 8: A portion of a small pit was exposed in unit 88N/160E ten cm northwest of Feature 4 (Fig. 6.9-10). It extends into the three contiguous, unexcavated units, particularly 88N/159E. It was first defined at a depth of 47-50 cm below surface and extended to 84 cm. The maximum diameter of its orifice, as exposed, was 76 cm and its form, seen in profiles on the west and north walls of 88N/160E, was comparable to that of Features 5, 6 and 9 (see below). On its southern perimeter, the walls tapered 30 cm to a slight concave floor (Fig. 6.13). On its eastern edge, it tapered from the surface of the B horizon to a platform 16 cm lower. This lower surface, like that of Feature 5, was 15-20 cm wide. From this platform, the walls tapered to an irregular floor 32 cm below the B horizon (Fig. 6.14).

The excavated portion of Feature 8 yielded only three flotation samples, one gm of picked charcoal, and five piece plotted artifacts. The latter consist of four bones and a flake. The heavy fraction of the flotation sample contained the following amounts of material: ceramics (23.6 gms), lithic debris (18.4 gms), burned bone (9.1 gms), bone (27.4 gms), burned earth (128.2 gms), burned limestone (1,040 gms), charcoal (4.2 gms), and sandstone (5.6 gms).

Feature 9: This small pit was slightly intrusive to Feature 4 on its northeastern edge. It extends into 88N/162E, though that portion remains unexcavated. It was first defined at a depth of 40-45 cm and extended to a slightly concave floor 90 cm below surface. Its maximum diameter at the surface of the B horizon was 55 cm and its form, as revealed on the east profile

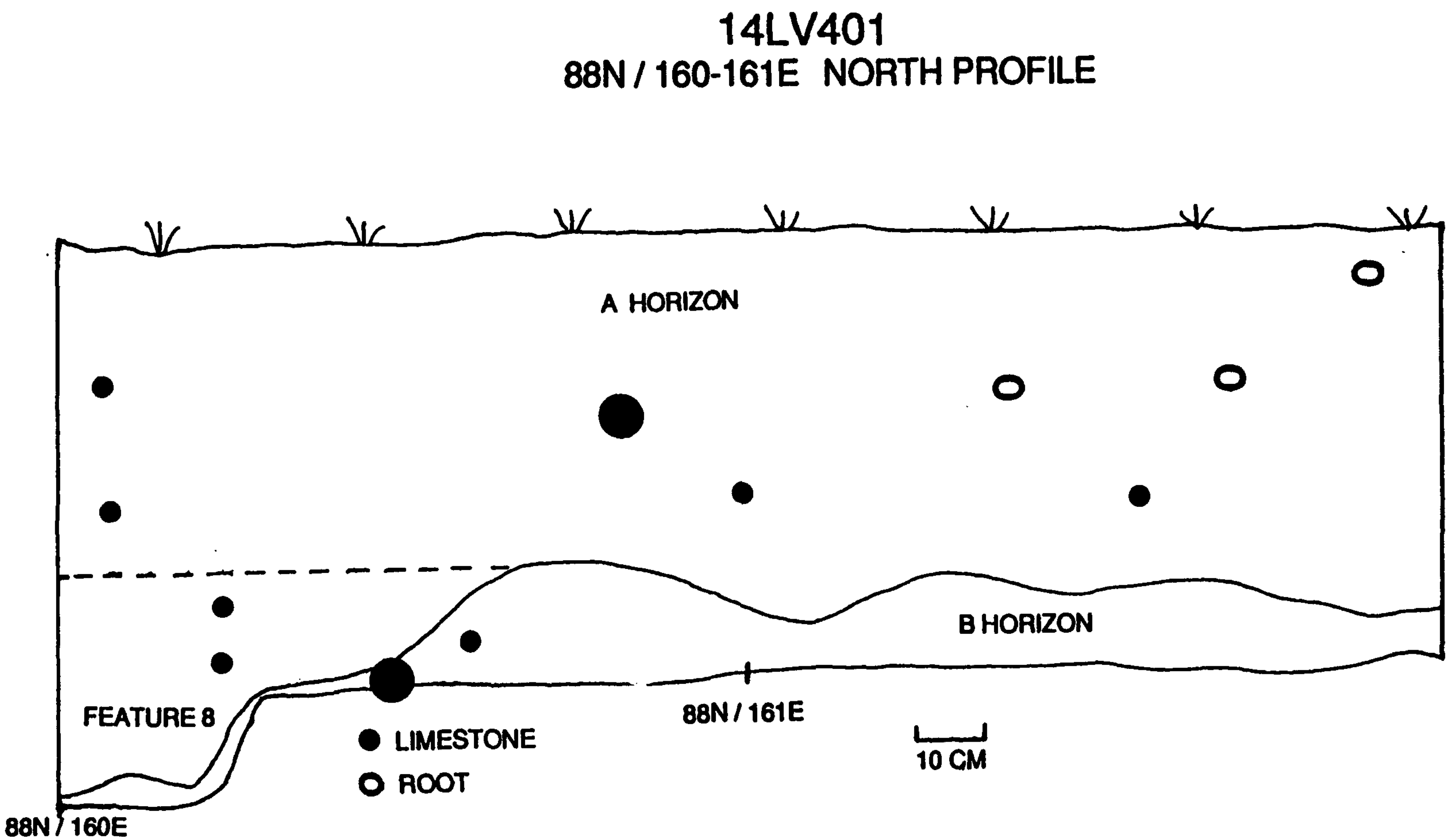


Figure 6.14 North Profile of 88N/160-161E Showing Feature 8 (in part) in Profile.

of 88N/161E, has a general basin shape (Fig. 6.15). Like Features 5, 6 and 8, this pit had a shallow platform, a portion of which is visible on the northern perimeter in the profile.

The excavated portion of this pit yielded five flotation samples, five pieces of plotted limestone (368 gms), two large pieces of caliche (22 gms), one gm of picked charcoal, and one plotted body sherd. The heavy fraction of the flotation samples contained the following material: ceramics (22.2 gms), lithics (86.1 gms), burned bone (20 gms), bone (43.1 gms), burned earth (108.2 gms), burned limestone (471.7 gms), charcoal (4.9 gms), and caliche (133.2 gms). The presence of this last material is curious since it far outweighs, by relative volume of excavated fill, the amount of caliche in Feature 4, which was the only other feature to yield this form of calcium carbonate. Indeed, only traces of this material were recovered from any of the midden deposits. It is possible that the caliche in Feature 4 was from that portion of Feature 9 intrusive to it and that nearly all of it therefore derives from the latter. It is difficult to imagine how a natural precipitate such as caliche could be so localized. Its presence in the fill of a pit that contained little else is also peculiar. None of this material was noted on the profile of the pit nor was it recorded as a discrete concentration within the fill. Whether the caliche records a unique function of this pit or simply the dumping of soil from a distinctive and artifact-poor area of the site are as yet unverified interpretations.

Feature 6: This pit was recognized in unit 90N/143E at a depth of 47 cm. Most of the feature was in the unit adjacent to the west and it extended 40 cm south into 89N\144E (Fig. 6.16). A small portion of the pit in unit 89N/143E was not excavated. The pit was oval in outline with a maximum inferred long axis of 140 cm and a short axis of 80 cm (Fig. 6.17). Like Features 5, 8 and 9, it had a narrow platform around portions of its perimeter, which is visible in the lower photograph of Figure 6.16, the partial profile of the south wall of 90N/143E (Fig. 6.18) and the cross-section shown in Figure 6.19. Below the platform, the walls were roughly vertical to a floor 1.0 m below surface. The relatively flat floor was 1.0 m in length along its major axis.

Feature 6 yielded 49 flotation samples (ca. 24.5 bushels) and 40 piece-plotted artifacts. The latter include: four rim sherds, five body sherds, one projectile point, two biface fragments, a bifacial scraper, an edge-modified flake, four flakes, a core, a hammerstone, eight bones, two mussel shells (one shown *in situ* on the floor of the pit in the upper photograph of Fig. 6.20), and eleven pieces (3,118 gms) of quartzite. A large quantity of burned limestone (17,217 gms) was recovered, most of which was found on the floor of the feature (Fig. 6.16, lower).

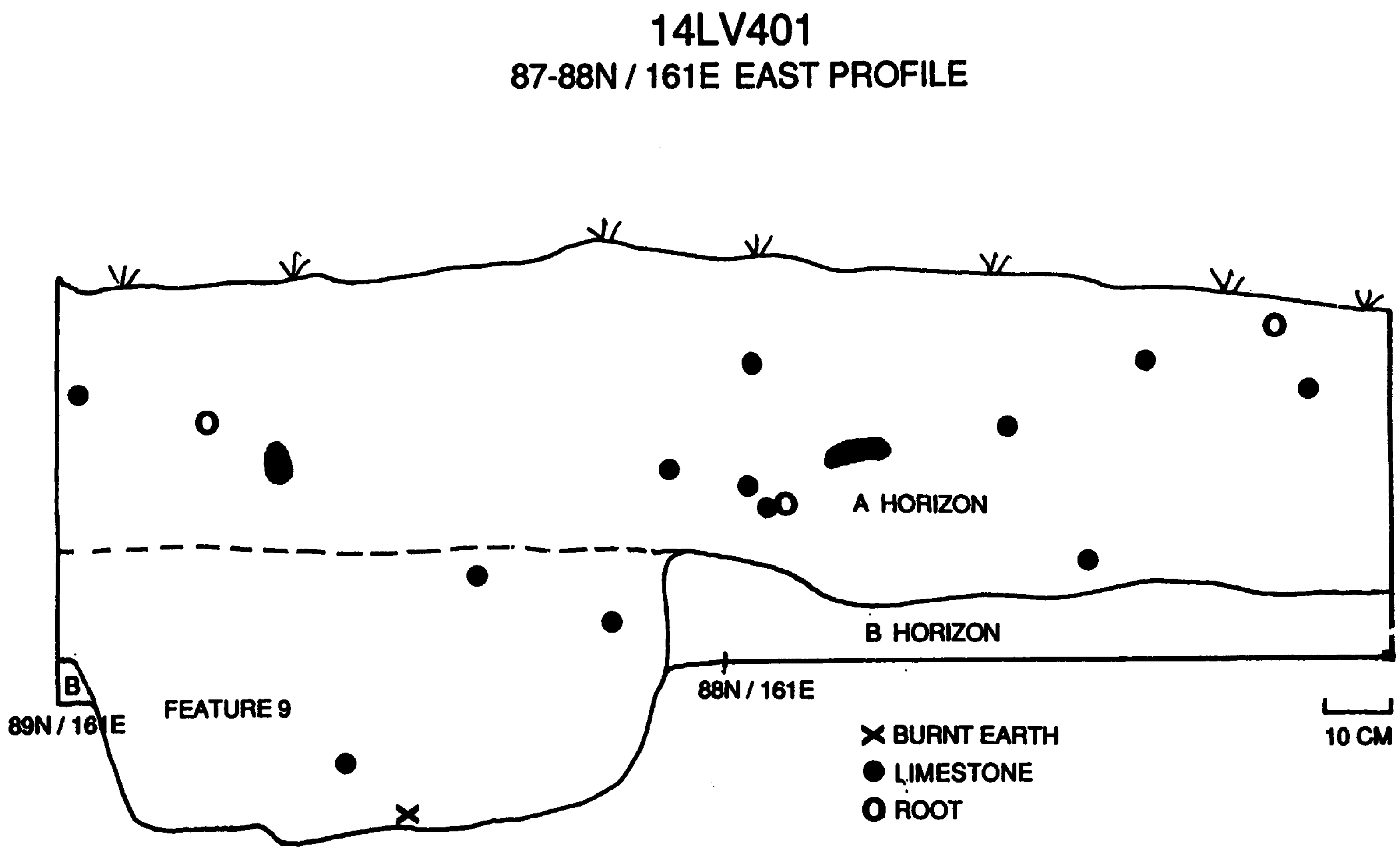
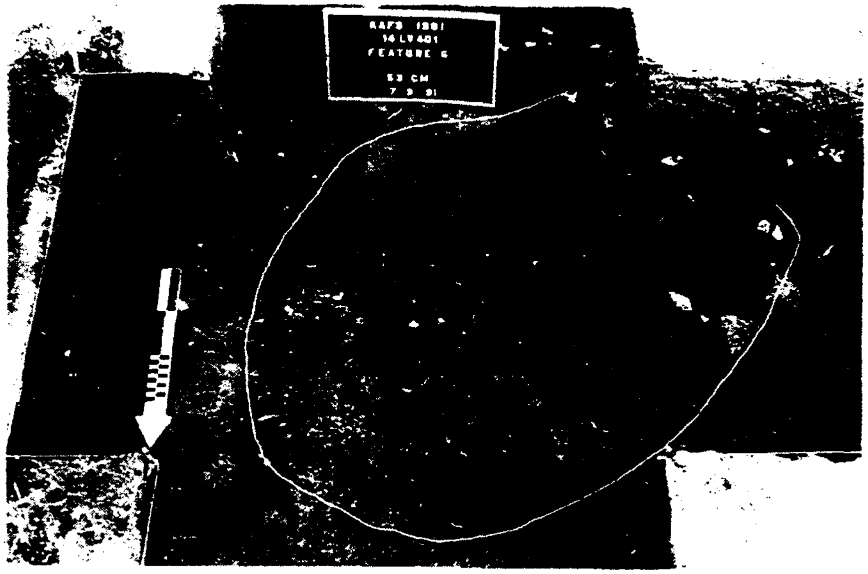


Figure 6.15 East Profile of 87-88N Showing Feature 9 (in part) in Profile.



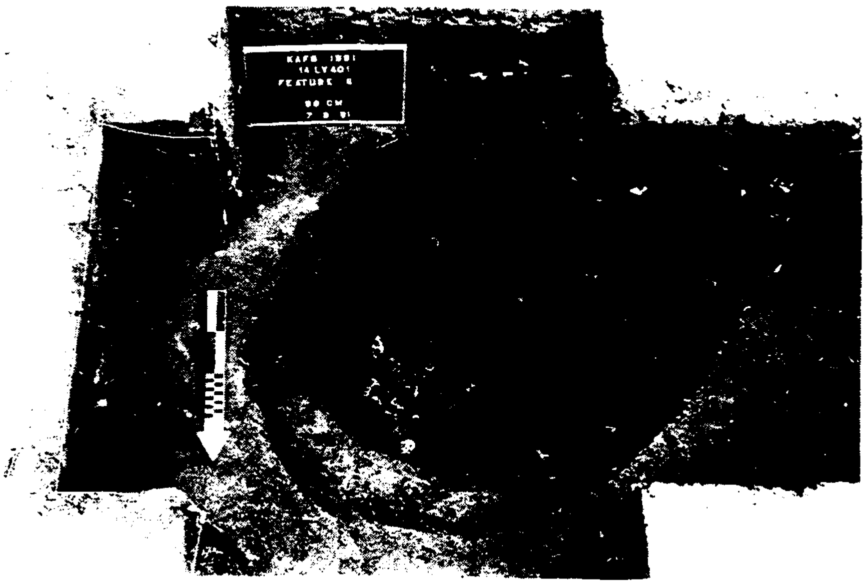


Figure 6.16 Above- Feature 6, Before Excavation, 53 cm b.s.; Below- Feature 6, 99 cm b.s., Note Concentration of Burned Limestone on Pit Floor.

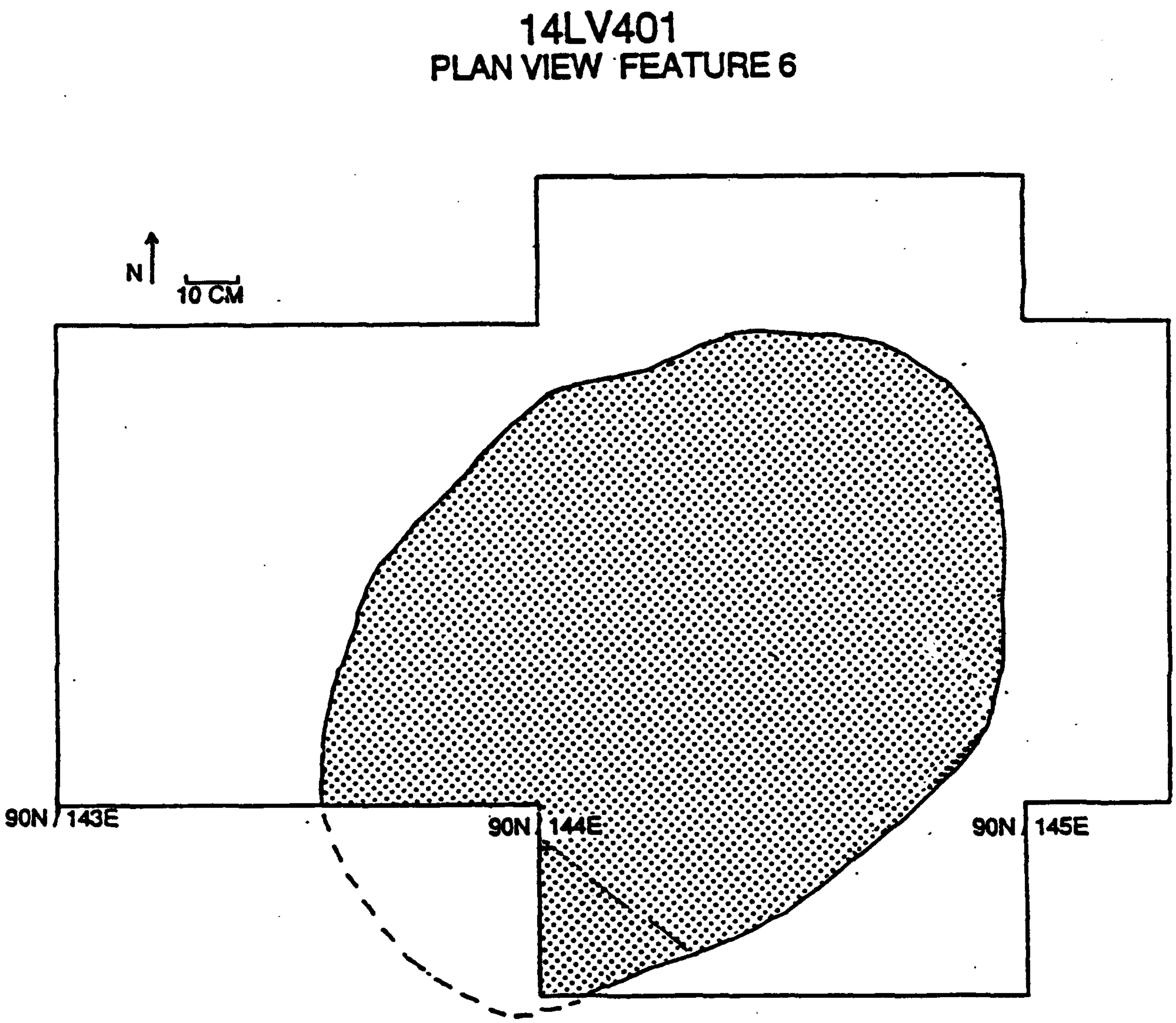


Figure 6.17 Plan View of Feature 6.

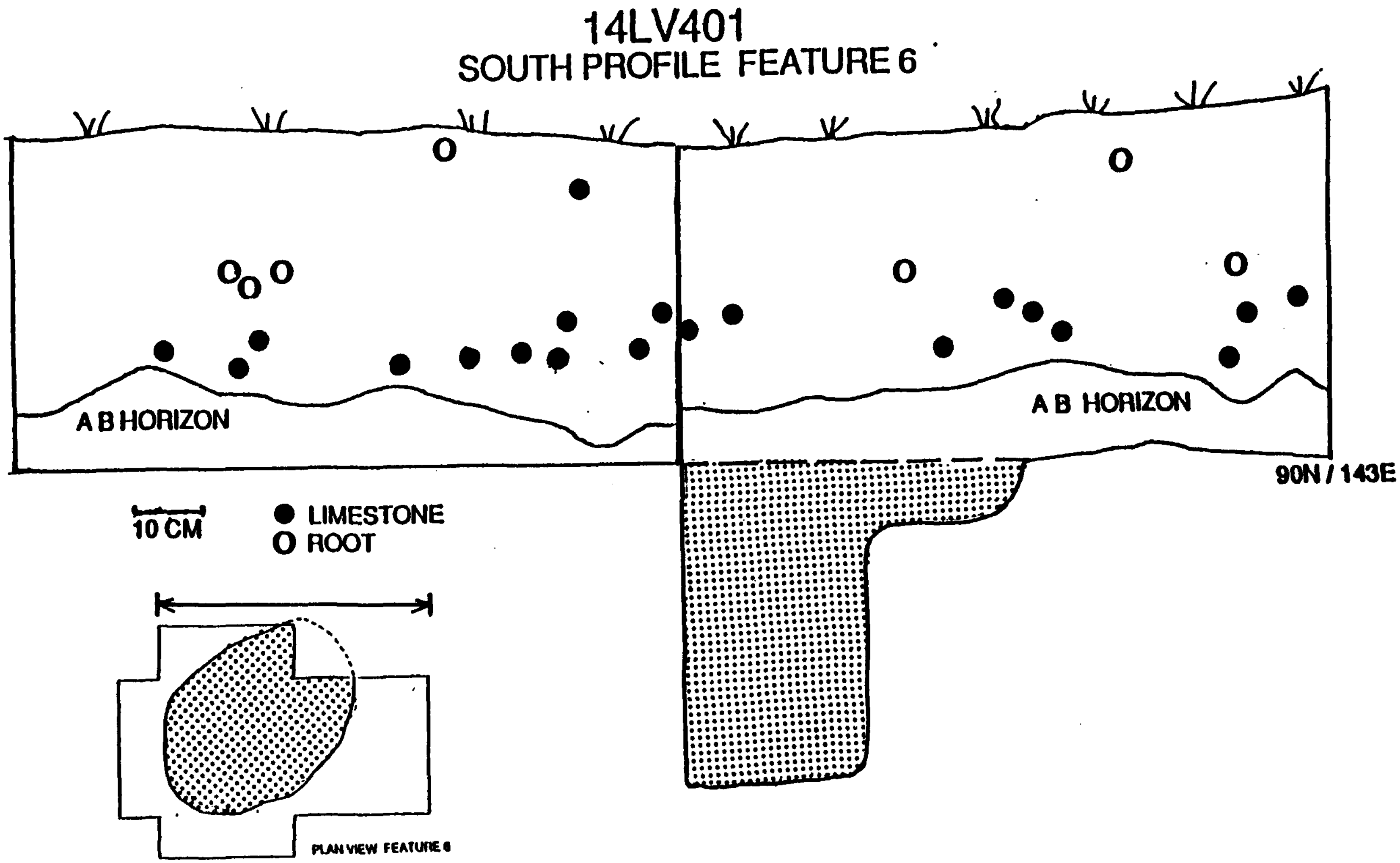


Figure 6.18 South Profile of 90N/143E and 89.60N/144E Showing Feature 6 (in part) in Profile. Arrows on Inset of Plan View Indicate Profiled Area.

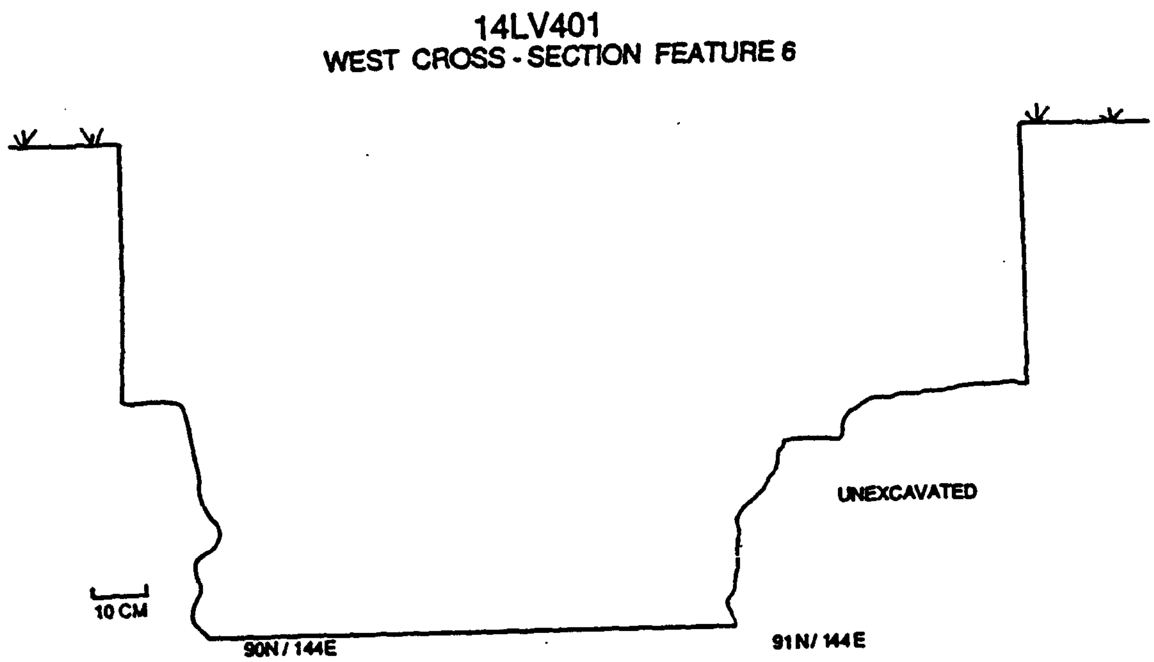


Figure 6.19 West Cross-Section of Feature 6.

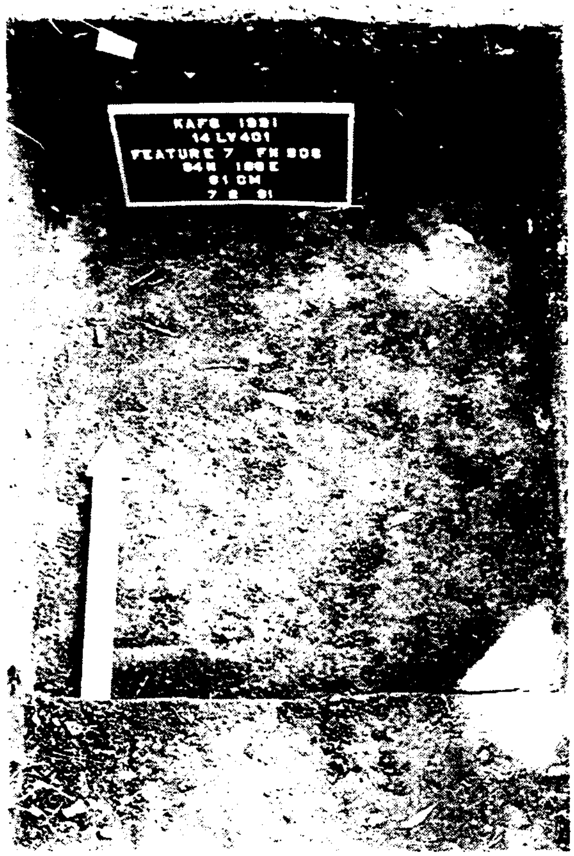


Figure 6.20 Above- Feature 6, After Excavation, 100 cm b.s.; Below- Feature 7, Initial Excavation, 61 cm b.s., Note Projectile Point.

The heavy fraction of the flotation samples contained the following material: ceramics (566.7 gms), lithics (669.9 gms), burned bone (292.9 gms), bone (508.7 gms), burned earth (486.7 gms), burned limestone (5,808.6 gms), charcoal (133.6 gms), sandstone (41.9 gms), mineral (188.9 gms), and shell (9.9 gms).

Sixteen gms of charcoal picked from the feature during its excavation was submitted for radiocarbon dating. The date is 1580±80 B.P.: A.D. 370 (Beta-47829). Calibration (Appendix 2) and interpretation of this assay are presented in chapter nine.

Feature 7: The pit which yielded the most abundant and varied artifact assemblage was first defined in unit 84N/168E at a depth of 61 cm (Fig. 6.20, lower). It was not detected during the magnetometer survey, though ex post facto review of that data revealed a weak anomaly at its location (see Weymouth herein). The mouth of this feature probably occurred at a higher elevation than that at which it could be defined within the B horizon soil. Sterile B horizon was encountered at depths of 45-50 cm in the two adjacent units of the trench. The presence of this pit was first suspected when cultural material continued to be found below that depth. A soil probe taken at a depth of 55 cm revealed AB horizon fill to a depth of at least another 30 cm. Three five cm levels (6-8) were excavated in unit 84N/168E before the perimeters of Feature 7 were recognized. These levels, and the cultural contents, undoubtedly belong to the pit. Indeed, the lower portion of level 5 (40-50 cm) probably contained its unrecognized mouth. Bitikofer (1993; Fig. 6.1-4) noted that the quantities/mass of ceramics, lithic tools, lithic debris and faunal material sharply increased in that level. Conversely, the amounts of this material sharply decreased in level 4 (30-40 cm) in comparison to those above it. The pit extended an inferred 8-10 cm into 84N/167 and 169E, portions left unexcavated.

At a depth of 65 cm the pit's outline was slightly oval, with a maximum exposed dimension (north-south axis) of 107 cm. The dimension along the long axis (east-west) is inferred to be 1.2 m (Fig. 6.21). Feature 7 had a bell-shaped cross-section with a relatively flat floor encountered at a depth below surface of 1.25 m (Figs. 6.22-23). Its form can also be seen, in part, on the east profile of unit 84N/168E (Fig. 6.24) and, in whole, on the trench profile (end page).

Feature 7 yielded 47 flotation samples, though one of these was a very small pocket of fill removed during excavation of a small ceramic pot discovered during the profiling of the west wall (see end page). As this pit was dug in ten cm levels, the final sample of each level may not have provided a full flotation measure. Moreover, as the feature was not completely excavated, the flotation samples do not provide an accurate estimate of its

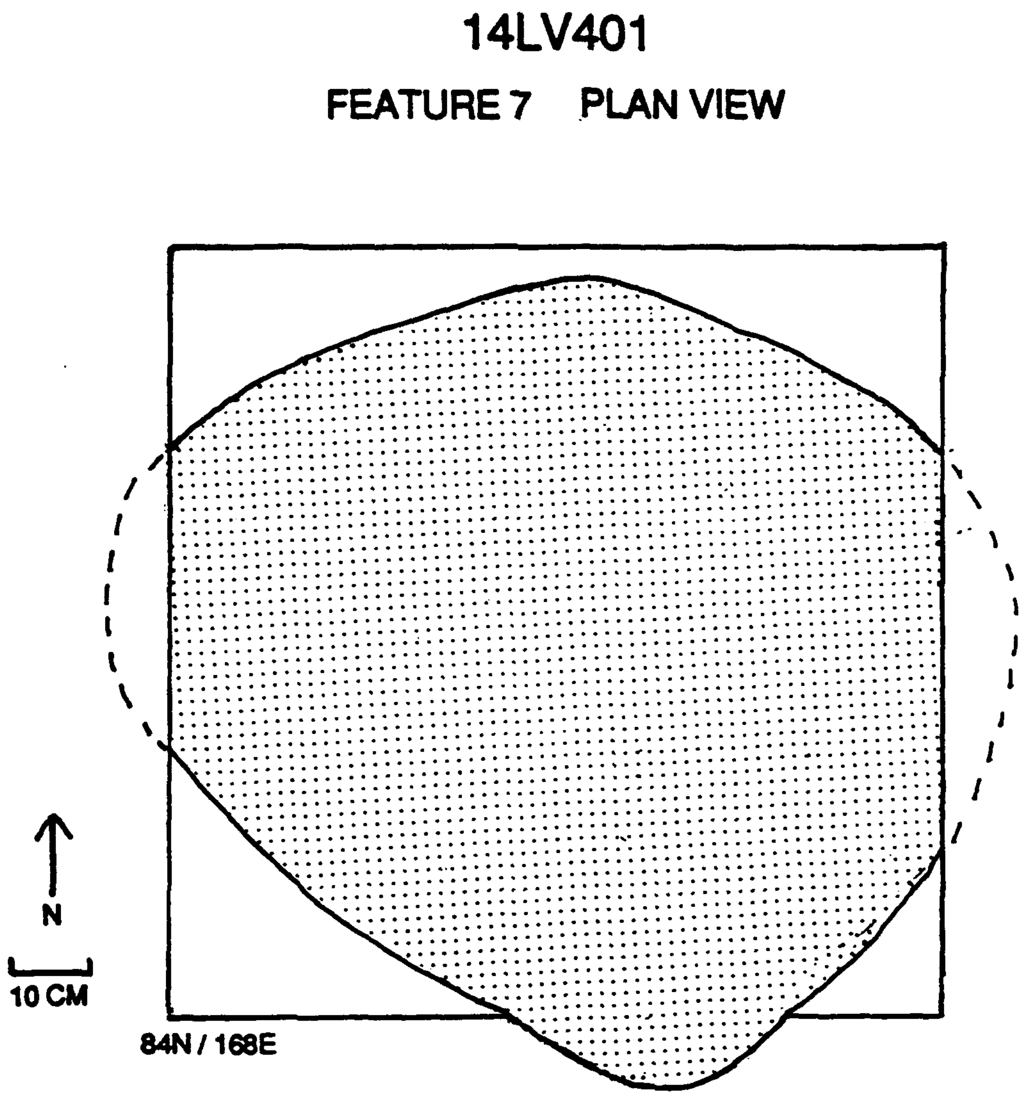


Figure 6.21 Plan View of Feature 7.

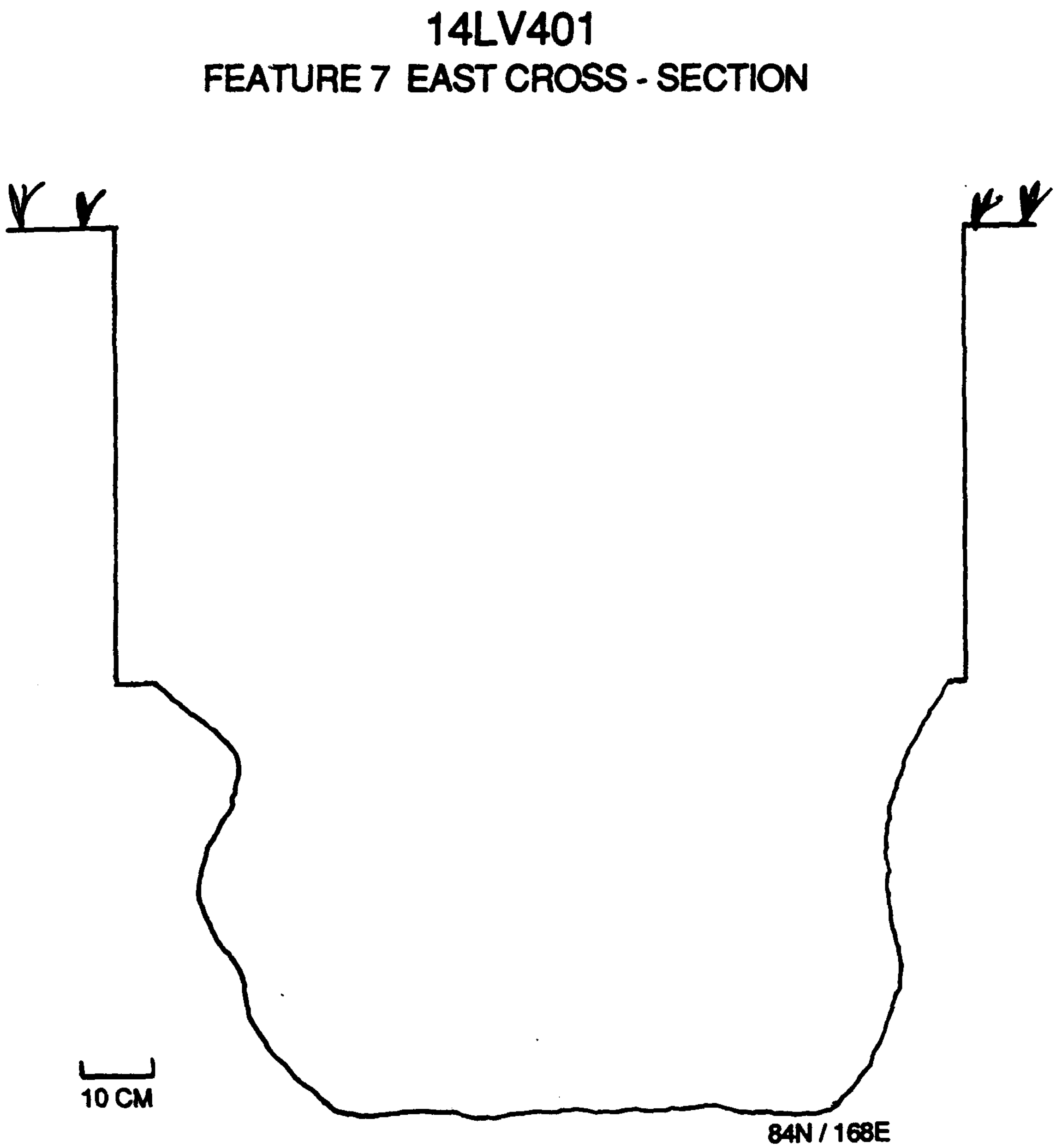


Figure 6.22 East Cross-Section of Feature 7.

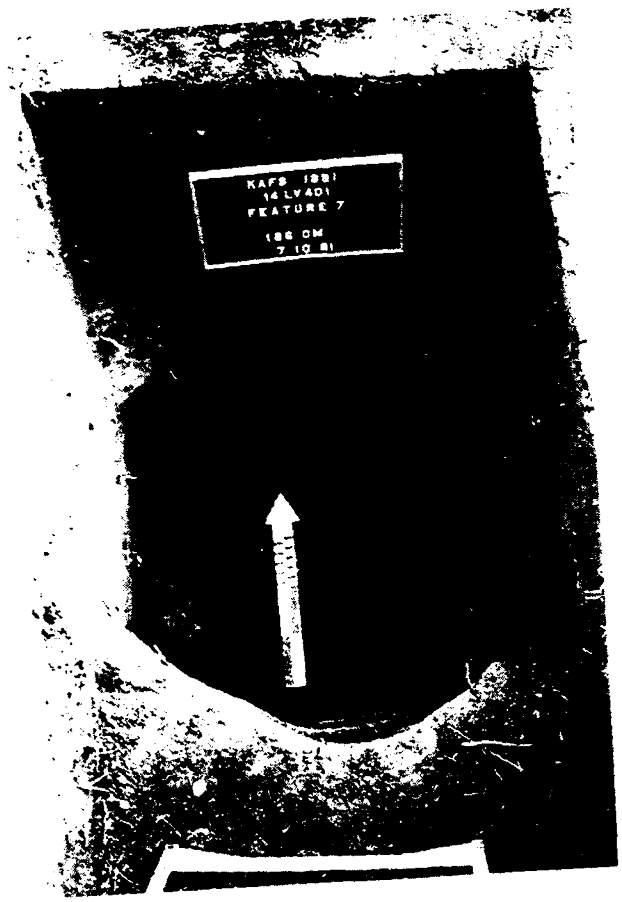


Figure 6.23 Above- Feature 7, 105 cm b.s., Note Deer Scapula; Below- Feature 7, After Excavation, 126 cm b.s.

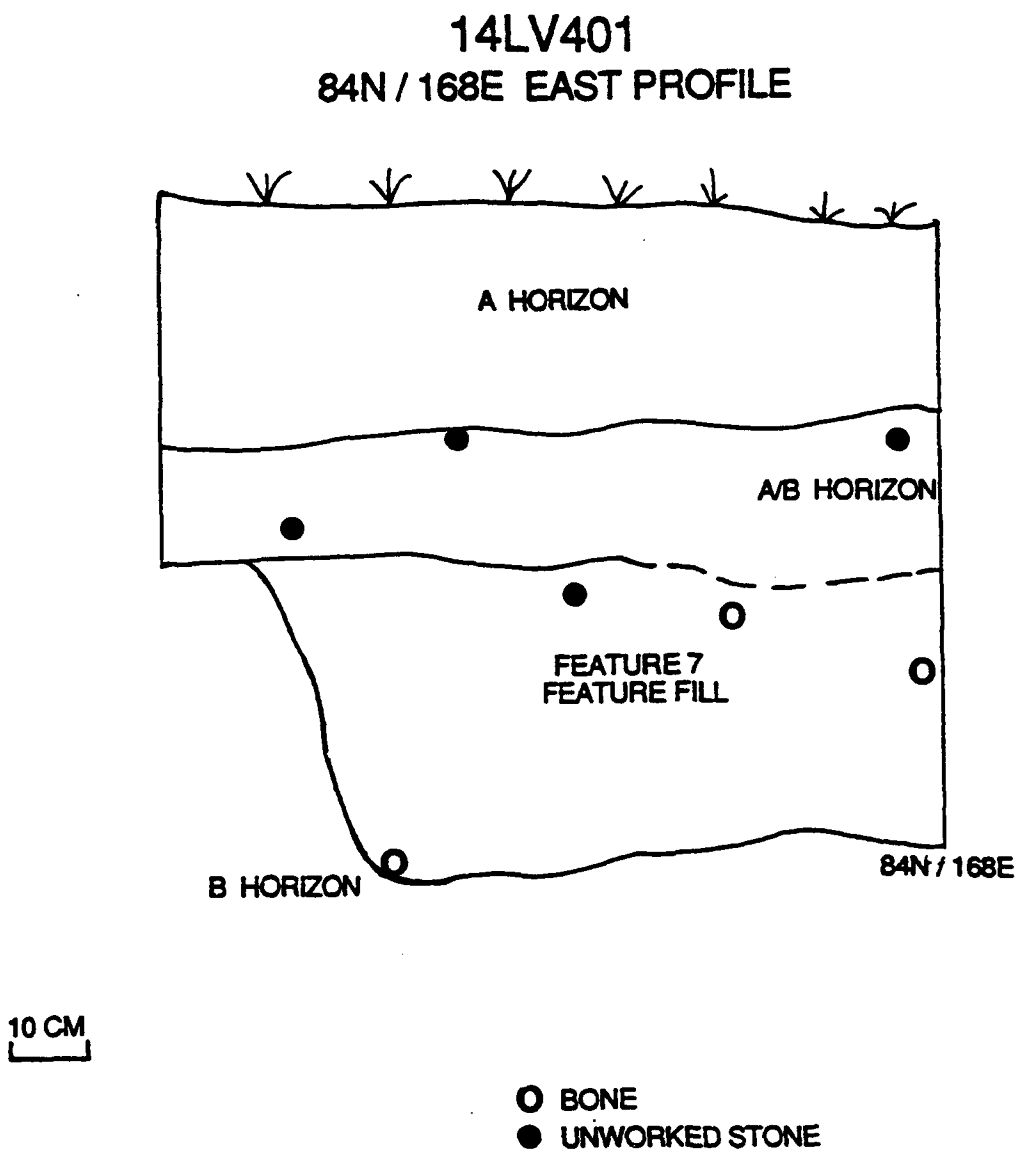


Figure 6.24 East Profile of 84N/168E Showing Feature 7 (in part) in Profile.

volume. A figure of ca. 30 bushels would be a reasonable estimate. The pit also contained a wealth of artifacts, of which 100 (2,088 gms) were piece-plotted and many more removed during excavation. Table 6.11 is a list of the former material and Table 6.12 presents the quantity/weight of latter artifacts. Material identified in the heavy fractions of the flotation samples is presented for each level of the feature in Table 6.13.

A 32 gm sample of charcoal picked from the pit during its excavation was submitted for radiocarbon dating. The date obtained is 1780±60 B.P.: A.D. 170 (Beta-47830). The calibration and interpretation of this date is presented in chapter nine.

Table 6.11. Point Provenience Artifacts from Feature 7 (No./Mass)

	Level					
Artifact	1	2	3	4	5	6
Pot	-	-	-	1/194	-	-
Bodysherd	3/ 35	2/23	2/150	-	-	-
Proj. point	1/ 14	-	3/ 24	-	-	-
Preform	1/ 29	-	2/ 34	1/ 11	-	-
Biface blank	-	-	-	-	1/ 72	-
Biface frag	1/ 6	-	-	3/ 59	4/ 33	-
Drill fragment	-	-	1/ 4	1/ 2	-	-
Scraper	1/ 7	1/37	-	-	1/ 29	3/ 64
Blade	1/ 3	1/ 3	-	-	-	-
Edge-mod flake	1/ 5	2/12	-	-	-	-
Flake	-	-	-	1/ 13	1/ 11	1/ 24
Core	1/ 54	-	-	-	-	1/ 38
Chunk	-	-	1/ 28	1/ 32	1/ 19	1/ 40
Abrader	-	-	-	-	-	1/112
Limestone celt	-	-	-	-	-	1/306
Antler	1/ 33	-	2/ 40	1/ 37	-	-
Mod. bone	1/ 10	-	-	1/ 3	1/ 15	-
Bone	4/ 21	3/16	6/ 36	7/ 75	12/109	11/154
Hematite	-	-	-	1/ 12	-	-
Totals	16/217	9/91	17/316	18/438	21/288	19/738

The features displayed some variability with respect to their age, size (volume), form and contents. Features 5, 8 and 9 appear, insofar as they were excavated, to be smaller than the other three in terms of orifice diameter, depth, and, by projection, volume. The latter two pits were impoverished in terms of artifact content. For the small portion of it dug, Feature 5 contained a relatively dense amount of cultural material. In that sense, it is comparable to Feature 6.

Table 6.12. Excavated Material from Feature 7 (Quantity/Mass-gms)

Artifact	Level 1	2	3	4	5	6
Bodysherds	5/ 19	8/ 33	5/ 19	12/ 33	4/ 20	7/ 25
Flakes	7/ 12	9/ 33	21/ 53	21/ 86	19/ 50	21/ 75
Chips	14/ 7	16/ 8	27/ 17	21/ 13	13/ 10	14/ 8
Shatter	3/ 7	3/ 7	12/ 21	1/ 3	-	1/ 5
Chunk	-	-	-	-	-	1/ 16
Blades	-	-	2/ 26	4/ 6	6/ 20	1/ 6
Bladelets	8/ 7	1/ 4	1/ 1	2/ 1	4/ 2	5/ 4
Tooth	1/ 1	1/ <1	-	-	-	-
Bone	*/ 36	1/ <1	*/ 24	*/ 47	*/ 72	*/ 74
Burntbone	*/ 3	*/ 14	-	-	*/ 3	*/ 3
Quartzite	*/ 7	*/ 1	-	-	-	-
Limestone	*/730	*/1338	*/2731	*/2104	*/1445	*/1434
Sandstone	*/ 21	*/ 8	-	*/ 1	-	*/ 27
Daub	*/ 13	*/ 17	-	*/ 1	-	-
Burntearth	*/ 15	*/ 2	-	*/ 28	*/ 29	*/ 8
Mineral	*/ 13	-	*/ 5	*/ 8	-	-
Charcoal[1]	*/ 2	-	*/ 3	*/ 32	-	-
Totals	38/893	39/1465	68/2900	61/2363	46/1651	50/1685[2]
Grand Total	302/10,957					

* Items not counted 1) Includes all carbonize plant matter
2 Includes Level 7 (1 cm thick) which had 1 chunk, 3 flakes (9 gms), 2 chips (2 gms) and 2 gms of bone.

Table 6.13. Material in Heavy Fraction of Flotation Samples from Feature 7 by Level (Mass-gms).[1]

Material	Level 1	2	3	4	5	6	7[2]	Total
Ceramic	50.2	22.0	31.7	43.2	27.7	12.6	4.0	191.4
Lithic	56.5	38.0	57.0	114.0	68.6	47.9	19.6	401.6
Bone	59.5	49.9	59.1	74.7	57.2	64.0	19.7	384.1
Burntbone	39.9	34.3	29.4	42.2	16.6	14.1	11.1	187.6
Shell	0	0	0	0	0	.2	0	0.2
Burntearth	74.7	74.6	61.8	73.6	80.0	51.6	18.5	434.8
Charcoal	8.5	9.4	8.5	13.4	12.2	8.6	3.1	63.7
Limestone	178.2	140.1	103.4	84.0	48.8	98.9	48.8	702.2
Sandstone	5.1	7.1	3.9	13.4	1.4	3.1	5.6	39.6
Mineral	0	0	0	13.9	4.3	18.9	6.6	43.7
Totals	472.6	375.4	354.8	472.4	316.8	319.9	137.0	2448.9
No. samples	10	7	9	9	5	4	3	47

1) From Romine 1993 2) This level was one cm thick

Features 6 and 7 were comparable in terms of general shape and volume. Feature 4 was unique in those respects, being more circular in shape and yielding considerably more fill than any other. Features 4, 5 and 6 appear to date to the same general time period, if not the same occupation. The first sigmas of their radiocarbon dates overlap, suggesting at least penecontemporaneity. Their ceramic and projectile point typologies also belong to the same general phase of the Kansas City Hopewell variant (see chapter eight, parts 1 and 2, and chapter nine).

The greatest contrast is between Feature 7 and all others with respect to age and content. This feature lacked the lipped or platform attribute shared by all others but Feature 4 and it was the only one of the six to have a more belled cross-section. The significance of these attributes for Hopewell storage pits in terms of function or time is as yet unknown. Feature 7 differed dramatically from the others, however, in other regards believed to be significant. As indicated by the radiocarbon date obtained from one of its central levels, this pit is demonstrably older than all others so dated. Unfortunately, no ceramic sherds were recovered to corroborate its assignment to an earlier phase of the Kansas City Hopewell variant. The relative dearth of ceramic material was observed during its excavation, though ironically it was Feature 7 which contained the only complete vessel recovered by the KAFS. Unfortunately, it was a small, crudely made pot of no apparent chronological value.

The projectile points recovered from Feature 7 do not differ from those found in the other pits, though they are remarkably better made. Indeed, in terms of both better quality and greater quantity, the lithic tools from the pit stand out from those of the other features. During its excavation, we noted the greater frequency of chipped stone tools, lithic debris, bone tools, and faunal remains in this feature. We also noted the relatively higher frequency of buff/brown chert debitage compared to other areas of the site. This last observation was tested by Romine (1993), who reviewed this material with respect to chert type and size. His data are summarized in Table 6.14.

Table 6.14. Debitage from Feature 7 Flotation: Size & Type.[1]

	Level 1 No./%	2 No./%	3 No.%	4 No./%	5 No./%	6 No./%	7 No./%	Total
>10cm								
GF	2/40	5/62.5	1/17	14/50	15/50	6/37.5	1/25	44/46
BB	3/60	3/37.5	4/83	14/50	15/50	8/50.0	3/75	50/52
NL	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0	2/12.5	0/ 0	2/ 2
Total	5	8	5	28	30	16	4	96
5-10cm								
GF	22/40	13/42	18/40	23/57.5	12/32	13/39	8/62	109/43
BB	34/60	18/58	27/60	17/42.5	26/68	20/61	5/38	147/57
NL	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0	0/ 0
Total	56	31	45	40	38	33	13	256
< 5cm								
GF	272/58	220/45	215/44	201/55	101/29	226/52	43/68	1278/48
BB	190/41	255/53	271/56	165/45	247/71	202/46	20/32	1350/51
NL	8/ 1	5/ 1	2/ 0	3/ 0	2/ 0	3/ 1	0/ 0	23/ 1
Total	470	480	488	369	350	431	66	2651

GF:Gray fossiliferous BB:Buff/brown NL:Non-local

1) From Romine 1993

Chapter 7

ARTIFACT ASSEMBLAGE ANALYSES

Part 1

CERAMIC ARTIFACTS

Eva Lord Cook

The Quarry Creek site yielded a ceramic sample representative of that found at other Hopewell sites excavated in the area including a minature rim, a complete pot, and intricately decorated rims representing the early and middle phases of the Kansas City Hopewell occupation, as well as the plain rims typical of the late phase. Two Plains Village (Pomona?) rim sherds were found, representing a possible brief occupation after the Hopewell occupations. These rim sherds have been carefully examined and described, the results providing information about the site and the Kansas City Hopewellians in general.

Three Kansas City Hopewell ceramic styles, associated with three periods in time, have been determined as follows:

> 1) Pottery rims decorated with cord-wrapped stick impressions, dentate impressions, or plain stick impressions and bosses (Trowbridge phase, ca. A.D. 1-250); 2) Pottery rims decorated with crosshatching and punctates (Kansas City phase, ca. A.D. 250-500); 3) Pottery rims lacking decoration or with crenations (Edwardsville phase, ca. A.D. 500-750) (Johnson, in press)

These changes correspond to style changes in Illinois Hopewell pottery (Johnson 1983:105).

The most decorative of the Kansas City Hopewell ceramics occur during the Trowbridge phase. Vessels of this phase often bear decorations on the rim, shoulder, and body. Diverse decorating techniques producing different effects are found in many different combinations; the resulting decorative patterns are often separated by trailed lines. Decorated areas may be interspersed with undecorated areas producing a zone-decorated piece. Cord-wrapped or plain stick impressions can be found at uniform intervals around the exterior rim of vessels. Alternatively, vertical or diagonally angled dentate stamps may decorate the rims of pottery vessels. Dentate stamping often appears in zoned areas. Bosses are dome-shaped protrusions formed by placing a tool perpendicular to the inside of the vessel and then punching toward the exterior. They are usually found below the upper rim decorations of the vessel (Chapman 1980). Trowbridge ceramics tend to have thicker lip diameters and the temper may be coarser than that of the ceramics of the later phases.

During the Kansas City phase, ceramic decoration became less elaborate. Stick impressions, dentate stamping, and bosses were replaced by crosshatching and punctates. Crosshatching appears as a band around the rim. The band extends downward from the lip nearly to the base of the rim. Below the crosshatching there is often a horizontal row of punctates. A narrow, undecorated area may be found beneath the punctates, and the punctates may be underlain by an incised line. The crosshatching is found either closely or widely spaced and it can be precisely or haphazardly placed. Punctates were produced by placing a round flat-ended tool perpendicularly against the exterior of the vessel and pressing inward. The type of tool used may have been a bone or a stick which had been smoothed and which had a flattened end. Punctates are found in round, oval, hemiconical, rectangular, ovoidal, or crescent shapes. As described by Wedel (1943:37), "the punctates vary widely, owing to the different instruments used to produce them and to the various angles at which the tool was impressed into the clay".

An alternative decoration found on Kansas City phase rims consists of rocker stamp markings (Johnson and Johnson 1975). These markings may be found placed vertically or horizontally on the rim and they appear as curved lines. There ay be several parallel rows of rocker stamp markings. These, also, may be underlain by a row of punctates. Rocker stamp markings are thought to have been applied by a tool with a curved end, possibly made of bone or antler. Kansas City phase ceramics are thinner and the tempering is finer than that of Trowbridge ceramics.

The Edwardsville phase of Kansas City Hopewell ceramics is characterized by plain rims or by crenated rims. Rims produced during the Edwardsville phase may bear a single row of punctates, and punctates may appear on the body of vessels (Johnson 1983).

Kansas City Hopewell ceramics for all phases are tempered with stone, varying from coarse to fine, or sand. Colors for both exterior and interior surfaces range from tan to brown to nearly black. Cores are often black. Some pieces have a reddish cast indicating exposure to heat. Surfaces are usually smoothed over with no evidence of a slip or glaze.

The Quarry Creek ceramic assemblage is representative of Kansas City Hopewell pottery. According to radiocarbon dates and the seriation of ceramic rim sherds, the occupation of the site appears to have first occurred late during the Trowbridge phase (ca. A.D. 200), throughout the Kansas City phase, and into the early Edwardsville phase (ca. A.D. 550). Only three sherds bearing Trowbridge phase decorations were found, and two of these have punctates which characterize the Kansas City phase (Tables 7.1-2). These sherds may represent a transition from the Trowbridge to phase to the Kansas City phase. In the sample examine for this analysis, the Kansas City phase at Quarry Creek consisted of 33 rim sherds; four have rocker stamp rims while 29 are cross-hatched. Twenty-eight Edwardsville phase ceramic rim sherds were excavated at Quarry Creek. Two are plain with punctates, nine are crenated and 17 are plain. Notched rims are included with crenated rims. Two of the rim sherds bear attributes of both Kansas City and Edwardsville phases and were recorded separately for purposes of the analysis as they also may represent an era of transition between phases.

A total of 99 rim sherds is included in the analysis. Thirteen of these were found in features which consisted of food storage pits which were converted to trash pits when they were no longer suitable for storage. When the pits were filled with trash, continued dumping formed a midden over the pits. Eighty-six of the rim sherds were excavated from an exploratory trench through the center of one of the middens (see chapters 4 and 6).

Eighty-one body sherds are included in the analysis. Twenty-four bear rocker stamp markings, two are dentate stamped and two are punctated. Fifty-three sherds are designated as being decorated. Because there are undecorated areas on ceramic vessels of both the Trowbridge and Kansas City phases, and many vessels produced in the Edwardsville phase are plain, it would not be possible to determine the phase of a body sherd based on decoration alone. Levels are available for most sherds in Feature 7. Of the 81 sherds, 54 were excavated from the trench, and 27 from the midden features.

Eleven different measurements were taken for rim sherds, and six measurements were taken for body sherds, each for a specific attribute. The weight of each sherd was measured in gms. and noted; however, this measurement is not discussed. A second measurement for both rim and body sherds is that of surface treatment. Each sherd examined appeared to be smoothed over with no evidence of a slip, glaze, or application of decorative paint. Tempering technique was examined, and each sherd, as is Kansas City Hopewell pottery in general, was tempered with sand or grit; texture ranged from coarse to fine. A last measurement common to both rim and body sherds was that of color. Color was determined according to the Munsell Soil Color Charts. Colors ranged between tan to very dark brown. Several sherds were reddish-yellow, and a large number of the cores were black. Black cores often were accompanied with very dark brown to black interiors which looked as if the dark color penetrated into the core of the

TABLE 7.1

SAMPLE SIZE SUMMARY

TROWBRIDGE:	Dentate Stamp Rims	- 2
	Boss and Punctates	- 1
	TOTAL:	3

Note: Trowbridge samples often have punctates.

KANSAS CITY:	Crosshatched Rims	- 40
	Rocker Stamp Rims	- 8
	TOTAL	48

EDWARDSVILLE:	Plain w/Punctates	- 4
	Crenelated	- 15
	Plain	- 27
	TOTAL:	46

KANSAS CITY/EDWARDSVILLE		- 2
	TOTAL:	2

TOTAL NUMBER OF SAMPLES: 99

TABLE 7.2

DEPTH LEVEL SUMMARY

	Catalog No.	Level
Trowbridge:	A3488/91	1
	A3182/91	3
	A3065/91	5
Kansas City:	A1569/91	1
	A2694/91	1
	A3236/91	2
	A1602/91	2
	A1918/91	2
	A2360/91	2
	A2792/91	2
	A2866/91	2
	A2936/91	2
	A3239/91	2
	A3717/91	2
	A1768/91	2
	A3423/91	2
	A3423/91	2
	A1628/91	3
	A2021/91	3
	A2885/91	3
	A3032/91	3
	A3260/91	3
	A3669/91	3
	A3671/91	3
	A1130/91	3
	A1377/91	3
	A3980/91	3
	A3980/91	3
	A0771/91	3
	A1646/91	4
	A2620/91	4
	A2546/91	4
	A0935/91	4
	A3535/91	4
	A3276/91	4
	A1232/91	5
	A1372/91	5
	A1372/91	5
	A2988/91	5
	A3211/91	5
	A3307/91	5
	A0821/91	5
Kansas City/ Edwardsville:	A2473/91	4
	A2750/91	4

	Catalog No.	Level
Edwardsville:	A2694/91	1
	A2774/91	1
	A0723/91	1
	A1569/91	1
	A3801/91	1
	A1114/91	2
	A2792/91	2
	A2884/91	2
	A3013/91	2
	A3013/91	2
	A3096/91	2
	A3097/91	2
	A3164/91	2
	A0863/91	2
	A3328/91	2
	A4390/91	2
	A1917/91	3
	A3260/91	3
	A4357/91	3
	A3671/91	3
	A0881/91	3
	A0782/91	3
	A1629/91	3
	A1783/91	3
	A3578/91	3
	A4392/91	3
	A2054/91	4
	A2823/91	4
	A3287/91	4
	A0936/91	4
	A1151/91	4
	A1393/91	4
	A1409/91	4
	A1167/91	4
	A4099/91	4
	A2559/91	5
	A4358/91	5
	A4363/91	5
	A3618/91	5
	A1276/91	6
	A2652/91	6
	A2683/91	8

Note: Duplicated catalog numbers indicate two or more sherds bearing same catalog number.

Note: Sherds found in Features do not have level numbers.

vessel as a result of the cooking process. Darker fire clouds on exteriors of sherds was also noted. The thickness of body sherds is recorded.

In addition to the above measurements, rim sherds were measured for rim height, rim thickness, mouth diameter, lip form and rim form. Rim height was taken from the lip of the vessel to the point at which the neck could be determine to begin, usually a point of inflection, a trailed line beneath a row of decoration, or a the base of the decorations themselves. If the piece was broken, or the measurement could not be made, the classification for this measurement was listed as undetermined. In the case of the Edwardsville phase pottery, rims often lack shoulders or any point of inflection as a result of a lack of decoration. There is no break between the lip and the body of the vessel. Rim height for these pieces was listed as not applicable (N/A). Thirteen Edwardsville sherds had discernible rim; each began to inflect at a given distance beneath the lip, providing a point at which a rim stopped and the shoulder began. Rim thickness was taken just below the lip of the vessel.

Mouth diameter was taken from the interior of the lip of each rim sherd according to its curvature. Measurements were made by placing the interior of the lip against a line of known curvature in cm. The only exception to this was the complete pot (A4279/91) which was measured with calipers. Rims were not measured if they were too small to see any meaningful curvature.

Lip form was determined by viewing the lip of the sherd as it appeared if held facing the core. Lip forms are found to be round, semi-flattened, or flattened. A designation of flattened was made if the lip appeared entirely flattened on the top. Lip form was round if a curve appeared, and semi-flattened if it apeared that some attempt had been made to flatten thelip without producing a flat surface. Rims with this designation have a line on the interior of the lip indicating that some attempt may have been made to flatten the lip, or that it was slightly flattened when place upside down while still in a pliable state to dry.

Rim form was examined to determine whether a rim flared outward (everted), or curved inward (inverted). Rims that remained vertical were designated as straight.

Table 7.2 provides a summary of all sherds for which a depth level was available (it does not include rims from features). Some catalog numbers are listed twice because sherds screened from the same level were assigned the same catalog number. The Trowbridge sample is too small to be meaningful in terms of sample distribution by style (Table 7.3). The Kansas City phase samples are tightly clustered in Levels 1 through 5 with equal numbers found in Levels 2 and 3 (12 sherds in each).

TABLE 7.3

SAMPLE DISTRIBUTION BY STYLE

TROWBRIDGE			KANSAS CITY			EDWARDSVILLE		
Level	Number	Percent	Level	Number	Percent	Level	Number	Percent
1	1	33%	1	2	5%	1	5	12%
2	0	0%	2	12	32%	2	11	27%
3	1	33%	3	12	32%	3	10	24%
4	0	0%	4	6	16%	4	9	20%
5	1	33%	5	7	16%	5	4	10%
6	0	0%	6	0	0%	6	2	5%
7	0	0%	7	0	0%	7	0	0%
8	0	0%	8	0	0%	8	1	2%
TOTALS:	3	100%		39	100%		42	100%

Note: Kansas City/Edwardsville transition pieces (2) in level 4.

Sherds found in Features do not have level numbers.

Edwardsville phase samples are distributed among more levels. In general, the clustering is similar to that of the Kansas City phase. Even though the site has not been disturbed by plowing, geological forces such as the freeze/thaw cycle, and biogenic forces such as rodent and earthworm burrowing and tree fall in which trees are uprooted, redistribute artifacts buried beneath the surface. A much larger sample size is needed to understand the depth distribution of the ceramic assemblage.

A Lip and Rim Summary is presented in Table 7.4. They are listed in terms of flat, round, or semi-flattened for lip form and straight, everted, or inverted for rim form. If the measurement could not be taken, it is designated as undetermined. The frequency of type of lip form with type of rim form is given in Table 7.5. During the Kansas City phase, the preferred lip form seems to be either flat or semi-flattened. This trend continues into the Edwardsville phase. The most notable change is that rim form preference shifts from everted during the Kansas City phase to inverted during the Edwardsville phase.

A summary of all mouth diameters which could be measured is available in Table 7.6. The relative mouth diameter distribution for each phase is presented in Table 7.7. Only one of the Trowbridge sherds could be measured for mouth diameter. During the Kansas City phase, mouth diameters are clustered from 20 cm to 36 cm. There is a large range for Edwardsville phase sherds. There are more very large pieces produced during the Edwardsville phase than during the Kansas City phase.

Table 7.8 is a rim height and thickness summary. Most Edwardsville sherds lack a discernable rim height. Only 12 had a measureable rim due to curvature of the vessel. Very little can be determined by rim height distribution (Table 7.9); however, the Edwardsville phase appears to have greater variation in rim height perhaps reflecting both the sample sizes and stylistic variations between phases. Rim thickness (Table 7.10) ranges more widely in Edwardsville phase vessels, and are more clustered and uniform in the Kansas City phase. As expected, Trowbridge rim sherds are very thick, measuring between .71-.80 cm and 1.01-1.10 cm. There is one Edwardsville phase sherd which measures between 1.00 and 1.10 cm. The Kansas City and Edwardsville phases are similar in distribution. Mean rim height and mean rim thickness are given in Table 7.11. Kansas City phase sherds tend to be thicker than Edwardsville phase sherds, while rim height is similar, 2.85 cm and 2.89 respectively. There may be a trend for vessels to become thinner over time; however, a larger sample size is needed to determine a definite trend. A summary of all body sherds included in the sample is presented in Table 7.12 They are listed according to type of decoration and the level in which they were found.

TABLE 7.4

LIP AND RIM FORM SUMMARY

	Catalog No.	Lip Form	Rim Form
Trowbridge:	A3065/91	F	S
	A3182/91	S-F	E
	A3488/91	F	E
Kansas City:	A4164/91	F	E
	A3276/91	F	E
	A3236/91	S-F	E
	A1628/91	F	I
	A4094/91	S-F	E
	A4098/91	S-F	I
	A4093/91	S-F	S
	A4122/91	R	E
	A4125/91	R	E
	A4127/91	R	S
	A4140/91	R	S
	A4147/91	F	E
	A2620/91	F	S
	A1918/91	F	E
	A2866/91	R	U
	A2360/91	F	U
	A2936/91	S-F	E
	A3239/91	S-F	E
	A1602/91	F	I
	A2021/91	F	E
	A3032/91	F	E
	A2546/91	R	U
	A1372/91	F	E
	A1372/91	S-F	I
	A1232/91	F	E
	A3307/91	S-F	E
	A2988/91	R	E
	A3211/91	S-F	E
	A2885/91	S-F	E
	A1646/91	F	E
	A2694/91	S-F	I
	A2792/91	F	I
	A3669/91	S-F	E
	A3671/91	S-F	E
	A3717/91	S-F	E
	A0935/91	F	E
	A1130/91	R	E
	A1377/91	F	E
	A1569/91	S-F	E
	A1768/91	R	S
	A3423/91	F	S
	A3423/91	U	U
	A3535/91	S-F	E
	A3980/91	F	I
	A3980/91	S-F	S
	A0771/91	S-F	S
	A0821/91	F	S
	A3260/91	U	U
Kansas City/ Edwardsville	A2472/91	R	S
	A2750/91	F	I
Edwardsville:	A4099/91	R	E
	A4074/91	R	S
	A4073/91	S-F	I
	A2792/91	S-F	U
	A4180/91	F	I
	A4279/91 (Complete Pot)	S-F	S
	A2823/91	F	S
	A1917/91	F	E
	A1276/91	F	S
	A1114/91	S-F	U
	A2054/91	F	E
	A3287/91	F	E
	A3097/91	F	I
	A1167/91	F	I
	A4363/91	F	I
	A3096/91	R	S
	A2774/91	F	E
	A2884/91	F	E
	A2652/91	S-F	I
	A2683/91	F	I
	A2559/91	S-F	I
	A4357/91	S-F	I
	A3164/91	F	E
	A4358/91	F	E
	A3260/91	S-F	S
	A2694/91	S-F	I
	A3013/91	F	I
	A3013/91	F	I
	A3671/91	F	I
	A0723/91	S-F	E
	A0863/91	R	S
	A0881/91	S-F	E
	A0782/91	S-F	S
	A0936/91	F	I
	A1151/91	F	S
	A1393/91	R	S
	A1409/91	F	E
	A1569/91	S-F	E
	A1629/91	F	I
	A1783/91	S-F	S
	A3328/91	F	S
	A3578/91	R	S
	A3618/91	S-F	I
	A4390/91	S-F	I
	A4392/91	R	S
	A3801/91	S-F	I

KEY:
- F = Flat
- S-F = Semi-Flattened
- R = Round
- S = Straight
- I = Inverted
- E = Everted
- U = Undetermined

Note: Duplicate catalog numbers indicate two or more sherds bearing same catalog number.

TABLE 7.5

LIP AND RIM FORM DATA SUMMARY

STYLE	RIM FORM EVERTED #	RIM FORM EVERTED %	STRAIGHT #	STRAIGHT %	INVERTED #	INVERTED %
TROWBRIDGE:						
F	1	33%	1	33%	0	0%
S-F	1	33%	0	0%	0	0%
R	0	0%	0	0%	0	0%
KANSAS CITY:						
F	11	26%	3	7%	4	9%
S-F	12	28%	3	7%	3	7%
R	4	9%	3	7%	0	0%
EDWARDSVILLE:						
F	8	18%	4	9%	10	23%
S-F	3	7%	4	9%	8	18%
R	1	2%	6	14%	0	0%

Kansas City/Edwardsville Transition Pieces:

One round lip form/straight rim form combination.

One flat lip form/inverted rim form combination.

KEY: F = Flat, S-F = Semi-flattened, R = Round

TABLE 7.6

MOUTH DIAMETER SUMMARY

	Catalog No.	Diameter(cm)
Trowbridge:	A3065/91	20
	A3182/91	U
	A3488/91	U
Kansas City:	A3276/91	32
	A3236/91	20
	A1628/91	20
	A4164/91	12
	A2620/91	40
	A1918/91	36
	A2866/91	44
	A2360/91	52
	A2936/91	44
	A3239/91	20
	A1602/91	U
	A2021/91	12
	A3032/91	20
	A2546/91	U
	A1372/91	30
	A1372/91	24
	A1232/91	20
	A3307/91	30
	A2988/91	32
	A3211/91	U
	A2885/91	16
	A1646/91	20
	A2792/91	20
	A4094/91	24
	A4098/91	32
	A4093/91	36
	A4122/91	60
	A4125/91	44
	*A4127/91	24
	*A4140/91	24
	A4147/91	36
	A3669/91	28
	A3671/91	U
	A3717/91	12
	A0935/91	34
	A1130/91	16
	A1377/91	18
	A1569/91	18
	A1768/91	26
	A3423/91	U
	A3423/91	U
	A3535/91	32
	A3980/91	U
	A3980/91	U
	A0771/91	34
	A0821/91	32
	A2694/91	U
	A3260/91	U
Kansas City/ Edwardsville	A2750/91	16
	A2472/91	60
Edwardsville:	A2823/91	64
	A1917/91	24
	A1276/91	12
	A4180/91	24
	A1114/91	26
	A2054/91	44
	A3287/91	24
	A3097/91	U
	A1167/91	28
	A4363/91	72
	A3096/91	60
	A2774/91	28
	A2884/91	24
	A2652/91	24
	A2683/91	20
	A2559/91	10
	A4357/91	18
	A3164/91	U
	A4358/91	U
	A3260/91	36
	A4099/91	18
	A4074/91	36
	A4073/91	48
	A3671/91	10
	A4279/91 (Complete Pot)	8.21
	A0723/91	10
	A0863/91	16
	A0881/91	20
	A0782/91	U
	A0936/91	36
	A1151/91	20
	A1393/91	22
	A1409/91	34
	A1569/91	20
	A1629/91	16
	A1783/91	24
	A3328/91	6
	A3578/91	16
	A3618/91	18
	A4390/91	6
	A4392/91	16
	A3801/91	U
	A2792/91	U
	A3013/91	U
	A3013/91	U
	A2694/91	U

*Crossmended

Key: (U) = Undetermined

TABLE 7.7

MOUTH DIAMETER DISTRIBUTION

TROWBRIDGE			KANSAS CITY			EDWARDSVILLE		
Diameter	Number	Percent	Diameter	Number	Percent	Diameter	Number	Percent
4cm	0	0%	4cm	0	0%	4cm	0	0%
6cm	0	0%	6cm	0	0%	6cm	2	6%
8cm	0	0%	8cm	0	0%	8cm	0	0%
10cm	0	0%	10cm	0	0%	10cm	3	8%
12cm	0	0%	12cm	3	8%	12cm	1	3%
14cm	0	0%	14cm	0	0%	14cm	0	0%
15cm	0	0%	15cm	0	0%	15cm	0	0%
16cm	0	0%	16cm	2	5%	16cm	4	11%
18 cm	0	0%	18cm	2	5%	18cm	3	8%
20cm	1	100%	20cm	8	21%	20cm	4	11%
22cm	0	0%	22cm	0	0%	22cm	1	3%
24cm	0	0%	24cm	4	10%	24cm	6	17%
26cm	0	0%	26cm	1	3%	26cm	1	3%
28cm	0	0%	28cm	1	3%	28cm	2	6%
30cm	0	0%	30cm	2	5%	30cm	0	0%
32cm	0	0%	32cm	5	13%	32cm	0	0%
34cm	0	0%	34cm	2	5%	34cm	1	3%
36cm	0	0%	36cm	3	8%	36cm	3	8%
38cm	0	0%	38cm	0	0%	38cm	0	0%
40cm	0	0%	40cm	1	3%	40cm	0	0%
42cm	0	0%	42cm	0	0%	42cm	0	0%
44cm	0	0%	44cm	3	8%	44cm	1	3%
46cm	0	0%	46cm	0	0%	46cm	0	0%
48cm	0	0%	48cm	0	0%	48cm	1	3%

TABLE 7.7 (continued)

50cm	0	0%	50cm	0	0%	50cm	0	0%
52cm	0	0%	52cm	1	3%	52cm	0	0%
54cm	0	0%	54cm	0	0%	54cm	0	0%
56cm	0	0%	56cm	0	0%	56cm	0	0%
58cm	0	0%	58cm	0	0%	58cm	0	0%
60cm	0	0%	60cm	1	3%	60cm	1	3%
62cm	0	0%	62cm	0	0%	62cm	0	0%
64cm	0	0%	64cm	0	0%	64cm	1	3%
66cm	0	0%	66cm	0	0%	66cm	0	0%
68cm	0	0%	68cm	0	0%	68cm	0	0%
70cm	0	0%	70cm	0	0%	70cm	0	0%
72cm	0	0%	72cm	0	0%	72cm	1	3%

Kansas City/Edwardsville: 1 sherd = 16 cm

1 sherd = 60 cm

Complete Pot = 8.21 cm

TABLE 7.8

RIM HEIGHT AND THICKNESS SUMMARY

	Catalog No.	H(cm)	T(cm)
Trowbridge:	A3065/91	3.64	1.06
	A3182/91	2.37	.80
	A3488/91	2.05	1.04
Kansas City:	A3276/91	3.06	.71
	A3236/91	3.47	.54
	A1628/91	U	.59
	A4164/91	2.45	.65
	A2620/91	4.90	.45
	A1918/91	2.20	.50
	A2866/91	U	.68
	A2360/91	U	.64
	A2936/91	U	.72
	A3239/91	U	.59
	A1602/91	U	.65
	A2021/91	2.30	.45
	A3032/91	U	.67
	A2546/91	U	.37
	A1372/91	2.12	.68
	A1372/91	U	.67
	A1232/91	U	.75
	A3307/91	U	.66
	A2988/91	2.39	.58
	A3211/91	U	.24
	A2885/91	1.76	.58
	A1646/91	U	.67
	A4094/91	1.91	.73
	A4098/91	4.32	.81
	A4093/91	2.41	.79
	A4122/91	2.83	.77
	A4125/91	2.90	.62
	A4127/91	3.47	.64
	A4140/91	3.33	.80
	A4147/91	1.91	.75
	A2694/91	U	.66
	A2792/91	U	.48
	A3717/91	1.92	.69
	A3669/91	3.01	.48
	A3671/91	1.78	.42
	A0935/91	4.70	.78
	A1130/91	3.19	.67
	A1377/91	U	.65
	A1569/91	U	.58
	A1768/91	U	.55
	A3423/91	U	.46
	A3423/91	U	.66
	A3260/91	U	U
	A3535/91	3.90	.60
	A3980/91	U	.56
	A3980/91	U	.60
	A0771/91	1.58	.50
	A0821/91	3.49	.68
Kansas City/ Edwardsville	A2472/91	2.85	.24
	A2750/91	2.72	.61

	Catalog No.	H(cm)	T(cm)
Edwardsville:	A2823/91	N/A	.55
	A1917/91	2.77	.43
	A1276/91	N/A	.49
	A3671/91	N/A	.41
	A3260/91	N/A	.58
	A1114/91	N/A	.78
	A2054/91	N/A	.49
	A3287/91	N/A	.50
	A3097/91	N/A	.41
	A4099/91	N/A	.63
	A1167/91	N/A	.39
	A4363/91	N/A	.48
	A3096/91	N/A	1.02
	A2774/91	N/A	.57
	A2884/91	N/A	.73
	A2652/91	2.10	.50
	A2683/91	N/A	.80
	A2559/91	N/A	.61
	A4357/91	N/A	.55
	A3164/91	N/A	.48
	A4358/91	N/A	.59
	A2694/91	N/A	.48
	A4074/91	N/A	.59
	A4073/91	N/A	.79
	A4180/91	N/A	.63
	A4279/91	N/A	.61
	A3013/91	N/A	.60
	A3013/91	N/A	.64
	A2792/91	N/A	.49
	A0723/91	N/A	.51
	A0863/91	N/A	.58
	A0881/91	3.90	.65
	A0782/91	N/A	.48
	A0936/91	3.54	.64
	A1151/91	5.15	.71
	A1393/91	N/A	.76
	A1409/91	2.76	.55
	A1569/91	N/A	.50
	A1783/91	N/A	.39
	A3328/91	N/A	.40
	A3578/91	2.64	.44
	A3618/91	2.23	.45
	A4390/91	1.51	.45
	A4392/91	N/A	.50
	A3801/91	2.31	.50
	A1629/91	N/A	.49

Note: Duplicate catalog numbers indicate two or more sherds bearing same catalog number.

Edwardsville sherds may have discernable curvature allowing rim height measurability.

Key: (U) = Undetermined H = Height
(N/A) = Not Applicable T = Thickness

TABLE 7.9

RIM HEIGHT DISTRIBUTION

TROWBRIDGE

Height	Number	Percent
0-1cm	0	0%
1-2cm	0	0%
2-3cm	2	67%
3-4cm	1	33%

KANSAS CITY

Height	Number	Percent
0-1cm	0	0%
1-2cm	6	24%
2-3cm	8	32%
3-4cm	8	32%
4-5cm	3	12%

EDWARDSVILLE

Height	Number	Percent
0-1cm	2	20%
1-2cm	1	10%
2-3cm	4	40%
3-4cm	2	20%
4-5cm	0	0%
5-6cm	1	10%

KANSAS CITY/ EDWARDSVILLE

0-1cm	0	0%
1-2cm	0	0%
2-3cm	2	100%
3-4cm	0	0%
4-5cm	0	0%

TABLE 7.10

RIM THICKNESS DISTRIBUTION

TROWBRIDGE Thickness	Number	Percent	KANSAS CITY Thickness	Number	Percent	EDWARDSVILLE Thickness	Number	Percent
.10- .20cm	0	0%	.10- .20cm	0	0%	.10- .20cm	0	0%
.21- .30cm	0	0%	.21- .30cm	1	2%	.21- .30cm	0	0%
.31- .40cm	0	0%	.31- .40cm	1	2%	.31- .40cm	3	7%
.41- .50cm	0	0%	.41- .50cm	8	17%	.41- .50cm	19	41%
.51- .60cm	0	0%	.51- .60cm	10	21%	.51- .60cm	10	22%
.61- .70cm	0	0%	.61- .70cm	17	36%	.61- .70cm	7	15%
.71- .80cm	1	33%	.71- .80cm	9	19%	.71- .80cm	6	13%
.81- .90cm	0	0%	.81- .90cm	1	2%	.81- .90cm	0	0%
.91-1.00cm	0	0%	.91-1.00cm	0	0%	.90-1.00cm	0	0%
1.01-1.10cm	2	67%	1.01-1.10cm	0	0%	1.00-1.10cm	1	2%

KANSAS CITY/ EDWARDSVILLE		
.10- .20cm	0	0%
.21- .30cm	1	50%
.31- .40cm	0	0%
.41- .50cm	0	0%
.51- .60cm	0	0%
.61- .70	1	50%
.71- .80	0	0%
.81- .90	0	0%
.91-1.00	0	0%
1.00-1.10	0	0%

TABLE 7.11

MEAN RIM HEIGHT AND THICKNESS SUMMARY

STYLE	MEAN RIM HEIGHT	MEAN RIM THICKNESS
Trowbridge	2.69 cm	0.97 cm
Kansas City	2.85 cm	0.62 cm
Edwardsville	2.89 cm	0.56 cm
Kansas City/ Edwardsville	2.79 cm	0.44 cm

TABLE 7.12

BODY SHERD SUMMARY

	Cat. No.	Decoration	Level		Cat. No.	Decoration	Level
Trench	A1971/91	Rocker Stamp	5	Trench	A1245/91	Undecorated	6
	A1924/91	" " " "	2		A1153/91	" "	4
	A1923/91	" " " "	3		A1108/91	" "	2
	A1519/91	" " " "	4		A1184/91	" "	5
	A1524/91	" " " "	4		A1244/91	" "	6
	A1520/91	" " " "	4		A1273/91	" "	6
	A1521/91	" " " "	4		A1186/91	" "	5
	A2473/91	" " " "	4				
	A3301/91	" " " "	5				
	A3297/91	" " " "	5				
	A1652/91	" " " "	4				
	A1713/91	" " " "	5				
	A1154/91	" " " "	4				
	A1270/91	" " " "	6				
	A1107/91	" " " "	2				
	A3279/91	Dentate Stamp	4				
	A1243/91	Punctated	6				
	A1450/91	Undecorated	2				
	A1484/91	" "	3				
	A1453/91	" "	2				
	A2339/91	" "	1				
	A1523/91	" "	4				
	A1484/91	" "	2				
	A1526/91	" "	4				
	A1451/91	" "	2				
	A1522/91	" "	4				
	A1485/91	" "	3				
	A1525/91	" "	4				
	A1483/91	" "	3				
	A1449/91	" "	2				
	A1452/91	" "	2				
	A3300/91	" "	5				
	A3299/91	" "	5				
	A1716/91	" "	5				
	A1717/91	" "	5				
	A1589/91	" "	2				
	A1587/91	" "	2				
	A1611/91	" "	3				
	A1614/91	" "	3				
	A1715/91	" "	5				
	A1588/91	" "	2				
	A1612/91	" "	3				
	A1613/91	" "	3				
	A1714/91	" "	5				
	A1742/91	" "	6				
	A1152/91	" "	4				
	A1185/91	" "	5				
Features	A4108/91	Rocker Stamp	4				
	A4108/91	" " " "	4				
	A4103/91	" " " "	4				
	A4111/91	" " " "	4				
	A4121/91	" " " "	5				
	A4126/91	" " " "	5				
	A4177/91	" " " "	6				
	A4217/91	" " " "	7 (L2)*				
	A4242/91	" " " "	7				
	A4248/91	Dentate Stamp	7 (L3)*				
	A4157/91	Punctates	6				
	A1816/91	Undecorated	9				
	A4219/91	" "	7 (L2)*				
	A4189/91	" "	7 (L1)*				
	A4188/91	" "	7 (L1)*				
	A4187/91	" "	7 (L1)*				
	A4120/91	" "	7				
	A4171/91	" "	6				
	A4170/91	" "	6				
	A4148/91	" "	6				
	A4128/91	" "	5				
	A4120/91	" "	5				
	A4102/91	" "	4				
	A4107/91	" "	4				
	A4086/91	" "	4				
	A4077/91	" "	4				
	A4076/91	" "	4				

Totals: Trench = 54 sherds

Features = 27 sherds
81 Total Sherds

Rocker Stamp = 24

Dentate Stamp = 2

Punctate = 2

Undecorated = 53

* Levels available for most sherds in Feature 7.

The most interesting aspect of the analysis of Quarry Creek Kansas City Hopewell ceramics is the examination of individual sherds. Many are unique and must be addressed on an individual basis while others are unremarkable. Figures 7.1-10 show representative examples of these artifacts.

Figure 7.1a-c includes examples of Trowbridge phase rim sherds. One sherd is unique in that it has a single boss which appears to have been produced with an instrument which may have been rectangularly shaped at the end (Fig. 7.1a). The depression it made on the interior of the pot visible. A second sherd (Fig. 7.1b) exhibits parallel, vertical rows of dentate impressions above a single boss. Figure 7.1c is a small sherd from a Feature 4 flotation sample and it was not icluded in the analysis. Its Trowbridge phase attribute is a series of nearly vertical, cord-wrapped stick impressions. The provenience of this sherd is hard to explain given the late radiocarbon date of the feature. However, it may have been an artifact of an earlier occupation that became incorporated in the trash deposited in the pit or one that had been stratigraphically displaced during prehistoric excavation of the pit.

The rocker stamped rim sherds in Figure 7.1d-f are here assigned to the Kansas City phase. These sherds exhibit horizontal rocker marks above a row of punctates. Figure 7.1d, a specimen cross-mended from two sherds from Feature 6, also has a trailed line below the punctates. Figure 7.1e is from Level 1, 90N/144E, the upper level of the midden above Feature 6. Figure 7.1f is from Level 2, 92N/168E. The shallow burial of these latter sherds, as well as the radiocarbon date from Feature 6 and the sherd associated with it, suggests this decorative motif may be indicative of late Kansas City phase.

One nearly complete pottery vessel was found at Quarry Creek (Figure 7.2). Though lacking a small section of the the rim and body from one side, most of the vessel is undamaged. It has a rim thickness of .61 cm and a body thickness, taken at the base of the broken area, of .82 cm. The mouth diameter is 8.21 cm and the height varies from 7.66 cm to 7.95 cm. The color on the exterior of the pot is mottled, and there is a dark area on the interior, possibly carbon build-up. The vessel seems to be an appropriate size to hold soups, stew, or other liquids. The dark carbon build-up indicates that foods or beverages may have been heated in it. In the tables of this report, the vessel has been assigned to the Edwardsville plain variety because of its lack of decoration. However, its small shape and crude modeling suggest a function different from those of the larger storage or cooking vessels upon which Johnson and Johnson (1975) based their seriation. Its context, in one of the middle levels of Feature 7, and the early radiocarbon date from that pit, would appear to preclude an Edwardsville phase assignment for this specimen.

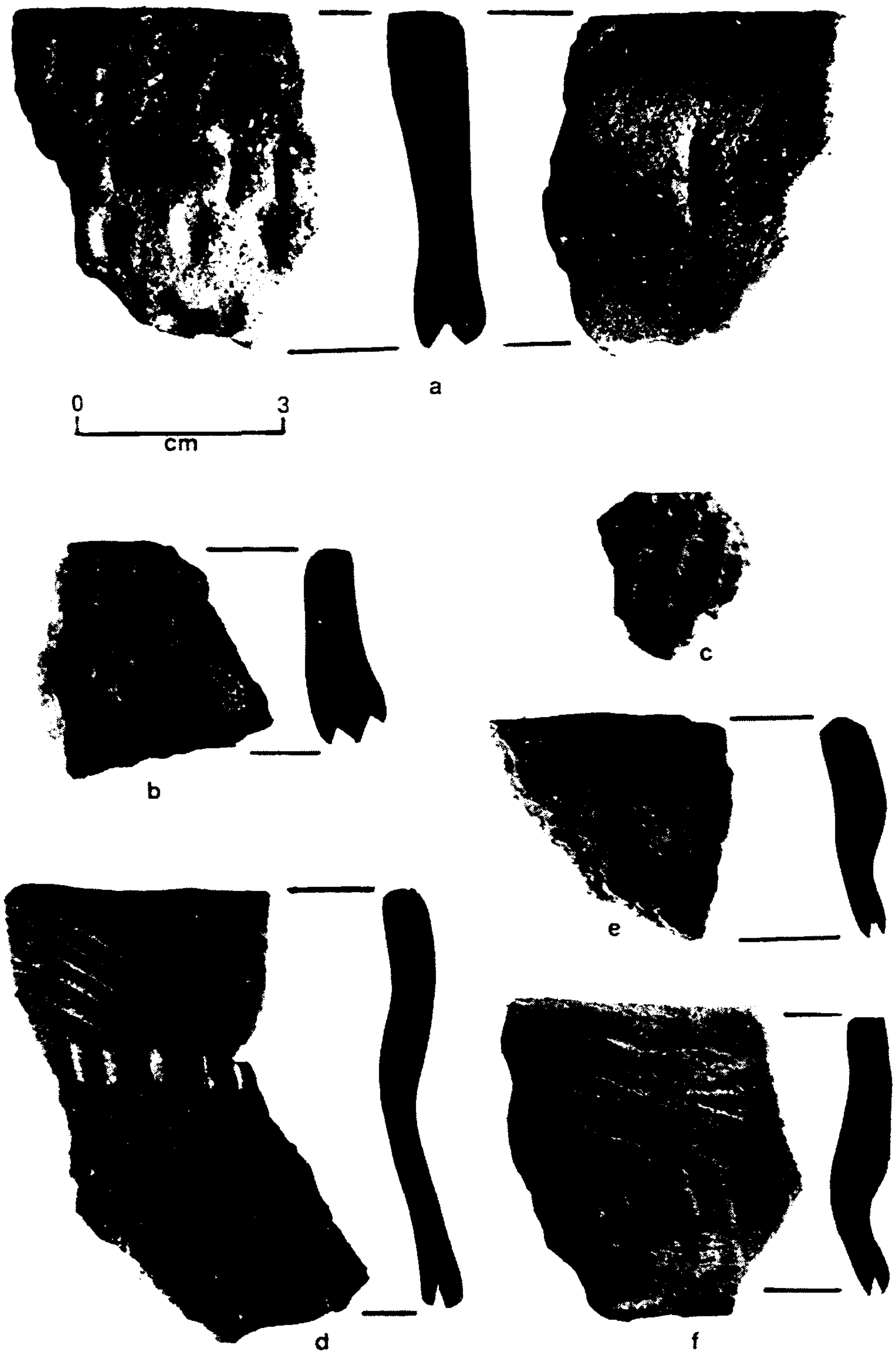


Figure 7.1 Rim Sherds: a-c) Trowbridge Phase d-f) Kansas City Phase (Rocker Decorated).

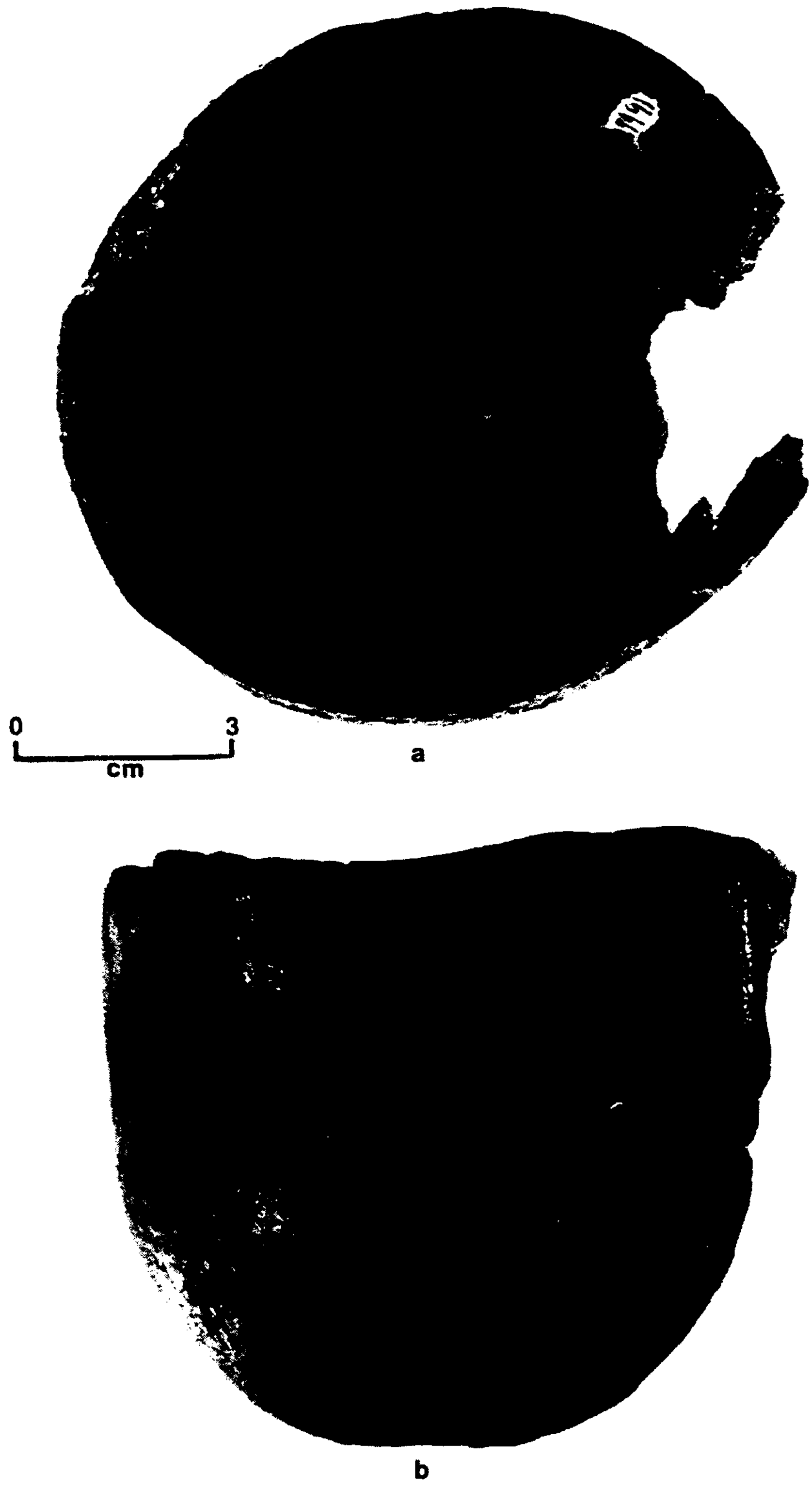


Figure 7.2 Top and Side Views of Vessel from Feature 7.

Figures 7.3-5 are Kansas City phase crosshatched rims. The rim sherd depicted in Figure 7.3d is intricately decorated, obviously produced by an experienced potter. This sherd is an example of a Renner Crosshatched rim (Chapman 1980:294). The crosshatching is closely spaced, somewhat like the size of screen wire. There is a narrow trailed line beneath the crosshatching with a row of lunate-shaped punctates just below. The punctates look as though they were produced by pressing the edge of a small round tool such as a bone or smooth stick into the clay, leaving a slight stick impression to the left of the punctate. The interior of the sherd has a channel with a width of 1.074 cm. It may have been produced by applying pressure with the pad of the second finger. The exterior has a fire cloud, and there appears to be carbon build-up on the interior. A second Renner Cross-hatched rim is included in the assemblage (Figure 7.3e). The punctates on this sherd are demarcated by a pair of narrow incised lines. The punctates are lunate in shape. The trailed lines are interesting because they appear to have been stopped and started, possibly as the vessel was turned during production. The stopping points are approximately 1.23 cm apart.

Of the specimens shown in Figure 7.4, that labeled b is from Level 3, 95N/151E; that labeled a is from Feature 6; and c-d are from Feature 5. Other examples of cross-hatching are seen in Figure 7.5. Figures 7.5a and d were recovered from Level 4, 97N/130E and Level 3, 86N/161E respectively. An example of widely spaced crosshatching is seen in Figure 7.5c. This piece, from Feature 4, also has lunate shaped punctates. It has areas of carbon build-up on the interior as well as encrustations, possibly food remains, and the exterior is fire-clouded.

The sherd depicted in Figure 7.6d is interesting in terms of decoration even though it is badly damaged. There are five diagonal widely spaced lines ranging from the upper left to the lower right of the rim. There is a single line ranging from the lower left to the upper right. The spacing of the lines indicates that this may have been a very widely spaced cross-hatching design, unusual even for widely spaced decorations.

Two sherds represent a transition from Kansas City phase to Edwardsville phase ceramic decoration. The sherd shown in Figure 7.5b is crosshatched and crenated. Another sherd (A2750/91), not shown, is both crosshatched and has a notched lip. Crenation of the former specimen appear to have been produced by placing a fingernail on the lip of the vessel, and then pressing downward toward the interior of the vessel, creating thickened areas on the interior of the lip. The diagonal notching on the lip of the latter sherd may have been made by pressing the edge of a wedge shaped instrument into the leathery clay.

Figure 7.3 Crosshatched Rims: Kansas City Phase.

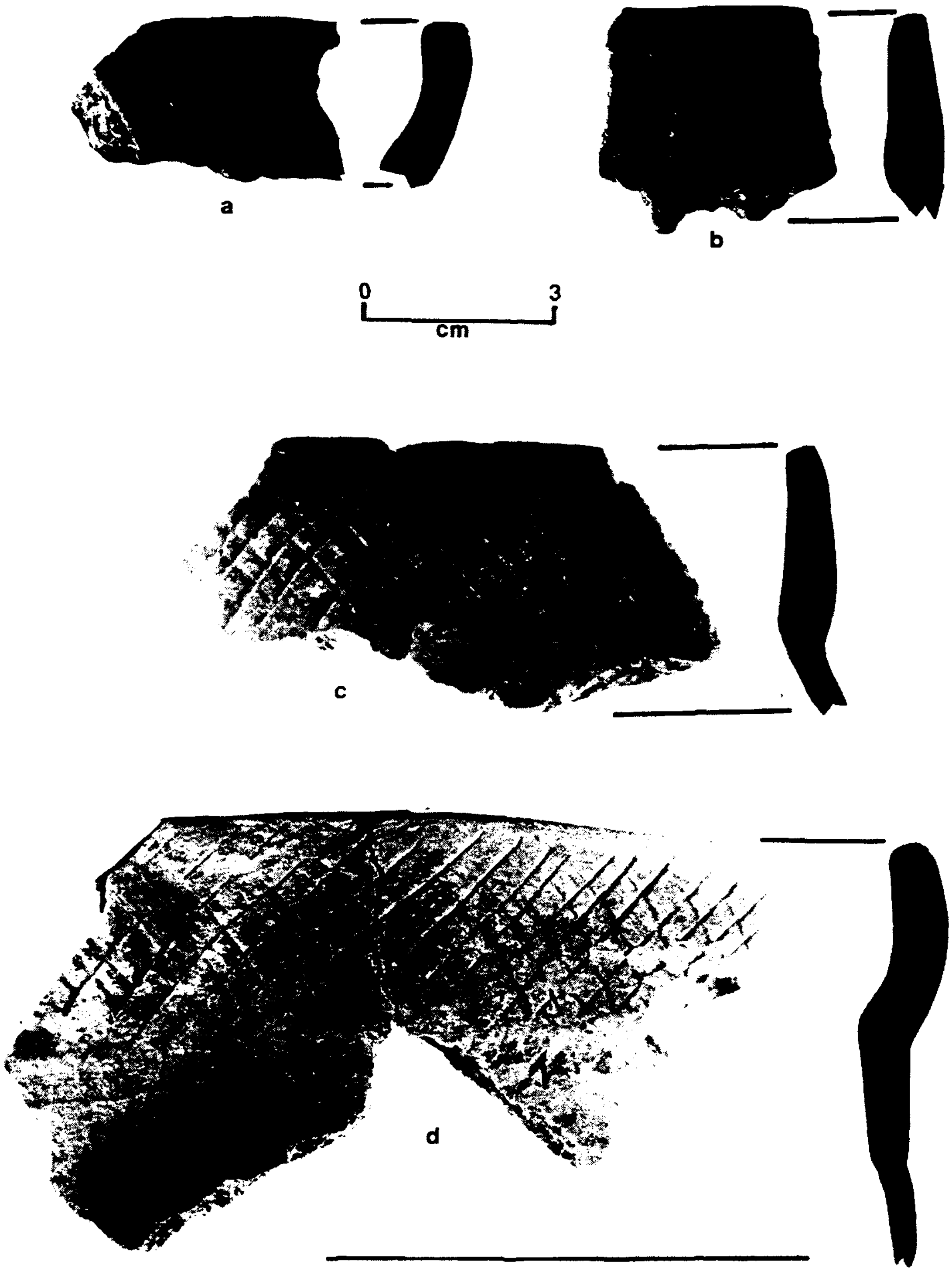


Figure 7.4 Crosshatched Rims: Kansas City Phase.

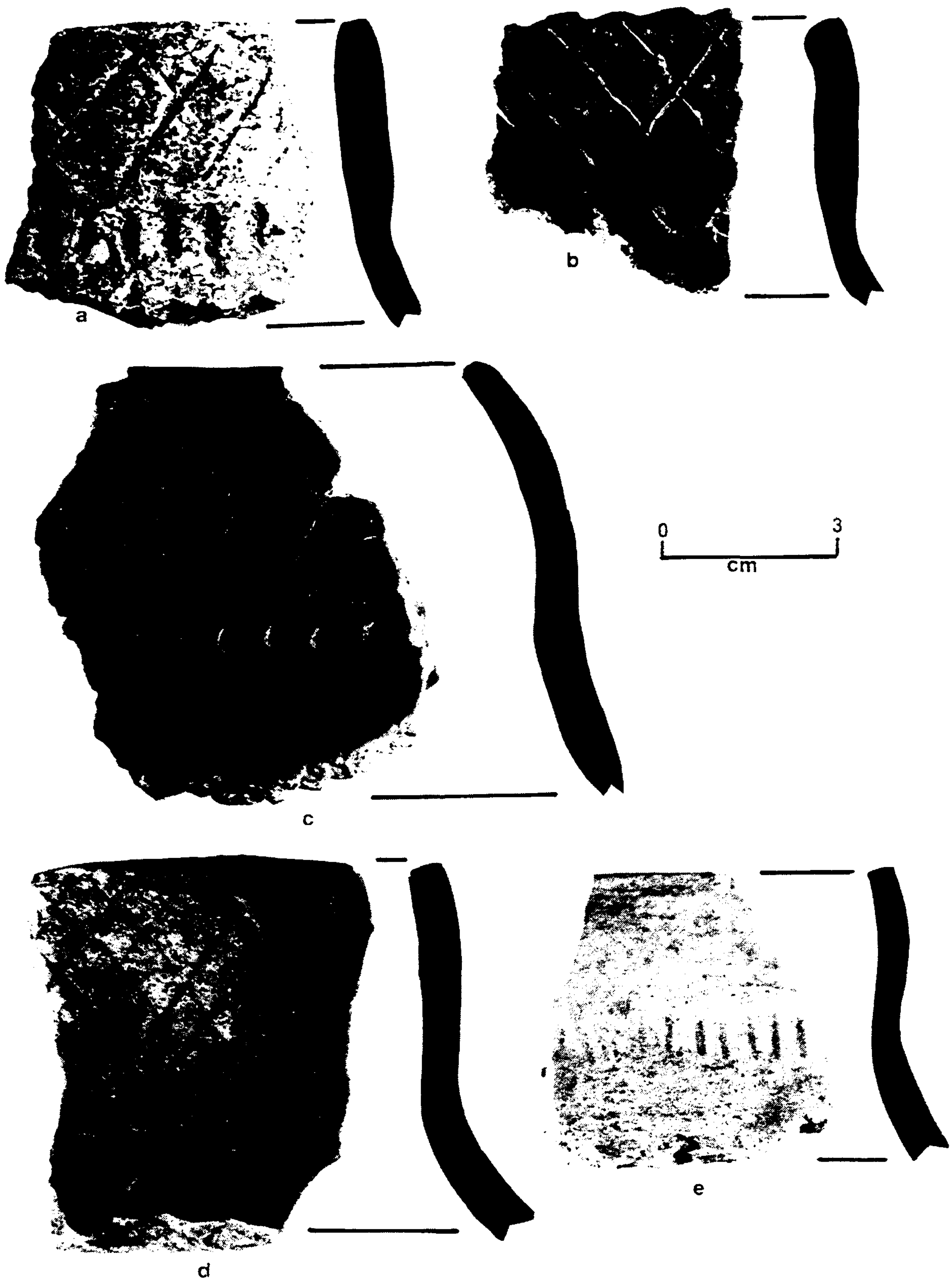


Figure 7.5 Crosshatched Rims: Kansas City Phase, a-d; Plain Punctate Rim: Edwardsville Phase, e.

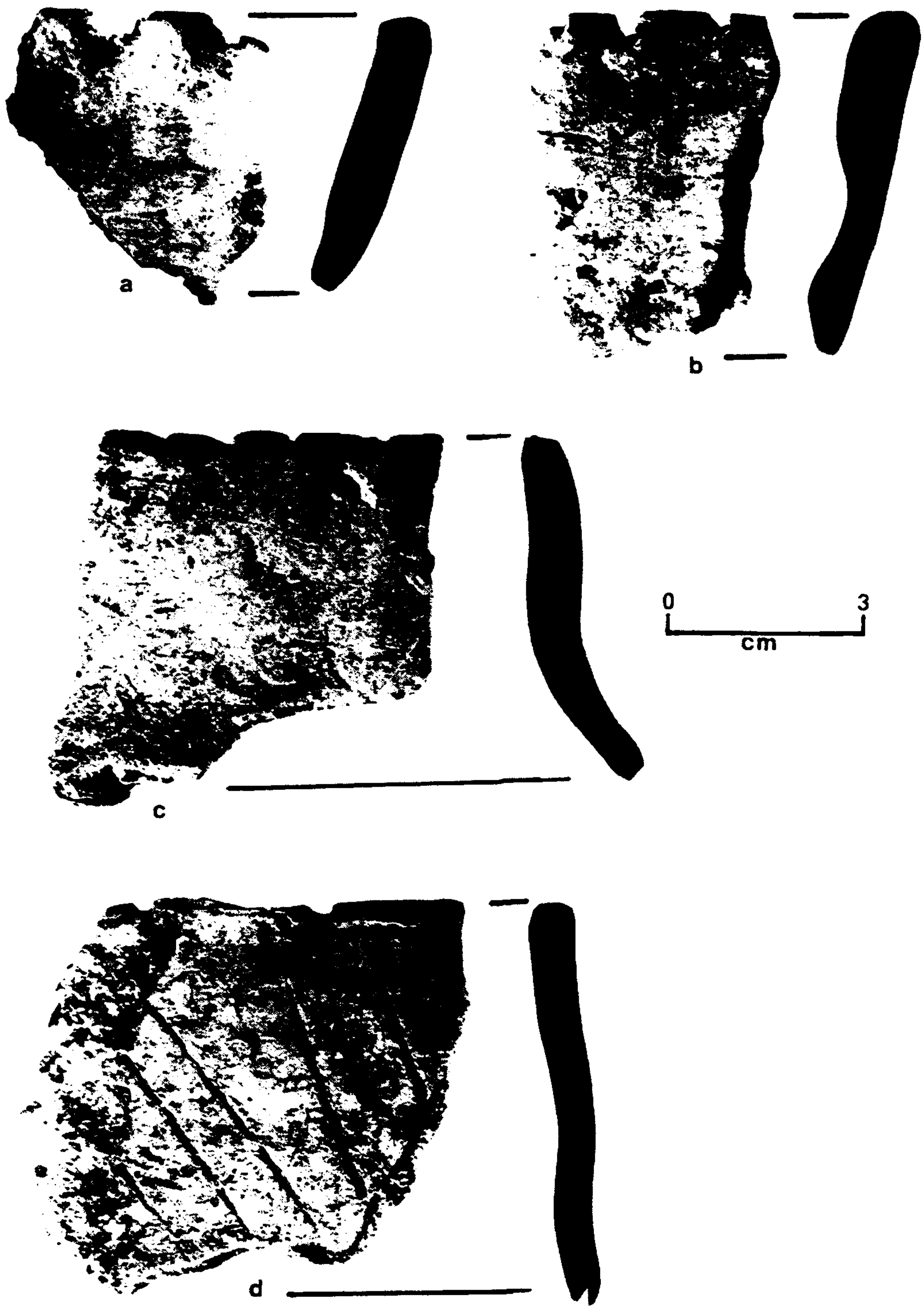


Figure 7.6 Plain Lip Notched Rims: Edwardsville Phase, a-c; Crosshatched Rim: Kansas City Phase, d.

Figures 7.6a-c are representative of Edwardsville phase crenated ceramics. Several of the sherds of this form in the analyzed sample seem to be more notched than crenated. The truly crenated sherds have a trough to trough measurement as well as a crest to crest measurement. As in the case of the transition sherds discussed above, the production of the notches and crenations often produced thickened areas on the interior of the lip of the vessel. This type of decoration may have been made with either the finger or fingernail, the round side of a stick or bone, or a wedge-shaped tool. The crenations or notches are the only decorative elements found on these ceramic sherds.

Figure 7.5e represents Edwardsville ceramics on which the only decoration applied is a single row of punctates. This sherd is distinctive due to its single row of narrow, rectangular punctates. The interval between punctates is 30 to 40 mm, with a punctate length of 65 mm. The punctate width is only 10 mm. Edwardsville plain sherds are distinctive in that they have no decorative elements. Sherds shown in Figure 7.7, with the exception of Figure 7.7b, are examples of Edwardsville plain pottery. The exception, from Level 4, 95N/151E, exhibits traces of rocker marks and was assigned to the Kansas City phase. Figure 7.7d is a rim sherd with a repair hole, one of two sherds (the other is a body fragment) with such treatment (a miniature rim sherd discussed below may also have such a hole).

Figures 7.8-9 show selected body sherds which exhibit a variety of surface treatments, most of which are indicative of Kansas City Hopewell pottery. Those shown on Figure 7.8 are the among the largest recovered during the excavation. Figure 7.8a weighs 126 gms and exhibits regularly placed punctates at intervals of approximately 43 mm. The punctates are one cm in height and 51 mm in width. There is a fire cloud on the exterior and the interior is mottled. The lower sherd on Figure 7.8 is from Feature 7 and it exhibits rocker-marking characteristic of Kansas City phase pottery. Other examples of this treatment are shown in Figure 7.9. Figure 7.9e bears dentate stamping and may be a fragment from a Trowbridge phase-like vessel. Figure 7.9d was the only cordmarked sherd recovered during the investigation. While this cordmarking is generally indicative of Late/Plains Woodland and Pomona variant ceramics, it is not possible to interpret the cultural-temporal affiliation of this specimen.

A single miniature vessel was represented at the Quarry Creek site (Figure 7.10d; see also part five of this chapter). While it is rare, it is not unusual in that other miniatures have been found at other Kansas City Hopewell sites. Wedel (1943) reports finding two complete miniature pots at the Renner site in Platte County, Missouri. He states that they "may have been the product of a child or other unskilled craftsman..." because they "are roughly and ineptly modeled" (Wedel 1943:42). The miniature

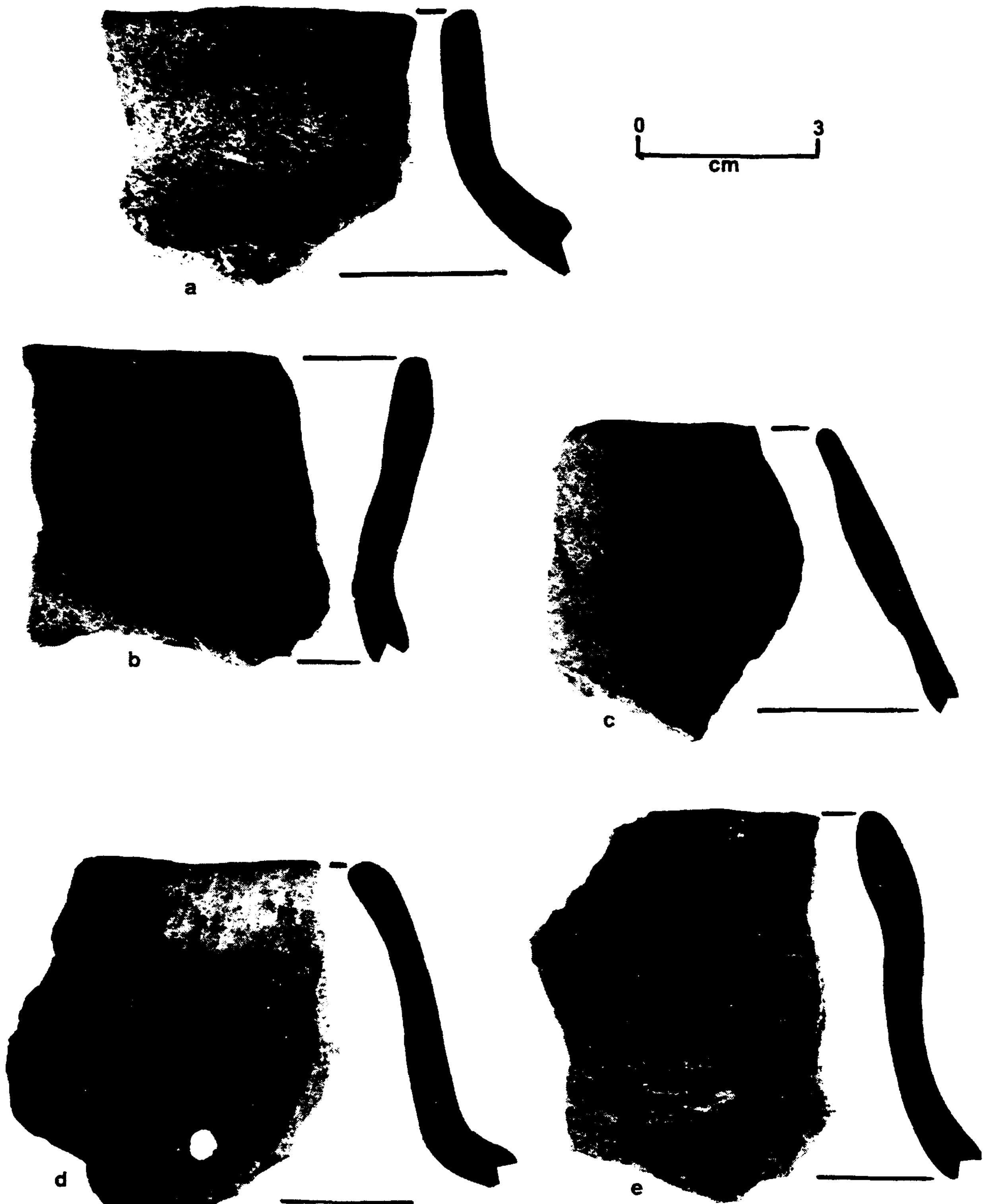


Figure 7.7 Plain Rims: Edwardsville Phase, Note Drilled Repair Hole on d.

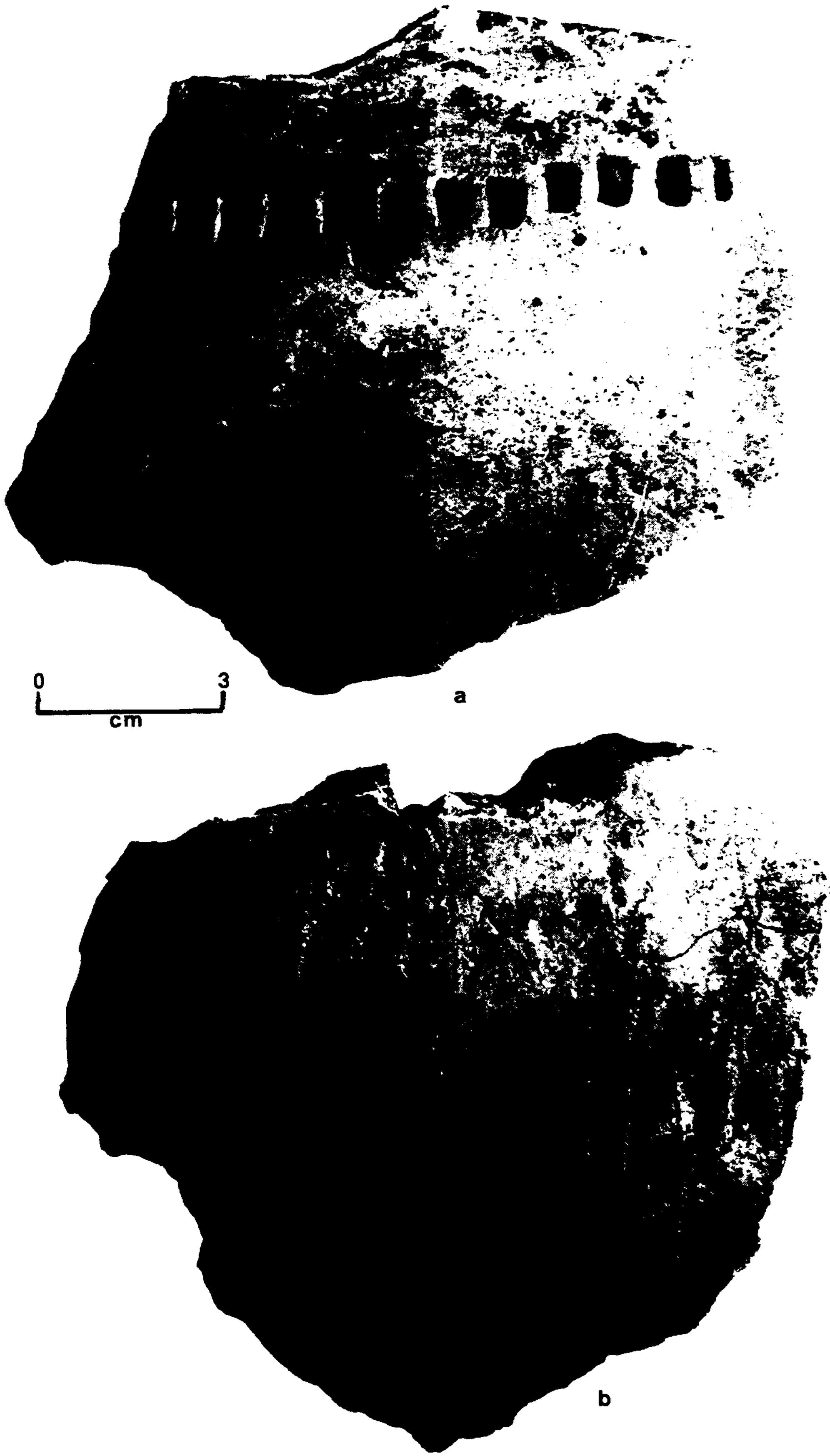


Figure 7.8 Punctated Body Sherd, a; Rocker Marked Body Sherd, b.

Figure 7.9 Rocker Marked Body Sherds, a-c; Cord-Marked Body Sherd, d; Dentate Stamped Body Sherd, e.

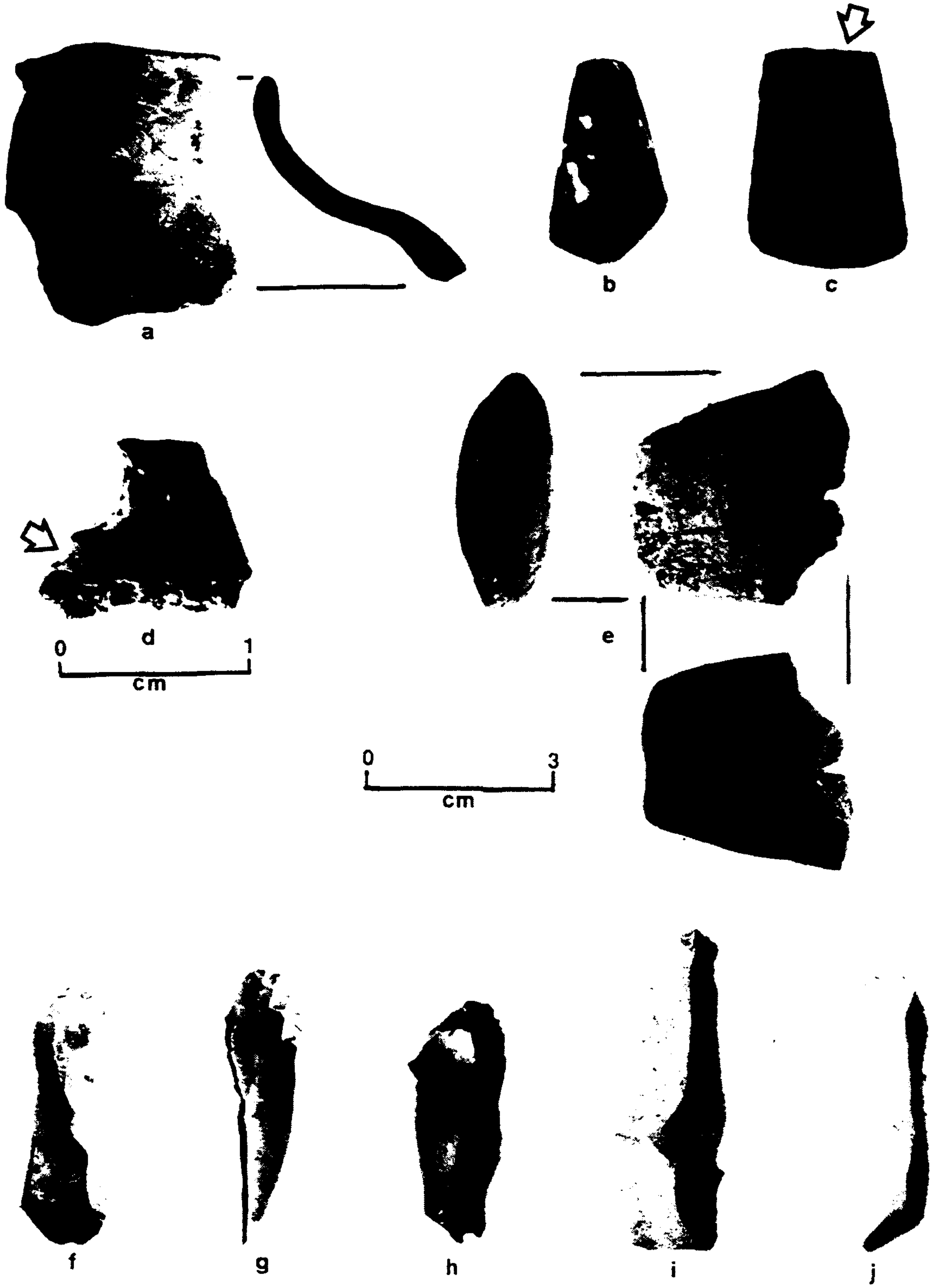


Figure 7.10 Plains Village Rim, a; Faceted Hematite, b; Miniature Copper "Celt", c; Miniature Rim, d; Ceramic Pipestem Fragment, c; Blades, f-j.

from Quarry Creek, in contrast, is well made, obviously the product of an experienced potter. It has a single crosshatch on its rim. Beneath the crosshatch, there is a single row of tiny, perfectly formed dentate stamping. The area beneath the dentate stamping is plain; however, just four mm below the dentate stamping at the point of breakage, there are more tiny square marks which may indicate that the original piece had at least a second row of dentate stamping. A minute semi-circular break on the left side of the sherd may have been a drill hole (arrow on Figure 7.10d). The piece was too small to make a mouth diameter measurement, but rim thickness was only 24 mm. The lip form is semi-flattened and the rim form is everted.

The use of these tiny vessels can only be guessed. They may have been prepared as toys for children; however, if the Quarry Creek sample does have drill hole, the speculation could be made that it may have been threaded with a thong and worn as an ornament or displayed by suspension in other ways. It increases the number of sites at which miniatures have been found.

Two sherds in the assemblage are from Plains Village, possibly Pomona variant, vessels (e.g., Figure 7.10a). Their presence indicates that a post-Kansas City Hopewellian people occupied the site for a time. The piece illustrated has a high straight rim which inflects to a globular pot. Its mouth diameter is 16 cm. The interior is very dark and there are fire clouds on the exterior. Its provenience is peculiar. It was piece plotted in Level 4, 89N/168E in the most dense level of the Hopewell midden. It is possible that it was incorporated in that earlier stratum through treefall, rodent activity or some other form of post-depositional disturbance. The nature of any such disturbance, however, was not documented during its excavation. The second Plains Village rim is a straight (insofar as it can be determined) cordmarked sherd-tempered specimen that is 1.78 cm high, .43 cm thick and with an estimated mouth diameter of 30 cm. It was also recovered from a depth and context inconsistent with its inferred cultural-temporal identification. It came from Level 5, 90N/143E, in the vicinity of Feature 6. An Edwardsville phase rim sherd was also collected from the same level. Again, some mixing of components may be indicated by this association.

In summary, the Quarry Creek ceramic assemblage greatly resembles pottery found at other Kansas City Hopewell sites in the area. As indicated by the find of a small sample of Trowbridge phase sherds, the site was occupied late during that phase and more intensely during the Kansas City and Edwardsville phases. The ceramic analysis of the site could be greatly enhanced by increasing the sample size, and future excavations may provide information necessary to the better understanding of the ceramic technology of the people who occupied northeastern Kansas and northwestern Missouri during Middle Woodland time.

Part 2

NON-FORMAL LITHIC ARTIFACTS

Brad Logan

The lithic assemblage from the Quarry Creek site consists of more than 20,000 pieces of debitage and informally used or shaped stone tools, in addition to formal chipped and groundstone tools. The latter are described in the next sections of this chapter. This section is devoted to an enumeration of the nonformal stone artifact categories used during the sorting and identification of the lithic assemblage from the site. This enumeration and a brief discussion of the research potential of this material follows a few necessary definitions, which are based on Ritterbush (1987). Table 7.13 presents counts and weights of these categories for the site.

BLADE- an elongate flake which has a length equal to or greater than twice the flake width and with nearly parallel lateral edges and dorsal flake scars (i.e., an arris plane).

BLADELET- as above but with a length along the axis of force no greater than two cm.

CHIP- a flake which measures less than two centimeters in length along the axis of force. This arbitrary measure is useful for identifying flakes generally too small to have been utilized, especially without hafting, and flakes often (although not exclusively) produced through pressure flaking.

CHUNK- any piece with the attributes of shatter but with any dimension greater than two cm.

CORE- a piece of lithic raw material exhibiting at least three well defined flake scars and recognizable striking platforms.

EDGE-MODIFIED FLAKE- any chipped stone blank (e.g., flake, blade) with at least ten mm of continuous retouch or use wear.

FLAKE- a piece of lithic material that has been removed from a mass of lithic raw material through force of percussion or pressure and which exhibits one or more of the following attributes: a) a striking platform, b) bulb of percussion or force, c) compression rings or ripple marks on the ventral surface, d) an erralieure scar, e) a thin termination edge.

SHATTER- any piece of chunky or irregularly shaped lithic material exhibiting at least one non-cortical surface, yet which lacks definite flake scars, negative bulbs of force, or striking platforms and which has a maximum dimension of less than two cm.

Table 7.13. Counts and Weights of Non-Formal Lithic Material.

Lithic Category	Quantity	Weight (gms)
Blades	194	367
Bladelets	255	125
Chips	12,776	3,649
Chunks	300	4,215
Cores	21	1,061
Edge-modified flakes	39	223
Flakes	3,083	6,550
Shatter	3,539	3,413
Totals	20,207	19,604

The distribution of this material horizontally and vertically across the site, as represented in the excavated sample, has yet to be finally analyzed. However, a preliminary analysis of the distribution of flakes, chips and shatter in the exploratory trench was conducted by Bitikofer (1993) in order to determine if there was any significant difference in the quantity of these items vertically or horizontally. A t-test indicates that there is a statistically significant difference between the amount of this material in levels 2 (10-20 cm) and 5 (40-50 cm) as compared to all other levels. The difference between level 5 and all others probably stems from the fact that it generally yielded less cultural debris since it was therein that the base of the A horizon and the upper portion of the sterile B horizon was generally encountered. Indeed, a comparison with the other levels is not valid for all units in the trench since some were not excavated to 50 cm but simply to the base of the A horizon. Consequently, the volume of screened fill from these levels was not always equal to those of the upper levels. Nonetheless, the t-test correctly indicates the relative paucity of these artifacts in level 5. The significance of the amount of lithic debris in level 2 as compared to the other upper levels is difficult to explain. It may indicate a longer occupation in the area of the trench at the time of the deposition of that level or more intense lithic manufacturing at that time and place.

Bitikofer (1993) also noted a statistically significant difference between the amount of flakes, chips and shatter along a horizontal dimension of the trench. Units 92-93N differed from about half of the other units of the trench; units 82N and 90N also differ significantly from a few others along that transect. Of contiguous units, only 89-90N differed significantly from the others. In conjunction with similar differences between the northern two units with respect to other material (i.e., ceramics and faunal remains), it is possible to see a consistent distinction between the quantity of cultural material in that area compared to those to its south. There are a number of possible explanations for such a difference. Among them are the possibilities that a distinct activity occurred in the area of 92-93N/168E or that the midden developed along a horizontal plane, as well as a vertical one, characterized by two different rates of deposition that can be distinguished at 90N/168E. It is interesting to note that the northern units are in the immediate vicinity of a magnetic anomaly recorded during our magnetometer survey (see Weymouth herein). This suggests that more expansive excavation around the northern end of the trench might reveal a feature that could further explain the differences detected statistically in the distribution of lithic debris.

Analysis of the relative frequencies of different chert types represented by the non-formal lithic artifacts has not been undertaken. However, such research would be worth while. Our cursory review of the lithic material indicates that the overwhelming majority of stone debris is local. Both local gray fossiliferous and local buff/brown cherts are predominant with the former being by far the most frequent. Given the proximity of the site to known sources of gray, fossiliferous cherts, this is not surprising (see chapter two). Exotic, or non-local, cherts are present in the assemblage. Among these are examples of Boone County (Mississippian) cherts from central Missouri. A qualitative review of the assemblage suggests that these occur more frequently as blades or bladelets, in keeping with Reid's (1976) interpretation of these items as a trade commodity. Examples of blades made from both local and exotic cherts are shown in Figure 7.10f-j. Figure 7.10i is an example of local buff/brown chert; Figure 7.10j is a good example of Boone County chert; Figure 7.10h is an unidentified non-local chert (possibly Winterset). Future researchers will want to conduct a more thorough analysis of the relative frequency of local vs. non-local raw materials represented in the Quarry Creek lithic assemblage.

Part 3

FORMAL CHIPPED STONE TOOL ANALYSIS

Christopher B. Raymond, Robert A. Rothman and Brad Logan

Introduction

The lithic tool assemblage at Quarry Creek includes 125 formal chipped stone tools. These have been sorted into the following functional or morphological classes: projectile points, drills, scrapers, blanks, preforms, and biface fragments. The tools are comparable to those represented in other Kansas City Hopewell assemblages, such as those of the Renner (Wedel 1943; Shippee 1967), Trowbridge (Bell 1976), Deister (Shippee 1967; S. Katz 1974) and Kelley (P. Katz 1969) sites, though the Quarry Creek sample lacks the larger knifes, celts, and hoes found in those collections. The tools are made from both local and nonlocal cherts, though as the following discussion indicates the former varieties are considerably more frequent. Metric and non-metric data of the artifacts discussed herein are presented in Appendix 4. Representative specimens are illustrated in Figures 7.12-16.

Projectile Points

Forty-five bifacial lithic tools from Quarry Creek have been identified as projectile points (or knives, depending on utilization). Their horizontal distribution at the site, which was rather random, is shown in Figure 7.11. Projectile points, or knives, are bifacially worked tools that have been notched or show evidence of having been hafted for use as a cutting tool or projectile weapon. Styles of manufacture can then be determined by the type of preform that is morphologically associated with each point. The most common styles of preforms (or points) are considered to be ovate, subtriangular, or lanceolate. Of the projectile points at Quarry Creek, thirty five can be considered diagnostic, and eleven are point fragments that have been broken and are impossible to determine with respect to diagnostic traits. All but two of these points can be identified as dart points. The exceptions are two triangular, unnotched arrow points that are evidence of a later, probably Plains Village period, occupation of the site.

Material composition of these points consists of a variety of cherts, from both local and nonlocal sources. Of the local material, the most prevelant is a grey, fossiliferous chert that has been previously examined in the Ft. Leavenworth locality (Wagner et al. 1989:180). This material may be either Plattsmouth or Spring Hill chert (see chapter two). Seventeen of

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Included in the assemblage of points is a grey, layered chert with some white inclusions which is comparable to Permian cherts from the Flint Hills of Kansas. There is one complete point made from this material. Its presence in the assemblage indicates either trade with groups of the Flint Hills or forays to this western region. The assemblage also includes a nearly complete fragment of a pink, slightly mottled chert that may be of a Mississippian origin (cf. Wagner et al. 1989:182). A midsection of heat-treated material which may be this same type of chert is also included. If these latter artifacts are Mississippian cherts, it indicates contact with groups of central Missouri state or forays to that area. Five points and fragments are included in a category of unspecified, nonlocal chert. One complete point is comprised of a buff/brown chert with slight layering of lighter brown/grey material. Another is of a basically homogenous grey chert with a lighter grainy appearance. The third complete point in this category is of a brown translucent material that has a small amount of cortex near the hafting edge. This point is one of the two unnotched arrow points that will be discussed later.

The assemblage of dart points from Quarry Creek can be separated into types according to morphological differences in their hafting elements. Two broad morphological types are represented in the recovered assemblage: corner-notched dart points and contracting-stem dart points. Corner-notched points exhibit diagonal or lateral notches, straight or slightly convex lateral edges, and expanding or square stems (Montet-White 1968: 67). In addition, further morphological distinction can be made seen in the base of the hafting element; i.e., whether it is straight or convex in shape. In the Quarry Creek sample, fifteen points and fragments are straight-based, expanding stemmed. Of these, eight have pronounced shoulders and diagonal corner notches, the result of direct percussion methods applied to a subtriangular preform. Five of the fifteen have shallow lateral notches, without a pronounced shoulder. The notching in these cases are the result of modification laterally toward the base of the point. Both of these forms compare to the Steuben expanded-stemmed points of the Illinois River Valley (Montet-White 1968:78), and are like those from the Trowbridge site described by Bell (1976: 32). Lengths of these forms range from 4.3 cm to 6.2 cm and widths range from 2.1 cm to 3.0 cm. Many of the shallow notched points show signs of retouching, both laterally and on the tip, that indicates resharpening of larger, more pronounced-shouldered points. Two of the diagonally corner-notched points have broken tips, the result of impact fracturing.

Fifteen of the recovered corner notched points are described as convex based, expanding stemmed. Examples of these points are shown in Figures 7.12-14. Five are of the shallow-notched variety, without pronounced shoulders. One (Fig. 7.12b) has been reworked on the tip and lateral edges for possible reuse as a cutting tool. Within the convex based, expanded-stemmed types are ten points that show a more pronounced shoulder and barb at the hafting element. Most of these are flaked from a subtri-angular preform, and many show signs of retouch and/or utilization. These points are morphologically similar to both the Ansell and Steuben types (Montet-White 1968:77). One point (Fig. 7.13a), of Permian chert, appears to have been made from a slightly ovate-type preform. This specimen has lateral edges that are slightly more convex than the others within the same category. This type resembles the Manker points from the Illinois River Valley (Montet-White 1968:73, fig. 29). Lengths of these points range from 4.3 cm to 7.5 cm, and widths range from 2.1 cm to 3.2 cm.

Three point fragments in the sample can be defined as corner notched, expanding-stemmed; however, not enough diagnostic attributes are preserved to categorize them. Two show signs of impact fracturing. Of these, one lacks the hafting element, and the other has no tip or lateral edge to the base. The third lacks the tip and had been exposed to heat, as evidenced by a potlid at the point of fracture and chromatic differentiation.

Two points are square-stemmed. Both of these specimens appear to have lost their tips through impact fracturing. Lateral edge utilization is evident on both of the points and a portion of the base is absent on one.

Another point type, distinguished by its contracting stem, is represented in the assemblage by two specimens. In contrast to the corner notched points, the contracting stems represented in the sample from Quarry Creek exhibit neither diagonal corner notching nor an increase in stem width toward the base. Of the two points, one is the lower half of a point (Figure 7.15b) and the other is only a basal fragment. The more complete point has a narrow shoulder, with laterally worked stem and terminates in a sharply convexed base. The upper half of this point is broken, probably through impact. The basal fragment of the other point appears to have been flaked in the same manner. This fragment

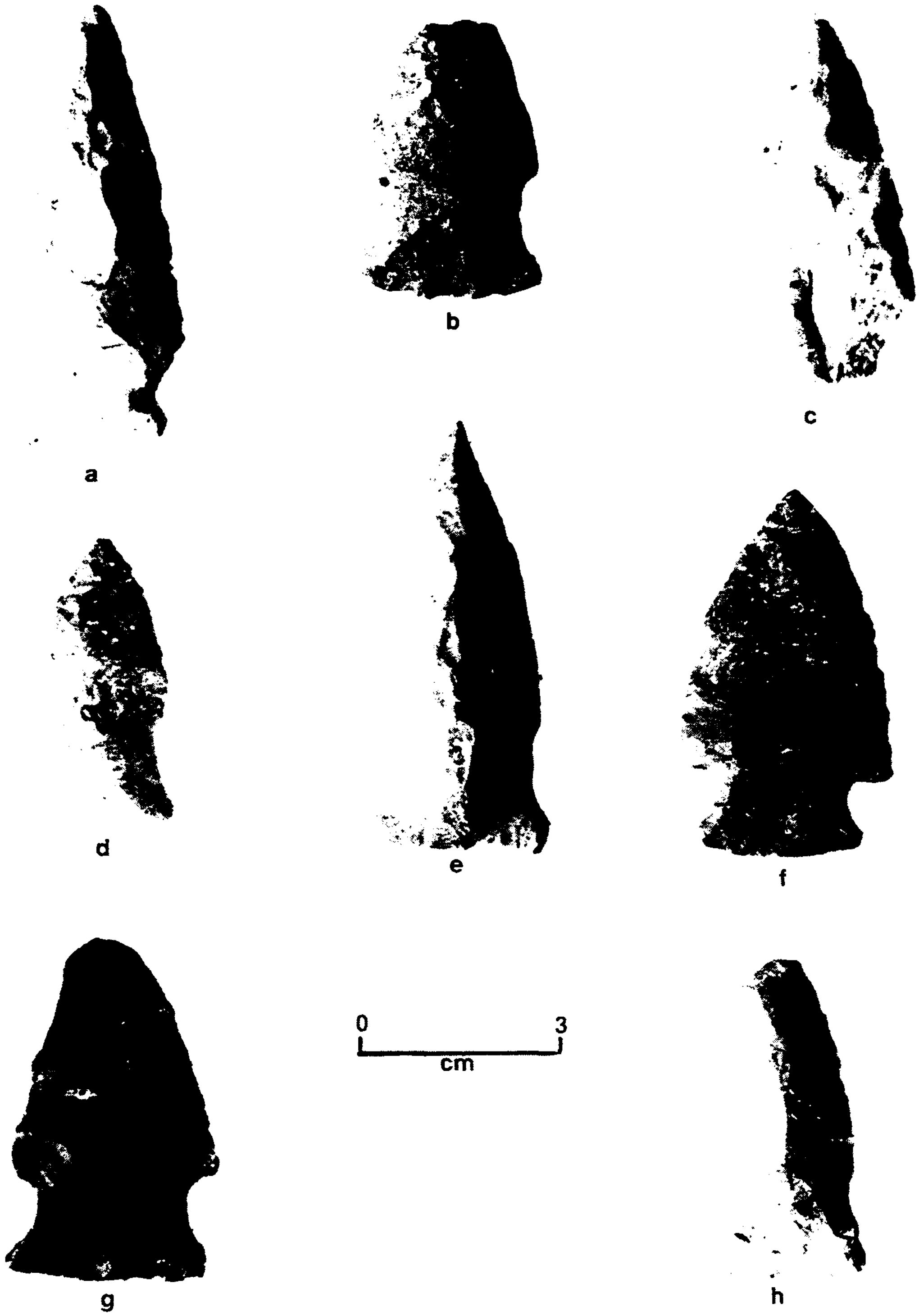


Figure 7.12 Corner-Notched Projectile Points: a) A3559/91, b) A3748/91 c) A3854/91 d) A2189/91, e) A4002/91 f) A2305/91 g) A2340/91, h) A2334/91.

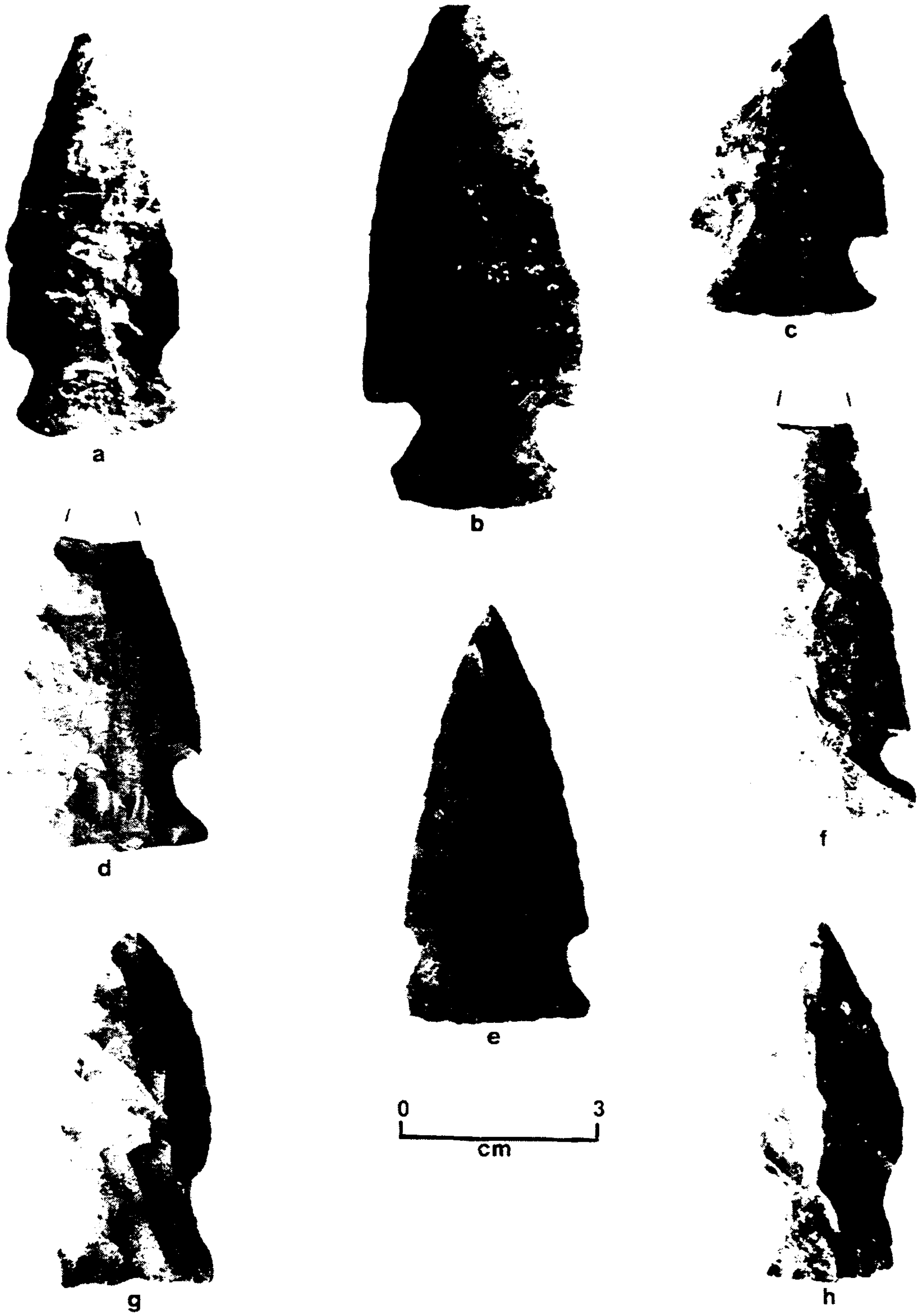


Figure 7.13 Corner-Notched Projectile Points: a) A2728/91, b) A1989/91, c) A3860/91, d) A3111/91, e) A0648/91, f) A3520/91, g) A0798/91, h) A3521/91 Note- c has been reworked into a drill.

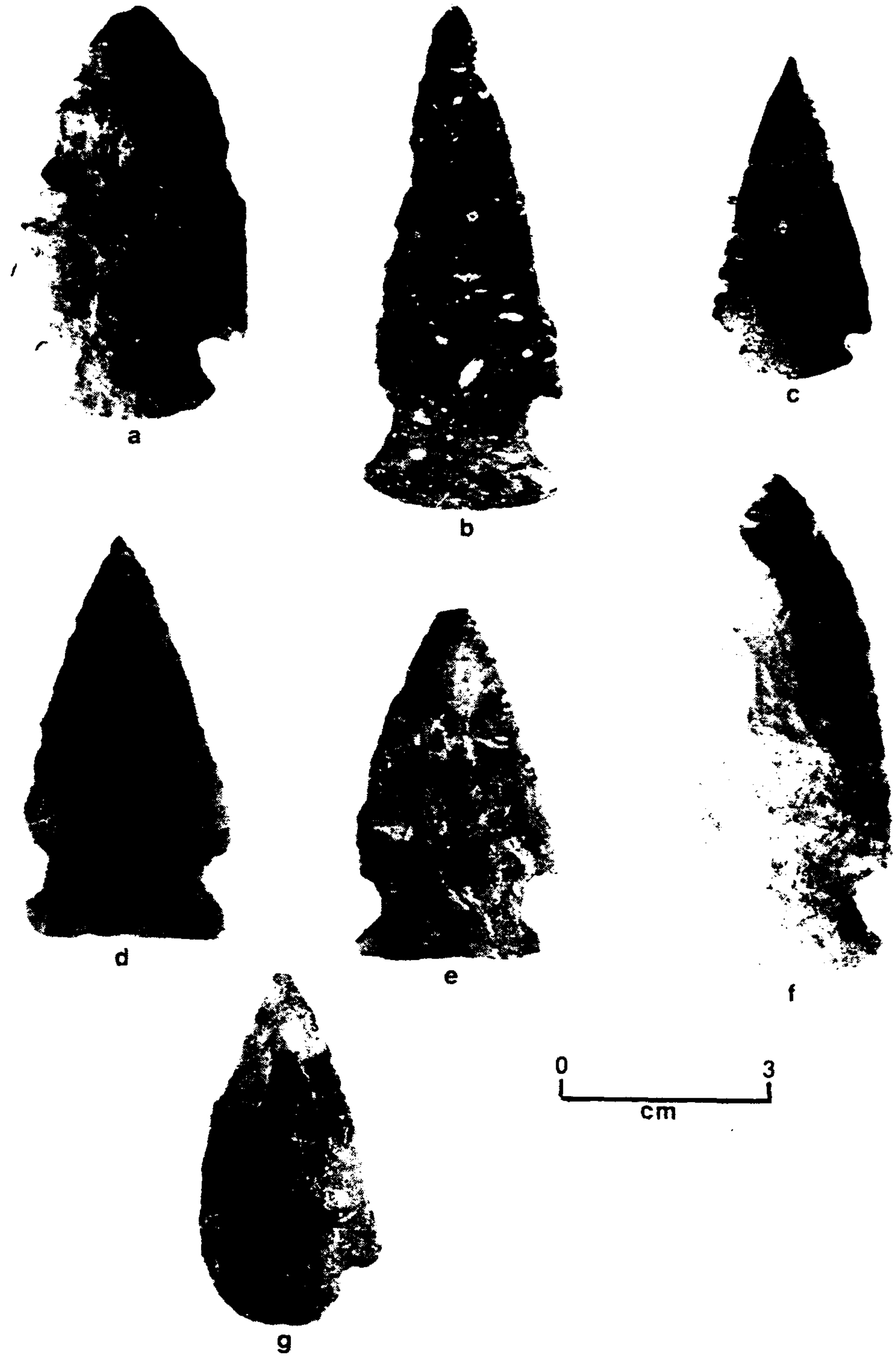


Figure 7.14 Corner-Notched Projectile Points: a) A4142/91, b) A4135/91, c) A1246/91, d) A4249/91, e) A4236/91, f) A4181/91, g) A4278/91. Note- g is a preform.

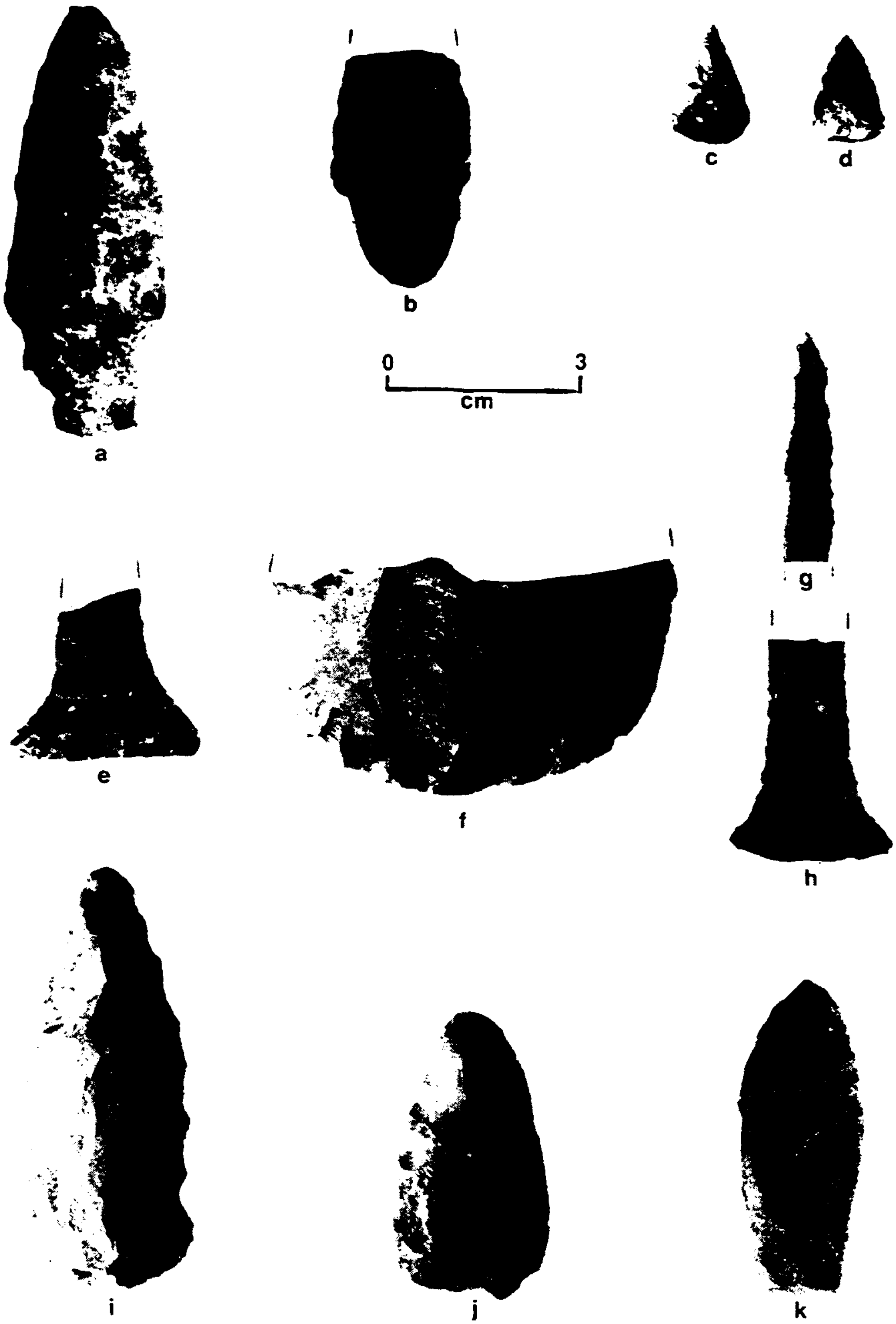


Figure 7.15 Straight-Stemmed Projectile Point, a) A1486/91; Contracting-Stemmed Point, b) A4085/91; Unnotched Arrow Points, c-d) A0806/91-A3703/91; Drills, e) A4354/91, g) A4266/91, h) A1818/91; Ovate Biface, f) A3439/91; Bifacial Blank, i) A3258/91, k) A2666/91; Preform, j) A3391/91.

has cortex on one side near the fracture, which may have contributed to the breakage. Both of these points resemble the Dickson and Gary types of the Illinois River Valley (Montet-White 1968:64). However, due to their fragmentary nature, it is difficult to assign them to a particular type.

Another projectile point type is represented by two triangular, unnotched arrow points (Figure 7.15c-d). Though they show slight signs of utilization, both are complete. Their average length is 1.7 cm and their greatest widths average 1.1 cm. Their presence at the site is evidence of a late prehistoric occupation of Quarry Creek (cf. Wagner et al. 1989:189, 196-7).

The projectile point assemblage from Quarry Creek is useful for general temporal placement of the site. The absence of both Snyders dart points and corner-notched (Scallorn type) arrow points is particularly noteworthy. The former point type is indicative of the early phase of the Middle Woodland period in both the Illinois River and Lower Missouri River valleys (Montet-White 1968; Bell 1976). Its absence from the site in conjuction with the low frequency of Trowbridge phase ceramics (see Cook herein) suggests the earliest occupation of Quarry Creek probably occurred either during the waning years of that phase or during the early years of the Kansas City phase.

The Scallorn point, which appeared in the Lower Missouri River valley ca. A.D. 500 (Johnson 1974), is one of the hallmarks of the Edwardsville phase and its Late (Plains) Woodland contemporaries in that region (Johnson 1983, 1984). The absence of the corner-notched arrow point is useful for refining the relative temporal placement of the Kansas City Hopewell occupation given the high frequency of Edwardsville ceramics (see Cook herein). The presence of plain and crenated rim sherds at Quarry Creek suggests the Hopewell occupation extended past A.D. 500. However, according to the temporal seriation of projectile points from the Trowbridge site (Bell 1976), the Kansas City Hopewell occupation(s) of Quarry Creek probably occurred ca. A.D. 200-500, a temporal placement more consistent with the radiocarbon dates from the site. The equally high frequency of Kansas City phase ceramics, the lack of Scallorn points and the range of the radiocarbon dates from the site point to its occupation primarily during the Kansas City phase and during the initial (transitional) years of the Edwardsville phase. Unless the recovery of another sample of projectile points indicates otherwise, the point assemblage from Quarry Creek is valuable in that it suggests the stylistic change in Hopewell ceramics in the Kansas City locality preceeded the change in hunting technology.

The presence of two late prehistoric (Plains Village or Protohistoric) arrow points attests to a later occupation of or transient activities at the site. One of these points (Figure

7.15c-d) was recovered from the uppermost level of unit 90N/144E, a stratigraphic context compatible with its temporal identity. The other point was excavated from a lower level of an historically disturbed unit (95N/151E). Its association with iron nails in the same level indicates that the deposits therein were probably disturbed.

Drills

The lithic assemblage from Quarry Creek includes five drills: one complete specimen, three bases, and one tip. The complete drill is from unit 87N/168E. Two of the bases and the tip are from Feature 7 (Fig. 7.15.e,g-h). A third base is from unit 100N/119E. The complete drill is a reworked corner-notched dart point (Fig. 7.13.c). This stemmed drill is comparable to specimens from the Renner site (Wedel 1943:Plate 14) and from the Illinois River Valley (Montet-White 1968: 89). It is made of a gray fossiliferous chert. The two bases from Feature 7 are of the winged drill type, similar to those found at the Snyders site and not uncommon at Early and Middle Woodland site throughout the Illinois River Valley (Montet-White 1968:88-89). The third base is straight-shafted with a rounded, slightly expanded base. In form it is comparable to one from the Renner site illustrated by Wedel (1943:53). All three bases are similar in size. Their widths are all ca. 14 mm and their maximum thickness ca. 8 mm. All three bases are of the gray fossiliferous type. The tip fragment from Feature 7 is of a brown/buff chert. The tip's maximum width is 9.9 mm. The tip seems well crafted and most likely had a base similar to the three found. The tip does not show much wear and was probably broken early in its use-life.

Bifacial Blanks

The lithic assemblage contains four bifacial blanks (e.g., Fig. 7.15.i, k). A blank is defined as a bifacially flaked artifact that has all the attributes of a preform but which lacks the thinner cross-section of that class. Bifacial blanks may have been abandoned or discarded in their unfinished form because of a flaw in the chert or they may have entered the deposits through artifact loss. Two of the specimens represented in the Quarry Creek assemblage are gray fossiliferous chert and two are brown/buff chert. One of the latter exhibits evidence of heat treatment on its tip.

Preforms

Six preforms were recovered from the site (e.g., Figs. 7.14 g; 7.15j). Three of these are complete and the others are fragments. Preforms have the general form of a dart point but lack the diagnostic hafting element. These were made perhaps for later use or abandoned for reasons such as chert flaws. The three complete preforms are at least twice as long as they are wide. One of the preforms (Fig. 7.14g), recovered from Feature 7, has one lateral notch, suggesting it was in the final stages of production before it was cached, discarded, or lost. Two are grey fossiliferous and one is heat treated brown/buff. The three fragments are ovate preforms. These are rounded and have more equable length-width ratios. One is a heat-treated gray fossiliferous material and the other two are brown/buff cherts.

Indeterminate Bifaces

Four bifaces in the Quarry Creek lithic assemblage cannot be classed according to the above categories. They exhibit bifacial flaking and retouch, but lack the distinctive patterns or attributes of those artifacts. All four are ovate in form. One is a heavy duty biface that has an edge which could have been used as a knife. It is made from a gray fossiliferous chert. The other three bifaces are somewhat comparable to bifacial scrapers, but do not exhibit wear patterns characteristic of that class. Their function is therefore unknown. Two are gray fossiliferous chert and the other is a nonlocal, tan fossiliferous material.

Biface Fragments

The site yielded 37 biface fragments, including 15 tips, six mid-sections, and five basal fragments. The remaining fragments include six indistinguishable pieces, three ovate pieces, and two lanceolates. The tips are most likely from darts or knives; one may be part of a drill. Nine of the tip fragments are made of gray fossiliferous chert, three are heat treated brown/buff, one is Winterset, one is Permian, and one is a non- local, off-white chert.

Five of the mid-sections appear to be dart or knife fragments. Two of these exhibit traces of notches, which support this inference. The sixth mid-section is a thick, heavy-duty biface probably from a celt or a hoe. The chert types are one gray fossiliferous, two brown/buff, one heat-treated brown/buff, and two non-local cherts, one gray, and one heat-treated banded. The basal fragments form two groups. Three are small fragments from the notch area of darts or drills. One such piece retains a well defined notch. The other two basal fragments are probably from ovate preforms. The chert types of the basal fragments are: one gray fossilferous, one brown/buff, one Winterset, one jasper (Niobrara silicified chalk), and one unidentifiable.

The three ovate biface fragments show characteristics of celts (cf. Montet-White 1968:84-85). The fragments are from the working edge and may have broken during use (e.g., Fig. 7.15f). Two exhibit polish that appears to reflect use as hoes or digging tools. These specimens were made from heat treated, brown/buff chert. The third is a nonlocal, speckled pink chert. The two fragments of lanceolate form lack any other distinguishable attributes. One of these may have been a dart and the other may have been a knife. The knife-like fragment is a gray fossiliferous chert and the possible dart is a brown/buff chert. Six biface fragments could not be described by general morphology. Five can be described functionally as light duty bifaces and one as a heavy duty biface. Four of these are gray fossiliferous chert, two of which are heat treated, one is a nonlocal pink chert, and one is a nonlocal tan/gray speckled chert.

Scrapers

The assemblage of lithic tools from Quarry Creek includes 24 scrapers. These scrapers are divided into types by the placement of retouch and/or use-wear. There are 20 end scrapers and four circular scrapers. The end scrapers are equally divided between those that have been bifacially and unifacially retouched. The end scrapers have been classed as blocky end scrapers, end scrapers with bilateral retouch, and indeterminate fragments.

Fourteen scrapers are of the blocky end type. Eight of these are bifacial scrapers (e.g., Fig. 7.16c, f) and six are unifacial scrapers (e.g., Fig. 7.16d, g). These range in size from 24 mm to 66 mm in length and from 7.5 mm to 20 mm in maximum thickness. Blocky end scrapers therefore include a wide range of sizes and shapes. With few exceptions, they are similar in having a thick unfinished look. Twelve of the blocky end scrapers are made of gray fossiliferous chert, one is worked from Winterset chert, and one is a nonlocal, white and tan banded chert. Two of the end scrapers are bilateraly retouched (Fig. 7.16a-b). These are similar to the preform scraper illustrated by Montet-White (1968:91, fig.5). One is made of a gray fossiliferous chert and the other is similar to Permian chert. Two scraper fragments are here considered to be indeterminate in type, though both are reminiscent of blocky end scrapers. The two fragments were unifacially worked from a gray fossiliferous chert.

The other type of scraper found at Quarry Creek is circular in outline. Scrapers of this form have also been referred to as semi-circular (Montet-White 1968) and as disc scrapers (Wedel 1943). They are generally round in form with retouch around the circumference. Their greatest thickness is at the center, with unifacial, invasive flaking. Excavations at Quarry Creek yielded four circular scrapers (e.g., Fig. 7.16e, h-i). All were made from local cherts, three from gray fossiliferous material and one from brown/buff chert. The latter artifact was heat-treated.

Figure 7.16 End Scrapers, a-b) A4079/91-A4156/91; Bifacial Scrapers, c, f) A1394/91, A1654/91; Unifacial Scrapers, d, g) A2335/91, A3601/91; Circular Scrapers, e, h-i) A3180/91, A4112/91-A4295/91.

Part 4

GROUNDSTONE TOOLS

Brad Logan

The groundstone tool assemblage from the Quarry Creek site is small (n=23) and consists predominately of informally shaped or modified pieces of limestone, sandstone, quartzite and granite. The sedimentary material is probably local, as the various Pennsylvanian formations in the Leavenworth area include not only limestone but sandstone members (e.g., the Tonganoxie sandstone of the Douglas Group). The metamorphic stone is also locally available, though it is not bedrock-derived. Metamorphic stones, predominately pinkish Sioux quartzite, occurs throughout northeastern Kansas in uplands and valleys as glacial detritus. In addition to serving as hearthstones, they were used in a variety of ways by the prehistoric inhabitants of the Lower Missouri River valley. Despite its size, the sample of groundstone tools from Quarry Creek reflects this variety.

Four hammerstones are included. All exhibit pitted or battered ends indicative of their use as percussors. One (Fig. 7.17a) was recovered from the interface of the midden deposit and the inferred top of the trash-filled pit designated Feature 7. The other (Fig. 7.17b) came from the upper level of the midden in the units above Feature 6. Woodworking tools are represented by two celts and an ax fragment. Of the former, one (Fig. 7.17c) is made of a grantic stone and lacks the poll, which may have been broken during its use. It was recovered from the midden a few cm above and north of Feature 6. The second (Fig. 7.17d) is a limestone object from Feature 7. Though made of a rather soft material to use for cutting wood, it could have served as a wedge for splitting such. It has been modified by scraping or pecking into a celt-like shape. The only axe in the assemblage is a piece of quartzite that bears a trace of the groove near the poll end. Sufficient surface is preserved to suggest it was at least a three-quarter grooved axe. Battering is apparent on the poll.

Plant food processing tools are represented by five groundstone artifacts. That two of these, both quartzite pebbles, were used as nutting stones is suggested by single pits about the size of a black walnut at their centers. The pit on one (Fig. 7.18a) is about three cm in diameter and is centered on a broad, relatively flat surface about nine cm wide. It may have served as an anvil for crushing nuts. The second nutting stone (Fig. 7.18b) is more spherical, 6.5 cm in diameter, with a pit that is also about three cm in diameter. Its shape suggests it served as a hammer. That both artifacts may have been used together is suggested by their context. They lay within six cm horizontally and three cm vertically of each other in the lower portion of the trenched midden (81N/168E).

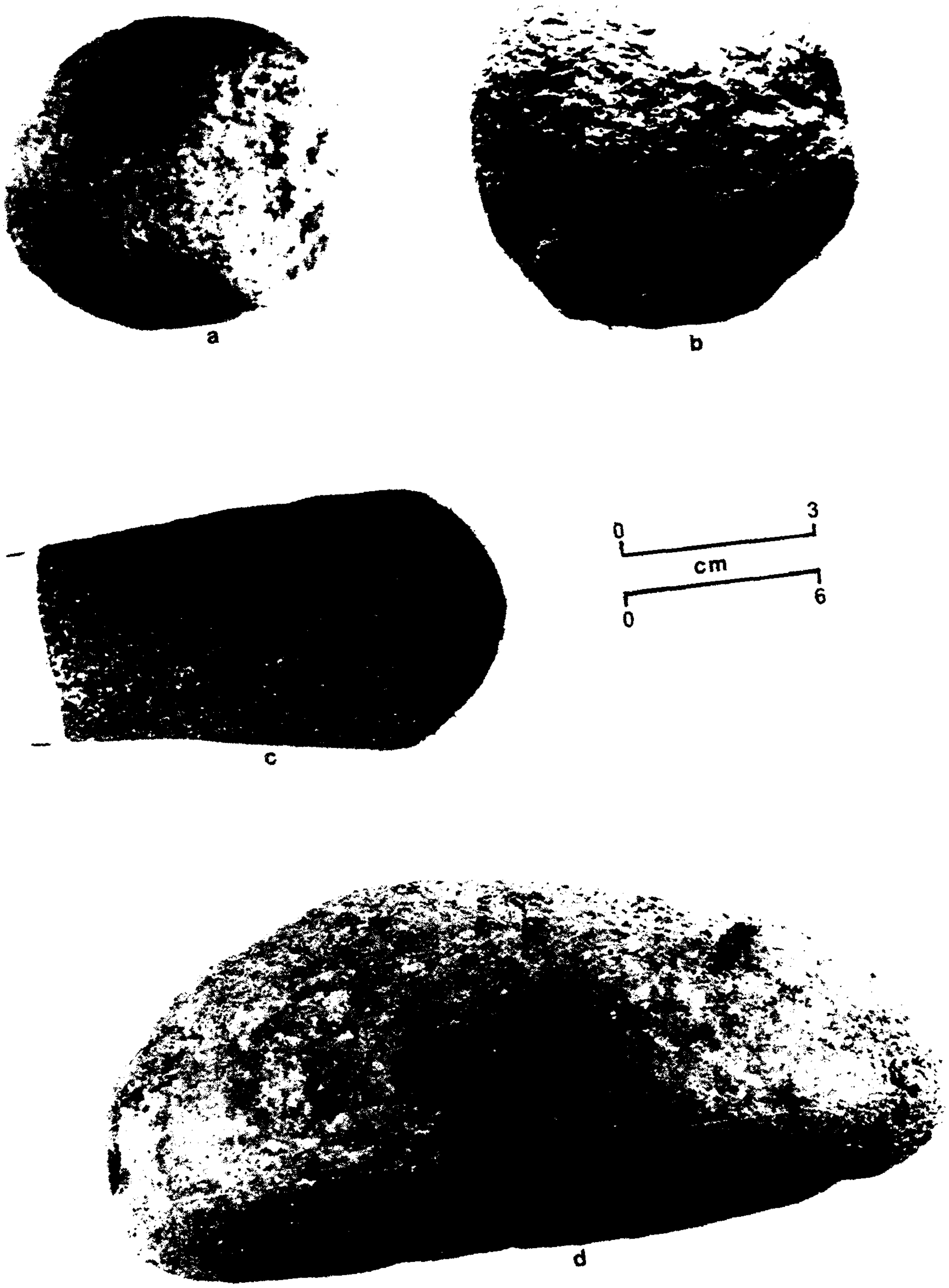


Figure 7.17 Hammerstones, a-b; Celts, c-d. Six cm scale applies to artifact c only.

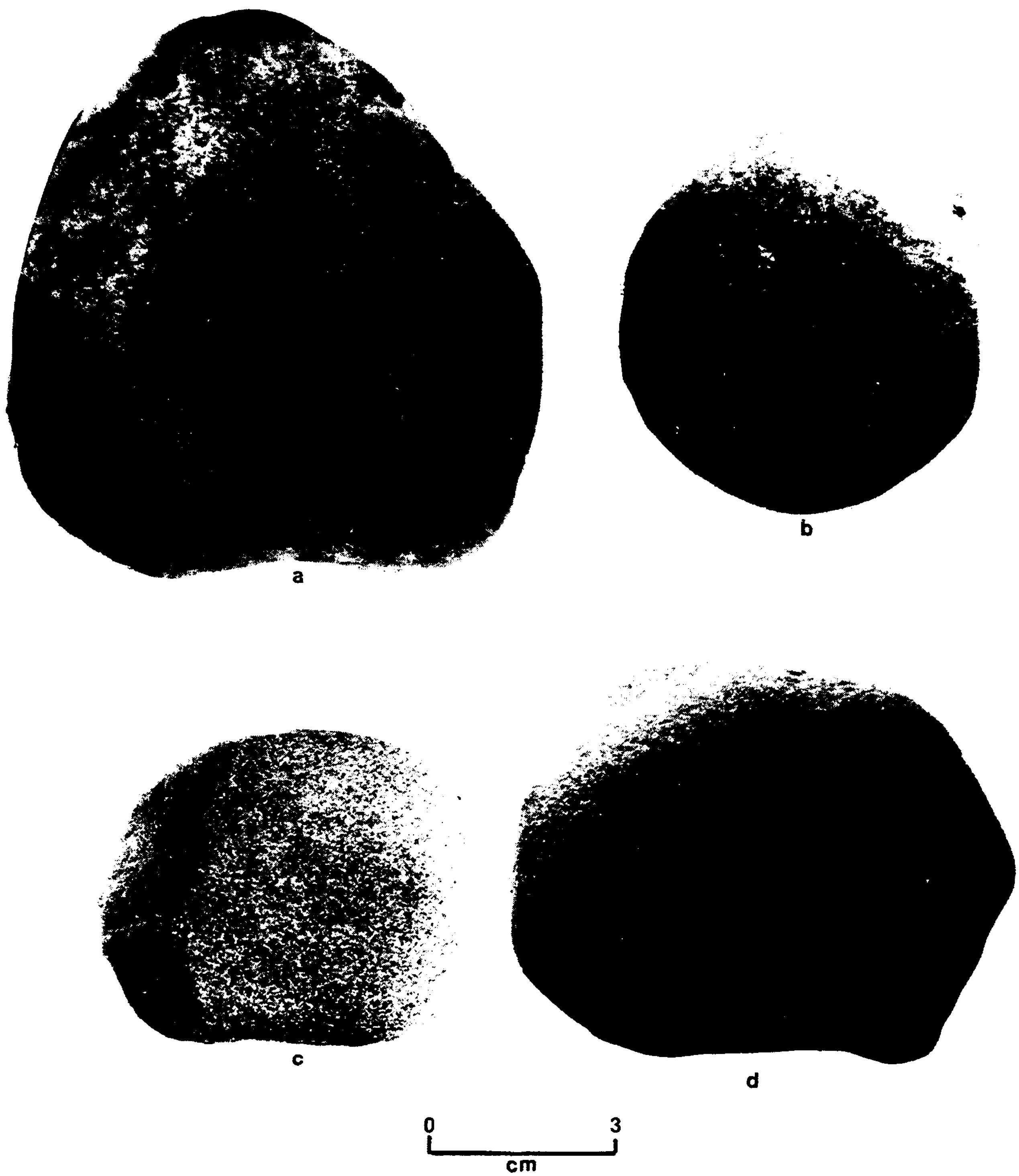


Figure 7.18 Nutting Stones, a-b; Grinding Stones, c-d.

The three other groundstone tools used in plant food preparation are manos. Two are hand-sized pebbles which exhibit flattened surfaces worn by grinding. One (Fig. 7.18c) is granitic and the other (Fig. 7.18d) is Sioux quartzite. The former was recovered from Feature 6 and the latter was found in one of the lower levels of the midden above the pit-cluster. The third such tool is a quartzite fragment 39 mm thick that has two parallel grinding surfaces. It was found in the lowest level of the midden in trench unit 82N/168E.

Abrading tools of sandstone are represented by seven items that reflect different specific honing, polishing or grinding tasks. One slab of sandstone about two cm thick (Fig. 7.19a) may have served as a palette, though no trace of any substance (e.g., hematite) that might have been ground on it is visible macroscopically. This artifact was recovered from the second level of the midden in the pit-cluster block. Another piece of sandstone 77 mm long, 50 mm wide and 23 mm thick bears a broad, abraded depression ca. 60x30 mm in area. This may have been a grinding surface, though it not a perfect plane and has no trace of any processed substance. This artifact was recovered from Feature 4.

Five irregular pieces of sandstone bear troughs or channels characteristic of abraders. Three of these tools have continuous, u-shaped troughs about five mm wide indicative of the abrasion of wooden shafts. Two of these (e.g., Fig. 7.19c) were found in level three of the midden deposit of the pit-cluster block. Another (Fig. 7.19e) came from level five of unit 99N/172E.

Two abraders exhibit short-stroke abrasion scars. The smaller of these (only 18 gms in mass), from level one of the midden in the trench unit above Feature 7, bears only a single such scar. The larger such tool (Fig. 7.19b), found in Feature 7, exhibits several short-stroke incisions. The shallow and generally v-shaped cross-sections of these scars are not indicative of wood shaft smoothing. Rather, they suggest the kind of grinding or polishing action involved in the finishing of bone tools, such as awls, or platform preparation of flakes or chipped stone tools prior to retouching. Either task can be inferred from this artifact's provenience. Three turkey bone awls were found in Feature 7, as was the scored-and-snapped distal end of a tarso-metatarsus from which such tools were made (see below). The honed ends of the awls all fit the grooves of the abrader. Similarly, other material from the feature attest to the various stages of lithic tool manufacture. This includes a hammerstone (see above), antler percussors and pressure flakers (see below), and a wealth of secondary and tertiary chipping debris.

Figure 7.19 Abraders.

Part 5

EXOTIC ARTIFACTS

Brad Logan

A few artifacts recovered during the KAFS investigation of the Quarry Creek site warrant description and discussion apart from all others in that they may be evidence of participation of the Kansas City Hopewell in the Hopewell Interaction Sphere (Struever 1964). These artifacts include a piece of faceted hematite (Fig. 7.10b), a miniature copper "celt" (Fig. 7.10c), a rim fragment of a miniature ceramic vessel (Fig. 7.10d), and a fragment of a ceramic pipe (Fig. 7.10e).

Johnson (1979) has noted that interaction sphere-like artifacts are relatively rare finds at Kansas City Hopewell sites. According to his tabulation, only 62 such artifacts had been recovered from excavations at seven of 23 sites of the variant. Of these items, only 14 could definitely be considered non-local. These included one fragment of a helmet shell from the Caribbean; two celts, three awls, and four fragments of copper; one obsidian flake; and three small pieces of sheet mica (Johnson 1979:91-92). Ceramic artifacts such as anthropomorphic figurines and pipes appeared to have been local imitations of exotic goods. Given this scarcity of trade goods, Johnson (1979) suggested the Kansas City Hopewell were not active participants in the interaction sphere.

The few items from the Quarry Creek site that bear on this interpretation do not alter its validity. They do, however, increase the small sample of artifacts that indicate the Kansas City Hopewell were at least peripheral to the extensive trade network that spanned much of the eastern woodlands of North America and that reached across the Great Plains as far as the Yellowstone region. These items are described below.

A piece of faceted hematite was recovered from Feature 4. Although hematite occurs in the glacial deposits in northeastern Kansas, the material the author has seen from these deposits in the Leavenworth area (e.g., in the vicinity of the Zacharias site, about three mi from Quarry Creek) have all been considerably less dense than that shown in Figure 7.10. Until further studies of the variability or traceability of the ferrous oxides of the glaciated region of northeastern Kansas and northwestern Missouri have been conducted, it remains a possibility that the artifact shown here may have been a trade item.

The minature copper "celt" is also from Feature 4 (it has point provenience within that pit). Its small size suggests it was not of utilitarian value, though its archaeological context does not provide any clue as to its significance in the lifeway of the Quarry Creek inhabitants. It is nearly identical to one illustrated by Wedel (1943:49, Plate 11) recovered from a midden deposit at the Renner site. Another such artifact from that site, in a private collection, is illustrated in Shippee (1967:Figure 51). Chapman (1980:44) also shows a comparable artifact he refers to as a "copper object" from a Wakenda phase site in central Missouri, along the putative trade route of the Hopewell of the Lower Missouri River valley (Reid 1976; Johnson 1979). That the "celt" from Quarry Creek is composed of copper has been verified through x-ray flourescence. This analysis was carried out by the offices of Professor Ted Kuwana, Department of Pharmaceutical Chemistry, University of Kansas. Figure 7.20 shows two views of the artifact through scanning electron microscopy, one at a scale of .60 mm and the other at a scale of 30 microns. The former photograph was taken at a point at the "poll" of the artifact (Figure 7.10c, arrow) where the corroded surface that covers nearly all of the item has exfoliated. The latter photograph is of a spot on the non-corroded surface and the linear fractures visible show clearly its basic structure. The compositional frequency shown in Figure 7.21 was taken at that spot and it demonstrates the high percentage of copper compared to other trace elements. We hope to undertake analysis of the artifact in the future that might trace the copper to its source, perhaps in the Great Lakes region (cf. Rapp et al. 1990)

A very small rim sherd from a minature vessel was recovered from level 5 of unit 91N/168E. Its small size necessitated an enhanced scale photograph (Figure 7.10d) in order to reveal its careful decoration with cross-hatched incisions above a row of dentates. A portion of what appears to have been a perforation is visible as well (arrow). Though little arc is preserved, it is clear that the orifice of the "vessel" from which this sherd derived could not have exceeded two cm. As such it is smaller than the three minatures from the Renner site described by Wedel (1943:42, Plate 11). It also differs from them in its careful decoration and finer construction. Struever and Houart (1964:88; cited in Johnson 1979:91) identify minature vessels as interaction sphere objects. Whether the minature from the Quarry Creek site qualifies as such remains unverified.

The mouthpiece of a ceramic pipestem was recovered from Level 2, 87N/161E, within the midden deposit above the feature cluster. Sufficient length and attributes of the pipe remain to identify it as one of the platform variety. No tempering agent is apparent in the paste and the broken end of the piece appears to have become worn or eroded to a somewhat smoothed aspect. As cited above, Struever and Houart (1964) list such items as interaction sphere commodities. Again, neither the context nor any particular attribute of the pipe fragment from Quarry Creek identifies it as a trade object. Perhaps a detailed analysis of its paste will provide the means of determining that status.

Figure 7.20 Scanning Electron Microscope Views of Miniature Copper "Celt" at Interface of Corroded and Exfoliated Surfaces (left) and on latter (right). Scale refers to distance between ends of dots.

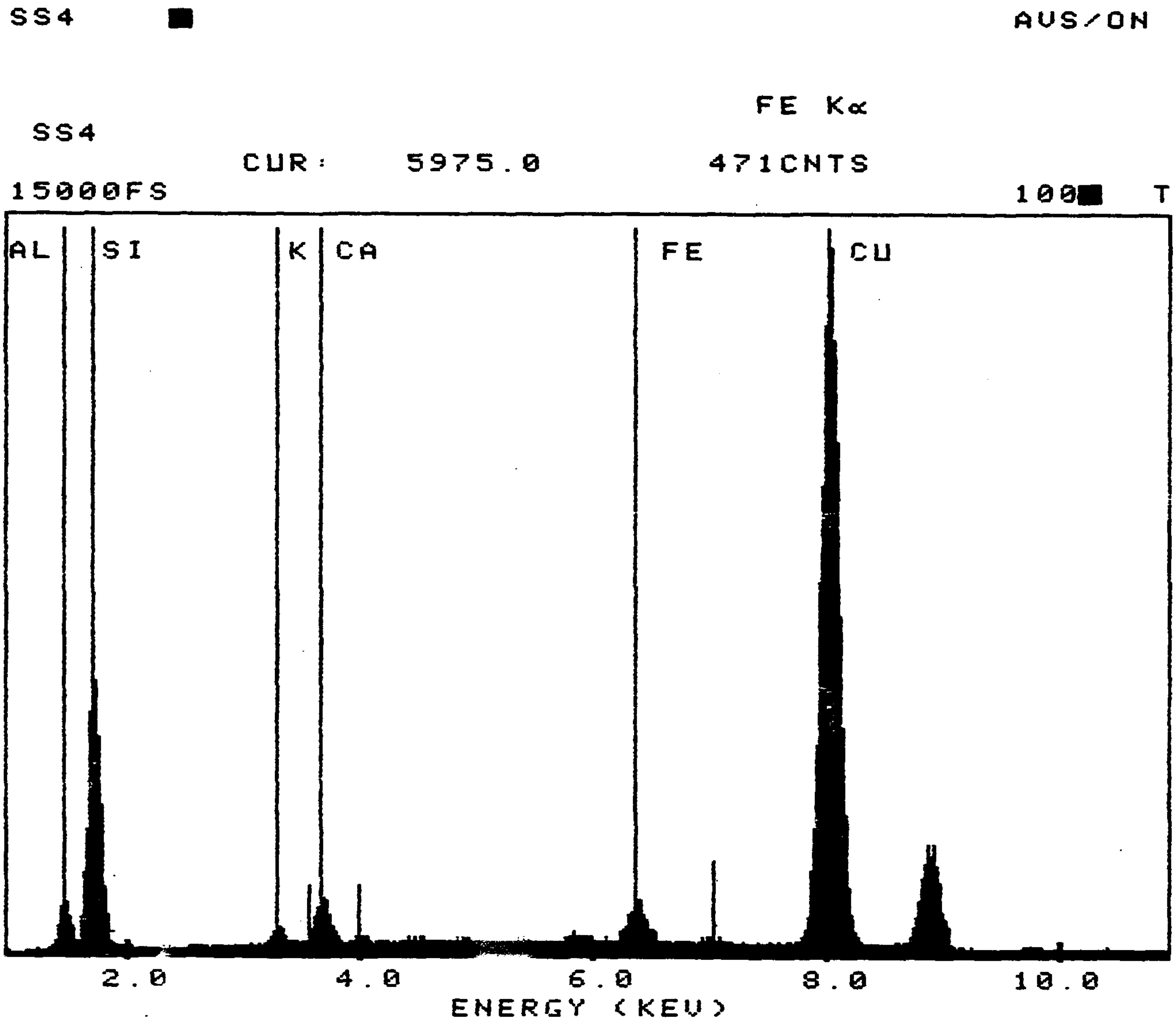


Figure 7.21 Element Spectrum by X-Ray Flourescence of Area Shown in Figure 7.20 (right). Note relatively high frequency of copper.

Part 6

MODIFIED BONE

Brad Logan

At least 27 bones, of the thousands of fragments recovered from the Quarry Creek site, were modified either for use as tools or during the process of butchering. Sixteen were found in the pit features and eleven of these are from Feature 7. Two bone tools came from Feature 4; one bone tool was found in Feature 5; and two bones with cut marks are from Feature 6. Four bone tools and two bones with cut marks are from units in the midden above the feature cluster. Four bone tools and one bone with cut marks were found in the midden in the northern half of the exploratory trench. Provenience and metric data of these artifacts are presented in Table 7.14. These items are described below.

Table 7.14. Modified Bone from the Quarry Creek Site.

Catalog #	Unit/Feature-Level	Weight (gm)	Length (mm)	Description
A2301/91	88N/160E-4	2	35.69	Turkey bone awl tip?
A2302/91	88N/160E-4	4	36.47	Deer antler point
A4385/91	87N/161E-5	1	27.40	Turkey tarso? awl tip
A4422/91	87N/161E-5	1	50.02	Cutmarks
A4016/91	87N/161E-4	7	62.00	Cutmarks
A4047/91	88N/161E-6	10	36.80	Deer antler billet?
A2876/91	87N/168E-2	2	29.00	Deer antler point
A2891/91	87N/168E-3	20	43.39	Astragalus-cutmarks
A3050/91	89N/168E-4	4	46.05	Deer antler flaker
A3068/91	89N/168E-5	15	121.39	Canid ulna punch
A4360/91	91N/168E-5	12	66.66	Burnt deer ulna punch
A4082/91	Feature 4	3	39.14	Bone point?
A4091/91	Feature 4	3	38.22	Deer antler point
A4115/91	Feature 5	16	107.77	Deer antler flaker-awl?
A4159/91	Feature 6	12	41.21	Astragalus-cutmarks
A4166/91	Feature 6	8	51.25	Bobcat maxilla-cutmarks
A4190/91	Feature 7-1	33	70.54	Deer antler billet
A4191/91	Feature 7-1	10	35.36	Deer scaphoid-cutmarks
A4194/91	Feature 7-1	3	109.65	Turkey tarso-met. awl
A4239/91	Feature 7-3	37	127.17	Deer antler billet
A4246/91	Feature 7-3	3	32.39	Deer antler point
A4267/91	Feature 7-3	37	155.42	Deer antler flaker
A4270/91	Feature 7-4	3	87.14	Turkey tarso-met. awl
A4298/91	Feature 7-5	15	96.08	Deer ulna punch
A4312/91	Feature 7-5	7	36.13	Deer radius cutmarks
SN203 (flot)	Feature 7-5	2	23.00	Turkey distal tarso-metatarsal score/snap
A4330/91	Feature 7-6	3	79.42	Turkey tarso-met. awl

Five bone tools in the assemblage are awls or the tips thereof. Three of these are identifiable as modifications of the tarsometatarsus of wild turkey (Meleagris gallopavo) and the other two fragments are probably the same element. Three of these awls were found in Feature 7 (Fig. 7.22a-c) and the two tips were recovered from the midden deposit above the feature cluster (e.g., Fig. 7.22d). Artifacts of this nature are common finds at Hopewell sites, both in the Kansas City locality (Wedel 1943:46, Plate 10; Adair 1977:97) and in the Hopewell heartland (Griffin 1967). In the Illinois River valley and the Great Lake area, they often occur as grave goods (Griffin et al. 1970). The context and broken or shortened form of the Quarry Creek awls reflect their utilitarian function. One of the steps in the manufacture of these tools is indicated by a distal portion of a tarsometatarsus from Feature 7 that exhibits scoring lines and a snap fracture (Fig. 7.22e). As noted above, a sandstone abrader from the same feature bears scars that could have resulted from smoothing the split element halves into their final shape.

Three ulnae, all from the trench excavation, were modified for use as punches. Two of these are deer (Odocoileus virginianus) elements and the third is from a large canid. The latter (Fig. 7.22g) is a previously unrecorded find in the Kansas City locality (to the writer's knowledge). It bears striae along the shaft, which has been beveled to a tip that was apparently broken during use. This artifact, partially burned, was found in the same level and within two meters of one of the deer ulna punches. The latter tool was burned and the shaft has been worn to a rounded nub (Fig. 7.22e). The second deer ulna punch was recovered from Feature 7 (Fig. 7.22f). The shaft of this tool also has been worn from use. Wedel (1943:47, Plate 10) describes identical perforating tools from the Renner site.

Deer antlers were modified and used as lithic manufacturing tools and as projectile points. The modified bone assemblage includes three antler tine flakers, three antler billets or rubbing tools and four antler tine tip projectile points. Three antler fragments show cutting scars where the tine was severed and beveled tips which apparently resulted from their use as pressure flaking tools. Two of these are illustrated, one from Feature 5 (Fig. 7.23d) and the other from Feature 7 (Fig. 7.23c). The former artifact exhibits a polished tip which may also reflect its use as a perforating tool. The latter pit feature yielded a variety of artifacts that suggest it was filled with items from a flint knapper's kit. In addition to an abundance of secondary and tertiary debitage and the flaker which may have been used to remove the latter, it contained portions of antlers which may have been used as billets for soft hammer percussion. The tine end of one of these (Fig. 7.23e) has been severed by the groove-and-snap method and the pedicle end has been worn through use. The second (Fig. 7.23-b) is a shaft section shaped by

Figure 7.22 Turkey Bone Awls, a-d; Deer Ulna Punches e-f; Canid Ulna Punch, g.

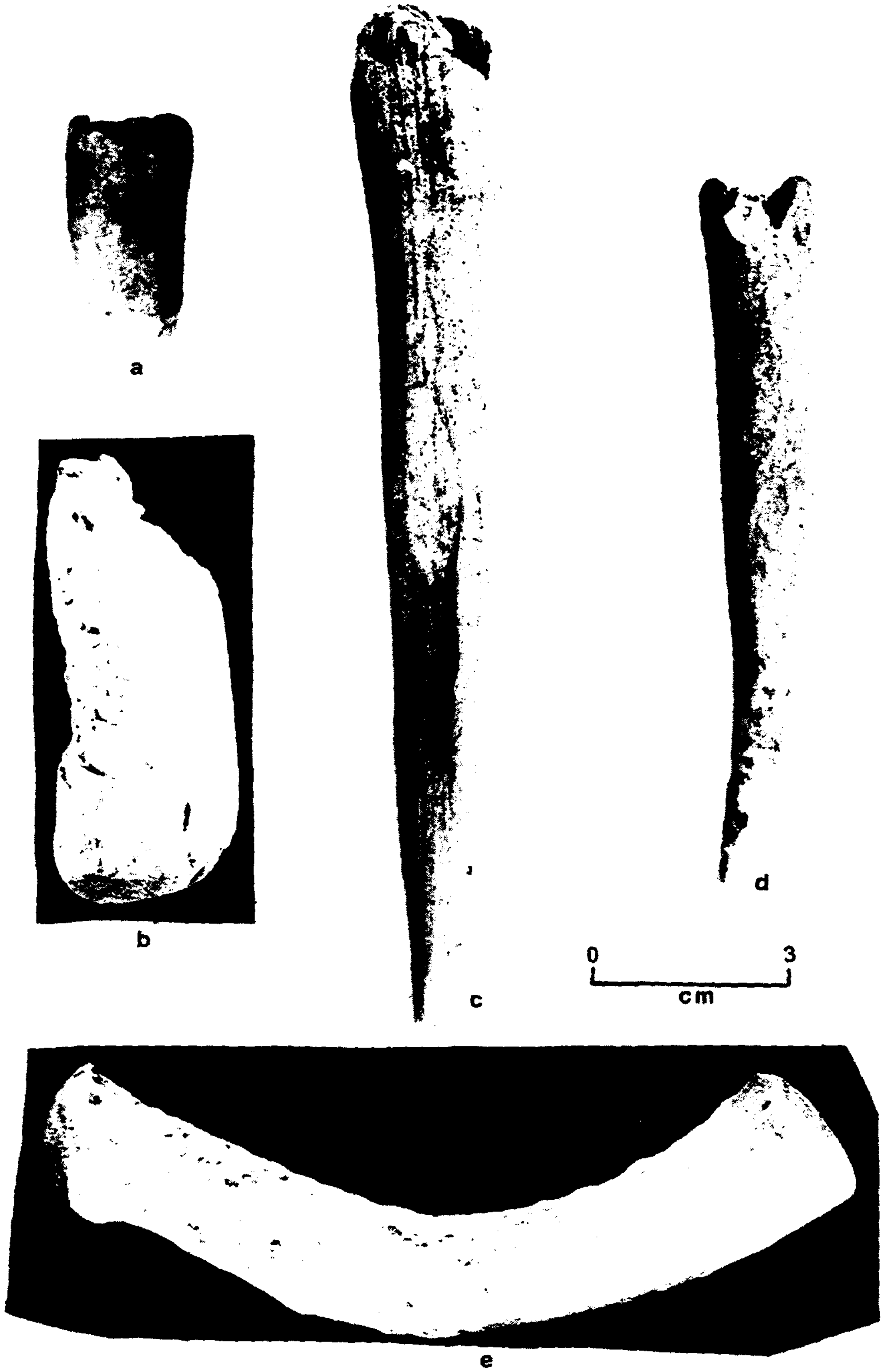


Figure 7.23 Modified Deer Antler.

cutting and polishing into a roughly cylindrical shape. It has suffered some rodent gnawing that appears to have occurred after its deposition, perhaps indicating the exposure of the upper portion of the trash filled pit (from which it comes) for a period prior to burial of the feature below the midden. A third antler shaft section (Fig. 7.23a) bears cutmarks at both ends, indicating it was in the process of being shaped into a cylinder. Admittedly, the use of these antler tools as billets is somewhat conjectural. Wedel (1943:44; Plate 9) describes comparable artifacts from the Renner site that he suggests were rubbing tools, rather than knapping instruments.

Four antler tine tips appear to have been used as projectile points. Three of these were recovered from pit features (e.g., Fig. 7.24a; from Feature 4) and the fourth (Fig. 7.24b), a burned fragment, was found in the upper portion of the midden in the exploratory trench. All are short (less than four cm) sections that appear to have been severed from the tine. As none exhibits the tell-tale tang or tapering basal socket of the points described by Wedel (1943:45, Plate 9) from the Renner site, their function as points remains speculative. However, they could easily have served as such tools with little or no additional modification. Finally, another bone that cannot be identified as to species or element, has been extensively modified for use as either a point or other piercing tool (Fig. 7.24c). One end of this artifact has been grooved-and-snapped and the other surfaces all exhibit abrasion and polishing that resulted in a tapering, beveled tool. The tip has been damaged, either through impact or use.

Eight bones exhibit cutmarks, nearly all of which are traces of the butchering process. One of these, a turkey element, was described above. Of the sample, only one is a cranial fragment. This is a portion of the maxilla of a bobcat (<u>Lynx rufus</u>) which bears two parallel incisions at the canine fossa (Fig. 7.24d). Personal experience in defleshing a raccoon, a fur-bearing animal of comparable size, suggests these strokes were necessary to remove the pelt from its attachment near the nose of the animal. These marks also indicate the pelt retained the skin around the head. A long bone shaft fragment of what might have been another turkey element has been extensively scored (Fig. 7.24f). At least two dozen parallel, semi-lunate cuts are visible along more than half the length of this shaft. Such severe cutting would seem to be excessive for defleshing of what must have been a relatively small animal. Neither do the cutmarks appear to be of a decorative nature. They may reflect a stage in the manufacturing process of an awl.

Of the other post-cranial elements represented, three are tarsals. Two of these are astragali (e.g., Fig. 7.24h) and the third is a scaphoid (Fig. 7.24j). All bear short, parallel

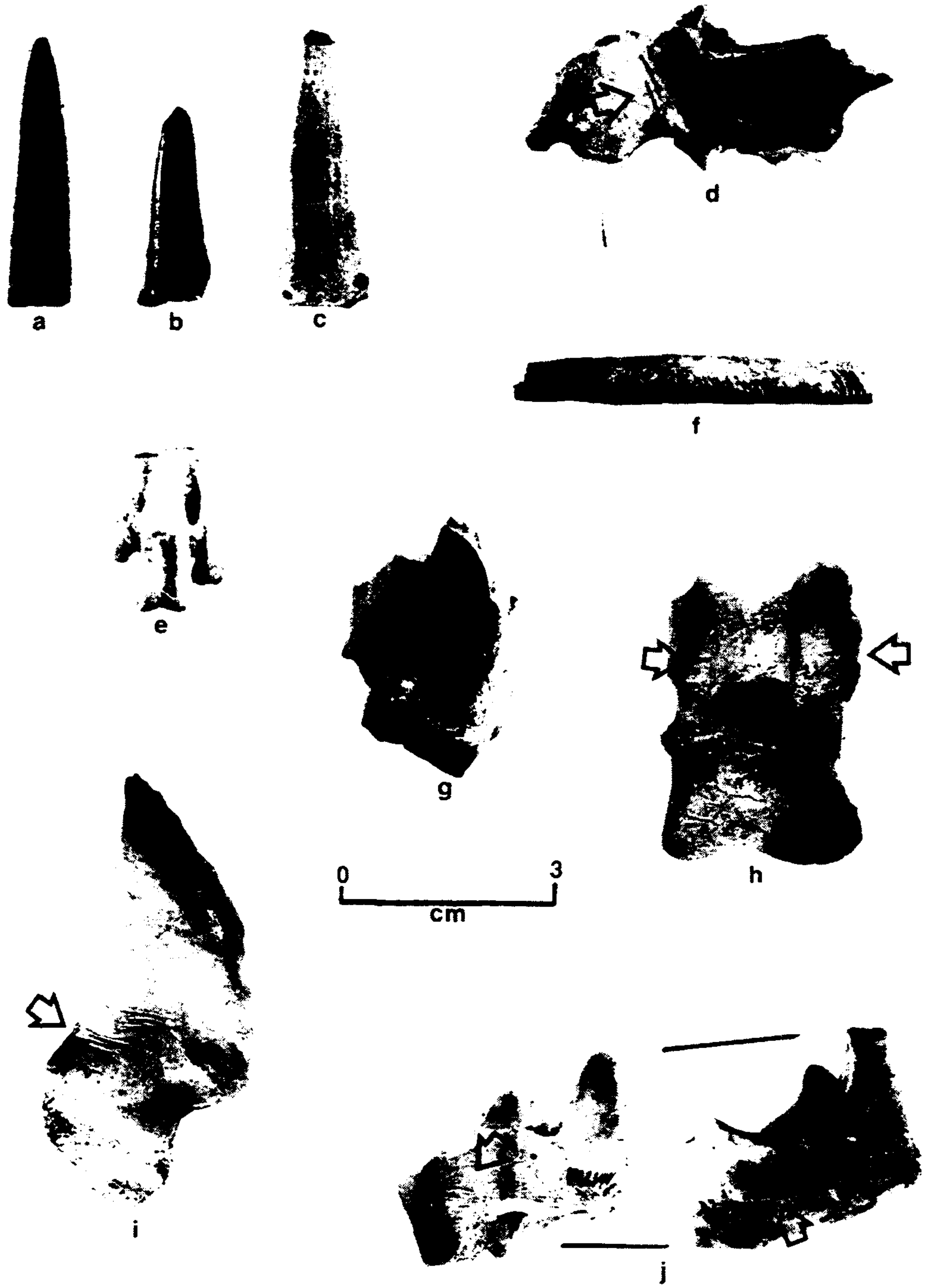


Figure 7.24 Deer Antler Points, a-b; Bone Point/Punch c; Bones with Cutmarks (arrows), d-j.

incisions that resulted from the severing of the tendons which bind these elements to the metatarsal and tibia. Comparable cutmarks on these deer elements are illustrated by Guilday et al. (1962) from Woodland sites in the eastern United States. Another deer element with cutmarks is the proximal end of a radius which has a series of parallel incisions on the lateral-anterior surface (Fig. 7.24g). These scores reflect the severing of attachments of the forelimb joint between the radius-ulna and the humerus. Another as yet unidentified element is a near-articular end of a long bone, possibly deer, with a series of score marks that reflects severing of the same joint (Fig. 7.24i).

Other modified bones, particularly those with cutmarks too subtle to have been detected during the cursory review by this author, are as yet unrecognized in the extensive faunal assemblage from the Quarry Creek site. A more thorough analysis of the faunal assemblage promises to yield more such data in the future (see following chapter).

Chapter 8

BIOLOGICAL ASSEMBLAGES

Introduction

Brad Logan

Among the many factors that make the Quarry Creek site of such great significance are its abundant, varied, and excellently preserved plant and animal remains. Poor preservation of organic materials is generally the rule throughout most of northeastern Kansas making it particularly difficult to draw inferences about the subsistence activities of the prehistoric inhabitants of that region. The Leavenworth area is not an exception to this rule as two seasons of excavations at a site in Salt Creek valley, just 4.2 km southeast of the Quarry Creek site, have demonstrated. The KAFS conducted extensive excavations at the Zacharias site, on an alluvial terrace in that valley, recovering abundant evidence of Plains Woodland and Plains Village occupations. Radiocarbon dates from two areas of the site indicate it was occupied ca. A.D. 775-960 and A.D. 1045-1200, perhaps during a time of transition from Woodland to Village adaptations (Logan 1990). Despite extensive and systematic flotation, very little bone and relatively little carbonized plant material was recovered. It is less likely that this deficiency is due to behavioral or depositional processes or sampling procedures than to the acidic nature of the soils or some other post-depositional factor of the site's environment.

During his inspection of the soils at the Quarry Creek site, Prof. Sorenson (see chapter two) was informed of the good state of organic preservation. He attributed this to the generally low acidity of loess-derived soils in upland settings. While this factor was essential, we may also attribute the preservation (and certainly the abundance and variety) of this material to the Hopewell themselves. Bone and carbonized plant materials stand a better chance of survival if they are quickly buried in low acidic soils. If exposed for any considerable length of time, bones in particular would suffer from trampling, carnivore and rodent gnawing, and weathering. While some of the bone from Quarry Creek exhibits tooth marks from rodent gnawing (e.g., Fig. 7.23b, the vast majority is free of such scarring and weathering cracks are rare. This is due undoubtedly to the relatively quick burial of animal remains in midde and trash pit deposits.

The following sections of this chapter examine selected samples of animal and plant remains from the site and point to the overall research potential of Quarry Creek for increasing our understanding of Kansas City Hopewell subsistence.

Faunal Remains

Brad Logan and William E. Banks

Faunal remains from Feature 7, including piece plotted elements and selected fragments from the level-excavated and flotation heavy fraction samples, were identified according to taxon, element, and side (Table 8.1). Feature 7 was selected because it had the highest frequency of bone and appeared to have a good representation of faunal remains from the site. Banks conducted this research as part of an independent project for a course in Identification of Mammal Bone offered by the Department of Systematics and Ecology at the University of Kansas that was directed by Prof. Larry D. Martin, Curator of Vertebrate Paleontology, Museum of Natural History. His listing was augmented by additional identifications by the senior author.

Table 8.1 Identified Faunal Remains from Feature 7.

Cat. No.	Taxon	Element	Part	Side
A4239/91	*Odocoileus*	Antler	Pedicle	?
A4190/91	*Odocoileus*	Antler	Pedicle	?
A4047/91	*Odocoileus*	Antler	Shaft	?
A4267/91	*Odocoileus*	Antler	Tine tip	?
A4183/91	*Odocoileus*	Cranial	Malar	?
A4294/91	*Odocoileus*	Maxillary P2	Complete	Left
A4272/91	*Odocoileus*	Mandible	Posterior horizontal ramus	Left
A4268/91	*Odocoileus*	Mandible	Horizontal ramus M1-M3	Right
A4348/92	*Odocoileus*	Mandibular M1	Complete	Left
A4313/91	*Odocoileus*	Scapula	Complete	Right
A3424/91	*Odocoileus*	Scapula	Complete	Left
A4154/91	*Odocoileus*	Scapula	Glenoid	Left
A4238/91	*Odocoileus*	Scapula	Complete	Right
A4195/91	*Odocoileus*	Atlas	Lateral half	--
A4332/91	*Odocoileus*	Cervical vert.	Fragment	--
A4240/91	*Odocoileus*	Cervical vert.	Fragment	--
A4220/91	*Odocoileus*	Thoracic vert.	Central fragment	
A4152/91	*Odocoileus*	Rib	Articular end	?
A4333/91	*Odocoileus*	Rib	Articular end	?
A4273/91	*Odocoileus*	Rib	Articular end	?
A4334/91	*Odocoileus*	Rib	Shaft frag	--
A4308/91	*Odocoileus*	Radius	Proximal juvenile	Right
A4312/91	*Odocoileus*	Radius	Distal	
A4234/91*	*Odocoileus*	Tibia	Distal epiphysis	Left
A4335/91*	*Odocoileus*	Tibia	Distal shaft	Left

Table 8.1 (continued)

A4234/91	Odocoileus	Malleolus	Complete	Left
A4331/91	Odocoileus	Tibia	Shaft	Left
A4262/91	Odocoileus	Tibia	Distal	Left
A4213/91	Odocoileus	Tibia	Distal	Left
A4301/91	Odocoileus	Tibia	Shaft	?
A4329/91	Odocoileus	Calcaneus	Complete	Right
A4256/91	Odocoileus	Metacarpal	Proximal	Left
A4336/91	Odocoileus	Metapodial	Shaft	?
A4304/91	Odocoileus	Metapodial	Shaft	?
A4348/91	Odocoileus	Metapodial	Distal	?
A4191/91	Odocoileus	Scaphoid	Complete	Right
A4202/91	Odocoileus	Scaphoid	Fragment	Left
A4237/91	Odocoileus	1st Phalange	Complete	?
A4264/91	Odocoileus	2nd Phalange	Complete	?
A4298/91	Odocoileus	Ulna	Proximal	Right
A4307/91	Odocoileus	Innominate	Acetabulum	Left
A4203/91	Procyon lotor	Ulna	Proximal	Right
Flot. Lv 4	Sciurus cf. carolonensis	Maxillary molar	Complete	?
A4256/91	Sciurus sp.	Humerus	Distal	Left
A4319/91	Meleagris gallapavo	Humerus	Shaft	Left
A4310/91	M. gallapavo	Ulna	Shaft	Right
A4381/91	M. gallapavo	Femur	Shaft	Left
A4311/91	M. gallapavo	Tibiotarsus	Shaft, more proximal	Left
A4270/91	M. gallapavo	Tarsometa-tarsus	Promimal	Right
A4330/91	M. gallapavo	T.metatarsus	Proximal	Left
A4256/91	M. gallapavo	T.metatarsus	Proximal	Right
A4194/91	M. gallapavo	T.metatarsus	Lateral shaft	Left
SN 203	M. gallapavo	T. metatarsus	Distal	Left
A4328/91	M. gallapavo	Femur	Proximal	Right
A4243/91	M. gallapavo	Cuneiform	Complete	Left
SN 176	Fulica americana	Carpometacarpus	Complete	Right
A4256/91	Aves-teal size	Ulna	Proximal	Right
A4296/91	Testudinae	Plastron		Left
A4276/91	Ictalurus ?	Vertebra	Complete	--

* same element

The above tabulation is not complete for Feature 7. Several fragments considered to be identifiable were not included in the sample selected. Neither is the list comprehensive with regard to the variety of species represented in the midden and other feature assemblages. Specimens elsewhere at the site selectively identified by the senior author are fur-bearing animals such as bobcat (Lynx rufus) (Fig. 7.24d), mink (Mustela vison) (Fig. 8.1c), cottontail (Sylvilagus floridanus) (Fig. 8.2e), and beaver (Castor canadensis). Raccoon (Procyon lotor) were more plentiful than the single specimen identified in Feature 7 suggests (e.g., Fig. 8.1a-b, maxillary and mandibular pieces from Feature 5).

Fish figured more importantly in the diet than the single identified element from Feature 7 suggests. Many vertebrae and other fish elements were found throughout the site. Unmodified scales of gar (Lepisosteus sp.) were recovered in considerable numbers as well. Mussels, as yet unidentified taxonomically and generally poorly preserved, were found in some of the features (e.g., Fig. 8.2g, a fragment from the midden in unit 86N/160E). The vertebra identified in Feature 7 (Fig. 8.2b) represents a large catfish that must have been taken from the Missouri River, since specimens of this size could not have survived very well in the shallow, intermittant Quarry Creek or nearby Salt Creek.

Reptiles are represented in larger numbers than the one large fragment identified in Feature 7 (Fig. 8.2f). Several carapace and plastron fragments were found, but remain unidentified, not only from that pit but others as well. Snake vertebra were nearly ubiquitous in the trash-filled pits and small rodent bones and teeth were noted in the flotation samples. These latter animals may have been intrusive.

The identified elements from Feature 7 are representative, however, of the dominance of deer, probably white-tailed deer (Odocoileus virginianus), in the assemblage. Clearly this animal was of primary importance to the site's occupants, as indeed it invariably was to those of all Kansas City Hopewell sites (cf. Adair 1977; Brown n.d.; Johnson 1972; Wedel 1943). The faunal remains from Quarry Creek hold great promise for zooarchaeologists interested in studying selective hunting practices. Deer of varying ages were taken. For example, juveniles are represented by a mandibular fragment with deciduous molars from 80N/168E (Fig. 8.1d) and middle aged animals by a mandible from Feature 7 that exhibits moderate crown wear (Fig. 8.1e). That deer were taken not only for their meat yield but for bone tool material is shown by several pieces of modified antler and ulnae described in the previous chapter. The inventory of Hopewell bone tools might include scapulae tools, if paired specimens from Feature 7 are any indication (Fig. 8.2a, d). The crests of both these elements had been removed. Unfortunately, the proximal portion of both blades, where wear patterns were expected, are broken and this precludes their identification as tools.

Figure 8.1 Elements of Raccoon (a-b), Mink (c), and Deer (d-e).

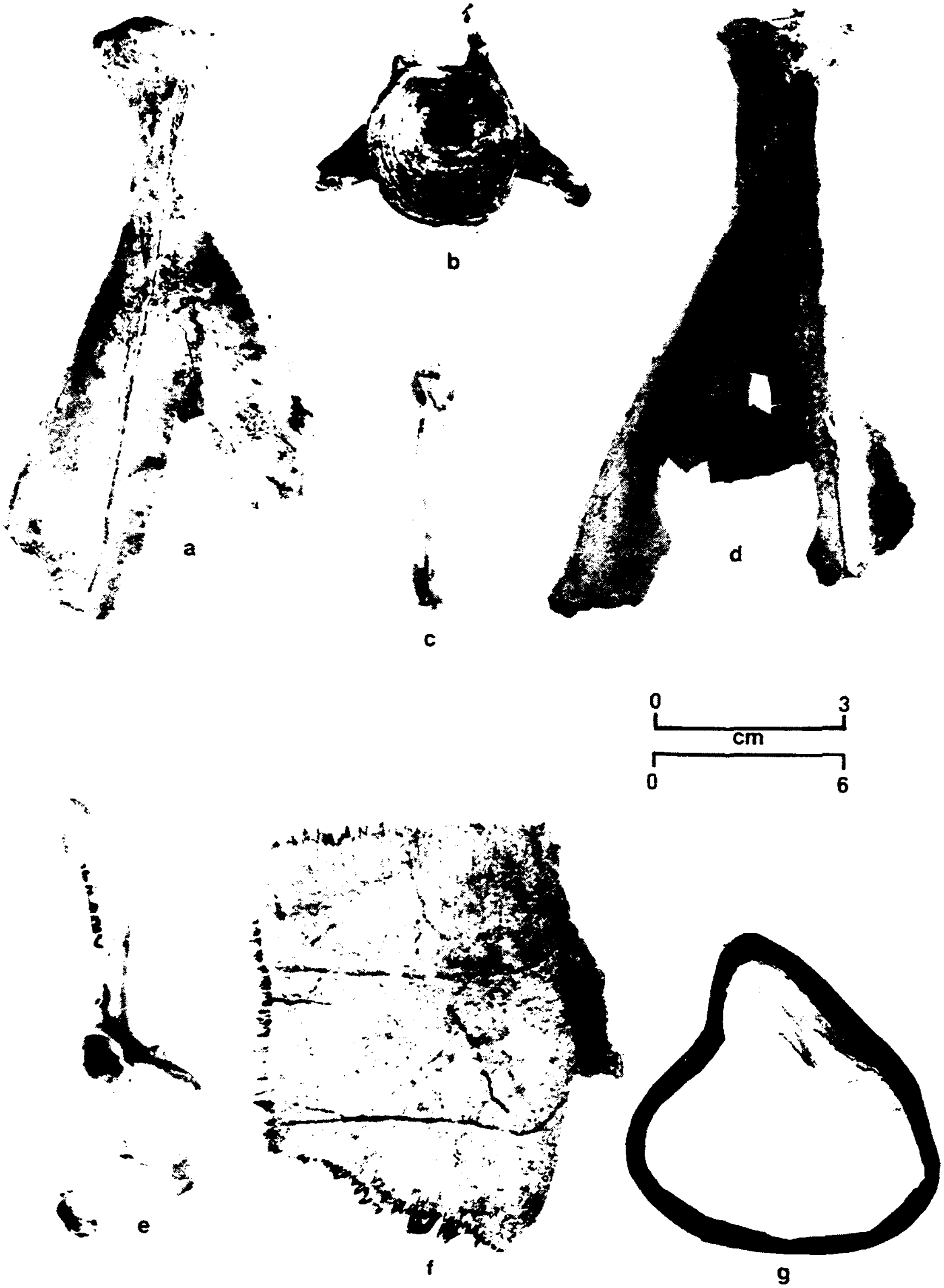


Figure 8.2 Elements of Deer (a, d), Catfish (b), American Coot (c), Cottontail (e), Turtle (f) and Mussel (g). Six cm scale is for scapulae.

The parts of deer represented in Feature 7 may reflect selective butchering practices. Cranial, axial and meat-poor lower limb elements are present but elements from the upper limbs which are richer in meat yield were not found. This may reflect collection of debris from an area where less desired deer portions had been processed or disposed.

The abundance of turkey elements in Feature 7 distinguishes that pit from others excavated. The inclusion of at least three (and quite possibly a fourth) turkey bone awls and fragments indicative of awl production (see previous chapter), suggests either a distinctive function of the feature or the dumping of debris collected from a specific activity area at the site. Not all of the turkey fragments in the pit are indicative of tool production. Several pieces are long bone splinters that may have been generated during marrow extraction. In all, the turkey bones reflect the importance of this animal in the economy and technology of the Kansas City Hopewell.

The animals indentified above point to reliance on animals of the woodland and riverine habitats of the Quarry Creek-Missouri River area. The importance of the resources associated with the latter stream to the site inhabitants has yet to be measured but is probably greater than Reid (1980b) would have us believe of the Kansas City Hopewell. As discussed in chapter two, Reid suggested the Missouri River floodplain was not an important or reliable resource area for these people. This inference was based on several characteristics of the river, including its turbidity, the fickle nature of its meanders, and the relative lack of stable backwater niches. Yet some of the bones from Quarry Creek point to expoitation of backwater areas, if not of the river itself. These include catfish and gar, species that probably could not have been found consistently, if at all, in tributaries, and marshland dwellers. The latter is represented by at least two elements, a carpometacarpus (Fig. 8.2c) and phalange, of an American coot (Fulica americana) from Feature 7. Given the small sample of bones in the recovered assemblage that have thus far been identified and the small sample of the site itself excavated by the KAFS, we may expect representation of more aquatic animals.

The bones from Feature 7 are in excellent condition. Most pieces show some limited longitudinal cracking, but this is as severe as the weathering progressed. Relatively few fragments are burned. The ratio of burned to unburned bone by weight in the heavy fractions of the flotation samples (augmented by the bone collected during excavation but not piece plotted) is rather low. Indeed, it is the lowest of the larger trash-filled pits excavated. The weights and ratios of burned bone and bone for all features are presented in Table 8.2. There is no apparent pattern to the ratios when all of the features are considered, other than the obvious observation that burned bone never outweighs unburned fragments. It would be worthwhile to compare the ratios of this material in all flotation samples from levels in the midden units to those of the features to see if one can distinguish a contrast between debris dumped in those two areas that might indicate discrimanant behavior. Such a comparison is just one of many possible zooarchaeological problems that can be addressed with the abundant faunal material from Quarry Creek.

Table 8.2. Ratios of Burned Bone to Unburned Bone in Feature Flotation Samples from the Quarry Creek Site.

Feature No.	Weight BB:UB	Ratios BB/UB
4	571.4:904.6	.63
5	28.8: 60.6	.48
6	292.9:508.7	.58
7	210.6:638.1	.33
8	9.1: 27.4	.33
9	20.0: 43.1	.46

Ethnobotanical Remains from the Quarry Creek Site: Identification and Interpretation

Mary J. Adair

Introduction

The recovery of plant remains from archaeological sites through the use of flotation or water screening has become a necessary technique to ensure the retrieval of a representative sample of the small and often fragmentary particles of plants that were once used by the prehistoric inhabitants. These remains have been used to reconstruct past environments, identify the economic mode of food procurement, suggest possible trade relations, identify specific site or feature function, and reconstruct the season(s) of occupation. In addition, the carbonized remains have often been used to date directly the occupation, since problems such as those related to "old wood" are seldom an issue with plant remains. For the Hopewell period specifically, carbonized plant remains have been used primarily to reconstruct diet. Research in the Eastern Woodlands has demonstrated the significant dietary contribution of several domesticated native annuals. Oily-seeded annuals such as marshelder (Iva annua) and sunflower (Helianthus annuus) and starchy seeded annuals like chenopod (Chenopodium berlandeiri), little barley (Hordeum pusillim) and erect knotweed (Polygonum erectum) are well represented in the archaeobotancial assemblage. While the tropical cultigens squash and maize are recognized in the collection, their value to the overall subsistence is deemed to be less substantial than once believed. In fact, direct accelerator mass spectrometer (AMS) age determination of many of these early maize samples has shown them to be related to later occupations (Fritz 1990; Smith 1992).

For the Kansas City Hopewell, archaeobotanical research has been more limited than that conducted in the Eastern Woodlands. For the most part, this is due to the fact that far fewer Kansas City Hopewell sites have been investigated and the systematic recovery of small particle remains has occurred at only the Young (23PL4), McPherson (14LV357) and Quarry Creek sites. In addition, direct age determination through the AMS technique has not been applied. Despite these obstacles, there are several similarities between the Kansas City Hopewell and the Illinois Valley Hopewell archaeobotanical records. First, the native cultigen marshelder (Iva annua) has been identified from several Kansas City Hopewell sites and at the Trowbridge site (14WY1) it was found in association with small quantities of squash and maize. Several sunflower achene fragments have also been recovered and there is some speculation that the remains are from the domesticated variety. Recent research (Adair 1993) using scanning electron microscopy has given preliminary attention to the presence of domesticated chenopodium in several temporal periods in the Central Plains, including Kansas City Hopewell sites. While several of the Hopewellian seeds did posses some of the morphological characteristics of the domesticated variety (Smith 1992), the sample size was inadequate to determine whether these characteristics were due to normal variability within the seed population or to effects of domestication. To date, remains of maygrass, little barley and erect knotweed have not been identified from Kansas City Hopewell assemblages.

Identified archaeobotanical remains from the Trowbridge, Young, Sibley (23CL73), McPherson, and Yeo (23CL199) sites gives us a composite picture of Kansas City Hopewell subsistence which can basically be described as a gathering-hunting economy, with various nuts (primarily hickory, black walnut and hazelnut), fruits (including grape, persimmon, pawpaw, and cherry) and oily-seeded annuals (such as chenopodium and sunflower) contributing a major portion of the plant food dietary component. Given the relatively undisturbed nature of the deposits at the Quarry Creek site and the systematic recovery of both midden and feature deposits, the archaeobotanical assemblage provides an excellent opportunity to better understand the subsistence practices of this cultural group as well as to understand the disposal patterns of refuse which occurred over time at the site.

The techniques of flotation and the size of the matrix samples have been described in previous sections of this report. The sorting of the light and heavy fractions was sampled to ensure that at least part of each feature and midden area would be analyzed. The plant remains reported in this section were identified from Features 6 and 7. A total of 50 flotation samples were taken in the field from Feature 7, yielding 100 fractions (half light and half heavy fractions), while 49 samples, or 98 total fractions, were taken from Feature 6. Of these fractions, approximately 58% of the samples taken from Feature 7 and 52% from Feature 6 were selected for this analysis. However, the majority of the samples sorted from Features 7 and 6 were the heavy fractions (80% and 79% respectively) resulting in a lower representation of small seeds in the identified collection. Light fractions from both of these features as well as samples from the midden are presently being sorted. Table 8.3 provides a list of the species identified and the quantities recovered so far from Features 6 and 7. A discussion of each species and their relative importance in the archaeobotanical collection follows.

Table 8.3. Identified Archaeobotanical Remains from 14LV401.

Feature 6	Feature 7
Nutshell	
Black Walnut (*Juglans nigra*) 5.4 gms / 81 fragments	Black Walnut (*Juglans nigra*) 1.8 gms / 43 fragments
Hickory (*Carya* sp.) 18.9 gms / 639 fragments	Hickory (*Carya* sp.) 6.5 gms / 243 fragments
Hazelnut (*Corylus* sp.) 1.7 gms / 54 fragments	Hackberry (*Celtis occidentalis*) 1 seed
	Unidentified Nutshell 1.0 gms / 18 fragments
Fruits	
Grape (*Vitis* sp.) 2 charred	Cherry (*Prunus* sp.) 4 charred, 6 modern
Seeds	
Purslane (*Portulaca* sp.) 1 charred	Sunflower (*Helianthus* sp.) 1 charred
Bulrush (*Scirpus* sp.) 1 charred, 2 modern	Bulrush (*Scirpus* sp.) 1 charred
Dock (*Rumex* sp.) 1 charred, 1 modern	Dock (*Rumex* sp.) 2 charred
Goosefoot (*Chenopodium* sp.) 6 charred	Goosefoot (*Chenopodium* sp.) 19 charred
Unidentified Grass (Gramineae) 4 charred	Pigweed (*Amaranthus* sp.) fragments
Cultigens	
Marshelder (*Iva annua*) 2 charred	
Maize (*Zea maize*) cf. 2 cupule fragments	Maize (*Zea maize*) 1 cupule

Identification and Interpretation

Identified plant remains are grouped into three categories: nutshell fragments, seeds and domesticates. Nutshell fragments were far more common in the samples analyzed with black walnut (*Juglans nigra*) and hickory (*Carya* sp.) predominating. Lesser amounts of hazel (*Corylus americana*) and possibly acorn (*Quercus* sp.) were present in some of the samples. Hackberry (*Celtis occidentalis*) shells were also present, although several of these fragments were uncharred, suggesting that they represent recent contamination. The black walnut and hickory nutshell fragments were more abundant and larger in size in the samples from Feature 6 as compared to Feature 7. A total of 1.8 gms (43 fragments) of black walnut was recovered from Feature 7, as compared to 5.4 gms (81 fragments) from Feature 6. Remains of hickory shells are even more abundant, with 18.9 gms (81 fragments) from Feature 6 and 6.5 gms (243 fragments) from Feature 7. These differences suggest these features may have been filled at different times of the year or that the remains represent different episodes of processing.

The seed category includes several fruits, oily and starchy annuals, and grasses. The fruits are represented by cherry (*Prunus* sp.) and grape (*Vitis* sp.) remains. Several of the cherry pits from Feature 7 are uncharred, indicative of recent contamination, while the grape seeds were recovered only from Feature 6. Both grape and cherry species can be found in habitats in proximity to the Quarry Creek site and both plants would have been available to the prehistoric occupants during the late summer. Seeds were identified as bulrush (*Scirpus* sp.), dock (*Rumex* sp.), purslane (*Portulaca* sp.), pigweed (*Amaranthus* sp.), goosefoot (*Chenopodium* sp.), and sunflower (*Helianthus* sp.). Several of the bulrush and dock remains from Feature 7 are modern contaminates while the purslane and sunflower are represented by only one seed each. These factors allow for some speculation as to the interpretation of these species as food remains, although such a conclusion is best made after additional samples have been sorted. Remains of *Amaranthus* sp. and, especially, *Chenopodium* sp. are far more abundant, with at least 19 *Chenopodium* sp., seeds recovered from Feature 6 alone. The plants are similar in their habitat preference and growing cycle and may have been some of the earliest plants to become established in disturbed areas surrounding the occupation area of the site. At present, the small quantity of remains of both species precludes determination of whether their presence in the assemblage is due to deliberate procurement strategies or to accidental charring and inclusion. However, several seed fragments from both features may also be remains of additional starchy annuals, while newly sorted samples have yielded numerous *Chenopodium* seeds. Several charred seeds from Feature 6 have been identified only to the grass family. While grasses may have served a variety of purposes other than as a food source, the remains from Quarry Creek are fragmentary and severely charred, making a specific identification difficult.

The recovery of marshelder seeds (Iva annua) and maize (Zea maize) cupule fragments allows for a discussion of domestication and the importance of cultivated crops to the Kansas City Hopewell complex. The distinction between the wild marshelder and the domesticated variety can be determined by the size of the achene or seed (Yarnell 1972), with the domesticated seed often being three to four times larger than its wild counterpart. Two complete seeds recovered from Feature 6 at Quarry Creek measured 3.5 x 3.0 mm and 3.3 x 2.5 mm. Size reconstruction, required because of loss of pericarp and shrinkage due to carbonization, establishes their sizes at 4.9 x 4.3 mm and 4.6 x 3.5 mm respectively. These sizes are well within the range of the domesticated variety (Iva annua var macrocarpa) but are somewhat smaller than those reported from other Kansas City Hopewell sites (Adair 1988). This may simply be a function of sample size and can perhaps be resolved with further analysis.

A total of three maize cupule fragments was identified, one from Feature 7 and two from Feature 6. Those from Feature 6 are more fragmented, as noted by the "cf" distinction in Table 8.3. While the identification of domesticated marshelder, an indigenous species, from Kansas City Hopewell sites (and from Hopewell sites in general) has been received very favorably by the profession, the association of maize, a tropical cultigen, with the same occupation has undergone considerable debate. At present, the oldest direct dates on maize from eastern North America are A.D. 175 (1775 RCYBP) from the Icehouse Bottom site in eastern Tennessee (Chapman and Crites 1987) and A.D. 220 and 230 (1730 and 1720 RCYBP) from beneath the Edwin Harness Mound in Ohio (Asch and Green 1992). While maize remains have been recovered from several Kansas City sites, including Trowbridge, Renner, and McPherson, there continues to be a considerable amount of speculation as to the age of these remains. Although this speculation can best be resolved with direct accelerator dates from the maize remains, it is important to recognize that there is a pattern in the recovery of small quantities of maize from Kansas City Hopewell sites. Several kernals were recovered from the Renner site (Wedel 1943). Two small maize cupule fragments and five fragmented kernals were identified from feature and midden deposits at the McPherson site (Wagner al el. 1988), while three cupule fragments have been identified so far at the Quarry Creek site, which may reflect the same occupation as the McPherson site. A slightly larger maize sample consisting of approximately 90 kernals and a fragment of a nubbin cob was recovered from the Trowbridge site. Both the cob and kernals have been described as presenting an early variety, probably related to the Chapalote series (Adair 1988, letter from Richard Ford, dated 5-11-83). While the maize remains from the Kansas City Hopewell sites are not suggested to be older than the early maize remains from the more eastern sites, the repeated association of this cultigen with Kansas City Hopewell occupations suggests that this issue warrants further research.

In summary, the archaeobotanical data from the Quarry Creek site, retrieved by systematic and controlled excavation techniques, provide an opportunity to address issues of Middle Woodland subsistence, relative importance of specific species, and the introduction of tropical cultigens. Combined with archaeobotanical data from other Kansas City Hopewell sites, particularly the McPherson site, these data may be useful in developing both local and regional models of subsistence change. For example, at present there is no acceptable ecological or cultural model available to explain the diffusion of maize from the Southwest to the Eastern Woodlands. Separating the Southwest from the Eastern Woodlands, the Plains may have played an important role in the diffusion of this plant northward and eastward. While larger quantities of maize are more commonly associated with late Plains Woodland sites in the Central Plains (Adair 1993), it is the earlier Middle Woodland samples that are potentially more significant in developing such a model.

Chapter 9

INTERPRETATION OF THE QUARRY CREEK SITE: A GUIDE TO FUTURE RESEARCH

Brad Logan

Introduction

The excavations of the Kansas Archaeological Field School demonstrated the significance of the Quarry Creek site, its great research potential, and its justifiable inclusion on the National Register of Historic Places. The data presented in the previous chapters are explored in this chapter in order to interpret several aspects of the site itself, its structure and formation, its physical environment at the time of its Hopewell occupation, and its potential for increasing our understanding of the various facets of the Kansas City Hopewell culture. Among the latter are its chronology, settlement-subsistence patterns, and relationships with other variants of the Middle Woodland period.

The bright prospect of further archaeological research of the Quarry Creek site and its unique state of preservation make its continued protection and management imperative. The final section of this chapter, and of the report, recommends steps for preservation and protection of the site.

Site Structure

The Quarry Creek site warrants further exploration at some future time, when another generation of technological advancement has further improved methods of archaeological recovery and analysis, for a variety of reasons. Perhaps the most important of these stems from the fact that of the Kansas City Hopewell sites now known, only Quarry Creek has been spared agricultural disturbance. This suggests the present topography of the site more closely approximates that of the time of its prehistoric occupation than any other. The low relief mounds visible today may appear much as they did when the last Hopewell departed the site. There is evidence of recent historic activity at Quarry Creek, concentrated around magnetic anomaly 12 and test unit 95N/151E. However, it does not appear to have greatly altered or affected the landscape nor to have penetrated the Hopewell deposits throughout most of the site. Neither does the vandalism that necessitated the clearing of trees, increasing of military police patrols and the KAFS investigation appear to have seriously affected the deposits.

The site is not entirely undisturbed. The tree harvesting efforts that led to its discovery in 1971 left more than two dozen craters from one to two meters square in the eastern quarter of the wooded portion of the site. This activity probably damaged a midden deposit in that area, though the craters are not deep enough to have disturbed any refuse pits. Our excavation of this part of the site was very limited, though sufficient to demonstrate the site extends there. Future investigators should more thoroughly test its deposits when the trees, brush and forest floor detritus that hampered our efforts in that portion of the site have decayed or been removed.

Beyond the documented event of tree removal noted above, that portion of the Quarry Creek drainage which includes the site is recorded to have been logged in the past (Burns and McDonnell 1993). Undoubtedly this source of wood would have been exploited not only by prehistoric inhabitants but also by the pre-fossil fuel occupants of Fort Leavenworth. The extent to which this activity affected the cultural deposits at Quarry Creek is not known. However, only stump removal would have affected buried deposits and tree cutting actually would have been beneficial insofar as it would have pre-empted natural tree fall. This latter process, through toppling of dead trees or windthrow, causes inversion and mixing of soils and any associated artifacts (Wood and Johnson 1978:328-333). Though the extent of such a process in the oak-hickory woodlands of the Lower Missouri River region is not as well known as that in other forested regions, such as the Great Lakes, it probably has had some affect on the cultural deposits in the Quarry Creek-McPherson locality.

Tree root growth, in addition to other natural processes such as faunal turbation, also has had some adverse affect, as yet unmeasured, on the cultural deposits throughout the site area. Yet even these aspects of Quarry Creek have research value for the study of site structure and formation. Archaeologists are increasingly interested in documenting, understanding, and, if possible, filtering out a variety of natural and cultural disturbance processes in order to better understand the archaeological record and its reflection of cultural behavior (e.g., Schiffer 1972, 1976; Wood and Johnson 1978; Binford 1983:213-386). The Quarry Creek site presents an excellent opportunity to study such processes without having to account, as is too often the case in the Lower Missouri River valley, for Euroamerican activities. Indeed, the fact that Quarry Creek is practically a single component site (a Plains Village occupation having been ephemeral) enhances its potential for understanding the effects of natural disturbance processes.

This last observation is also critical for appreciating another value of the Quarry Creek site. Because it is for all practical purposes a single component site, we have the opportunity to address questions about how sites of the Kansas City

Hopewell variant developed during their occupation. Midden formation, house placement and architecture, feature location and form are all aspects of this culture we can study at Quarry Creek. We have already demonstrated the presence and structure of middens and features at the site and we suspect that more extensive explorations will encounter better evidence of habitation structures that occasional finds of daub indicate. The spatial relationship of houses, features and middens at the site can be profitably compared to those recently described at sites in the Illinois River Valley, American Bottom, Ohio River Valley, and Duck River Valley of Central Tennessee, where Smith (1992:201-248) has recently noted distinctive patterns of such associated with garden plots. Archaeological investigations at the Quarry Creek site should focus on the inter-midden areas to see if they might be the locations of houses or garden plots.

Our excavations did not extend to the ravine north of the site area, since we assumed any deposits there would have eroded over the last 1,500 years. This assumption should be tested at some time to see if the ravine might have served as a handy "landfill" for the Hopewell occupants. It is interesting to note along this line that the depth of cultural debris was greatest, except where trash-filled pits were found, in 99N/172E, the unit nearest the slope to this ravine and 44 cm lower in elevation than the northernmost unit of the trench through the midden. It is possible that the midden is thicker, not near the "summit" of the mounds at the site, but along the slope of the ravine.

Environmental Reconstruction

Geomorphological study of the Quarry Creek locality is essential for understanding the evolution of the upland terraces of the drainage and its relation to the dynamics of the Missouri River. The Hopewell may have inhabited the locality not only because of its proximity to a variety of habitats essential to their subsistence economy but also because it was distant enough from the Missouri River valley to be a haven from floods and other lowland maladies such as insect pests. Geomorphology of the terrain within the meander loop of the Missouri River at the mouth of Quarry Creek may reveal the frequency and magnitude of floods during the Middle Woodland period. Such study could also establish the relative stability or fickleness of the meander loop and, by consequence, the potential stability of any floodplain resources valued by the Hopewell. In this context it is worth mentioning discovery, by archaeologists from the Kansas State Historical Society, of a trash-filled Hopewell pit exposed on a cut-bank of Plum Creek near its confluence with Salt Creek (Witty and Marshall 1968:41-44). This feature, recorded as site 14LV316, is described as being ten feet below surface within the lowermost of three distinctive soil zones. Deep burial of a Hopewell pit in this area (3.3 km northwest of the Quarry Creek site) near the Missouri River floodplain indicates significant alluviation within the past ca. 1,500 years. The paleo-environmental implications of this feature have yet to be researched.

Site specific geoarchaeology should address the role played by anthropogenic processes in the formation of soils at Quarry Creek. A brief inspection of the soil horizons in the deepest test unit at the site by Prof. Curt Sorensen (see chapter 2) was conducted during the KAFS fieldwork. His study suggested the thick, cumulic A horizon and thicker AB horizon reflect a long period of stability. This would imply that the terrain was relatively unaffected by flooding of the river. The thickness of the A horizon and its development over a period of about 300 years of continuous or repeated occupation may also reflect the role played by humans (e.g., debris accumulation, trash dumping, etc.) in soil development. This interpretation should be tested by more extensive geoarchaeological investigation of the site.

Microfaunal remains in the current assemblage provide a clue to the nature of the immediate site environment. Flotation samples from Feature 4 yielded numerous snails, those of Features 5 and 6 contained some of the same species but in markedly lower quantity, and Feature 7 contained none. Romine (1993), based on a preliminary analysis, recognized two species of snails in the Feature 4 assemblage, Anquispira alternata and Carychium exile. According to Leonard (1959), these species prefer a moist, high humus, forest floor habitat and both can survive in small watery depressions. It is intriguing that with regard to their gastropod assemblages Features 4, 5, and 6, which are proximate spatially and roughly contemporaneous, differ markedly from Feature 7, which is only a few meters distant spatially but dates to an earlier occupation. One interpretation of the contrast is that the pits filled under differing environmental circumstances. Perhaps, at the time the later pits were being filled with trash, the site area was wooded and conditions were damp. When Feature 7 was being filled, the area either was less wooded or the season was drier. These differences can be further explored by examining the habitat and seasonal preferences of other micro-fauna represented at the site.

Paleobiological material from Quarry Creek is abundant, varied and well preserved in both midden and refuse pit deposits. They lend themselves well to analyses of Hopewell subsistence practices and reconstruction of the site's catchment area. Brumwell's (1941) biological survey of Fort Leavenworth and particularly his definition of the vegetation associations that constitute a prairie-forest mosaic (see chapter two) provide a model for the Quarry Creek site catchment. This model can be tested by analyses of plant and animal remains from the site.

Preliminary analysis of the biological assemblages from the features and midden indicate a woodland-riverine environment with little indication of the expansive prairie habitat recorded by Brumwell. Bison and wapiti, recorded in other Kansas City Hopewell assemblages (Adair 1977; Anderson 1972; Brown n.d.), have thus far not been identified in the Quarry Creek fauna. Deer, raccoon, and wild turkey dominate the assemblage with fur-bearing species such as mink and bobcat occurring in lower frequency. Aquatic animals including gar, catfish, and mussels were also of importance. Whether this reflects a diminished prairie habitat at the time of the Hopewell occupation or the selective preferences of the Hopewell themselves are alternative hypotheses that can be tested both by more extensive analysis of the KAFS assemblages and by further excavation.

Settlement-Subsistence

Settlement decision-making by hunter-gatherers, or hunter-gatherer-gardeners, was based on a variety of factors not all strictly related to subsistence needs. Nonetheless, settlement location patterns and subsistence practices have been linked by anthropologists as two intertwined variables of past lifeways that can be pursued rewardingly through archaeological data. This is certainly the case with the information from Quarry Creek. We have already seen, by analogy to Brumwell's (1941) data, how the site's inhabitants selected a location which provided them with easy access to the greatest variety of habitats with the least amount of effort. We noted in chapter two that the nearest exploitable chert resource is no more than a few minutes walk from the site. Timber for tools and shelter and a nearby water source that was at least seasonally reliable (perhaps more so during the Middle Woodland period) were at hand. Given these factors, we can readily understand the presence of a Hopewell site in the Quarry Creek locality.

What is remarkable about the site, however, is its presence in a drainage of such small size. Archaeologists have conducted fieldwork at numerous prehistoric sites, not just Hopewellian, in the Lower Missouri River basin for many years completely unaware of the rich potential of a stream of such apparently minor consequence (it does not appear on maps showing the distribution of major Kansas City Hopewell sites in Adair 1977 and Johnson 1976a). More substantial tributaries of the Missouri River such as Brush Creek and Line Creek were selected for survey or site investigations (Johnson 1974; Wedel 1943). Yet, in conjunction with other upland sites such as Trowbridge, the Quarry Creek locality points to an as yet unexplored niche of the Missouri River bluffs- the small, intermittent stream valley.

Johnson (1976a) postulated a settlement pattern for the Kansas City Hopewell that developed, with continued population growth and resource exploitation efficiency, into a system centered on a permanently occupied village near the mouth of a tributary valley. Such sites included Renner, Young and Aker. Associated with the base village were a series of smaller, temporarily occupied camp sites scattered up the valley. Examples of such sites were Deister (in Line Creek valley) and Nieman (in Brush Creek valley), associated with the Renner and Young sites respectively. By the time of the Edwardsville phase, this pattern of base settlements and ancillary camp sites had given way, perhaps through population pressure on resources, to a Late Woodland pattern of small, scattered campsites more densely distributed throughout the alluvial landscape.

The pattern recognized by Johnson, though applicable to certain drainages in northwestern Missouri, has no known examples along the tributary valleys of the Missouri River in northeastern Kansas. This distinction may well be attributable to the fact that most of the tributary systems in the latter area have not been thoroughly surveyed. Indeed, passing mention should again be made here of the buried Hopewell component at 14LV316. It is unlikely that the pit there excavated is the only such feature at the site and that archaeologists fortuitously discovered chance exposure of one indication of a more extensive settlement, now buried, near the mouth of Salt and Plum Creeks. Such a location is suggested by Johnson's (1976a) model.

Johnson (1976a:15) has also suggested that the narrower band of oak-hickory forest and corresponding expanse of tallgrass prairie controlled by prairie fires are reasons for the scarcity of Hopewell sites in that area. However, extensive upland settlements such as Trowbridge and Quarry Creek-McPherson may be indicative of a heretofore unrecognized pattern- the intensive utilization of that terrain. To date, the Trowbridge site has been treated as an exception to a single pattern. In the light of the Quarry Creek locality, we must now recognize greater variability to Kansas City Hopewell settlement patterns than has been appreciated heretofore. Moreover, we must also acknowledge the greater density of Hopewell sites throughout the Lower Missouri River valley that probably existed prior to Euroamerican settlement but which has no doubt been severely disturbed by it.

There are several small drainages along the Missouri River Valley that drain upland settings such as that of Quarry Creek and early "archaeological" accounts describe Woodland-like mounds associated with some of them. For example, George Remsburg (n.d.), an avid collector and site excavator who investigated many sites in northeastern Kansas during the late 19th and early 20th centuries, opened Ingalls burial mound on a bluff above Walnut Creek in Atchison County. From his description and its comparability to Hopewell mounds in Platte County, Missouri (Wedel 1943), it must have been a mortuary site of that affiliation. Remsburg (1893) opened another mound overlooking Owl

Creek, south of Walnut Creek in Atchison County, that appears to have been Hopewell. This site overlooked a "camping ground" in the valley below, though Remsburg's (1891) poor description of this site precludes its cultural identification. More recent investigations by the Kansas Archaeological Field School in Little Walnut Creek valley south of Owl Creek revealed evidence of Hopewell activities there as well (Logan 1986). Remsburg (1909, 1912) also described mounds of undetermined but quite possibly Hopewellian affiliation in upper Stranger Creek basin. Surveys in that drainage by the author (Logan 1981) located six Hopewell sites. From the foregoing evidence, it is apparent that northeastern Kansas has much to offer our understanding of Kansas City Hopewell settlement pattern variability.

Much of the archaeological literature up to the 1980's that describes the subsistence adaptation of Hopewell cultures throughout the eastern United States focuses on their non-agricultural economy. Indeed, the concept that dominated much of this literature was "primary forest efficiency" (Caldwell 1959), which envisioned Woodland populations expert at squeezing the maximum amount of subsistence energy from woodland-riverine environments without reliance on farming (cf. the Griffen-Brose exchange in a discussion section of Brose and Greber 1979:15). Research within the past decade has altered this perception by noting that the Hopewell were in fact gardeners of "camp-follower" plant species such as chenopod, amaranth, marshelder and sunflower, that properly cultivated could provide as much caloric yield as tropical cultigens (Smith 1992; cf. Adair 1988). The species recognized by Adair (this volume) in the Quarry Creek floral assemblage include some of these species and may point to such a gardening strategy that complemented the hunting and gathering of other resources. The identified plant remains also include maize, an introduced species with a tropical origin in the New World. The time of introduction of maize, as well as the route of its entry to the Eastern Woodlands and its significance to Middle Woodland cultures, is a subject of much interest. The presence of maize at the Quarry Creek site is, therefore, important both to local and to regional archaeology. Adair's analysis is based on her review of a select sample of the extensive and systematically obtained flotation samples from the KAFS excavations. A more comprehensive analysis might shed more light on these aspects of Hopewell subsistence.

The faunal remains from Quarry Creek also warrant more extensive analysis than was possible for this report. The animal taxa identified in chapter eight are not a comprehensive listing of those represented in the recovered assemblage. Microfauna, avian species and fish, in particular, are more varied than this tabulation indicates. Aquatic resources, particularly those that must have come from the Missouri River, must be more closely identified in order to appreciate what I believe will prove to be an unappreciated exploitation of that major stream. If geomorphic research demonstrates long-term stability of the Missouri River meander at the mouth of Quarry Creek and zooarchaeological research indicates a high frequency of riverine species in the faunal assemblage, then we will have to reevaluate Reid's (1980b) suggestion that the Kansas City Hopewell economy was independent of Missouri River resources. It is possible that the confluence of Quarry Creek and the Missouri River was somewhat unique and that the "backwater" habitat indicated for that area on a late 19th century map of Fort Leavenworth was analogous to the Hopewell situation (Hunt and Lorence 1937).

The well preserved animal bones and teeth from Quarry Creek will also lend themselves well to seasonality studies to determine the relative permanence of the Hopewell occupation. The frequency and seasonal availability of certain animal species have been used to recognize the long-term habitation of major Hopewell sites such as Trowbridge and Young (Anderson 1972; Adair 1977). Scrutiny of seasonally developed cementum annuli on deer teeth has also provided corroborative support for such inferences (Adair 1977). These avenues of zooarchaeology and others still being explored by that developing discipline, hold great promise for future research at Quarry Creek.

External Relationships

The importance of trade in the economy or social life of the Kansas City Hopewell has been examined by Reid (1976) and Johnson (1979), who focused on different kinds of artifacts that they suggest were commodities of exchange with Hopewell populations of other regions. Reid focused on the presence of bladelets of non-local cherts, those of the Burlington formation of west-central Missouri, in the lithic assemblage from the Trowbridge site as evidence of trade between the Hopewell of the Kansas City and the Big Bend localities. The presence of these items suggests trade but their low frequency at Trowbridge suggests economic independence of the Hopewell of the former locality from those of the latter. He speculates that the relationship was maintained primarily for social, as opposed to economic, reasons.

Numerous bladelets were recovered by the KAFS at Quarry Creek, but relatively few of them appear to be of non-local cherts. This admittedly qualitative statement needs quantitative assessment with a statisitical analysis of the raw material types of these artifacts. The observation is consistent, however, with that of Wagner and others (1989:181-182), who noted a low frequency of Burlington cherts in the McPherson site assemblage. This analysis, and conclusions derived therefrom, would further test Reid's interpretation of the presence of exotic bladelets at Kansas City Hopewell sites.

Johnson (1979) reviewed the non-chert exotic artifacts from Kansas City Hopewell sites as examples of interaction sphere items. The remarkably low frequency of these artifacts, of marine shell, hematite, mica, obsidian, and copper, also suggests a non-economic motive for any exchange relationship with the Hopewell of eastern woodlands.

A small number of interaction sphere-like artifacts were found at Quarry Creek. These include a fragment of a ceramic pipe, a piece of faceted hematite, a rimsherd from a miniature vessel, and a miniature copper "celt". All of these items were found in refuse contexts, in contrast to the mortuary contexts of exotic materials at Hopewell sites in the core area (Struever and Houart 1972). The low incidence of these items reinforces the economic independence of the Kansas City Hopewell from the interaction spere inferred from the paucity of exotic bladelets.

Bearing in mind that the sample of exotic artifacts from the site is represented by nonperishable goods, the small number of these items, in conjunction with the high frequency of lithic artifacts produced from local sources, the evidence for procurement of readily available animal resources, and the apparent (at this writing) primary reliance on wild plant foods, supports the interpretation of the Kansas City Hopewell variant as one largely independent of contemporary Eastern Woodland cultures (i.e., Havana, Crab Orchard and Ohio Hopewell). The close parallel in the historical trajectories of Kansas City and Havana Hopewell with respect to certain material traits, particularly ceramic and projectile point technologies and styles, does not necessarily imply a dependent relationship. Neither does westward diffusion of those traits indicate a broader acceptance of socio-political aspects of eastern Middle Woodland cultures, such as corporate control of resource production and kin-based (as opposed to individual) prestige enhancement (cf. Benn 1990:223-225).

Chronology

Temporal placement of the Hopewell occupation of Quarry Creek was achieved through both relative and absolute means. The types and frequencies of ceramics and projectile points from the site suggest a temporal placement from the late Trowbridge phase to the early Edwardsville phase. The very low frequency of Trowbridge phase design attributes on rim sherds and the lack of Snyders projectile points suggests any Trowbridge phase occupation was brief. The near equivalence of Kansas City and Edwardsville phase ceramic designs on the sample of rim sherds examined by Cook (see chapter eight) points to an occupation between A.D. 250 and A.D. 750. However, the absence of Scallorn arrow points suggests the occupation did not extend beyond the sixth century A.D., the time of the introduction of the bow and arrow (Johnson 1976a).

Four radiocarbon dates were obtained on charcoal samples from as many features. Calibration of the dates based on the dendrochronological curve developed by Stuiver and Pearson (1993) and generated by a computer program by Stuiver and Reimer (1993) is provided in Appendix 2. The laboratory dates, calendrical equivalents and calibrations are summarized in Table 9.1. and illustrated in Figure 9.1.

Table 9.1. Radiocarbon Dates of the Quarry Creek Site.

Provenience	Beta No.	Lab Date	Date A.D.	Calib. Date[1]
Feature 4	47827	1590±90	360	400 (450) 600
Feature 5	47828	1650±80	300	270 (420) 540
Feature 6	47829	1580±80	370	410 (460, 480, 510, 530) 650
Feature 7	47830	1780±60	170	210 (250) 340

1 One sigma age range (cal age); results rounded to nearest 10 yr

All dates were tested together for significant difference and found to be statistically the same at the 95% level (pooled mean age=1675; square root of variance of pooled mean age=38; t-statistic=5.30; Chi-square=3.84). Each date was tested individually against the oldest date, that from Feature 7, and only that from Feature 6, the youngest obtained, was found to be different at the 95% level (pooled mean age=1708; square root of variance of pooled mean age=49; t-statistic=3.88; Chi-square= 3.84). Interestingly, the ten year difference in the both the means and one sigma values of the dates from Features 4 and 6, when tested for signficant difference against that from Feature 7, had contrasting results. The date from Feature 4 was not statistically different from that of Feature 7 (pooled mean age=1751; square root of variance=51; t-statistic=3.01; Chi-square=3.84).

The difference between the dates from Features 6 and 7, however, supports archaeological interpretation that these pits were filled during different occupations of the site. The overlapping one sigma age ranges of the dates from Features 4, 5 and 6 as compared to that of Feature 7 suggest the first three pits are more similar to each other than to the last and date to a later occupation. Comparability of their ceramic assemblages also supports this interpretation, though it is unfortunate that Feature 7 lacked rim sherds that would have supported or refuted the contrast between it and the others.

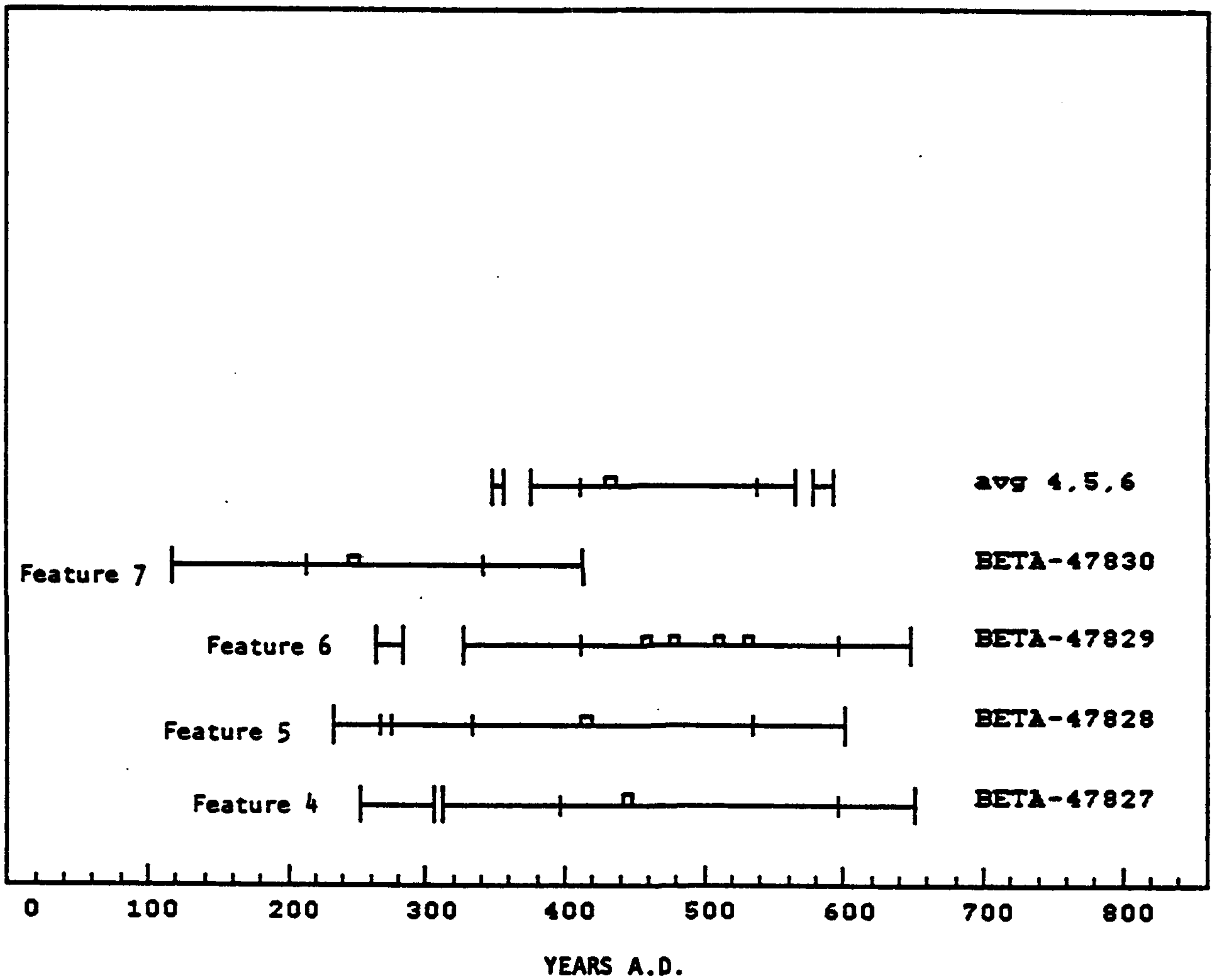


Figure 9.1. Calibrated Radiocarbon Dates from Features 4, 5, 6, and 7. Open boxes are intercepts, short vertical lines indicate one sigma values and taller vertical lines indicate two sigma values. Calibrated average of dates from Features 4, 5, and 6 is shown as well. Modified from a graphics plot provided by the CALIB 3.0.3 program (Stuiver and Reimer 1993).

The overlapping first sigmas of the dates from Features 4, 5 and 6 permit averaging. The weighted average of their laboratory dates is 1607.9±48.5 (calibrated curve sigma): A.D. 340. The calibrated average is A.D. 410 (430) 540 (one sigma and (cal) age; rounded). These dates support the general temporal placement of the site based on relative means to the Kansas City phase and early Edwardsville phase of the Kansas City Hopewell variant. Inclusion of the earlier date from Feature 7 increases the span to ca. A.D. 210-540. This inference and the data on which it are based enable us to refine the temporal ceramic and projectile point seriations of the Kansas City Hopewell variant.

The temporal spans of the Kansas City Hopewell phases established by Johnson (in press) are general. Each of the three phases has been assigned 250 years beginning ca. A.D. 1. Each phase is recognized by certain projectile point types and ceramic designs. It is understood that these types are not exclusive to any one period but are characterized, like all seriations, by their relative frequencies. It was expected that the acquisition of additional chronological information would lead to refinement of these phases and seriations. Quarry Creek now permits such refinement, though it is based on a relatively small sample of the site proper, and an even smaller sample of the Quarry Creek-McPherson locality.

The lack of Scallorn arrow points and the relatively high frequency of Edwardsville ceramics indicates changes in ceramic and projectile point typologies were not concurrent for the Kansas City and Edwardsville phases. There is no reason to expect such concurrence since ceramic designs and hunting technologies or strategies were under different selective pressures. But we can now hypothesize a temporal lag in the introduction of the bow-and-arrow vis-a-vis the innovation or introduction of new pottery decorative motifs. It is suggested that the production of plain or crenated ceramics began as early as A.D. 400, rather than after A.D. 500 (cf. Johnson 1983; in press).

The recent radiocarbon dating of Plains (Late) Woodland sites in northeastern Kansas to the seventh century requires interpretation of the relationship of such with the Edwardsville phase of the Kansas City Hopewell variant. For example, a crematorium at the Richland site, in the Wakarusa River valley, contained a Scallorn arrow point and charcoal which yielded two radiocarbon dates averaging A.D. 640 (Logan 1990c). Sites assigned to the Grasshopper Falls phase of the Plains Woodland period in the Delaware River basin have been dated as early as the seventh century A.D. (e.g., 14AT2, Williams 1986; 14JF331, Reynolds 1979; and 14JF414, Logan 1990a). Two Grasshopper Falls phase sites in Jackson County, Kansas have C14 dates that also would be roughly contemporaneous with the Edwardsville phase (i.e., 14JN332, Baugh 1991; 14JN349, Fosha and Williams 1990).

It is particularly intriguing that none of these sites has displayed any Hopewellian aspects. If, as Johnson (in press) suggests, the Edwardsville phase persisted until ca. A.D. 750, it is rather strange that a Late Hopewell culture could exist in such close proximity to other Woodland cultures without sharing or influencing some material culture traits. It is difficult to imagine that a cultural barrier of some kind prevented the interaction of these cultures in the Lower Kansas River basin.

It is more likely that the terminal date of the Edwardsville phase is ca. A.D. 600-650 and that this period witnessed either the disappearance of the Hopewell in the Lower Missouri and Kansas River valleys or their cultural transformation into a Plains (Late) Woodland phase such as Grasshopper Falls. This problem is best pursued at Late Woodland sites in the Lower Missouri River valley, the core area of the Kansas City Hopewell variant. Archaeologists should seek sites that suggest, through their ceramic assemblages, a transitional Late Hopewell-Plains Woodland occupation. The absence of any such site might indicate the Hopewell variant in the Kansas City locality died without cultural descendants. The documented presence of both Plains Woodland and Hopewell components in the Salt and Plum Creeks drainage just north of the Quarry Creek divide (Witty and Marshall 1968; Logan 1990b), suggests the general Leavenworth area is a promising arena in which this game might be pursued.

Site Management and Preservation

The Kansas Historic Preservation Department has already established guidelines for the protection of the Quarry Creek site. While I can add little to these, I can endorse these steps, provide logistical information based on the KAFS excavations, and urge some essential follow-up investigation in the Quarry Creek locality.

The Kansas State Historic Preservation Officer, through a letter dated March 31, 1989 to the Director of the Department of Engineering and Housing, Fort Leavenworth (Kansas State Historical Society 1989b), suggested that-

> -trees with trunk diameters in the range of fourteen inches to sixteen inches be left in place but that numerous smaller trees be removed by hand. Three permanent benchmarks should be established and the site contours mapped. Holes from earlier tree removal should be indicated on the site map and then backfilled with sand or soil of contrasting color and texture to that of the soil at the site so they will be recognized as modern disturbances. Finally, native grass should be established and maintained.

The removal of trees and planting of native grass was not to be accomplished with heavy machinery. Reduction of the wooded cover at the site would facilitate periodic patrols of the area by the military police, discourage vandalism, and prevent further disturbance of the cultural deposits by root growth. This policy was urged in a second letter from the SHPO to DEH on February 13, 1990 (Kansas State Historical Society 1990). This communication also endorsed investigation of the site by the Kansas Archaeological Field School.

Some of the trees at the site were removed prior to the KAFS field work by members of Boy Scout Troop 66 in the spring of 1990 and considerable brush was cut down during the first day of our project the following summer. Inspection of the site by the author in the autumn of 1992 revealed that much of the woody vegetation had been cut down but that a considerable amount of tall weeds had become established. Planting of native grass was still being planned (Matt Nowak, personal communication).

The recommendation of the SHPO that no heavy machinery be used to disturb the site grounds during the planting of native grasses and forbs is strongly supported. Archaeological material was found at the surface of the site and even the shallowest tillage would destroy the integrity of the upper level of the middens and intervening areas. More precise mapping of the site area than was possible in 1991 is also recommended. At the time of our fieldwork, the site was still clothed in some trees and fallen timber that prevented accurate contour mapping. The site map provided in chapter one of this report (Fig. 1.3) is accurate to the nearest meter horizontally and to the nearest half meter vertically. However, with the use of an EDM transit, a better map can be produced that will show the low relief mounds and tree craters in great detail.

The limits of the site as shown on the State of Kansas site form and on the maps provided the author by DEH are greater than those established by the KAFS. However, we conducted no testing south of the stream nor north of the ravine. The former area is more logically considered part of the McPherson site, though hind-sight suggests both sites should have been recorded as one. Limited coring with an Oakfield tool was done in the latter area and no deposits were encountered. Thus, the site is more accurately defined by the natural boundaries shown in Figure 1.2. However, additional testing in the grassy area between the stream and McPherson Avenue is recommended in order to determine the relationship between the McPherson and Quarry Creek sites.

As important as the establishment and maintenance of native grass cover at the Quarry Creek site and its monitoring by fort personnel is further exploration of the archaeological potential of the entire drainage. It is difficult to imagine how a prehistoric population could have lived at the Quarry Creek-

McPherson area for at least 300 years and not occupied other parts of the tributary system. Unfortunately, most of the system remains wooded and very little of it has yet to be surveyed. Scrutiny of the 7.5' topographic map that includes the military reservation reveals at least two settings in the watershed identical to that of the Quarry Creek site, elongate ridges at the confluence of feeder streams. At a minimum, these settings should be surveyed and tested. Comparison of U.S.G.S. Leavenworth topographic quadrangles based on aerial photography done in 1947 and 1982 shows the penetration of several off-road trackways through the woods of Quarry Creek during the interim. One of these roads crosses a ridgetop like that of the site. This demonstrates the vulnerability of any unrecorded sites in that area. It is imperative that the Department of the Army and Fort Leavenworth not only protect the Quarry Creek and McPherson sites, but that they follow the mandate of Executive Order No. 11593 with regard to unexplored areas within the Quarry Creek drainage. This requires a survey and assessment of the cultural resources of that unknown terrain, which promises to enhance our perspective of the Quarry Creek locality and its use by our prehistoric antecedents.

REFERENCES CITED

Adair, Mary J.
1977 Subsistence Exploitation at the Young Site: A Predictive Model for Kansas City Hopewell. Master's Thesis, Department of Anthropology, University of Kansas.

1988 Prehistoric Agriculture in the Central Plains. University of Kansas, Publications in Anthropology, 16.

1993 Pre-Maize Gardening in the Central Plains. Paper presented at the 58th Annual Meeting of the Society for American Archaeology.

Antevs, Ernst
1955 Geologic-Climatic Dating in the West. American Antiquity 20(4):317-335.

Artz, Joe A.
1978 Faunal Analysis. In, Nebo Hill, by Kenneth C. Reid, pp. 226-246. Report submitted to the Missouri State Highway Commission, Jefferson City. Museum of Anthropology, University of Kansas, Lawrence.

1983 The Soils and Geomorphology of the East Branch Walnut Valley: *Contexts of Human* Adaptation in the Kansas Flint Hills. Master's Thesis, Department of Anthropology, University of Kansas.

Artz, Joe A. and Kenneth C. Reid
1984 Geoarchaeological Investigations in Cotton Creek Valley. In, Hunters of the Forest Edge: Culture, Time, and Process in the Little Caney Basin, by K.C. Reid and J.A. Artz, pp.97-186. University of Tulsa, Laboratory of Archaeology, Contributions in Archaeology 14.

Asch, David L. and William Green
1992 Crops of Ancient Iowa: Native Plant Use and Farming Systems. Report prepared for Leopold Center for Sustainable Agriculture. Office of the State Archaeologist, University of Iowa, Iowa City.

Barr, Thomas P. and Don D. Rowlison
1977 An Archaeological Inventory of the Fort Leavenworth Military Reservation. Prepared for Kansas City District, U.S. Army Corps of Engineers, Robert G. Muir and Associates, Colorado Springs.

Baugh, Timothy G.
1991 The Avoca Site (14JN332): Excavation of a Grasshopper Falls Phase Structure, Jackson County, Kansas. Kansas State Historical Society, Contract Archeology Publication No. 8. Topeka.

Bee, James W., Gregory Glass, Robert S. Hoffman, and Robert R. Patterson
1981 Mammals in Kansas. University of Kansas, Museum of Natural History, Public Education Series, 7.

Bell, Patricia
1976 Spatial and Temporal Variability within the Trowbridge Site, A Kansas City Hopewell Village. In, Hopewellian Archaeology in the Lower Missouri Valley, ed. by A Johnson, pp.16-58. University of Kansas, Publicat in Anthropology, 8.

Benn, David W.
1990 Woodland Cultures on the Western Prairies: The Rainbow Site Investigations. Office of the State Archaeologist, University of Iowa, Report 18.

Binford, Lewis R.
1983 Working at Archaeology. Academic, New York.

Bitikofer, Shaun
1993 Analysis of Quarry Creek Trash Midden Artifacts. Ms. on file, Museum of Anthropology, University of Kansas.

Brenner, Gary David
1986 Recent Excavations at the Renner Village Site. The Kansas City Archaeologist, Special Bulletin 1:33-53.

1990 Excavations at the Renner Site - 1985 and 1986. The Kansas City Archaeologist, Special Bulletin 2:51-67.

Brockington, Paul E.
1976 Variability in the Archaeological Record: Some Comments Based on Analyses of Surface Collection. In, Hopewellian Archaeology in the Lower Missouri Valley, ed. by A.E. Johnson, pp.126-137. University of Kansas, Publications in Anthropology 8.

1980 Culture Drift: A Case Study of the Kansas City Hopewell. Unpublished Doctoral Dissertation, Department of Antropology, University of Kansas, Lawrence.

Brogan, William T.
1981 The Cuesta Phase: A Settlement Pattern Study. Kansas State Historical Society, Anthropological Series 9.

Brose, David S. and N'aomi Greber (editors)
1979 Hopewell Archaeology: The Cillicothe Conference. Kent State University, Kent, Ohio.

Brown, Kenneth L.
1976 A Search for Patterns in the Horizontal and Vertical Distributions of Artifacts in the Kansas City Hopewell Component at the Young Site (23PL4). In, Hopewellian Archaeology in the Lower Missouri Valley, ed. by A.E. Johnson, pp.116-125. University of Kansas, Publications in Anthropology, No. 8.

Brown, Kenneth L.
n.d. Analysis of Faunal Remains from the Aker Site, 23PL43, a Hopewellian Village Site in Northwestern Missouri. Manuscript on file, Museum of Anthropology, University of Kansas, Lawrence.

Brumwell, Malcolm J.
1941 An Ecological Survey of the Leavenworth Military Reservation. Master's Thesis, University of Kansas, Department of Zoology.

Burns and McDonnell Engineers, Inc.
1993 Site Location of a Proposed New Disciplinary Barracks on the Fort Leavenworth Military Reservation: Environmental Impact Statement. Submitted to the Kansas City District, U.S. Army Corps of Engineers. Burns and McDonnell Engineers, Inc., Kansas City, Missouri.

Caldwell, Joseph R.
1959 Trend and Tradition in the Prehistory of the Eastern United States. Illinois State Museum, Scientific Papers 10. Springfield.

1964 Interaction Spheres in Prehistory. In, Hopewellian Studies, ed. by J.R. Caldwell and R.L. Hall, pp.133-143. Scientific Papers of the Illinois State Museum, Vol. 12.

Caspall, F. C.
1970 The Spatial and Temporal Variations in Loess Deposition in Northeastern Kansas. Doctoral Dissertation, Department of Geography, University of Kansas.

Chambers, Mary E., Sally K. Tompkins, Robert L. Humphrey, and Cecil R. Brooks
1977 The Cultural Resources of Clinton Lake, Kansas: An Inventory of Archaeology, History, and Architecture. Iroquois Research Institute, Fairfax, VA.

Chapman, Carl H.
1980 The Archaeology of Missouri, Volume 2. University of Missouri, Columbia.

Chapman, Jefferson and Gary D. Crites
1987 Evidence for Early Maize (Zea maize) from the Icehouse Bottom site, Tennessee. American Antiquity 52(2):352-354.

Corps of Engineers
1981 Stranger Creek: Flood Control Study (2 vols.). Kansas City District, U.S. Army Corps of Engineers.

Dick-Peddie, W. A.
1952 The Primeval Forest Types in Iowa. Master's Thesis, Iowa State College.

Dickey Harold P., Jerome L. Zimmerman, and Harold T. Rowland
1977 Soil Survey of Jefferson County, Kansas. U.S. Department of Agriculture, Soil Conservation Service, Washington.

Dufford, A. E.
1958 Quaternary Geology and Groundwater Resources of the Kansas River Valley between Bonner Springs and Lawrence, Kansas. Kansas Geological Survey, Bulletin 130(1):1-96.

Fenneman, N. M.
1938 Physiography of the Eastern United States. McGraw Hill, New York.

Fosha, Michael R. and Barry G. Williams
1990 Dates, Pots and Pits: A Grasshopper Falls Phase Site in Northeastern Kansas. Paper presented at the 12th Annual Flint Hills Archaeological Conference, Kansas City, Missouri.

Fritz, G.
1990 Multiple Pathways to Farming in Precontact Eastern North America. Journal of World Prehistory 4:387-435.

Frye, J. C. and A. B. Leonard
1952 Pleistocene Geology of Kansas. State Geological Survey of Kansas, Bulletin 99.

Griffin, James B.
1967 Eastern North American Archaeology: A Summary. Science 156(3772):175-191.

Griffin, James B., Richard E. Flanders, and Paul F. Titterington
1970 The Burial Complexes of the Knight and Norton Mounds in Illinois and Michigan.

Gruger, Johanna
1973 Studies on the Late Quaternary Vegetation History of Northeastern Kansas. Geological Society of America, Bulletin 84:239-250.

Guilday, John E., Paul W. Parmalee, and Donald P. Tanner
1962 Aboriginal Butchering Techniques at the Eschelman Site (36 La 12), Lancaster County, Pennsylvania. Pennsylvania Archaeologist 32(3):59-83.

Holien, Christopher W.
1982 Origin and Geomorphic Significance of Channel-Bar Gravel of the Lower Kansas River. Master's Thesis, Department of Geology, University of Kansas.

Honderich, J. P.
1970 Origin and Environment of Deposition of Cenozoic Chert Gravel in Eastern Kansas. Unpublished Master's Thesis, Department of Geology, University of Kansas, Lawrence.

Howell, D. L. and C. L. Kucera
1956 Composition of Pre-settlement Forests in Three Counties of Missouri. Torrey Bontanical Club, Bulletin 83(3):207-217.

Hunt, Elvid and W. E. Lorence
1937 History of Fort Leavenworth, 1827-1937. The Command and General Staff School Press, Fort Leavenworth, Kansas.

Johnson, Alfred E.
1974 Settlement Pattern Variability in Brush Creek Valley, Platte County, Missouri. Plains Anthropologist 19(64):107-122.

1976a Introduction. In, Hopewellian Archaeology in the Lower Missouri Valley, ed. by A.E. Johnson, pp.1-6. University of Kansas, Publications in Anthropology, 8.

1976b A Model of the Kansas City Hopewell Subsistence-Settlement System. In, Hopewellian Archaeology in the Lower Missouri Valley, ed. by A.E. Johnson, pp.7-15. University of Kansas, Publications in Anthropology, 8.

1979 Kansas City Hopewell. In, Hopewell Archaeology: The Cillicothe Conference, ed. by D.S. Brose and N. Greber, pp.86-93. Kent State University, Kent, OH.

1983 Late Woodland in the Kansas City Locality. Plains Anthropologist 28(99):99-108.

1984 Temporal Relationships of Late (Plains) Woodland Components in Eastern Kansas. Plains Anthropologist 29(106):277-288.

1992 Early Woodland in the Trans-Missouri West. Plains Anthropologist 17(139):129-136.

in press Plains Woodland. In, Handbook of North American Indians, Plains. Smithsonian Institution, Washington, D.C.

Johnson, Alfred E. and Ann S. Johnson
1975 K-Means and Temporal Variability in Kansas City Hopewell Ceramics. American Antiquity 40(3):283-295.

Johnson, Eileen M.
1972 An Analysis and Interpretation of Faunal and Floral Material from a Kansas City Hopewell site. Master's Thesis, Department of Anthropology, University of Kansas, Lawrence.

Kansas State Historical Society
1972 Progress Report by Thomas Witty, May 5. On file, Archeology Division.

Kansas State Historical Society
1973 NRHP Nomination Form for the Quarry Creek Site, January. On file, Historic Preservation Department.

Kansas State Historical Society
1974 Letter from Thomas Witty to Curator, Fort Leavenworth Museum, May 20. On file, Archeology Division.

Kansas State Historical Society
1989a Progress Report by Thomas Witty, March 14. On file, Archeology Division.

Kansas State Historical Society
1989b Letter from Ramon Powers to Lt. Col. C.D. Knowlton, March 31. On file, Historic Preservation Department.

Kansas State Historical Society
1989c Progress Report by Thomas Witty, May 2. On file, Archeology Division.

Kansas State Historical Society
1990 Letter from Ramon Powers and Richard Pankratz to Lt. Col. C.D. Knowlton, February 13. On file, Historic Preservation Department.

Katz, Paul R.
1969 An Analysis of Archaeological Data from the Kelley Site, Northeastern Kansas. Master's Thesis, Department of Anthropology, University of Kansas.

Katz, Suzanna R.
1974 Kansas City Hopewell Activities at the Deister Site. University of Kansas, Museum of Anthropology, Research Series, 1.

Kay, Marvin
1975 Central Missouri Hopewell Subsistence-Settlement System. Doctoral Dissertation, Department of Anthropology, University of Colorado.

Kay, Marvin and Alfred E. Johnson
1977 Havana Tradition Chronology of Central Missouri. Midcontinental Journal of Archaeology 2(2):195-217.

King, Frances B. and Russell W. Graham
1981 Effects of Ecological and Paleoecological Patterns on Subsistence and Paleoenvironmental Reconstruction. American Antiquity 46(1):128-142.

Knox, J. C.
1983 Responses of River Systems to Holocene Climates. In, Late-Quaternary Environments of the United States, Vol 2: The Holocene, ed. by H.E. Wright, Jr., pp.26-41. University of Minnesota, Minneapolis.

Kuchler, A. W.
1964 Potential Natural Vegetation of the Coterminous United States. American Geographical Society, Special Publication, 36.

1974 A New Vegetation Map of Kansas. Ecology 55:586-604.

Larsen, Clark S. and Patricia J. O'Brien
1973 The Cochran Mound, 23PL86, Platte County, Missouri. The Missouri Archaeological Society, Newsletter 267.

Lehmer, Donald J.
1970 Climate and Culture History in the Middle Missouri Valley. In, Pleistocene and Recent Environments of the Central Great Plains, ed. by W. Dort, Jr., and J.K. Jones, Jr., pp.117-129. University of Kansas, Lawrence,

Leonard, Byron A.
1959 Handbook of Gastropods in Kansas. University of Kansas, Museum of Natural History, Miscellaneous Publications 20. Lawrence.

Logan, Brad
1979 Cultural Resources of Kansas City International Airport and its Environs: An Archaeological Reconnaissance. University of Kansas, Museum of Anthopology, Research Series, 3.

1981 An Archaeological Survey of the Stranger Creek Drainage System, Northeast Kansas. University of Kansas, Museum of Anthropology, Project Report Series, 48.

1985 O-Keet-Sha: Culture History and Its Environmental Context: The Archaeology of Stranger Creek Basin, Northeastern Kansas. Doctoral Dissertation, Department of Anthropology, University of Kansas.

1986 The 1986 Kansas Archaeological Field School: A Summary Report of Survey and Test Excavations in Little Walnut Creek Valley, Atchison County, Kansas. Manuscript on file, Office of Archaeological Research, Museum of Anthropology, University of Kansas, Lawrence.

1987a Archaeological Investigations in the Clinton Lake Project Area, Northeastern Kansas: National Register Evaluation of 27 Prehistoric Sites. Report submitted to the Kansas City District, U.S. Army Corps of Engineers, Kansas City, Missouri, by Kaw Valley Engineering, Junction City, Kansas.

1987b An Archaeological Survey in the Vicinity of Bonner Springs and Edwardsville, Kansas. University of Kansas, Museum of Anthropology, Project Report Series, 63.

1988 Lithic Resources, Terrain Variation and Prehistoric Site Distribution in the Kansas City Locality. Plains Anthropologist 33:321-336.

1990a Archaeological Investigations in the Perry Lake Project Area, Northeastern Kansas: National Register Evaluation of 17 Prehistoric and Historic Sites. Report submitted to the Kansas City District, U.S. Army Corps of Engineers, Kansas City, Missouri, by Kaw Valley Engineering, Junction City, Kansas.

1990b Archaeological Investigations in the Plains Village Frontier, Northeastern Kansas. University of Kansas, Museum of Anthropology, Project Report Series, 70.

1990c The Richland Crematorium: New Evidence of Plains Woodland Mortuary Practices in the Central Plains. Plains Anthropologist 35(128):103-124.

Logan, Brad and John Hedden
1990 14JO46. In, Archaeolotgical Investigations in the Plains Village Frontier, Northeastern Kansas, ed. by Brad Logan, pp. 92-110. University of Kansas, Museum of Anthropology, Project Report Series No. 70.

Loomis, W. E. and A. L. McComb
1944 Recent Advance of the Forest in Iowa. Iowa Academy of Science, Proceedings 51:217-224.

Marshall, James O.
1972 The Archeology of the Elk City Reservoir. Kansas State Historical Society, Anthropological Series 6. Topeka.

Montet-White, Anta
1968 The Lithic Industries of the Illinois Valley in the Early and Middle Woodland Period. University of Michigan, Museum of Anthropology, Anthropological Papers, 35.

Moore, Raymond, C., J. C. Frye and J. M. Jewett
1944 Tabular Description of Outcropping Rocks in Kansas. Kansas State Geological Survey, Bulletin 52(4):127-212.

Nathan, Michele
1980 Survey and Testing of Archaeological Resources at Clinton Lake, Kansas, 1978-1979. Report submitted to the Kansas City District, U.S. Army Corps of Engineers, Kansas City, Missouri, by Iroquois Research Institute, Fairfax, VA.

O'Brien, Patricia J., Margaret Caldwell, John Jilka, Lynn Toburen and Barbara Yeo
1979 The Ashland Bottoms Site (14RY603): A Kansas City Hopewell Site in North-Central Kansas. Plains Anthropologist 24(83):1-20.

O'Connor, H. G.
1960 Geology and Ground-water Resources of Douglas County, Kansas. Kansas Geological Survey, Bulletin 148.

Odum, Eugene P.
1971 Fundamentals of Ecology. Third Edition. W. B. Saunders, Philadelphia.

Rapp, George, Jr., Eiler Henrickson, and James Allert
1990 Native Copper Sources of Artifact Copper in Pre-Columbian North America. In, Archaeological Geology of North America, ed. by N.P. Lasca and J. Donahue, pp. 479-498. Geological Society of America, Centennial Special Vol. 4.

Reeder, Robert L., E. E. Voigt, and Michael J. O'Brien
1983 Investigations in the Lower Perche-Hinkson Drainage. American Archaeology Division, Department of Anthropology, University of Missouri-Columbia, Publications in Archaeology, 1.

Reid, Kenneth C.
1976 Prehistoric Trade in the Lower Missouri River Valley: An Analysis of Middle Woodland Bladelets. In, Hopewellian Archaeology in the Lower Missouri Valley, ed. by A.E. Johnson, pp.63-99. University of Kansas, Publications in Anthropology, 8.

1979 Appendix 2: Stone Tool Resources. In, A Reconnaissance Survey of Prehistoric Resources in the Nodaway Basin, Southwestern Iowa. Report submitted to the Iowa Division of Historic Preservation, Iowa City, IA.

1980a Upper Pennsylvanian Cherts of the Forest City Basin: Missourian Stage. Plains Anthropologist 25(88):121-134.

1980b The Achievement of Sedentism in the Kansas City Region. In, Archaic Prehistory on the Prairie Plains Border, ed. by A.E. Johnson, pp.29-42. University of Kansas, Publications in Anthropology, 12.

1984 Nebo Hill and Late Archaic Prehistory on the Southern Prairie Peninsula. University of Kansas, Publications in Anthropology, 15.

Remsburg, George J.
1891 Indian Remains. Atchison Patriot, December 26. Atchison County Clippings 3:106-111. Kansas State Historical Society, Topeka.

1893 Many Old Mounds. Atchison Champion, May 31. Atchison County Clippings 3:106-111. Kansas State Historical Society, Topeka.

1909 Archaeology of Stranger Creek. Potter Kansan, March 17.

1912 A Burial Mound Once Existed on Nieman Farm. Leavenworth Times, Janurary 25.

n.d. The Ingalls Indian Mounds. Privately printed pamphlet. Kansas State Historical Society, Topeka.

Reynolds, John D.
1979 The Grasshopper Falls Phase of the Plains Woodland. Kansas State Historical Society, Anthropological Series, 7.

Ritterbush, Lauren W.
1987 Lithic Analyses. In, Archaeological Investigations in the Clinton Lake Project Area, Northeastern Kansas: National Register Evaluation of 27 Prehistoric Sites, ed. by Brad Logan, pp. 197-222. Submitted to the Kansas City District, U.S. Army Corps of Engineers. Kaw Valley Engineering and Development, Junction City, Kansas.

Ritterbush, Lauren W. and Edward J. Kost
1983 An Approach to the Analysis of Chipped Stone Assemblages on a Regional Basis. Manuscript on file with authors.

Robinson, Sarah
1976 An Analysis of Charred Seeds from a Middle Woodland Occupation Site in Central Missouri. In, Hopewellian Archaeology of the Lower Missouri Valley, ed. by Alfred E. Johnson, pp. 100-109. University of Kansas, Publications in Anthropology 8. Lawrence.

Roedl, L. J. and J. H. Howard
1957 Archaeological Investigations at the Renner Site. The Missouri Archaeologist 18(1&2):52-96.

Rogers, Richard A. and Larry D. Martin
1983 American Indian Artifacts from the Kansas River. Transactions of the Nebraska Academy of Sciences 11:13-18.

Romine, John
1993 Comparative Analysis of Flotation Samples of Refuse Pits at the Quarry Creek Site. Manuscript on file, Museum of Anthroplogy, University of Kansas, Lawrence.

Roper, Donna C.
1979 Archaeological Survey and Settlement Pattern Models in Central Illinois. Midcontinental Journal of Archaeology, Special Paper, 2.

Schiffer, Michael B.
1972 Archaeological Context and Systemic Context. American Antiquity 37:156-165.

1976 Behavioral Archaeology. Academic, New York.

Schmits, Larry J.
1987 Archaeological Survey and Testing at Perry Lake, Jefferson County, Kansas. Publications in Archaeology 2. Environmental Systems Analysis, Inc. Overland Park, Kansas.

Schoewe, Walter H.
1949 The Geography of Kansas: Part II, Physical Geography. Transactions of the Kansas Academy of Science 52(3):261-333.

Schultz, Floyd and Albert Spaulding
1948 A Hopewellian Burial Site in the Lower Republican Valley, Kansas. American Antiquity 13:306-313.

Shelford, Victor E.
1963 The Ecology of North America. University of Illinois, Urbana.

Shippee, J. Mett
1967 Archaeological Remains in the Area of Kansas City: The Woodland Period, Early, Middle, and Late. Missouri Archaeological Society, Research Series, 5.

Smith, Bruce D.
1992 Hopewellian Farmers of Eastern North America. In, Rivers of Change: Essays on Early Agriculture in Eastern North America, by B. D. Smith, pp. 201-248. Smithsonian Institution Press, Washington, D.C.

Soil Conservation Service
1959 Big Stranger Creek Watershed, Joint District No. 11, General Work Plan: Atchison, Jefferson, and Leavenworth Counties, Kansas. Manuscript, Soil Conservation Service, U.S. Department of Agriculture, Leavenworth, Kansas.

Struever, Stuart
1964 The Hopewell Interaction Sphere in Riverine-Western Great Lakes Culture History. In, Hopewellian Studies, ed. by J.R. Caldwell and R.L. Hall, pp.85-106. Illinois State Museum, Scientific Papaers, 12.

Struever, Stuart and Gail L. Houart
1964 An Analysis of the Hopewell Interaction Sphere. In, Social Exchange and Interaction, ed. by W. N. Wilmsen, pp. 47-49. Museum of Anthropology, University of Michigan, Anthropological Papers 46. Ann Arbor.

Stuiver, Minze and G. W. Pearson
1993 High Precision Calibration of the Radiocarbon Time Scale, AD 1950-500 BC and 2500-6000 BC. Radiocarbon 35:1-23.

Stuiver, Minze and Paula J. Reimer
1993 Calib: Radiocarbon Calibration Program Rev 3.0.3. Radiocarbon 35:215-230.

Tarling, D. H.
1990 Some Uses for the Magnetic Properties of Materials in Archaeological Sites. In, Archaeological Geology of North America, ed. by N.P.Lasca and J. Donahue, pp.597-602. Geological Society of America, Centennial Special Vol. 4.

Thornthwaite, C. W.
1941 Climate and Settlement in the Great Plains. In, Climate and Man, U.S. Department of Agriculture, Yearbook of Agriculture, pp.177-187.

Tjaden, Rex
1974 The Cogan Mounds, 23PL125, Platte County, Missouri. The Missouri Archaeological Society, Newsletter, 284.

Todd, J. E.
1918 Kansas During the Ice Age. Transactions of the Kansas Academy of Science 28:33-48.

Transeau, E. N.
1935 The Prairie Peninsula. Ecology 16(3):423-437.

Wagner, Mark J. Brad Koldehoff, Terrance J. Martin, and Kathryn E. Parker
1989 Archaeological Investigation of the McPherson Site (14LV357). In, Phase I, II, and III Archaeological Investigations at Fort Leavenworth, Kansas, pp. 159-198. Report submitted to the Kansas City District, U.S. Army Corps of Engineers. American Resources Group, Ltd. Carbondale, Illinois.

Wedel, Waldo R.
1938 Hopewellian Remains Near Kansas City, Missouri. Proceedings of the U.S. National Museum 86:99-106. Washington, D.C.

1939 Excavations in Platte County, Missouri. Smithsonian Institution, Exploration and Fieldwork, 1938, pp. 95-98. Washington, D.C.

1940 Cultural Sequences in the Central Great Plains. In, Essays in Historical Anthropology of North America, e.d by J. H. Steward, pp. 291-352. Smithsonian Miscellaneous Collections, 100. Washington, D.C.

1943 Archaeological Investigations in Platte and Clay Counties, Missouri. Smithsonian Institution, United States National Museum, Bulletin 183.

1959 An Introduction to Kansas Archeology. Smithsonian Institution, Bureau of American Ethnology, Bulletin 174.

1970 Some Environmental and Historical Factors of the Great Bend Aspect. In, Pleistocene and Recent Environments of the Central Great Plains, ed. by W. Dort, Jr., and J.K. Jones, Jr. University Press of Kansas, Lawrence.

Wendland, W. M. and R. A. Bryson
1974 Dating Climatic Episodes of the Holocene. Quaternary Research 4:9-24.

Weymouth, John W.
1986 Geophysical Methods of Archaeological Site Surveying. In, Advances in Archaeological Method and Theory, Vol. 9, ed. by M.B. Schiffer, pp.311-391. Academic, Orlando.

Williams, Barry G.
1986 Early and Middle Ceramic Remains at 14AT2: A Grasshopper Falls Phase House and Pomona Focus Storage Pits in Northeastern Kansas. Kansas State Historical Society, Contract Archeology Publication 4. Topeka.

Witty, Thomas A., Jr., and James A. Marshall
1968 Archaeological Survey of the Lower Salt and Plum Creek Valley, Leavenworth County, Kansas. Kansas State Historical Society, Anthropological Series, 4.

Wood, W. Raymond and Donald L. Johnson
1978 A Survey of Disturbance Processes in Archaeological Site Formation. In, Advances in Archaeological Method and Theory, Vol. 1, ed. by M.B. Schiffer, pp. 315-381. Academic Press, New York.

Wright, Christopher A.
1980 Archaeological Investigations in the Proposed Blue Springs Lake Area, Jackson County, Missouri: The Early Woodland Period. Report submitted to Burns and McDonnell Engineers, Kansas City, Missouri. Museum of Anthropology, University of Kansas, Lawrence.

Yarnell, Richard A.
1972 Iva annua var. macrocarpa: Extinct American Cultigen? American Anthropologist 74:335-341.

Zabel, Douglas E.
1976 Phosphate and pH Analysis of Soil at a Kansas City Hopewell Site (23PL4). In, Hopewellian Archaeology in the Lower Missouri Valley, ed. by A.E. Johnson, pp.110-115. University of Kansas, Publications in Anthropology, 8.

Zavesky, Larry D. and William C. Boatright
1977 Soil Survey of Leavenworth and Wyandotte Counties, Kansas. Soil Conservation Service, U.S. Department of Agriculture, Washington.

Ziegler, Robert J.
1985a Sites Tested. In, Prehistoric Cultural Resources Within the Right-of-Way of the Proposed Little Blue River Channel, assembled by K. L. Brown and R. J. Ziegler, pp. 78-141. Report submitted to the Kansas City District, U.S. Army Corps of Engineers. Museum of Anthropology, University of Kansas, Lawrence.

1985b Excavations at 23JA40. In, Prehistoric Cultural Resources Within the Right-of-Way of the Proposed Little Blue River Channel, assembled by K. L. Brown and R. J. Ziegler, pp. 142-189. Report submitted to the Kansas City District, U.S. Army Corps of Engineers. Museum of Anthropology, University of Kansas, Lawrence.

APPENDIX 1

MASS (GMS) OF CULTURAL MATERIAL FROM HEAVY FRACTIONS OF FLOTATION SAMPLES FROM THE QUARRY CREEK SITE

Key: Sample Flotation Number (SFN#)
Feature Number/Unit Coordinates (FEAT/UNIT)
Level Number (LV)
Ceramics (CERA)
Lithics (LITH)
Burned Bone (BBON)
Bone (BONE)
Burned Earth (BRTH)
Limestone (LMST)
Charcoal (CCL)
Sandstone (SSTN)
Mineral (e.g., hematite) (MINR)
Caliche (CAL)
Shell (SHL)
Quartzite (QTZT)

SFN#	FEAT/UNIT	LV	CERA	LITH	BBON	BONE	BRTH	LMST	CCL	SSTN	MINR	CAL	SHL	QTZT
120	100N/119E	2	13.4	13.3	4.3	2.2	4.9	30.8	0.4	2.6	0	0	0	0
177	100N/119E	3	5.4	22.3	2.6	4.1	5.2	1.2	0.3	15.5	2.2	0	0	38.8
181	100N/119E	4	14.6	27.7	4.4	2.6	3.4	155.0	0.6	1.5	10.4	0	0	0
184	100N/119E	5	1.5	2.6	1.9	9.5	0.8	50.1	0.2	2.6	0.9	0	0	0
42	100N/139E	2	5.6	7.8	2.3	1.5	5.9	0.1	0.3	1.3	1.1	0	0	0.2
43	100N/139E	3	4.5	5.1	2.1	1.7	8.6	1.2	0.2	0.7	1.5	0	0	0
48	100N/139E	4	2.7	3.8	1.8	1.3	2.2	0	0.3	16.3	0.4	0	0	1.1
28	100N/140E	2	4.8	8.9	3.7	0.7	7.2	3.9	0.1	0.7	0.3	0	0.2	0
29	100N/140E	3	14.3	11.3	2.2	0.2	7.7	0.7	0.1	1.7	1.3	0	0	0
32	100N/140E	4	16.6	4.7	2.4	2.3	4.2	0.4	0.2	1.2	2.5	0	0	0
37	100N/140E	5	5.1	2.8	1.1	1.4	3.4	0.4	0.3	0.1	0.4	0	0	0
118	110N/100E	2	0.4	2.2	0.2	0.1	1.1	0.3	0.2	0.5	0	0	0	0
178	110N/100E	3	0	5.7	1.1	0	0	0	0.1	0.8	0	0	0	0
182	110N/100E	4	15.1	1.2	0.2	0	0	0.1	0.2	0.2	1.4	0	0	5.5
18	79N/167E	2	24.0	9.6	6.5	6.6	10.0	29.5	0.5	3.7	0	0	0	0
23	79N/167E	3	26.0	25.5	6.3	7.0	14.8	26.0	0.2	8.0	0	0	0	0
26	79N/167E	4	7.5	9.4	4.5	6.5	6.3	45.0	0.4	3.7	0	0	0	0
36	79N/168E	2	6.3	21.7	8.5	6.5	21.8	17.8	0.2	4.4	0	0	0	0
39	79N/168E	3	7.9	6.6	7.1	7.2	6.3	9.5	0.4	2.1	0.6	0	0	0
46	79N/168E	4	3.3	9.1	10.0	8.1	10.1	22.2	1.1	2.4	0	0	0	0
57	79N/168E	5	0	1.5	1.8	0.7	26.1	0.9	0.4	0	0	0	0	0
65	79N/168E	6	0.7	2.5	2.5	2.0	6.3	2.6	0.4	3.4	0	0	0	0
3	80N/168E	2	0.4	7.2	8.4	2.9	13.4	11.6	0.1	0	0	0	0	39.2
5	80N/168E	3	7.9	11.7	4.6	1.2	11.7	13.1	0.1	0	10.4	0	0	0
11	80N/168E	4	0.1	4.1	9.2	2.8	36.7	2.2	0.1	0	3.3	0	0	0
61	80N/168E	5	5.6	6.3	3.4	0.6	15.8	1.2	0	0	0	0	0	0
74	81N/168E	2	15.3	8.1	5.3	3.4	5.5	7.4	0	0.9	4.3	0	0	0.4
78	81N/168E	3	3.9	11.3	6.4	4.8	11.0	0.0	0.2	4.1	1.6	0	0	0.5
85	81N/168E	4	12.7	8.4	6.5	4.2	7.3	11.5	0.6	2.5	1.6	0	0	0.6
89	81N/168E	5	0	1.2	1.7	0.9	2.5	0.9	0.2	0.5	0.5	0	0	0
93	82N/168E	2	12.3	2.8	8.1	6.3	5.9	19.8	0.4	3.9	2.7	0	0	0
96	82N/168E	3	13.1	7.6	7.2	5.7	7.6	4.3	0.3	2.4	2.4	0	0	0
100	82N/168E	4	12.4	9.6	4.7	5.5	9.3	8.4	0.4	10.4	6.3	0	0	0
110	82N/168E	5	3.2	19.6	4.9	9.2	9.8	75.6	0.4	3.2	3.8	0	0	0
66	83N/168E	2	5.4	14.2	5.3	7.4	6.4	10.3	0.1	2.3	3.5	0	0	0
67	83N/168E	3	9.1	38.9	9.6	6.6	7.7	37.1	0.1	4.5	5.1	0	0	0
73	83N/168E	4	7.5	8.4	7.2	7.5	13.3	12.4	0.6	1.9	5.4	0	0	0
81	83N/168E	5	6.2	2.1	5.1	6.4	4.7	56.4	0.1	4.9	3.6	0	0	0
87	84N/168E	2	0	16.5	5.0	5.0	4.3	22.0	1.0	3.6	0	0	0	0
90	84N/168E	3	13.0	25.0	6.6	10.0	12.0	31.4	1.5	2.6	0	5.4	0	0
91	84N/168E	4	20.5	18.8	10.0	6.0	7.6	27.0	0.6	10.0	2.6	0	0	0
92	84N/168E	5	10.0	11.5	6.8	14.0	11.0	59.0	0.4	4.7	0	0	0	0
101	84N/168E	6	14.9	16.0	6.0	8.0	5.6	61.4	0.7	6.0	0	0	0	0
113	85N/168E	2	9.9	23.6	8.8	8.8	10.4	130.0	0.1	3.9	0	0	0	0
117	85N/168E	3	6.4	8.8	8.8	12.5	14.4	42.2	0.5	3.6	0.4	0	0	0
179	85N/168E	4	32.3	11.9	13.2	7.1	11.1	50.5	0.5	2.3	0.6	0	0	1.0
1	86N/161E	2	10.1	11.8	7.4	6.5	10.5	18.4	0.5	4.1	0	0	0	0
10	86N/161E	3	3.6	10.0	8.5	8.6	11.6	8.0	0.3	2.0	0	0	0	0
17	86N/161E	4	10.3	12.5	11.4	11.2	13.2	22.9	0.2	5.3	0	0	0	0
33	86N/161E	5	3.0	10.4	10.4	10.1	14.0	28.6	0.5	2.7	0.1	0	0	0
94	86N/168E	2	15.4	11.5	9.4	5.5	12.8	22.6	0.3	3.3	2.5	0	0	0
99	86N/168E	3	15.6	39.1	8.4	9.3	21.6	39.9	0.2	3.4	2.8	0	0	0
104	86N/168E	4	9.1	22.8	7.1	5.3	8.3	15.6	0.3	1.9	1.8	0	0	29.5
108	86N/168E	5	6.1	11.9	8.1	6.3	14.6	17.6	0.5	3.2	1.1	0	0	0
68	87N/160E	2	13.3	15.7	10.5	7.7	12.9	62.6	0.1	3.7	0.8	0	0	0.1
70	87N/160E	3	19.8	16.4	8.1	8.7	12.2	39.2	0.1	7.4	3.5	0	0	0
76	87N/160E	4	11.1	23.5	9.7	22.7	16.5	50.7	0.4	19.8	0	0	0	0

83	87N/160E	5	30.6	12.2	9.2	9.1	13.9	67.7	0.2	4.6	0	0	0	0
88	87N/160E	6	19.7	9.5	4.5	11.7	7.2	66.7	0.6	0	0	0	0	0
40	87N/161E	2	26.2	10.1	7.2	9.4	17.3	30.5	0.1	81.9	5.1	0	0	1.6
45	87N/161E	3	19.4	16.1	12.6	9.6	15.7	26.3	0	8.2	1.6	0	0	2.5
49	87N/161E	4	8.6	13.6	11.3	13.1	13.5	43.4	0.4	1.7	2.1	0	0	0
56	87N/161E	5	20.3	7.1	6.1	18.2	14.2	78.4	0.5	5.5	1.8	0	0	0
62	87N/161E	6	5.4	9.6	7.6	6.5	17.1	156.0	0.4	3.1	0.7	0	0	0
107	87N/168E	2	7.3	13.5	8.6	7.5	14.7	130.0	1.3	0	0	0	0	0
109	87N/168E	3	1.5	16.7	12.0	7.4	3.6	30.9	1.1	2.5	0	0	0	11.2
112	87N/168E	4	1.4	15.4	9.5	6.5	12.6	73.6	0.5	0.5	0	0	0	0
114	87N/168E	5	2.0	162.9	3.7	3.6	7.2	103.8	0.1	1.6	0	0	0	0
309	87N/168E	6	7.1	24.7	15.4	18.1	11.4	324.0	0.4	1.8	0	0	0	0
98	88N/160E	2	13.6	7.5	7.8	4.9	7.5	35.4	0.1	2.6	0	0	0	0
102	88N/160E	3	25.5	7.2	5.3	4.4	10.4	35.8	0.1	0	0	0	0	0
106	88N/160E	4	16.6	14.5	4.6	18.6	9.5	82.4	0.1	0	0	0	0	0
111	88N/160E	5	11.4	5.5	7.3	8.6	15.9	56.6	0.4	1.8	0.3	0	0	0
119	88N/161E	2	15.7	32.4	10.5	3.6	12.8	188.0	0.1	3.5	3.2	0	0	0
121	88N/161E	3	13.7	7.8	10.6	2.2	14.3	70.8	0	3.2	0.8	0	0	0
180	88N/161E	4	19.2	18.7	11.5	9.3	12.9	126.0	0.4	1.8	4.5	0	0	0
183	88N/161E	5	20.5	30.2	10.1	18.3	21.6	302.0	0.2	10.1	1.1	0	0	30.2
185	88N/161E	6	10.7	12.6	7.7	25.2	28.5	172.0	1.1	4.4	1.8	0	0	4.7
95	88N/168E	2	7.8	9.3	6.2	7.3	15.8	33.3	0.1	1.5	5.3	0	0	0
97	88N/168E	3	14.1	10.5	6.6	4.2	11.9	51.7	0.1	1.6	1.4	0	0	0
103	88N/168E	4	3.1	10.4	2.8	3.3	4.2	17.5	0.4	0.9	1.3	0	0	0
105	88N/168E	5	0.8	1.9	4.6	2.2	5.1	9.4	0.2	1.1	2.3	0	0	0
69	89N/168E	2	10.2	24.2	7.3	3.3	14.6	24.5	0.3	2.1	5.3	0	0	0
72	89N/168E	3	8.6	17.1	4.3	6.6	10.6	182.0	0.7	4.2	1.3	0	0	0
79	89N/168E	4	11.8	7.1	2.8	3.5	8.4	87.7	0.1	6.2	0.8	0	0	0
84	89N/168E	5	8.6	10.3	4.3	5.1	10.9	18.5	0.1	2.2	2.6	0	0.2	0
41	90N/143E	2	3.2	6.7	4.7	4.2	9.9	23.4	0.2	3.3	4.2	0	0	0
47	90N/143E	3	15.6	8.8	5.6	6.4	11.6	32.6	0.1	4.5	1.7	0	0	6.7
0	90N/143E	4	0	0	0	0	0	0	0	0	0	0	0	0
75	90N/143E	5	9.1	12.7	7.5	13.5	17.2	196.0	0.2	2.1	0.7	0	0	0
34	90N/144E	2	12.1	10.2	8.3	5.2	17.7	5.4	0.3	5.4	3.1	0	0	0.6
52	90N/144E	3	3.5	9.4	7.6	4.3	10.4	26.2	0.0	2.4	2.6	0	0	0.5
60	90N/144E	4	14.1	8.2	5.2	9.4	15.2	72.6	0.6	1.6	2.7	0	0	0
80	90N/144E	5	22.1	31.5	11.2	14.3	35.8	139.0	0.2	4.2	1.7	0	0	6.2
51	90N/168E	2	5.7	16.2	8.4	3.1	11.3	56.7	0.1	1.2	7.4	0	0	1.4
54	90N/168E	3	7.3	11.9	13.7	4.7	15.5	17.3	0.2	0	5.7	0	0	0
58	90N/168E	4	9.0	13.4	7.4	7.4	50.8	26.8	0.1	0	0	0	0	0
63	90N/168E	5	2.4	15.1	6.6	9.5	10.4	35.1	0.1	0	0	0	0	0
9	90N/172E	2	3.8	4.3	0.2	0.2	3.1	0	0.1	0	0	0	0	0
16	90N/172E	3	0	4.5	0.7	0.1	1.2	0	0.2	0	0	0	0	0
19	90N/172E	4	3.8	8.7	3.3	1.6	5.4	6.6	0.1	0	0	0	0	0
71	91N/168E	2	19.1	15.0	8.1	9.2	19.6	43.0	0.3	1.2		0	0	0
77	91N/168E	3	25.3	31.4	9.6	10.5	8.8	19.6	0.4	10.8	2.3	0	0	0
82	91N/168E	4	16.4	22.8	12.8	8.4	19.2	15.4	0.4	2.9	0	0	0	9.2
86	91N/168E	5	3.3	23.7	5.0	5.1	13.5	2.4	0.7	3.2	0	0	0	0
53	92N/168E	2	15.3	12.1	10.1	9.3	17.4	49.7	0.4	1.7	5.1	0	0	0
55	92N/168E	3	16.3	23.1	9.6	8.6	13.7	6.1	0.6	2.4	5.6	0	0	0
59	92N/168E	4	10.3	16.3	5.6	19.7	15.3	132.3	0.2	2.7	0.7	0	0	58.6
64	92N/168E	5	5.3	53.5	8.2	9.1	17.3	69.6	0.6	2.4	3.6	0	0	0
25	93N/168E	2	20.1	8.2	8.8	6.2	12.8	12.4	0.6	2.4	2.1	0	0	0
27	93N/168E	3	11.6	11.1	8.4	11.8	10.5	10.2	0.4	2.1	1.3	0	0	0
30	93N/168E	4	14.4	7.0	10.3	7.9	11.2	66.0	0.6	0.6	2.9	0	0	0
38	93N/168E	5	13.5	9.0	9.2	15.4	15.4	112.0	0.5	3.1	4.9	0	0	0
44	93N/168E	6	3.9	7.1	5.4	9.3	15.2	20.3	1.9	3.8	1.5	0	0	0

6	95N/151E	2	7.8	4.8	4.7	3.1	6.6	0.7	0.2	0	0	0	0	0
12	95N/151E	3	3.4	8.5	5.3	1.6	8.6	1.5	0.1	0	0	0	0	0
14	95N/151E	4	0.1	3.4	2.6	1.2	5.1	0.2	0.2	0	0	0	0	0
24	95N/151E	5	0	2.8	1.4	0.1	4.7	0.2	0	0	0	0	0	0
188	97N/130E	2	3.1	9.1	1.2	1.2	3.9	0.1	0.2	2.7	1.2	0	0	0
221	97N/130E	3	29.1	14.9	2.2	0.8	4.7	28.1	0.1	1.8	0.7	0	0.1	0
231	97N/130E	4	0.3	1.5	0.4	0.1	0.7	0	0.1	0.4	0	0	0	0
186	99N/119E	2	10.1	12.2	3.6	0.5	8.3	3.6	0.2	3.3	0.5	0	0	6.8
187	99N/119E	3	6.6	6.7	2.2	0.4	7.6	1.5	0.2	2.3	0.1	0	0	0
222	99N/119E	4	2.9	4.4	3.4	4.4	2.5	5.1	0.3	2.5	0.1	0	0	0
2	99N/172E	2	6.7	5.1	7.2	5.7	7.9	6.4	0.1	0.3	1.3	0	0	0
7	99N/172E	3	6.5	9.3	7.5	3.6	13.9	14.6	0.1	0.6	1.5	0	0	7.1
13	99N/172E	4	4.2	9.6	5.5	5.6	16.6	12.2	0	1.6	1.6	0	0	0.4
15	99N/172E	5	10.5	4.3	2.7	4.6	12.5	20.3	0.3	0.1	0.4	0	0	0.1
275	99N/172E	6	2.7	6.6	4.2	8.1	10.4	6.4	0.1	1.3	0.5	0	0	4.1
31	99N/172E	7	2.6	2.2	2.1	1.8	4.3	0.5	0.1	0.4	1.5	0	0	0
50	Feature1	-	28.0	6.5	4.9	4.0	374.0	5.5	1.5	7.0	0	0	0	0
22	Feature2	-	0.2	5.7	3.2	0.6	1.3	0.9	0.3	1.1	2.3	0	0	0
21	Feature2	-	3.2	11.2	7.1	9.5	18.1	33.6	0.4	4.5	0	0	7.8	0
20	Feature2	-	22.3	34.1	12.7	22.3	22.7	33.6	0.6	7.2	0	0	0	0
35	Feature3	-	1.1	1.6	0.5	0.4	1.2	4.4	0.1	0	0.5	0	0	0
303	Feature4	-	0	11.7	4.4	11.4	11.4	658.0	3.0	3.0	4.0	0.7	0	0
251	Feature4	-	0.5	6.0	4.9	2.9	32.0	23.5	1.0	0	0	0	0	0
252	Feature4	-	1.0	3.8	3.6	5.7	7.0	69.0	2.0	1.6	0	0.4	0	0
308	Feature4	-	1.0	9.0	5.9	11.7	13.0	10.0	2.0	2.0	0	0	0	0
247	Feature4	-	1.0	16.5	7.0	5.5	8.0	273.0	0.6	7.4	0	0	0.1	0
242	Feature4	-	1.4	16.4	8.0	19.5	10.5	494.0	2.0	4.0	0	6.9	0.5	0
215	Feature4	-	1.4	16.7	14.5	19.9	41.8	240.0	3.0	0	0	0	0	0
256	Feature4	-	1.6	1.0	2.0	2.6	1.7	28.0	0.9	4.0	0	0.1	0.1	0
250	Feature4	-	1.7	5.9	5.0	6.3	6.9	40.0	1.6	0.5	0.2	7.4	0.1	0
246	Feature4	-	1.7	6.6	7.0	17.5	5.0	160.0	0	0	0	0	0.1	0
198	Feature4	-	2.5	5.0	7.0	13.3	25.0	162.0	1.0	10.0	0	0	0	3.6
227	Feature4	-	3.0	10.0	10.3	11.0	33.0	104.0	1.7	0	0	0	0	0
239	Feature4	-	3.0	10.7	5.0	20.0	16.0	272.0	3.8	1.3	0	7.8	0.1	0
306	Feature4	-	3.5	27.0	9.0	20.0	36.0	115.0	2.0	1.7	1.5	0	0	0
220	Feature4	-	3.6	17.0	8.5	21.3	7.5	176.0	1.7	2.4	2.0	0	0.1	0
249	Feature4	-	3.7	2.4	4.0	2.0	9.0	9.0	0.1	0	0.1	0	0	0
232	Feature4	-	3.9	8.7	7.6	8.7	12.5	363.0	1.0	2.0	9.6	6.6	0.4	0
240	Feature4	-	4.0	13.8	2.5	12.9	7.0	450.0	2.0	14.0	0	1.0	0.1	0
255	Feature4	-	4.5	3.8	1.9	5.0	3.0	64.5	2.0	2.0	0	2.0	0.1	0
230	Feature4	-	5.0	8.7	4.0	15.0	11.6	378.0	2.5	3.0	0.1	7.0	0.3	0
271	Feature4	-	5.0	12.6	7.6	6.4	0	83.0	1.4	1.6	0	0	0.2	0
233	Feature4	-	5.0	20.6	14.0	20.5	32.4	484.0	2.5	0	0	0	0.1	0
243	Feature4	-	5.5	8.7	9.0	10.0	20.5	365.0	1.4	1.5	0	3.5	0.1	0
254	Feature4	-	6.3	9.0	6.8	8.0	18.0	240.0	0.6	8.7	0	0.4	0.1	0
300	Feature4	-	6.5	8.2	12.4	13.0	13.6	314.0	1.2	4.0	0.3	2.3	0	0
115	Feature4	-	6.7	6.0	6.0	13.5	16.8	106.0	3.0	5.5	0	2.0	0	0
216	Feature4	-	7.0	6.6	10.0	11.4	16.8	158.0	4.7	0	0	0	0	0
218	Feature4	-	7.0	12.9	21.4	12.5	48.0	175.0	8.5	0	0	0	0	0
229	Feature4	-	7.0	13.6	6.0	9.4	18.0	120.0	0.6	3.5	0	4.0	0.1	0
219	Feature4	-	7.6	7.6	9.0	17.7	17.0	136.0	2.0	8.0	0	9.0	0	0
317	Feature4	-	8.5	5.7	6.7	16.0	24.5	557.0	1.0	7.7	0	2.7	0.1	0
248	Feature4	-	10.0	5.8	7.7	7.0	4.0	84.0	0.1	0	0.1	0	0.1	0
298	Feature4	-	10.0	6.4	11.0	10.0	8.0	152.0	0	5.0	0.5	0	0	0
210	Feature4	-	10.0	11.0	6.2	13.3	8.3	123.0	2.4	2.3	0	3.4	0.4	0
213	Feature4	-	10.0	15.4	7.7	13.0	8.5	63.0	0.1	1.7	0	0	0.1	0
194	Feature4	-	10.4	10.0	5.5	12.8	23.0	767.0	0.7	4.9	0	1.4	0	0

304	Feature4	-	10.5	5.5	7.4	11.3	35.9	145.0	0.9	5.0	0	0.9	0	0
190	Feature4	-	10.5	8.0	9.6	7.4	18.0	266.0	1.4	2.0	0	0	0	0
225	Feature4	-	10.5	10.6	14.0	9.0	6.5	445.0	1.4	4.4	0	0	0	0
228	Feature4	-	10.8	12.0	3.7	14.1	9.0	202.0	2.0	7.5	0	0	0	0
237	Feature4	-	11.0	6.7	18.7	10.0	11.4	485.0	0.6	2.0	0	1.7	0.6	0
244	Feature4	-	11.0	16.7	8.7	28.7	21.0	100.0	1.8	8.0	0	3.5	0.5	0
195	Feature4	-	11.0	18.5	10.0	10.7	19.5	200.0	0.7	5.0	0	0.4	0	0
189	Feature4	-	11.5	17.5	8.7	23.0	13.0	338.0	0.8	3.0	0	5.0	0.1	0
211	Feature4	-	12.0	8.0	12.0	11.0	11.0	303.0	2.7	3.5	0	6.0	0.2	0
191	Feature4	-	12.0	45.0	6.0	12.0	15.7	421.0	1.4	2.4	0	3.9	0.1	0
234	Feature4	-	12.5	45.0	8.0	13.5	21.5	1,225	3.0	4.0	0	1.7	0.5	0
196	Feature4	-	12.8	5.6	8.0	13.6	17.3	446.0	1.0	3.7	0	1.0	0	0
212	Feature4	-	13.3	43.0	6.7	10.0	8.0	152.0	0	5.0	0.5	1.0	0	0
299	Feature4	-	13.8	11.6	7.0	12.6	17.0	270.0	1.0	2.5	2.0	0	0	0
217	Feature4	-	14.0	24.6	8.0	11.5	16.7	136.0	2.5	4.5	0	2.6	0.1	0
197	Feature4	-	14.5	13.3	8.6	21.5	23.0	423.0	1.7	4.0	0	1.7	0.1	0
318	Feature4	-	15.5	24.0	14.0	18.7	25.7	238.0	1.6	4.6	0	0	0	0
302	Feature4	-	16.0	10.0	9.0	22.9	19.0	256.0	1.7	0	0	0	0	0
235	Feature4	-	16.0	12.0	5.0	15.4	33.0	1,427	0.4	0.3	6.8	0	0.1	0
192	Feature4	-	16.8	12.0	16.6	13.7	18.6	476.0	2.0	6.4	0.6	0.6	0.1	0
301	Feature4	-	18.0	8.8	8.7	15.0	13.9	423.0	0.6	1.0	0	1.7	0	0
245	Feature4	-	18.0	10.9	11.4	13.4	14.9	224.0	2.0	2.0	2.4	0	2.8	0
253	Feature4	-	18.3	3.5	5.5	6.9	25.0	136.0	1.0	0	0	0	0	0
193	Feature4	-	19.6	12.0	6.5	16.7	25.4	367.0	2.0	6.0	0	0	0	0
307	Feature4	-	19.9	13.7	6.4	16.0	18.0	84.5	2.2	5.5	0	0.4	0	0
214	Feature4	-	20.7	6.7	12.9	9.0	13.7	605.0	0.8	5.0	0	0	0.1	0
226	Feature4	-	20.8	17.4	5.5	13.7	15.0	195.0	1.8	6.7	0	18.0	0.3	0
224	Feature4	-	23.0	7.5	12.0	10.0	14.0	289.0	2.6	8.5	0	8.0	0.5	0
241	Feature4	-	24.4	12.4	7.3	10.0	19.3	168.0	2.0	2.7	0	5.5	1.9	0
238	Feature4	-	28.0	12.7	4.7	27.0	12.7	365.0	2.6	1.6	0	4.9	0.6	0
316	Feature4	-	30.0	10.5	5.7	24.5	19.4	195.0	1.0	4.8	0	18.3	0.1	0
305	Feature4	-	31.0	5.0	6.0	9.5	15.5	222.0	1.5	5.7	0	1.7	0.2	0
236	Feature4	-	37.6	53.5	11.0	12.0	15.0	298.0	1.4	11.7	0	4.5	0.1	0
116	Feature4	-	39.0	20.4	9.0	13.6	10.0	310.0	2.0	0	0	0	0.6	0
268	Feature5	-	2.3	40.8	6.9	11.9	11.7	92.4	2.1	0	0.8	0	0	0
272	Feature5	-	7.4	32.6	3.5	5.3	4.4	149.0	0.4	0	0	0	0.4	0
259	Feature5	-	29.8	22.6	4.8	12.2	14.6	210.0	1.6	0	0	0	0	0
261	Feature5	-	48.9	0	4.3	18.2	22.2	233.0	1.9	0.9	5.1	0	0	0
266	Feature5	-	51.1	41.0	9.3	12.8	41.2	253.0	4.0	0	4.0	0	0	0
313	Feature6	-	0	6.6	2.9	9.4	5.5	18.1	0.5	0	0	0	0.1	0
126	Feature6	-	0	12.8	4.6	4.5	3.2	41.3	0.3	0	0	0	0	0
154	Feature6	-	2.4	10.4	3.5	10.1	8.6	41.9	0.6	3.9	9.4	0	0	0
152	Feature6	-	2.4	13.3	3.1	16.1	12.9	172.0	0.2	0.9	2.6	0	0	0
289	Feature6	-	2.4	15.4	4.3	9.2	6.3	192.0	1.1	0.3	3.2	0	0.1	0
164	Feature6	-	3.1	14.3	3.4	3.5	7.1	93.3	1.1	0	1.2	0	1.5	0
125	Feature6	-	3.3	9.5	4.7	11.7	4.3	98.3	0.1	1.4	3.3	0	0	0
151	Feature6	-	3.6	5.3	2.7	5.7	4.5	19.3	0.2	5.2	0.8	0	0	0
292	Feature6	-	3.7	6.3	5.2	9.3	4.7	26.7	0.7	0	0.9	0	0	0
150	Feature6	-	3.7	10.9	6.2	8.6	18.7	329.0	0.2	1.2	1.6	0	0	0
122	Feature6	-	3.8	9.7	13.9	14.7	4.7	189.0	0.3	1.5	7.3	0	0	0
132	Feature6	-	4.6	8.4	5.2	11.8	4.5	8.1	0.2	0.2	1.9	0	0	0
131	Feature6	-	5.3	4.8	6.4	10.4	5.9	22.9	0.5	0.9	1.9	0	0	0
157	Feature6	-	5.4	19.3	5.4	6.1	7.3	55.6	0.3	3.8	2.4	0	0	0
293	Feature6	-	5.5	15.2	6.5	13.7	17.6	33.5	1.1	0.1	0.9	0	0.1	0
291	Feature6	-	5.8	15.6	4.1	9.8	10.8	90.3	1.7	0.7	10.8	0	0	0
160	Feature6	-	5.9	30.4	12.4	8.5	15.0	30.6	0.5	2.0	2.1	0	0	0
287	Feature6	-	5.9	52.2	4.3	13.4	10.3	27.4	1.4	2.3	5.6	0	0	0

295	Feature6	-	6.6	12.3	8.2	12.1	10.5	79.3	1.3	1.6	2.7	0	0.4	0
163	Feature6	-	6.7	19.4	6.1	17.2	17.7	34.9	1.3	0.9	3.2	0	0	0
145	Feature6	-	7.1	6.2	6.1	10.3	5.8	199.0	0.2	0.1	0.2	0	0	0
294	Feature6	-	8.4	12.3	3.4	9.4	11.4	50.7	2.3	0.2	2.3	0	0	0
311	Feature6	-	8.5	11.1	4.8	9.4	6.2	92.7	1.8	2.9	9.7	0	0.9	0
147	Feature6	-	8.5	11.6	6.6	13.3	6.9	325.0	0.3	1.3	3.8	0	0	0
315	Feature6	-	8.7	10.4	8.3	7.2	7.4	336.0	0.7	0	1.9	0	0.8	0
155	Feature6	-	8.9	20.6	10.3	8.1	6.2	35.7	0.8	1.2	0.7	0	5.8	0
156	Feature6	-	9.2	21.4	6.2	7.3	7.7	7.8	0.9	0.7	3.9	0	0	0
158	Feature6	-	10.9	19.8	6.1	9.7	9.3	68.1	1.4	1.6	2.6	0	0	0
149	Feature6	-	12.3	10.2	6.2	7.2	10.0	398.0	1.8	0.4	1.2	0	0	0
161	Feature6	-	12.3	10.4	6.6	12.7	10.9	46.3	1.1	8.2	6.1	0	0	0
129	Feature6	-	12.4	6.2	6.6	8.2	3.7	167.0	0.8	0.3	11.2	0	0	0
123	Feature6	-	13.2	13.9	5.3	7.4	7.7	200.0	0.1	3.4	2.6	0	0	0
148	Feature6	-	13.4	10.3	4.8	9.6	9.8	238.0	0.3	0	0.5	0	0	0
153	Feature6	-	13.5	12.2	8.4	9.2	7.8	124.0	1.4	2.8	3.1	0	0	0
128	Feature6	-	14.2	3.6	2.9	5.7	5.1	48.9	0.2	3.3	6.5	0	0	0
144	Feature6	-	14.8	23.1	5.7	9.9	11.2	158.0	0.3	0.3	2.4	0	0	0
290	Feature6	-	15.5	23.1	5.2	8.2	16.3	136.0	0.4	0.1	0.2	0	0	0
312	Feature6	-	18.2	4.2	6.3	18.2	9.3	160.0	0.7	0.6	1.7	0	0	0
314	Feature6	-	18.9	19.1	1.5	24.4	30.2	136.0	2.1	2.5	39.3	0	0	0
159	Feature6	-	19.5	14.6	5.5	8.4	10.3	190.0	0.9	1.6	1.5	0	0	0
165	Feature6	-	20.4	20.8	15.2	12.5	15.0	50.1	2.1	0.2	1.3	0	0	0
130	Feature6	-	20.5	8.1	7.1	12.3	3.1	264.5	0.7	0.8	1.6	0	0	0
146	Feature6	-	21.3	8.2	4.9	11.6	23.2	30.4	0.4	1.5	0.9	0	0	0
127	Feature6	-	22.1	13.9	6.8	7.9	13.1	75.7	0.7	0.3	6.1	0	0	0
296	Feature6	-	22.3	11.1	5.4	8.6	17.1	94.0	3.6	4.6	0.5	0	0	0
288	Feature6	-	26.7	11.3	4.9	12.7	11.4	172.0	0.6	2.3	3.5	0	0.1	0
297	Feature6	-	27.4	8.6	6.8	10.1	16.1	164.0	1.3	0.9	2.8	0	0.1	0
124	Feature6	-	38.1	10.9	5.3	12.9	2.9	170.0	0.4	1.2	7.3	0	0	0
162	Feature6	-	39.4	20.6	6.6	10.5	11.5	67.2	0.9	2.2	1.7	0	0	0
172	Feature7	1	0	0.6	0.8	0.9	2.5	5.2	0.1	0	0	0	0	0
283	Feature7	1	1.4	5.5	4.2	5.9	7.4	13.1	1.6	0	0	0	0	0
281	Feature7	1	2.1	3.7	7.8	7.5	9.3	11.1	0.4	1.4	0	0	0	0
319	Feature7	1	2.2	13.5	1.1	11.4	12.2	21.4	0.8	0	0	0	0	0
286	Feature7	1	3.4	5.5	4.7	7.9	6.3	16.4	0.9	0	0	0	0	0
282	Feature7	1	3.8	4.3	2.7	6.4	9.1	7.9	0.9	1.4	0	0	0	0
285	Feature7	1	3.9	9.1	4.3	5.2	4.3	8.5	1.5	0	0	0	0	0
284	Feature7	1	7.8	5.7	4.7	8.3	8.1	35.4	1.7	1.1	0	0	0	0
133	Feature7	1	12.1	4.1	3.4	3.1	8.1	27.0	0.4	1.2	0	0	0	0
280	Feature7	1	13.5	3.6	6.2	2.9	7.4	32.2	0.2	0	0	0	0	0
173	Feature7	2	0	2.4	0.9	1.2	6.3	0.6	0.8	0	0	0	0	0
137	Feature7	2	2.2	5.7	4.7	6.5	11.2	27.7	1.6	0	0	0	0	0
134	Feature7	2	3.1	6.0	6.2	7.1	12.8	29.6	1.3	1.7	0	0	0	0
138	Feature7	2	3.5	3.0	3.5	7.0	7.0	12.0	2.0	3.5	0	0	0	0
135	Feature7	2	3.8	7.2	8.4	7.1	11.1	48.2	0.6	0	0	0	0	0
136	Feature7	2	4.6	6.5	5.1	8.5	15.0	4.6	1.7	0	0	0	0	0
320	Feature7	2	4.8	7.2	5.5	10.5	11.2	17.4	1.4	1.9	0	0	0	0
141	Feature7	3	0	5.7	2.6	9.6	11.8	0	1.1	0	0	0	0	0
142	Feature7	3	0	10.0	5.1	11.7	10.7	15.5	1.8	0	0	0	0	0
321	Feature7	3	0.9	6.8	0.9	5.5	10.0	11.3	0.7	2.9	0	0	0	0
174	Feature7	3	1.6	2.4	0.5	0.2	1.1	0	0.3	0	0	0	0	0
167	Feature7	3	3.6	4.4	2.5	6.9	5.6	8.2	0.5	0	0	0	0	0
139	Feature7	3	4.3	9.2	3.7	7.2	5.5	11.7	1.6	0	0	0	0	0
143	Feature7	3	5.9	8.2	5.7	5.3	7.0	16.6	0.9	0	0	0	0	0
166	Feature7	3	6.0	6.0	3.0	8.5	7.0	26.0	0.2	1.0	0	0	0	0
140	Feature7	3	8.6	4.3	5.4	4.2	3.1	14.1	1.4	0	0	0	0	0

171	Feature7	4	0	9.7	3.1	4.5	9.2	20.5	1.4	0.7	0	0	0	0
176	Feature7	4	0.9	19.5	4.3	8.1	10.2	0	0.9	0	8.4	0	0	0
322	Feature7	4	1.2	7.6	2.4	6.2	8.9	2.3	0.4	1.7	0	0	0	0
175	Feature7	4	4.9	18.6	4.4	17.3	3.6	6.2	1.5	0	0	0	0	0
168	Feature7	4	5.0	6.0	6.0	9.0	13.0	6.0	2.0	6.0	1.5	0	0	0
170	Feature7	4	5.3	8.1	4.1	5.5	3.9	5.1	1.7	4.4	0	0	0	0
169	Feature7	4	6.1	9.2	2.4	12.3	4.3	9.0	2.9	0	0	0	0	0
199	Feature7	4	7.1	13.1	10.4	2.4	8.1	12.8	1.5	0	0	0	0	0
200	Feature7	4	12.7	22.2	5.1	9.4	10.4	22.1	1.1	1.1	4.0	0	0	0
203	Feature7	5	2.0	15.5	3.0	11.0	12.5	14.0	2.0	0.5	3.0	0	0	0
204	Feature7	5	3.7	12.4	3.3	11.1	14.8	6.1	4.3	0	0	0	0	0
323	Feature7	5	3.9	10.4	0.7	8.7	2.5	3.5	1.4	0	0	0	0	0
201	Feature7	5	6.1	17.2	4.4	16.4	34.8	8.0	2.1	0	0	0	0	0
202	Feature7	5	14.0	13.1	4.2	10.0	15.4	17.2	2.4	0.9	1.3	0	0	0
207	Feature7	6	1.6	15.5	4.7	24.9	18.2	26.6	0.5	0.4	0.5	0	0	0
206	Feature7	6	1.9	12.1	3.6	16.8	20.4	38.6	2.3	2.5	18.4	0	0.2	0
205	Feature7	6	3.0	14.5	4.0	12.0	8.0	19.0	4.0	0	0	0	0	0
208	Feature7	6	6.1	5.8	1.8	10.3	4.2	14.7	1.8	0.2	0	0	0	0
209	Feature7	7	1.0	15.0	9.0	13.0	13.9	382.0	2.0	5.4	0	0	0	0
263	Feature7	7	1.2	2.3	0.7	2.0	1.6	8.5	0.4	0	0	0	0	0
223	Feature7	7	1.8	2.3	1.4	4.7	3.9	2.1	0.7	0.1	6.6	0	0	0
279	Feature7	8	0	2.9	2.7	1.6	4.1	51.4	0.5	0	0	0	0	0
278	Feature7	8	3.8	12.0	7.9	13.0	20.5	104.3	1.0	1.9	0	0	0	0
277	Feature7	8	12.9	4.4	6.3	10.1	4.6	1.2	65.4	0	0	0	0	0
265	Feature8	-	0.5	8.6	1.4	7.4	8.1	259.0	0.6	1.4	0	0	0	0
262	Feature8	-	4.0	4.8	4.5	7.3	107.3	30.0	2.2	3.6	0	0	0	0
310	Feature8	-	19.1	5.0	3.2	12.7	12.8	751.0	1.4	0.6	0	0	0	0
267	Feature9	-	0	7.0	1.3	5.5	12.4	119.0	1.1	0	0	15.3	0	0
257	Feature9	-	0	45.0	0	20.0	30.0	232.0	2.0	0	0	0	0	0
273	Feature9	-	5.1	9.1	4.4	4.2	5.0	30.5	0	0	0	0	0	0
264	Feature9	-	8.2	15.0	11.2	4.1	35.6	31.4	1.8	0	0	43.1	0	0
260	Feature9	-	8.9	10.0	3.1	9.3	25.2	58.8	0	0	0	74.8	0	0

APPENDIX 2

RADIOCARBON DATES FROM THE QUARRY CREEK SITE:
CALIBRATION DATA
FROM CALIB 3.0.3 PROGRAM

UNIVERSITY OF WASHINGTON
QUATERNARY ISOTOPE LAB
RADIOCARBON CALIBRATION PROGRAM REV 3.0.3
Stuiver, M. and Reimer, P.J., 1993, Radiocarbon, 35, p. 215-230.

Calibration file(s): INTCAL93.14C
Listing file: C14FIL.TXT

Beta-47827Feature 4

Radiocarbon Age BP 1590 þ 90 Reference(s)
Calibrated age(s) cal AD 445 (Stuiver and Pearson, 1993)

cal AD/BC age ranges obtained from intercepts (Method A):
one Sigma** cal AD 397 - 596
two Sigma** cal AD 252 - 305 313 - 652

Summary of above:

minimum of cal age ranges (cal ages) maximum of cal age ranges:
1Í cal AD 397 (445) 596
2Í cal AD 252 (445) 652

Beta-47828Feature 5

Radiocarbon Age BP 1650 þ 80 Reference(s)
Calibrated age(s) cal AD 415 (Stuiver and Pearson, 1993)

cal AD/BC age ranges obtained from intercepts (Method A):
one Sigma** cal AD 267 - 275 334 - 535
two Sigma** cal AD 234 - 601

Summary of above:

minimum of cal age ranges (cal ages) maximum of cal age ranges:
1Í cal AD 267 (415) 535
2Í cal AD 234 (415) 601

Beta-47829Feature 6

Radiocarbon Age BP 1580 þ 80 Reference(s)
Calibrated age(s) cal AD 459, 478, 510 (Stuiver and Pearson, 1993)
531

cal AD/BC age ranges obtained from intercepts (Method A):
one Sigma** cal AD 411 - 596
two Sigma** cal AD 263 - 283 327 - 648

Summary of above:

minimum of cal age ranges (cal ages) maximum of cal age ranges:
1Í cal AD 411 (459, 478, 510, 531) 596
2Í cal AD 263 (459, 478, 510, 531) 648

Beta-47830Feature 7

Radiocarbon Age BP 1780 þ 60 | Reference(s)
Calibrated age(s) cal AD 249 | (Stuiver and Pearson, 1993)

cal AD/BC age ranges obtained from intercepts (Method A):
one Sigma** cal AD 214 - 342
two Sigma** cal AD 118 - 413

Summary of above:

minimum of cal age ranges (cal ages) maximum of cal age ranges:
1Í cal AD 214 (249) 342
2Í cal AD 118 (249) 413

References for datasets used:
Stuiver, M and Pearson, GW, 1993, Radiocarbon, 35, 1-23.

Comments:
éThis standard deviation (error) includes a lab error multiplier.
** 1 sigma = square root of (sample std. dev.»+ curve std. dev.»)
2 sigma = 2 x square root of (sample std. dev.»+ curve std. dev.»)
[ ] = calibrated with linear extension to calibration curve
0* represents a "negative" age BP
1955* denotes influence of bomb C-14
For cal yrs between 5500-5190 BC an offset of 25 years is possible.
NOTE: Cal ages and ranges are rounded to the nearest year which may be too precise in many instances. Users are advised to round results to the nearest 10 yr for samples with standard deviation in the radiocarbon age greater than 50 yr.

APPENDIX 3

ON THE USE OF SIMULTANEOUS REFERENCES READINGS WHEN CONDUCTING A MAGNETIC SURVEY

John W. Weymouth

ON THE USE OF SIMULTANEOUS REFERENCES READINGS WHEN CONDUCTING A MAGNETIC SURVEY

A magnetic survey was carried out as part of the investigation of the Quarry Creek Site (14LV401) conducted by the Kansas Archaeological Summer Field School. The survey was carried out on June 4 and 5, 1991. All reference readings were taken at the same time as the moving or grid values. The students who were recording the data observed that the reference values were changing quite a bit. After the survey it was established that the geomagnetic field was stormy during those two days. In spite of the storms, data results were very good.

The survey was done with two geometric G-816 magnetometers with a sensitivity of 1/4 nT, the reference magnetometer fired at all times simultaneously with the moving magnetometer. All values were hand recorded. The time at the start of each row was recorded. On June 4 two 20mx20m blocks (A and B) were surveyed. On June 5 one 20x10 block (C), one 10x10 block (D) and one 10x10 block (E) were surveyed.

Figures 1, 2 and 3 are from NOAA-SESC Preliminary Report and Forecast of Solar Geophysical Data, 16 July 1991 and contain information on the magnetic stormy conditions. The K-indices of Fredericksburg for the dates are important. Values of 6 and 7 are "stormy".

Figures 4 through 8 are plots of the reference readings. Times are in hours and decimal parts of hours, CDT. Magnetic values are in nT with an offset of 55,000 nT. Since the times were only recorded at the beginning of each row, the times of subsequent values in each row were estimated by using a reasonable time interval of 10 seconds between measurements.

In general none of the maps in this report display any linear false anomalies that would arise if the reference readings were incorrect. It would have been difficult to obtain correct reference readings using periodic base station readings and linear (or other) interpolation, particularly e. g. 6/4:10.60, 6/4:13.70, or 6/5:9.50.

Highlights of Solar and Geomagnetic Activity
03 - 09 June 1991

Solar activity was predominantly moderate to high. The only day of low activity was 08 June when the largest event was a C5/SF from Region 6659 (N31, L=248, class/area, Ekc/2230 on 08 June). As suggested last week, this region did continue its major flare production, adding two X12's and an X10 to last week's X12. The first X12 this week was an X12/3B at 04/0352UT which saturated the GOES satellite X-ray sensors from 0342-0401UT. The second was an X12/4B at 06/0108UT. This flare saturated the sensors from 0105- 0131UT. The final major flare was an X10/3B at 09/0143UT. All three of these flares were huge Tenflares, (up to 55,000 sfu from the 06 X12 flare) and each was associated with strong type II and IV radio sweeps. The X10 was the only one that was not of long duration. In addition to these three major flares, Region 6659 produced seven M-class flares, including a long duration M4/3B Tenflare at 07/0143UT. Although not the only region to produce flares which have saturated the GOES X-ray sensors this solar cycle, Region 6659 is the first to have produced three such events. There were 10 other M-class flares this week, five of these were from Region 6666 (S17, L=241, class/area, Cki/360 on 06 June) including an M4/1N at 05/0203UT.

The proton event which began on 30 May ended at 03/1235UT after a maximum of 22 pfu at 01/0445UT. A second proton event began at 04/0820UT in response to the earlier X12. An increase to 94 pfu was observed corresponding to a sudden commencement. (details below) A second increase to 130 pfu was observed at 06/1045UT in response to the X12 early on the 6th. This event reached a maximum flux of 220 pfu at 07/0415UT. The event began a slow decline thereafter but remained in progress throughout the period.

The geomagnetic field ranged from unsettled to severe storm levels. The field was unsettled until 04/1400UT, when a sudden commencement was recorded at a number of magnetic observatories. The GOES 6 and 7 spacecraft experienced magnetopause crossings from about 04/1715-1800UT due to this disturbance. The storming reached severe levels around 0600UT on 05 June and continued into 06 June. This activity resulted in a daily magnetic index second only to the March 1989 activity. A Forbush decrease of less than 10 percent and a polar cap absorption of about 5db was associated with this storming. A sudden impulse of 88 nanoteslas (measured at Boulder) at 07/2225UT is believed to be in response to the X12 of 06 June. The heightened activity anticipated to follow this impulse failed to materialize. Activity levels were at minor to major storm levels when a sudden impulse of 114 nanoteslas (measured at Boulder) at 09/0400UT was observed. This sudden impulse in believed in response to the long duration M4 from Region 6659 on 07 June.

Figure A3-1

Daily Solar Data

Date	Radio Flux 10.7 cm	Sun-spot No.	Sunspot Area (10^{-6} hemi.)	X-ray Background Flux	Flares X-ray C	Flares X-ray M	Flares X-ray X	Flares Optical S	Flares Optical 1	Flares Optical 2	Flares Optical 3	Flares Optical 4
03 June	220	231	2550	C1.1	11	1	0	8	1	0	0	0
04 June	239	261	3270	C1.6	13	2	1	13	1	0	1	0
05 June	251	235	3300	C1.5	13	3	0	19	2	0	0	0
06 June	240	243	3370	C1.7	4	4	1	15	6	1	0	1
07 June	230	227	2900	C1.6	5	3	0	16	3	0	1	0
08 June	243	304	3080	C1.3	11	0	0	11	0	0	0	0
09 June	238	295	3090	C1.6	7	4	1	16	2	0	1	0

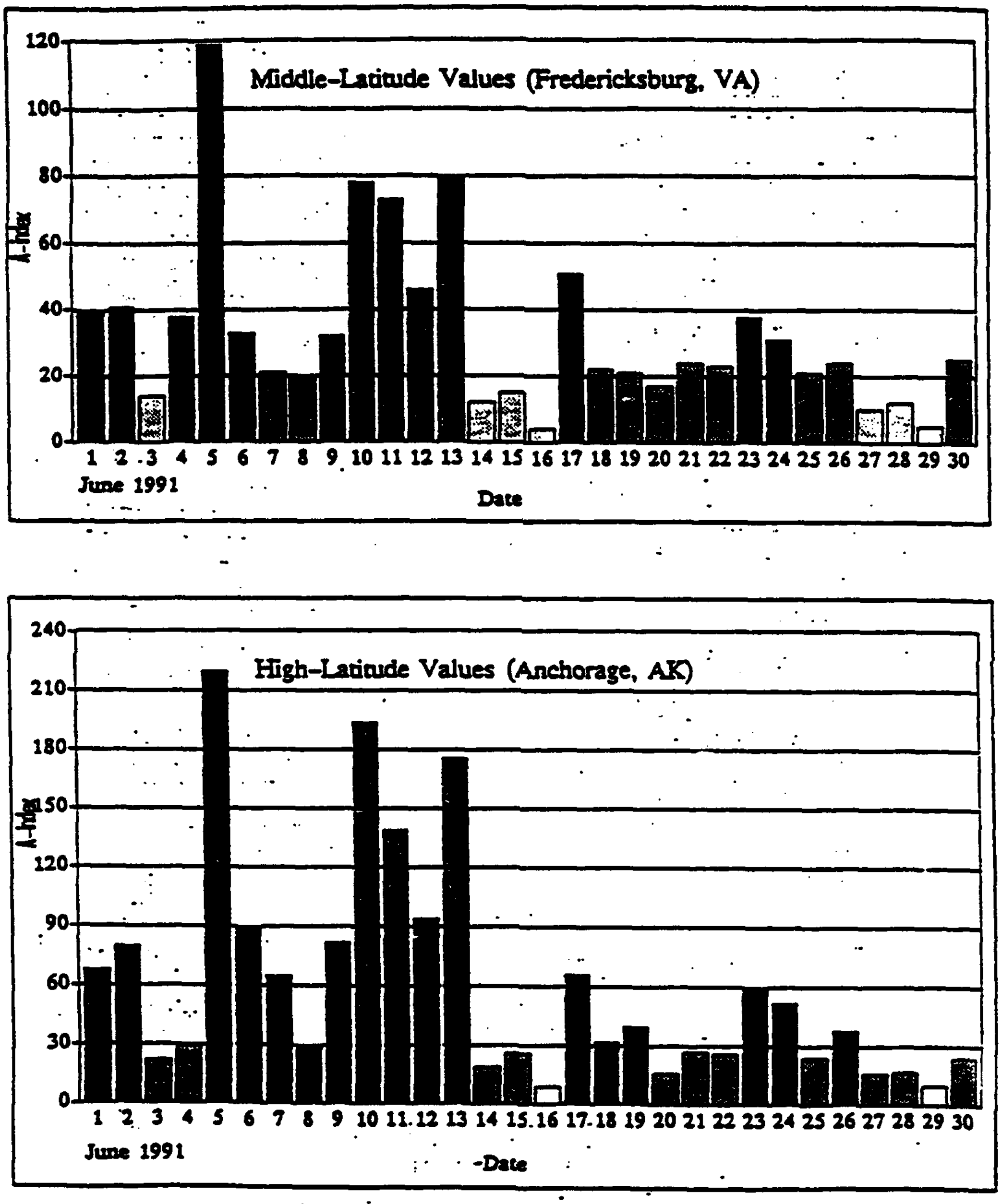
Daily Particle Data

Date	Proton Fluence (protons/cm^2-day-sr) >1Mev	>10Mev	>100Mev	Electron Fluence (electrons/cm^2-day-sr) >2Mev
03 June	3.8E+7	8.6E+5	5.8E+3	3.9E+7
04 June	1.4E+8	1.4E+6	2.1E+4	6.6E+7
05 June	5.8E+7	3.0E+6	1.5E+5	4.0E+7
06 June	9.7E+7	8.4E+6	1.6E+5	1.1E+8
07 June	1.6E+8	1.5E+7	3.4E+5	1.9E+8
08 June	2.1E+8	1.3E+7	3.2E+5	1.7E+8
09 June	1.4E+8	6.7E+6	1.1E+5	8.2E+7

Daily Geomagnetic Data

Date	Middle Latitude Fredericksburg A	K-indices	High Latitude Anchorage A	K-indices	Estimated Planetary A	K-indices
03 June	14	3-2-4-2-2-2-4-3	22	3-4-5-3-3-3-4-3	19	3-3-5-3-3-3-4-3
04 June	38	2-2-2-3-4-6-6-6	29	2-3-2-3-3-6-5-5	45	2-2-2-2-4-7-6-5
05 June	119	5-6-7-6-7-8-6-7	220	6-8-8-8-8-9-8-6	150	5-8-8-7-6-8-7-7
06 June	33	5-6-4-5-3-3-2-4	90	8-6-7-7-6-3-3-3	50	5-7-6-5-3-3-2-3
07 June	21	3-3-4-3-3-3-3-5	65	4-6-8-6-4-4-3-4	34	3-5-6-4-3-3-3-4
08 June	20	3-3-2-3-4-4-4-4	30	4-3-3-3-3-6-5-4	26	3-3-3-3-4-5-5-4
09 June	32	6-4-3-3-3-5-4-4	82	7-6-6-6-5-6-7-3	44	6-5-4-4-4-5-5-4

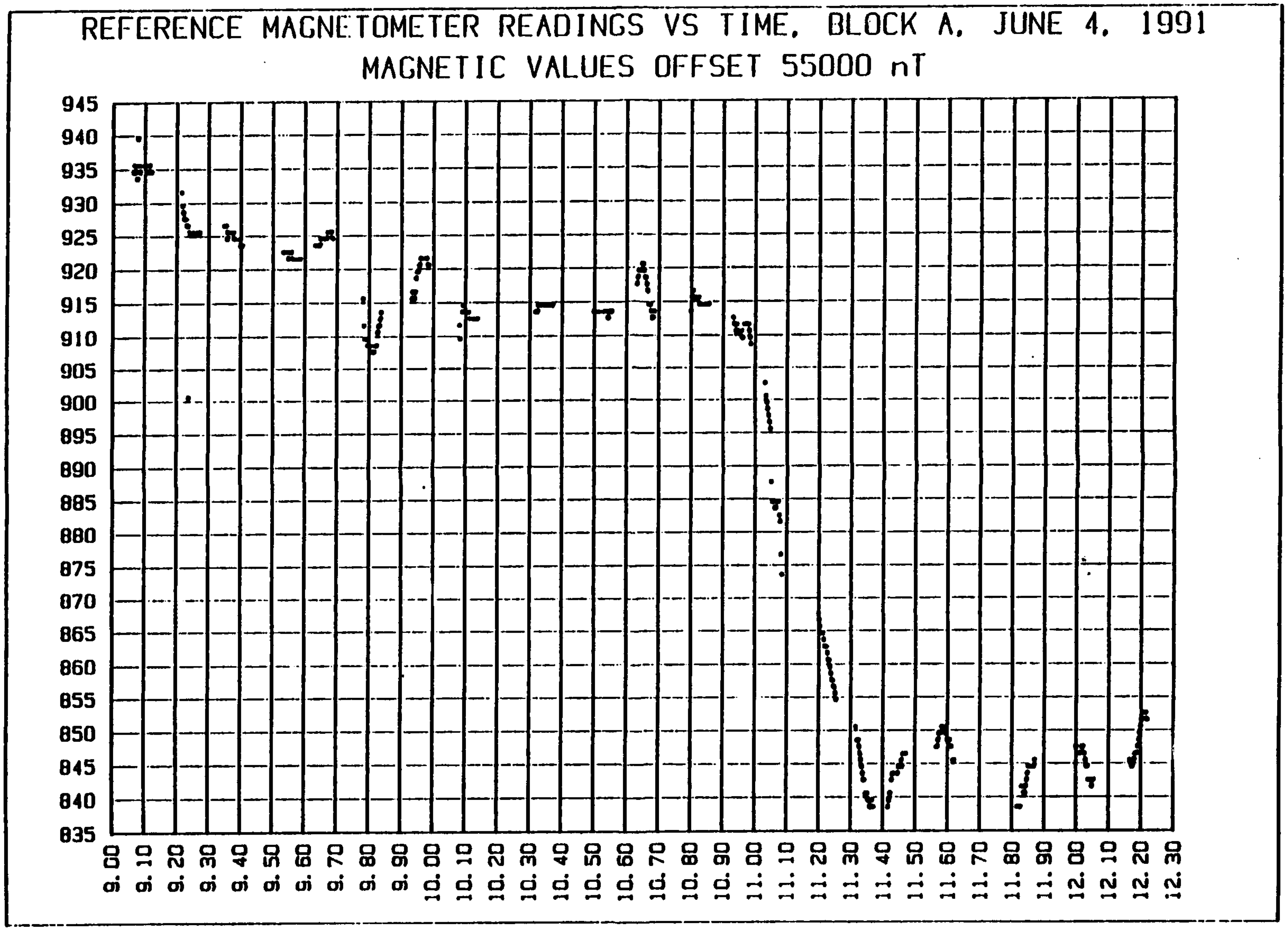
Figure A3-2



Daily Geomagnetic A-Index Values from Fredericksburg, VA, and Anchorage, AK

Values of $0 \leq A < 16$ indicate quiet or unsettled conditions, $16 \leq A < 30$ active, $A \geq 30$, geomagnetic storm conditions.

Figure A3-3



REFERENCE MAGNETOMETER READINGS VS TIME, BLOCK A, JUNE 4, 1991
MAGNETIC VALUES OFFSET 55000 nT
945
940
935
930
925
920
915
910
905
900
895
890
885
880
875
870
865
860
855
850
845
840
835
9.00 9.10 9.20 9.30 9.40 9.50 9.60 9.70 9.80 9.90 10.00 10.10 10.20 10.30 10.40 10.50 10.60 10.70 10.80 10.90 11.00 11.10 11.20 11.30 11.40 11.50 11.60 11.70 11.80 11.90 12.00 12.10 12.20 12.30

Figure A3-4

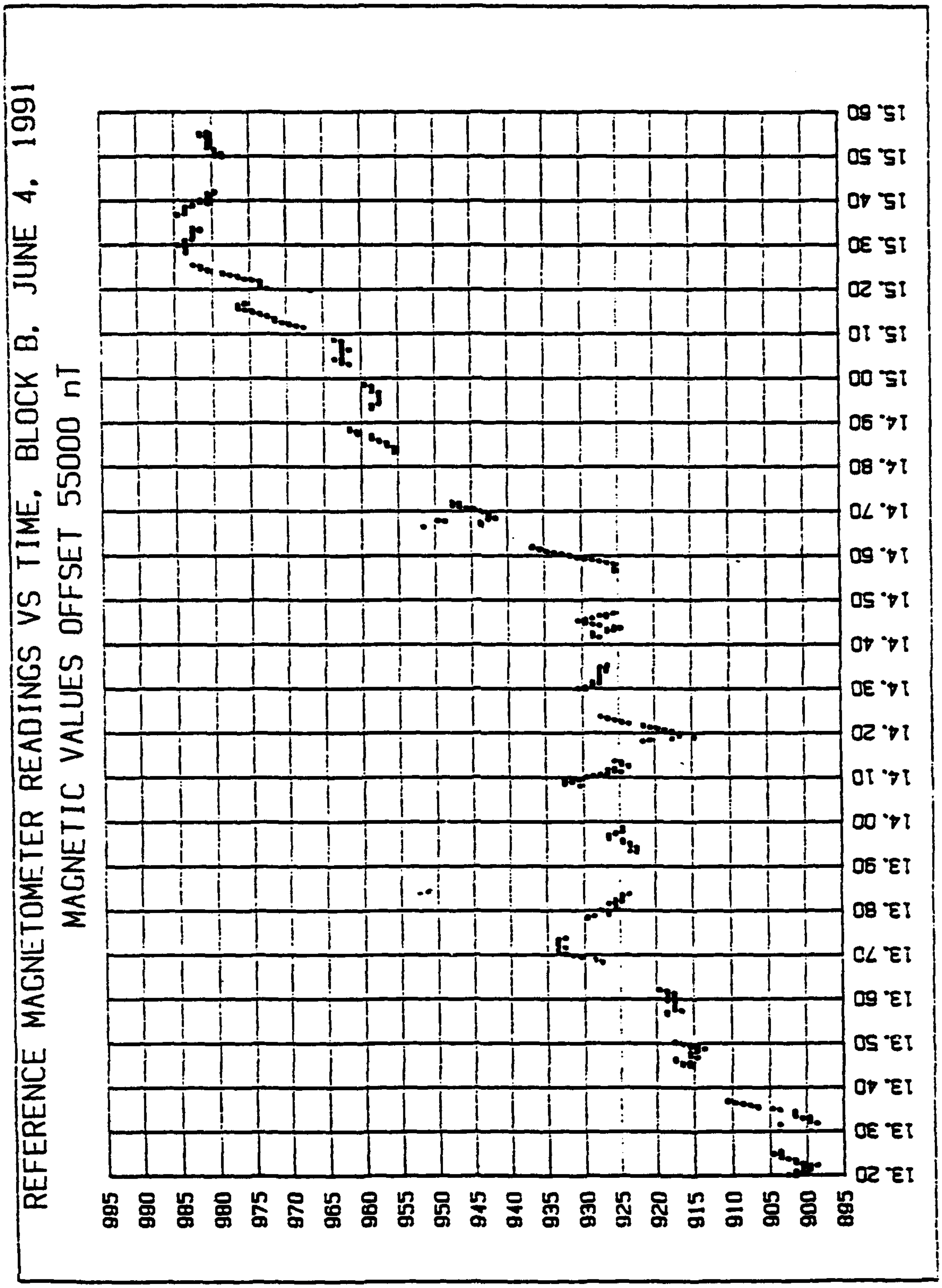

REFERENCE MAGNETOMETER READINGS VS TIME, BLOCK B, JUNE 4, 1991
MAGNETIC VALUES OFFSET 55000 nT
995
990
985
980
975
970
965
960
955
950
945
940
935
930
925
920
915
910
905
900
895
13.20
13.30
13.40
13.50
13.60
13.70
13.80
13.90
14.00
14.10
14.20
14.30
14.40
14.50
14.60
14.70
14.80
14.90
15.00
15.10
15.20
15.30
15.40
15.50
15.60

Figure A3-5

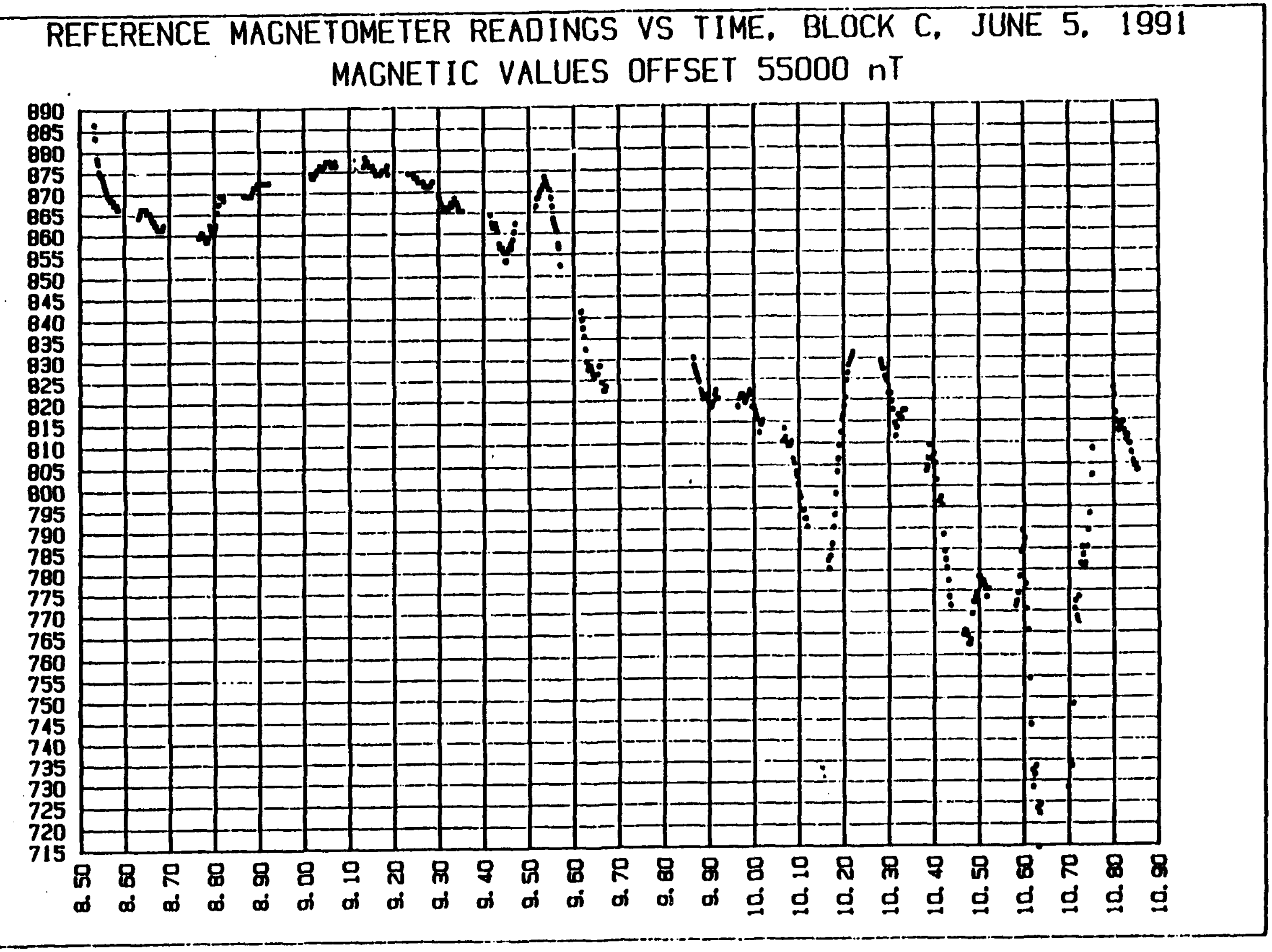

REFERENCE MAGNETOMETER READINGS VS TIME, BLOCK C, JUNE 5, 1991
MAGNETIC VALUES OFFSET 55000 nT
890
885
880
875
870
865
860
855
850
845
840
835
830
825
820
815
810
805
800
795
790
785
780
775
770
765
760
755
750
745
740
735
730
725
720
715
8.50
8.60
8.70
8.80
8.90
9.00
9.10
9.20
9.30
9.40
9.50
9.60
9.70
9.80
9.90
10.00
10.10
10.20
10.30
10.40
10.50
10.60
10.70
10.80
10.90

Figure A3-6

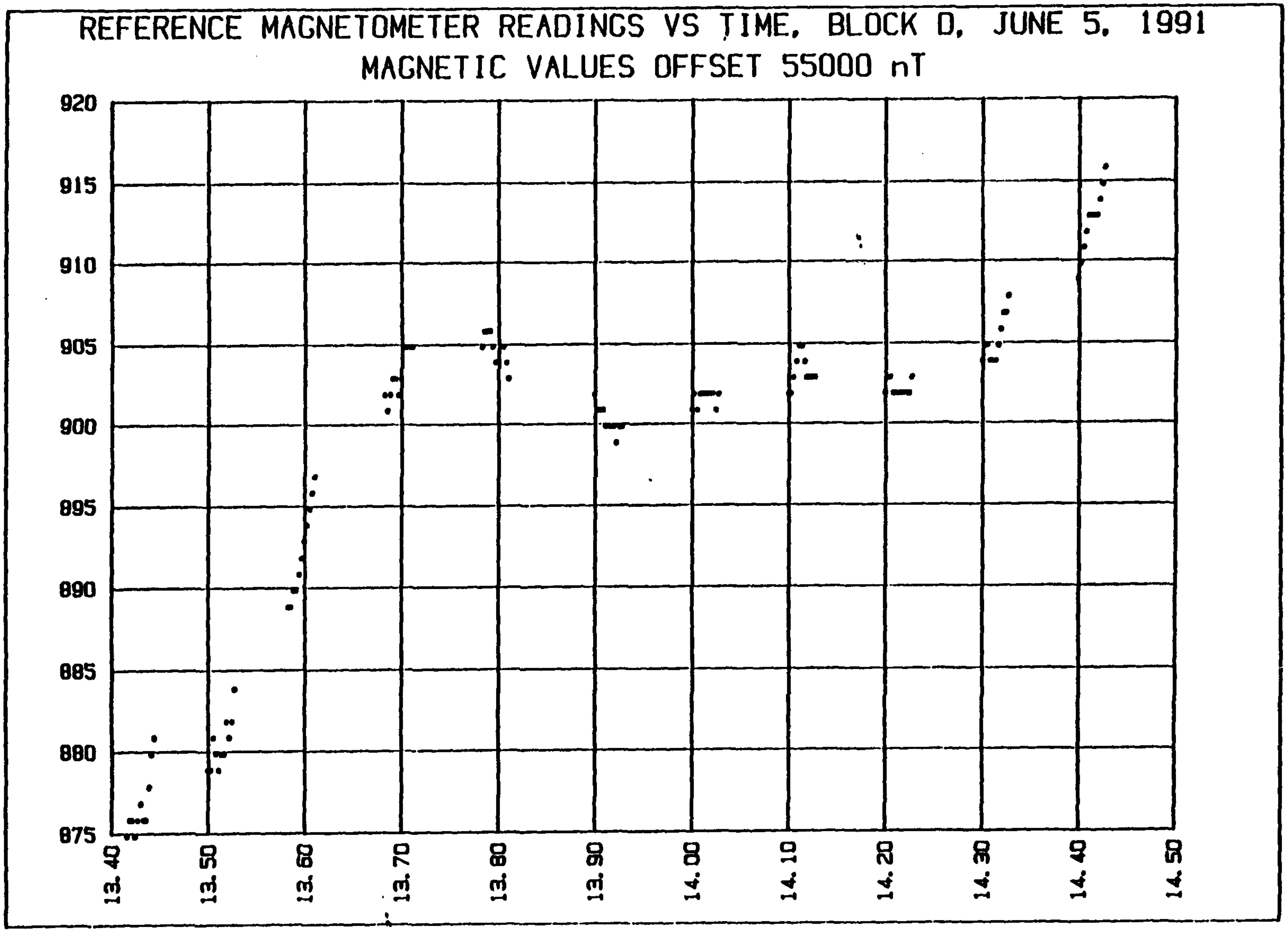

REFERENCE MAGNETOMETER READINGS VS TIME, BLOCK D, JUNE 5, 1991
MAGNETIC VALUES OFFSET 55000 nT
920
915
910
905
900
895
890
885
880
875
13.40
13.50
13.60
13.70
13.80
13.90
14.00
14.10
14.20
14.30
14.40
14.50

Figure A3-7

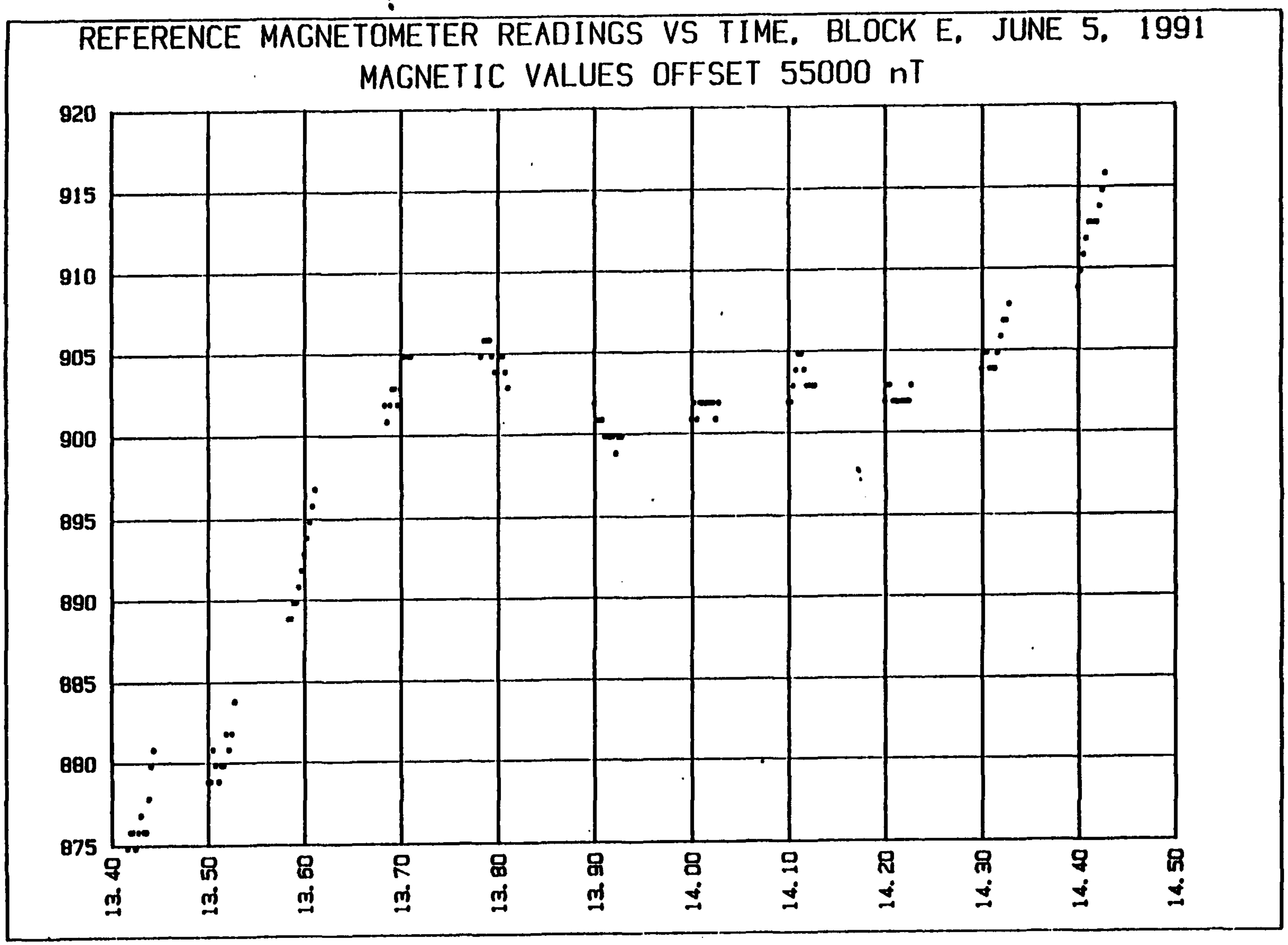

REFERENCE MAGNETOMETER READINGS VS TIME, BLOCK E, JUNE 5, 1991
MAGNETIC VALUES OFFSET 55000 nT
920
915
910
905
900
895
890
885
880
875
13.40
13.50
13.60
13.70
13.80
13.90
14.00
14.10
14.20
14.30
14.40
14.50

Figure A3-8

APPENDIX 4

METRIC AND NON-METRIC DATA OF FORMAL CHIPPED STONE TOOLS FROM THE QUARRY CREEK SITE

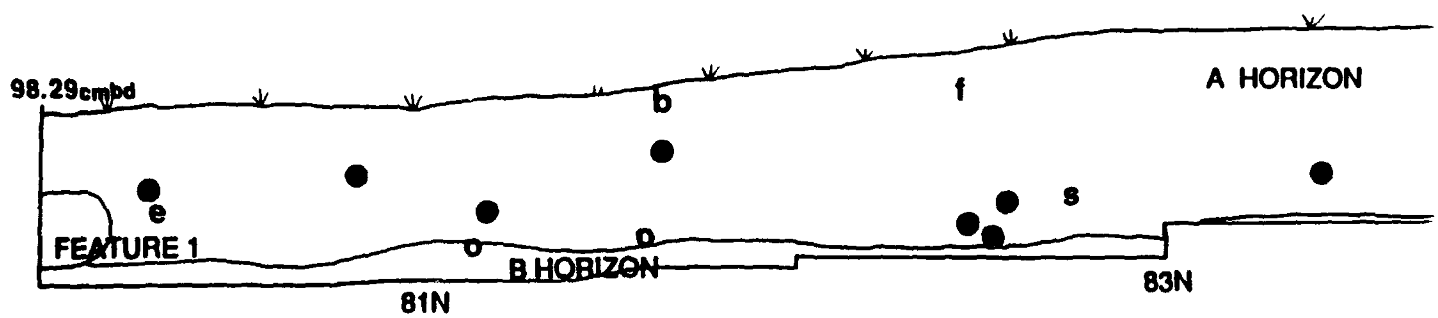
METRIC AND NON-METRIC DATA OF FORMAL CHIPPED STONE TOOLS

CAT.NO.	TYPE	L	W	T		WT	CHERT TYPE	REMARKS
A4168-91	BIFACE	43.95	35.73	14.33	--	21	GRAYFOSSIL	--
A4071-91	BIFACE	55.38	40.13	17.41	--	42	GRAYFOSSIL	--
A4263-91	BIFACE	57.37	38.40	18.92	--	40	NONLOCAL	WITHCORTEX
A4356-91	BIFACE	34.73	27.10	11.67	--	11	TANWITHFOSL	--
A3256-91	BIFACEBLANK	63.53	26.69	14.80	--	48	BROWN/BUFF	HEATREATED
A2666-91	BIFACEBLANK	48.03	20.96	9.69	--	11	BROWN/BUFF	LANCEOLATEFORM
A4303-91	BIFACEBLANK	77.52	38.69	28.10	--	72	GRAYFOSSIL	CRUDE
A4024-91	BIFACEBLANK	56.73	25.74	12.19	--	18	GRAYFOSSIL	--
A3946-91	BIFACEFRAGMENT	23.32	18.55	6.94	--	2	BROWN/BUFF	HEATREATED
A3921-91	BIFACEFRAGMENT	43.38	16.71	6.61	--	5	BROWN/BUFF	HEATREATED
A4353-91	BIFACEFRAGMENT	15.93	13.70	6.27	--	1	BROWN/BUFF	HEATREATEDTIP
A0725-91	BIFACEFRAGMENT	21.65	19.49	7.82	--	5	BROWN/BUFF	MIDSECTION
A1395-91	BIFACEFRAGMENT	30.30	36.16	14.13	--	14	BROWN/BUFF	MIDSECTION
A3855-91	BIFACEFRAGMENT	34.51	35.12	8.25	--	11	BROWN/BUFF	SCRAPER?
A0757-91	BIFACEFRAGMENT	17.01	20.94	4.67	--	1	BROWN/BUFF	SIDENOTCHED
A1379-91	BIFACEFRAGMENT	34.82	7.53	6.13	--	2	BROWN/BUFF	UNIDEN
A4302-91	BIFACEFRAGMENT	31.92	27.68	8.63	--	9	BROWN/BUFF	--
A4151-91	BIFACEFRAGMENT	35.28	27.71	7.42	--	8	GRAYFOSSIL	MIDSECTION
A2151-91	BIFACEFRAGMENT	26.09	18.80	6.46	--	3	GRAYFOSSIL	TIP
A2637-91	BIFACEFRAGMENT	29.21	26.53	9.09	--	4	GRAYFOSSIL	TIP
A2973-91	BIFACEFRAGMENT	35.48	30.73	8.87	--	9	GRAYFOSSIL	TIP
A3983-91	BIFACEFRAGMENT	36.06	30.72	8.12	--	7	GRAYFOSSIL	TIP
A4305-91	BIFACEFRAGMENT	40.00	26.46	6.45	--	7	GRAYFOSSIL	TIP
A4300-91	BIFACEFRAGMENT	41.84	30.97	11.62	--	14	GRAYFOSSIL	TIP
A4265-91	BIFACEFRAGMENT	30.37	33.12	11.62	--	13	GRAYFOSSIL	WITHCORTEX
A1608-91	BIFACEFRAGMENT	20.42	30.54	11.08	--	5	GRAYFOSSIL	--
A3874-91	BIFACEFRAGMENT	21.85	34.84	9.32	--	6	GRAYFOSSIL	--
A2729-91	BIFACEFRAGMENT	26.26	50.36	20.89	--	29	GRAYFOSSIL	--
A1091-91	BIFACEFRAGMENT	27.10	21.97	8.83	--	4	GRAYNOFOSL	UNIDEN
A3439-91	BIFACEFRAGMENT	34.59	63.60	11.64	--	33	NONLOCAL	AXEFRAG?
A0726-91	BIFACEFRAGMENT	15.20	12.42	5.52	--	1	NONLOCAL	HEATREATED
A3819-91	BIFACEFRAGMENT	25.60	27.25	7.73	--	6	NONLOCAL	MIDSECTION
A1859-91	BIFACEFRAGMENT	16.20	18.27	5.02	--	1	NONLOCAL	TIP
A4182-91	BIFACEFRAGMENT	36.74	30.04	7.60	--	6	NONLOCAL	TIP
A4269-91	BIFACEFRAGMENT	37.00	29.18	6.79	--	6	NONLOCAL	TIP
A0745-91	BIFACEFRAGMENT	42.48	18.35	7.82	--	5	NONLOCAL	TIP
A4110-91	BIFACEFRAGMENT	70.33	21.24	8.62	--	12	NONLOCAL	?
A3506-91	BIFACEFRAGMENT	12.07	27.25	5.84	--	3	NONLOCAL	--
A4293-91	BIFACEFRAGMENT	25.27	19.69	6.09	--	3	NONLOCAL	--
A3749-91	BIFACEFRAGMENT	39.54	42.87	11.03	--	19	NONLOCAL	--
A2289-91	BIFACEFRAGMENT	7.23	13.11	5.56	--	1	NONLOCAL?	--
A1831-91	BIFACEFRAGMENT	32.85	29.99	6.75	--	6	PERMIAN?	TIP
A1335-91	BIFACEFRAGMENT	15.08	25.78	8.89	--	4	PINKWHITE	UNIDEN
A1571-91	BIFACEFRAGMENT	15.54	26.68	5.72	--	2	TANWITHFOSL	HEATREATED
A2901-91	BIFACEFRAGMENT	40.13	22.86	14.70	--	13	TANWITHFOSL	HEATREATED?
A1654-91	BIFACESCRAPER	45.83	34.51	12.47	--	18	GRAYFOSSIL	BLOCKYEND
A1394-91	BIFACESCRAPER	66.39	41.37	9.15	--	31	GRAYFOSSIL	BLOCKYEND
A4326-91	BIFACESCRAPER	44.29	35.01	12.02	--	23	GRAYFOSSIL	--
A4212-91	BIFACESCRAPER	52.28	41.89	20.32	--	37	GRAYFOSSIL	--

L= Length; W= Width; T=Thickness; NOTCH W= Notch Width; WT= Weight (gms)

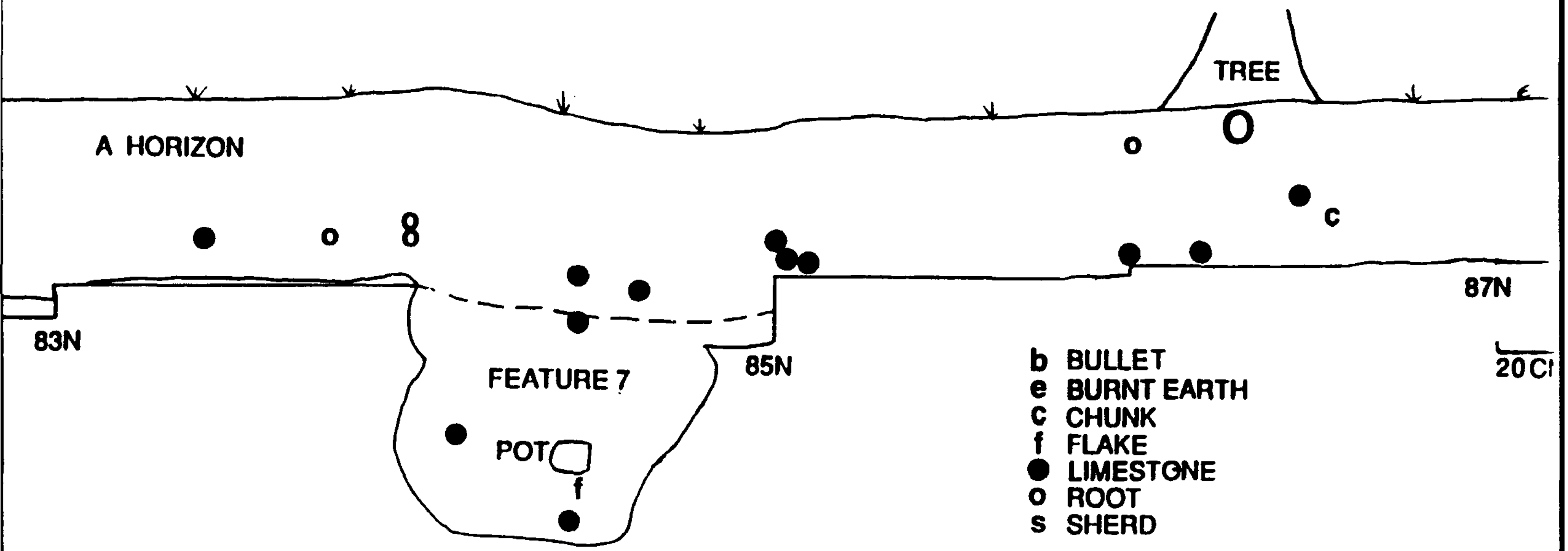
CAT.NO.	TYPE	L	W	T	NOTCH W	WT	CHERT TYPE	REMARKS
A4079-91	BIFACESCRAPER	52.85	26.97	8.73	--	11	GRAYFOSSIL	--
A3918-91	BIFACESCRAPER	60.29	32.02	16.58	--	39	GRAYFOSSIL	--
A2789-91	BIFACESCRAPER	19.51	49.42	9.10	--	9	NONLOCAL	--
A3601-91	BIFACESCRAPER	38.12	32.58	14.45	--	21	NONLOCAL	--
A3048-91	BIFACESCRAPER	45.60	36.70	13.46	--	26	NONLOCAL	--
A4156-91	BIFACESCRAPER	59.79	23.92	10.18	--	15	NONLOCAL	--
A4112-91	CIRCULARSCRAPER	39.12	--	14.31	--	26	BROWN/BUFF	HEATREATED
A3180-91	CIRCULARSCRAPER	37.33	34.03	18.08	--	24	GRAYFOSSIL	--
A4295-91	CIRCULARSCRAPER	42.57	40.43	21.76	--	29	GRAYFOSSIL	--
A4340-91	CIRCULARSCRAPER	33.80	29.62	16.25	--	22	GRAYWHITE	--
A4266-91	DRILL	35.39	9.93	6.50	--	2	BROWN/BUFF	TIP
A4354-91	DRILL	25.41	28.79	8.03	16.00	4	GRAYFOSSIL	BASE
A1818-91	DRILL	33.98	25.27	8.05	--	4	GRAYFOSSIL	BASEFRAG
A3463-91	DRILL	24.79	17.99	7.26	--	4	GRAYFOSSIL	--
A2850-91	DRILL	48.87	30.25	9.44	19.05	10	GRAYFOSSIL	--
A3391-91	PREFORM	43.30	23.05	5.99	--	6	BROWN/BUFF	HEATREATED
A4139-91	PREFORM	47.89	41.22	14.03	--	33	BROWN/BUFF	--
A4184-91	PREFORM	60.32	35.25	15.11	--	29	BROWN/BUFF	--
A4241-91	PREFORM	54.61	31.85	9.58	--	15	GRAYFOSSIL	--
A4235-91	PREFORM	44.53	36.30	10.21	--	19	NONLOCAL	HEATREATEDPLATS?
A4278-91	PREFORM	49.68	27.63	9.67	--	11	NONLOCAL	ONENOTCH
A1830-91	PROJECTILEPOINT	36.70	31.66	8.24	18.21	14	BROWN/BUFF	
A3309-91	PROJECTILEPOINT	36.95	29.69	6.89	--	10	BROWN/BUFF	
A1527-91	PROJECTILEPOINT	28.44	27.85	9.24	20.20	9	BROWN/BUFF	CONVEX EXPAND
A3559-91	PROJECTILEPOINT	64.89	24.64	8.63	17.22	12	BROWN/BUFF	CONVEX EXPAND
A4181-91	PROJECTILEPOINT	70.87	28.82	7.20	17.01	14	BROWN/BUFF	CONVEX EXPAND
A1655-91	PROJECTILEPOINT	39.19	31.75	14.17	24.62	17	BROWN/BUFF	SQUARESTEMMED
A2794-91	PROJECTILEPOINT	14.51	31.78	6.61	--	3	BROWN/BUFF	STRAIGHT EXP
A3111-91	PROJECTILEPOINT	48.09	29.60	7.92	20.91	13	BROWN/BUFF	STRAIGHT EXP
A4249-91	PROJECTILEPOINT	57.04	29.50	7.22	22.14	12	BROWN/BUFF	STRAIGHT EXP
A3520-91	PROJECTILEPOINT	58.92	29.93	8.64	21.20	14	BROWN/BUFF	STRAIGHT EXP
A4002-91	PROJECTILEPOINT	63.65	27.21	10.23	22.11	15	BROWN/BUFF	STRAIGHT EXP
A3860-91	PROJECTILEPOINT	22.25	25.84	7.12	16.89	4	GRAYFOSSIL	CONVEX EXPAND
A3748-91	PROJECTILEPOINT	40.51	26.47	9.24	21.92	12	GRAYFOSSIL	CONVEX EXPAND
A2189-91	PROJECTILEPOINT	43.15	21.38	7.55	16.68	7	GRAYFOSSIL	CONVEX EXPAND
A3521-91	PROJECTILEPOINT	53.84	21.45	8.29	15.81	10	GRAYFOSSIL	CONVEX EXPAND
A2305-91	PROJECTILEPOINT	54.29	30.93	7.03	19.34	13	GRAYFOSSIL	CONVEX EXPAND
A2728-91	PROJECTILEPOINT	61.86	25.26	9.84	18.84	13	GRAYFOSSIL	CONVEX EXPAND
A1486-91	PROJECTILEPOINT	65.53	25.73	10.55	--	16	GRAYFOSSIL	CONVEX EXPAND
A4135-91	PROJECTILEPOINT	71.86	29.34	8.73	19.79	16	GRAYFOSSIL	CONVEX EXPAND
A1989-91	PROJECTILEPOINT	75.50	32.70	10.68	17.64	22	GRAYFOSSIL	CONVEX EXPAND
A3982-91	PROJECTILEPOINT	33.46	21.46	7.02	--	4	GRAYFOSSIL	EXPAND STEMMED
A3945-91	PROJECTILEPOINT	36.05	29.97	10.27	18.46	11	GRAYFOSSIL	EXPAND STEMMED
A1972-91	PROJECTILEPOINT	37.37	24.23	7.46	--	4	GRAYFOSSIL	EXPSTEM HEATREATED
A3945-91	PROJECTILEPOINT	32.80	24.68	5.30	--	5	GRAYFOSSIL	STRAIGHT EXP
A3213-91	PROJECTILEPOINT	34.86	27.91	8.95	18.13	10	GRAYFOSSIL	STRAIGHT EXP
A2334-91	PROJECTILEPOINT	47.42	25.27	9.91	20.75	12	GRAYFOSSIL	STRAIGHT EXP
A4236-91	PROJECTILEPOINT	49.03	28.95	6.99	20.25	10	GRAYFOSSIL	STRAIGHT EXP
A2340-91	PROJECTILEPOINT	49.68	30.07	8.06	21.94	13	GRAYFOSSIL	STRAIGHT EXP
A4247-91	PROJECTILEPOINT	11.21	25.71	6.47	--	2	GRAYFOSSIL	STRAIGHTEXP HEATREATED
A0806-91	PROJECTILEPOINT	18.44	11.95	3.34	--	1	GRAYFOSSIL	UNNOTCHED ARROWPT
A2190-91	PROJECTILEPOINT	12.67	18.91	4.59	--	2	INDETERM	
A2654-91	PROJECTILEPOINT	15.29	15.96	5.79	--	1	INDETERM	CONTRACT STEMBASE
A0865-91	PROJECTILEPOINT	14.99	18.44	5.91	--	1	INDETERM	CONVEX EXPAND
A1570-91	PROJECTILEPOINT	24.96	25.61	9.70	--	3	INDETERM	STRAIGHT EXP
A4026-91	PROJECTILEPOINT	25.56	30.72	7.28	--	7	NONLOCAL	
A3854-91	PROJECTILEPOINT	54.20	31.80	7.78	20.43	13	NONLOCAL	

CAT.NO.	TYPE	L	W	T	NOTCH W	WT	CHERT TYPE	REMARKS
A1246-91	PROJECTILEPOINT	46.05	22.52	5.00	14.75	5	NONLOCAL	CONVEX EXPAND
A0798-91	PROJECTILEPOINT	52.22	24.06	8.69	17.89	11	NONLOCAL	STRAIGHT EXP
A3703-91	PROJECTILEPOINT	16.54	11.07	2.79	--	1	NONLOCAL	UNNOTCHED ARROWPT
A4142-91	PROJECTILEPOINT	58.03	35.77	8.50	19.02	17	PERMIAN	CONVEX EXPAND
A3462-91	PROJECTILEPOINT	15.60	13.16	5.10	--	1	WINTERSET	
A4085-91	PROJECTILEPOINT	36.18	22.35	6.17	16.89	6	WINTERSET	CONTRACT STEM
A1444-91	PROJECTILEPOINT	44.55	27.68	8.90	--	14	WINTERSET	SQUARE STEMMED
A3192-91	PROJECTILEPOINT	42.24	30.22	8.89	20.07	13	WINTERSET	STRAIGHT EXP
A0648-91	PROJECTILEPOINT	62.57	27.78	7.15	22.30	12	WINTERSET	STRAIGHT EXP
A1396-91	UNIFACESCRAPER	48.57	33.78	11.86	--	14	GRAYFOSSIL	BLADE
A2399-91	UNIFACESCRAPER	38.88	31.43	6.38	--	8	GRAYFOSSIL	BLOCKYEND
A2335-91	UNIFACESCRAPER	64.77	28.34	14.78	--	27	GRAYFOSSIL	BLOCKYEND
A1366-91	UNIFACESCRAPER	25.67	33.29	6.27	--	6	GRAYFOSSIL	INCOMPLETE
A4192-91	UNIFACESCRAPER	26.82	27.40	9.52	--	7	GRAYFOSSIL	--
A2191-91	UNIFACESCRAPER	28.09	22.63	11.77	--	10	GRAYFOSSIL	--
A4325-91	UNIFACESCRAPER	32.34	40.32	13.77	--	19	GRAYFOSSIL	--
A4081-91	UNIFACESCRAPER	36.84	23.69	15.68	--	21	GRAYFOSSIL	--
A4027-91	UNIFACESCRAPER	51.76	36.34	16.40	--	23	GRAYFOSSIL	--
A2475-91	UNIFACESCRAPER	44.80	38.37	17.44	--	30	NONLOCAL	--

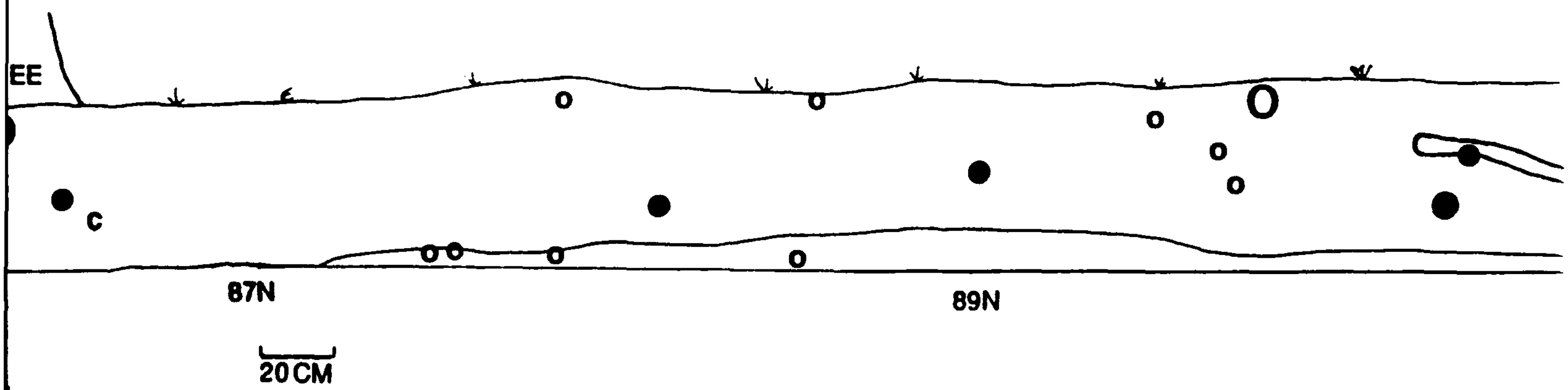


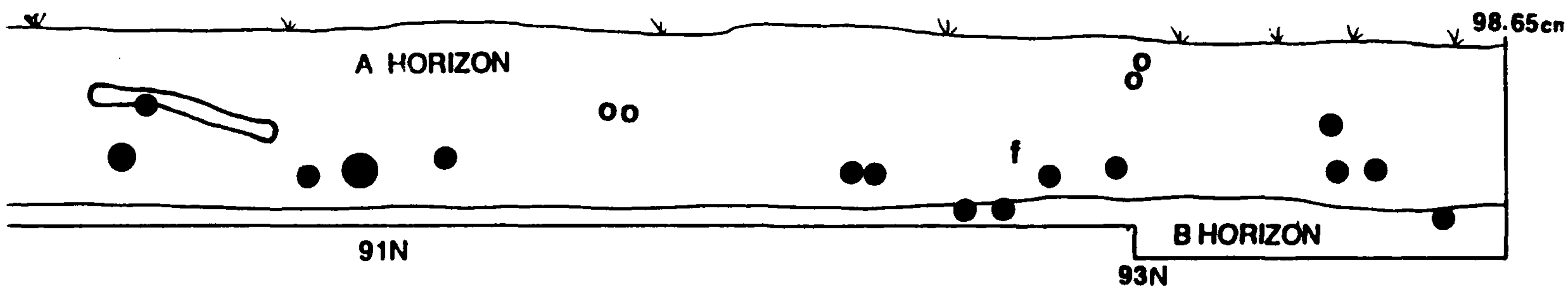
1

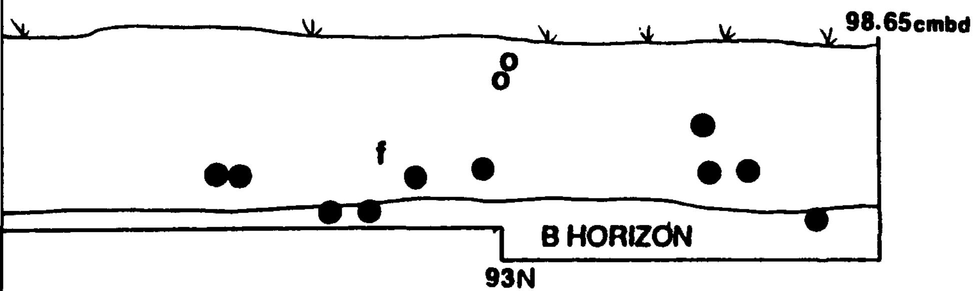
14LV4C
TRENCH WEST
80-93N / 1€



14LV401
TRENCH WEST PROFILE
80-93N / 168E




98.65cm
A HORIZON
f
B HORIZON
91N
93N


98.65cmbd
f
B HORIZON
93N