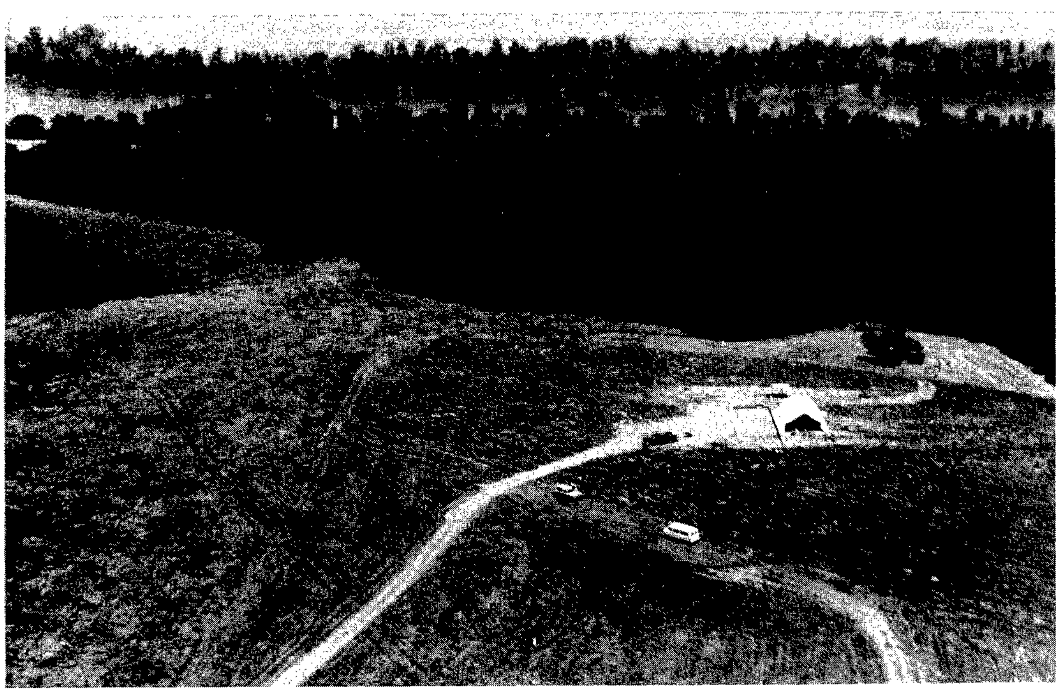
PREHISTORIC SETTLEMENT OF THE LOWER MISSOURI UPLANDS

THE VIEW FROM DB RIDGE FORT LEAVENWORTH, KANSAS

Edited by
Brad Logan



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Edited by
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Report submitted to

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&
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Phase IV (Kansas) investigation of the DB site, a multicomponent occupation on an upland ridge on the Ft. Leavenworth reservation, entailed plowing to increase surface visibility; intensive surface grid collection; machine removal of the plow-zone from a target area; excavation of a block of units in the target area totaling 163m^2, and; mechanical stripping of 3,500m^2 of the site centered on the block. Data recovered attest to short-term, probably late summer-autumn, occupation during the Paleoindian (Folsom, Plainview, Dalton), late Middle Archaic, Late Archaic (Nebo Hill phase, unknown terminal Archaic phase), late Middle Woodland (Edwardsville phase), and Late Prehistoric (Steed-Kisker phase) periods. Preceramic components are in an eroded, buried soil (Brady) of the Late Pleistocene; ceramic components are in the modern soil, developed in Holocene (Bignell) loess. Analyses focus on the extensive lithic (chipped and groundstone) assemblage, a modest ceramic assemblage, chert procurement, experimental groundstone cobble tool utilization, spatial analyses (bioturbation of deposits; integrity of Late Prehistoric component and reconstruction of its activity areas), geoarchaeology, opal phytolith analysis, and data synthesis. The signficance of the site lies in its multicomponency, upland locale, and buried deposi

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Abstract

The DB site (14LV1071), a National Register of Historic Places (NRHP) eligible property on the Fort Leavenworth military reservation, was excavated during the summer of 1996 in order to mitigate the adverse impact it would incur as a result of construction of a new U.S. Disciplinary Barracks. The site is situated on an upland loess ridge that provides an overlook of the Missouri River Valley and that of its tributary, Salt Creek. Phase III and IIIA test excavations had been undertaken in 1995 to evaluate its NRHP eligibility and to gather information for a Data Recovery Plan (DRP) respectively. These investigations suggested the site contained stratified deposits of at least two, possibly three, prehistoric components-Paleoindian, Late Archaic, and Late Prehistoric.

Phase IV investigation included: 1) plowing, to increase surface visibility; 2) intensive surface grid collection, which demonstrated the summit of the ridge contained the greatest density of cultural material; 3) machine removal of the plowzone from a target area on the summit; 4) excavation of a block of units 163m^2 (bringing the total excavated area of the site for all projects to 204.4m^2), which entailed piece-plotting of artifacts, systematic collection of flotation samples, and water-screening of all other fill, and; 5) mechanical stripping of 3,500m^2 of the site centered on the block excavation, piece-plotting of diagnostic material, and collection of all visible artifacts. Ancillary fieldwork included excavation of seven backhoe trenches and extraction of a 13m long core to obtain geoarchaeological and paleoenvironmental data.

Geoarchaeological research identified a buried soil as the Brady geosol, a terminal Pleistocene indicator of surface stability ca. 9,000-11,000 BP, that developed in the uppermost Peoria (Wisconsinan) loess. A suite of 17 radiocarbon dates on humates from one backhoe trench indicates the Brady soil at this locality is younger, ca. 6000-2400 BP, probably the result of its shallow burial and absorption of more recent organic material. Despite the radiocarbon dates, phytolithic and magnetic signatures support its interpretation as the Brady soil. Erosion of the Brady soil is indicated by the fact that its A horizon was only exposed in two of seven Phase IV backhoe trenches. Elsewhere the Brady B horizon is welded to that of the modern soil. The latter developed in Bignell (Holocene) loess that mantles the ridge to a depth of ca. 40-50cm. Pre-ceramic components occur in the Brady B horizon; ceramic-age occupations are associated with the modern soil. Bioturbation of the soils has resulted in some stratigraphic mixing. Pre-ceramic artifacts in the Brady soil have little stratigraphic integrity.

Analyses of recovered data indicate the site was occupied during the Paleoindian, Middle Archaic, Late Archaic, Middle Woodland, and Late Prehistoric periods. Diagnostic artifacts of the Paleoindian period include Folsom, Dalton, and Plainview projectile points. While Archaic artifacts are mixed, the Paleoindian artifacts consistently occurred ca. 50-60+cm bs.

Middle Archaic artifacts include side-notched points comparable to Logan Creek, Godar, Helton, and Matanzas points and scrapers reworked from Helton-like points. While some of the points are like those of the Logan Creek complex, the artifacts are suggested to date to later, unidentified late Middle Archaic occupations ca. 5500-5000 BP, contemporary with the Helton phase of western Illinois and eastern Missouri. One bifacial knife of the Munkers Creek type is compatible with this age range.

Late Archaic artifacts include a few lanceolate bifaces of the Nebo Hill phase and a more extensive assemblage of expanding-stemmed and corner-notched dart points suggested to belong to a terminal Late Archaic occupation. Several of the points were reworked into hafted scrapers. Also affiliated with the pre-ceramic levels were several knives, drills, and other chipped stone tools and a groundstone assemblage that included full-grooved axes, celts, manos, metate fragments, hammerstones, expedient cobble tools, and scoria/clinker abraders. Two AMS dates from a hearth feature, one of only two cultural features discovered, and two other dates from the same level of a unit 12m distant show no statistically significant difference from a humate date on a bulk soil sample from the same depth (50-55cm bs) in the A horizon of the Brady soil in backhoe Trench 1. These dates attest a terminal Late Archaic occupation ca. 2800-2600 BP.

Middle Woodland artifacts are restricted to a few Edwardsville phase rim sherds. The Late Prehistoric component, assigned to the Steed-Kisker phase, is identified from a modest but distinctive assemblage of Platte Valley ware, both Plain and Incised, notched and unnotched arrow points, end scrapers, sandstone arrowshaft abraders and an incised hematite celt. Most of these materials were associated with a concentration of daub suggested to be the remains of a shelter of wattle-and-daub construction. Two AMS dates on charred maize kernels support a 14th century AD occupation. One sherd of Beckman Pinched Rim pottery points to interaction with Nebraska phase populations in the region.

Spatial analysis of the Late Prehistoric occupation reveals some structural integrity. Identifiable are the remains of at least one shelter and a nearby, extramural hearth/activity area that included a concentration of charcoal, burned bone, charred maize, curcurbits, and nutshells, in association with a vessel fragment and chipped stone tools.

Chipped stone tools are compared to regional archaeological cultures, particularly those of the St. Louis locality, which has a long prehistoric tradition of parallel cultural development and influence on that of the Kansas City locality. Lithic raw materials are examined to track the mobility of site occupants through time and their relative dependence on local, near-local, and exotic cherts. Analysis of groundstone tools included experimental use of a comparative collection of till-derived cobbles and the groundstone artifacts from the block excavation. Phytolith analysis of groundstone washes revealed evidence of the processing of wild grass seeds with formal manos.

All assemblages/components are evaluated with respect to a set of hypotheses concerning the following problem domains: taxonomy, geography, chronology, settlement patterns, subsistence economy, cultural relations, and technology. The site is significant because it points to the potential for burial of prehistoric human settlements in the Lower Missouri River loess hills and to a long tradition of such settlement. Cultures of diverse adaptations made at least short-term, periodic use of the resources offered by settings such as DB, including proximity to upland woodlands (nut mast, deer, etc.) and prairies, and lowland habitats of the adjacent valleys. The application of different technologies by different cultures to the gathering of these resources shows at least 10,000 years of change and continuity.

Acknowledgements

The DB project benefited from the remarkable talents of several persons foremost of whom is Margaret Beck, who served both as Field Director and as overall Lab Director. Her hard work and dedication were critical to the successful completion of the project through all phases. None of those listed below, many of whom also contributed significantly to its completion, would begrudge my singling her out for special recognition. They know that Margaret is one of those rare people who combine diligence, grace and patience in their work.

The following people worked in the field, and are heartily thanked for their contribution to acquiring data that would otherwise have been lost: Will Banks, Bryan Barragree, Margaret Beck (Field Director) Ann Begeman, Tod Bevitt, Jeannette Blackmar, Tammy Coffey, Bobby Conard, Destiny Crider, Kiersten Fourshe, Jared Grillot, Ginny Hatfield, India Hesse (Field Lab Director), Scott Hickman, Matt Hill (Field Lab Director), Doug Kolom, Caroline Krueger, Mark Latham, Janice McLean, Yukiyo Note, Justin Oliver, Bill Perkins, Jim Prothe, Sylvia Reyna, Jason Roberts, David Schneider, Todd Seacat, David Soldo, and Michael Strelow.

Lab personnel who devoted several months to sorting the thousands of artifacts from the waterscreen samples and piece-plotted items, were: Margaret Beck (Lab Director), Ann Begeman, Ginny Hatfield, Matt Hill, Janice McLean, and Kara Milford. Mark Peck, Rich Edmiston, Caye Edmiston, Scott Bossell, and Marian Montgomery volunteered 145 hours to these tasks as well, and for their unrecompensed devotion I am grateful. Specialized analyses were conducted by Bill Johnson, whose insights concerning the evolution of the DB ridge are critical to our understanding of the cultural stratigraphy; Steve Bozarth, who added something new by detecting the phytoliths of wild grass seeds in selected groundstone wash samples; and Mary Adair, who examined samples of the charred plant macrofossils. Sarah Moore's talent for scientific illustration is evident in the artifact drawings. My thanks to them all.

Critical funding for radiocarbon dates came from the Museum of Anthropology, University of Kansas. The federal funds for this type of analysis for the DB project covered only three AMS dates on cultural material. The failure of the sponsoring agencies to modify the contract for more C^{14} dates threatened our ability to gain temporal control over the site. Consequently, more extensive funding for an additional three AMS dates and for 17 humate radiocarbon dates came from KUMA.

The DB project was sub-contracted to KUMA by Burns and McDonnell Engineers, Kansas City, Missouri. We are grateful to Bob Sholl, Project Manager, and Dan Shinn, Cultural Resources Specialist. Dan, Dean Sather and I found DB during a KUMA survey in November 1994. Dan found the first of nine small flakes we turned up in our shovel tests of the DB pasture. He helped me direct the follow-up Phase III and IIIA testing projects and, like me, watched in amazement during the Phase IV dig as artifacts by the tens of thousands were revealed at the waterscreen station and in the block excavation. A journalist once asked me why we dig and I told her that otherwise you never know what might be just beneath your feet. Dan and I were there at the "finding" and now we know what was beneath us that autumn day.

Thanks are due to Camille Lechliter and Bob Ziegler at the Kansas City District, U.S. Army Corps of Engineers for moving the project along; and to Tim Hanna, Historical Architect, Directorate of Public Works, Fort Leavenworth for his aid in coordinating the project with Fort personnel. Finally, thanks again to Lauren and Eli. In many different ways, they always help get the job done.

Brad Logan, Principal Investigator
Senior Curator, KUMA

Table of Contents

List of Figures

Chapter 7

Chapter 8

Chapter 9

Chapter 10

Chapter 11

Chapter 12

Chapter 14

List of Tables

Chapter 11

Chapter 12

Chapter 13

Chapter 14

Prehistoric Settlement of the Lower Missouri Uplands
The View From DB Ridge

Chapter 1

Introduction

Brad Logan

This report presents the detailed descriptive and interpretive results of a Phase IV (Kansas) investigation of the DB site (14LV1071), a multicomponent prehistoric occupation on an upland ridge in the northwestern corner of the Fort Leavenworth military reservation, northeastern Kansas. The investigation was required because the site will be destroyed by construction of a proposed U.S. Disciplinary Barracks, currently scheduled to begin in 1998. Found during a survey in 1994 (Logan 1995a), National Register of Historic Places evaluation of the site in July 1995 had demonstrated its eligibility for nomination (Logan 1995b). Testing in October 1995 provided additional information for the preparation of a Data Recovery Plan (Logan 1996a). The site had yielded stratified deposits suggested to be of the Paleoindian, Archaic, possibly Middle Woodland, and Late Prehistoric periods. The significance of the site lay not only in the stratified nature and relative integrity of the deposits but in their upland context, which promised to provide new insights to prehistoric settlement patterns related to that part of the Lower Missouri Valley landscape.

The Phase IV mitigation was carried out by the Museum of Anthropology, University of Kansas (KUMA) through a subcontract from Burns and McDonnell Engineers, Kansas City, Missouri, which had received the contract from Fort Leavenworth and the Kansas City District, U.S. Army Corps of Engineers. The editor of this report was Principal Investigator, Bob Sholl and Orvil (Dan) Shinn, Burns and McDonnell Engineers, were Project Manager and Cultural Resources Specialist respectively. Most of the contributors to this report participated in the field work phase of the project, and therefore provided valuable continuity through subsequent laboratory, data analyses, and report preparation phases. Personnel at the Museum of Anthropology included: Margaret Beck, Field Director and, during the postfield period, Lab Director; Matthew Hill, Lab Director during the second half of the fieldwork phase (India Hesse served in that capacity during the first half); Virginia (Ginny) Hatfield, Janice McLean, and Ann Begeman, Archaeological Assistants during the excavation. William Johnson and Steven Bozarth, Department of Geography, University of Kansas, conducted geoarchaeological and paleoenvironmental investigations at the site. The following sections briefly describe the setting and significance of the site, previous investigations, and the organization of the report.

The DB Site: Setting and Significance

The DB site (Area A) covers about 23,000m^2 on a northwest-southeast oriented loess-mantled ridge whose summit is 285m (934.5ft) above mean sea level and 51.7m (170ft) above the floodplain of the Missouri River Valley, 350m (1,148ft) to its north (Fig. 1.1)[1] The ridge provides a broad view of the valley and that of Salt Creek, a tributary of the Missouri River whose confluence is 1.2km northwest (Fig. 1.2). The ridge is isolated, grading gently southward about 800m (730ft) before the terrain rises rather abruptly to an elevation of 326m (1,070ft) on Hancock Hill, an elongate north-south ridge and ready source of lithic raw materials for the site's occupants (see chapters 10-11). Southeastward 150m from a lower ridge spur of Area A, the site includes at least 4,180m^2 of a narrower and distinct ridge, called Area B. The saddle between the two ridges, an area of about 2,000m^2, is designated Area C. Survey and test excavation in Areas B and C revealed shallow, mixed, and relatively impoverished deposits of 20th century trash and undiagnostic prehistoric material (Logan 1995b). Hereafter, discussion of the DB site refers to Area A, the focus of Phase IV investigations. As the following chapter makes clear, the site was favorably situated with regard to aspect, water sources, and a variety of habitats with their associated plant and animal resources. The archaeological record is testimony that these factors were appreciated over a long period of time by groups of diverse prehistoric cultures.

Phase IV investigation of the DB site entailed excavation of a 163m^2 block on the summit of the ridge and mechanical stripping of a 3,500m^2 area around it. Waterscreened fill, flotation samples, and piece-plotted artifacts (the latter from both the block and stripped areas) revealed evidence of Paleoindian (Folsom, Dalton, and Plainview), Middle Archaic (unknown affiliation), Late Archaic (Nebo Hill phase and unknown terminal Archaic affiliations), Middle Woodland (Edwardsville phase), and Late Prehistoric (Steed-Kisker phase) occupations. The presence of Middle Archaic and terminal Late Archaic components had not been anticipated (see Previous Investigations). A late Middle Archaic component (ca. 5500-5000 BP) is suggested by side-notched dart points that compare to those of the Helton and Falling Springs phases of the St. Louis locality, the source of cultural influence in the Kansas City locality throughout most of the late Holocene. The terminal Archaic occupation is indicated by expanding-stemmed and contracting-stemmed points, one hearth feature, and four AMS radiocarbon dates on charred nutshells that suggest a temporal range of 2800-2600 BP.

The preceramic occupations occur within a buried soil identified as the Brady geosol that formed during a time of late Pleistocene surface stability. They took place during or before a time of surface erosion that removed most of the A horizon of the Brady soil from the ridge and, in conjunction with cultural and natural disturbances, resulted in the mixture of artifacts within a 20-30cm thick horizon. Attempts to discern structural integrity of activity areas within this zone were not successful. While site formation processes preclude much interpretation of

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[1]This is a revision of the estimate of 33,000m^2 presented in previous reports (Logan 1995b, 1996a). The revision is based on the intensive grid collection described in chapter 6.

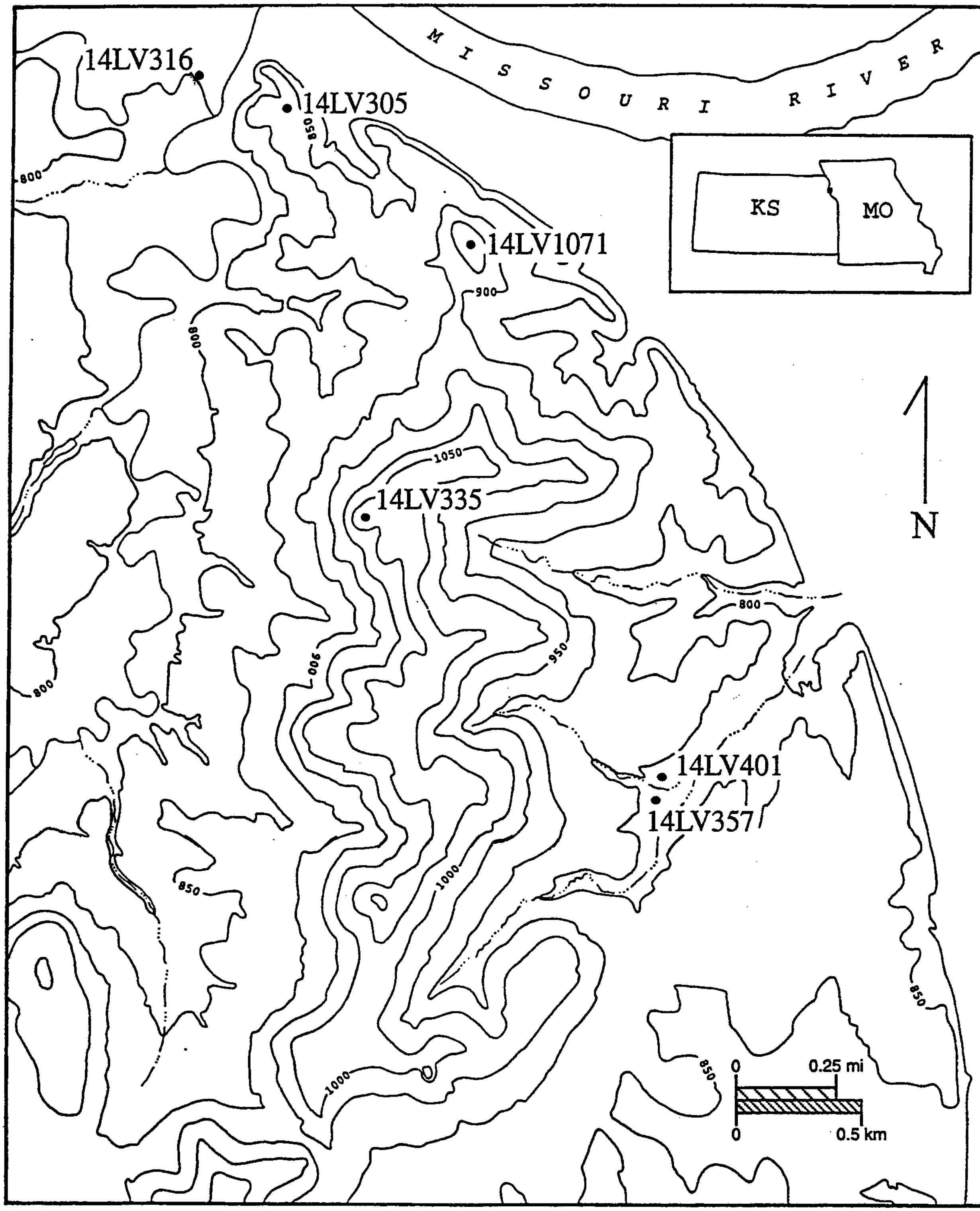

Figure 1.1. Map of the Fort Leavenworth military reservation and environs showing the location of the DB site and other sites discussed in the report. Contour intervals are 50ft.

Figure 1.2. above) View southwest of the DB site (foreground); x- Hancock Hill, y-Salt Creek, z-Zacharias site (14LV380; see chapter 5). below) View north of site showing proximity to bluff slope hardwood forest and Missouri River. Photos taken July 19, 1996.

these components, their significance is not lessened. They point to the potential for burial of contemporary components on similar upland settings along the Lower Missouri Valley that might have more integrity.

Evidence of Middle Woodland (Hopewell) activity is limited to a few diagnostic sherds that attest very brief occupation. More extensive remains of a Late Prehistoric (Steed-Kisker phase) occupation include a daub concentration that represents a structure of wattle-and-daub construction, a modest but insightful ceramic assemblage of Platte Valley ware and one sherd that may reflect contact with Nebraska phase groups, and a lithic assemblage that includes arrow points, end scrapers, and worked and incised hematite. The upper level of the block excavation that included this component exhibited relatively good structural integrity. Spatial analysis of data from that level reveals a shelter, reflected by a concentration of daub, and nearby activity areas, including a hearth and burned bone scatter, and discarded artifacts (points, scrapers, debitage). Two AMS radiocarbon dates on charred maize kernels support a 14th century time of occupation, which supports previous, tentative suggestions that the Steed-Kisker phase persisted beyond its generally accepted terminus of A.D. 1250. This component is only the second upland Steed-Kisker settlement to have been excavated. It thus adds significant insight to Late Prehistoric utilization of upland habitats in the region.

Previous Investigations

Phase II-Discovery: The DB site was discovered by a team of three persons on November 14, 1994 during reconnaissance survey of a five km^2 area in and adjacent to the Quarry Creek drainage (Logan 1995a). This survey, supported by a grant from the Department of Defense, Legacy Resource Management Program, was undertaken by KUMA to explore the archaeological potential of terrain around the Quarry Creek (14LV401) and McPherson (14LV356) sites (Fig. 1.1). Both sites contain significant evidence of occupation by people of the Kansas City Hopewell culture (ca. A.D. 1-650), a variant of the Middle Woodland period in the Lower Missouri valley (Johnson 1976, 1979). Quarry Creek had been the subject of an intensive investigation in 1991 by the Kansas Archaeological Field School (KAFS), a program of the University of Kansas and Kansas State University (Logan 1993).

Of a series of 50 shovel tests dug across the ridges and saddle in the site area, nine were positive. These tests yielded debitage and burned earth but did not provide culturally or temporally diagnostic evidence of the prehistoric components. Historic debris, concentrated in the saddle area and on the smaller ridge, is attributable to 20th century dumping (Logan and Hesse 1995). When the locations of the positive shovel tests were plotted with respect to the footprint of the proposed Disciplinary Barracks (35% redesign; Fig. 1.3), it was apparent that construction of that facility would adversely affect the site. Consequently, a Phase III investigation was recommended in order to evaluate the site's eligibility for placement on the National Register of Historic Places (NRHP) (Logan 1995a).

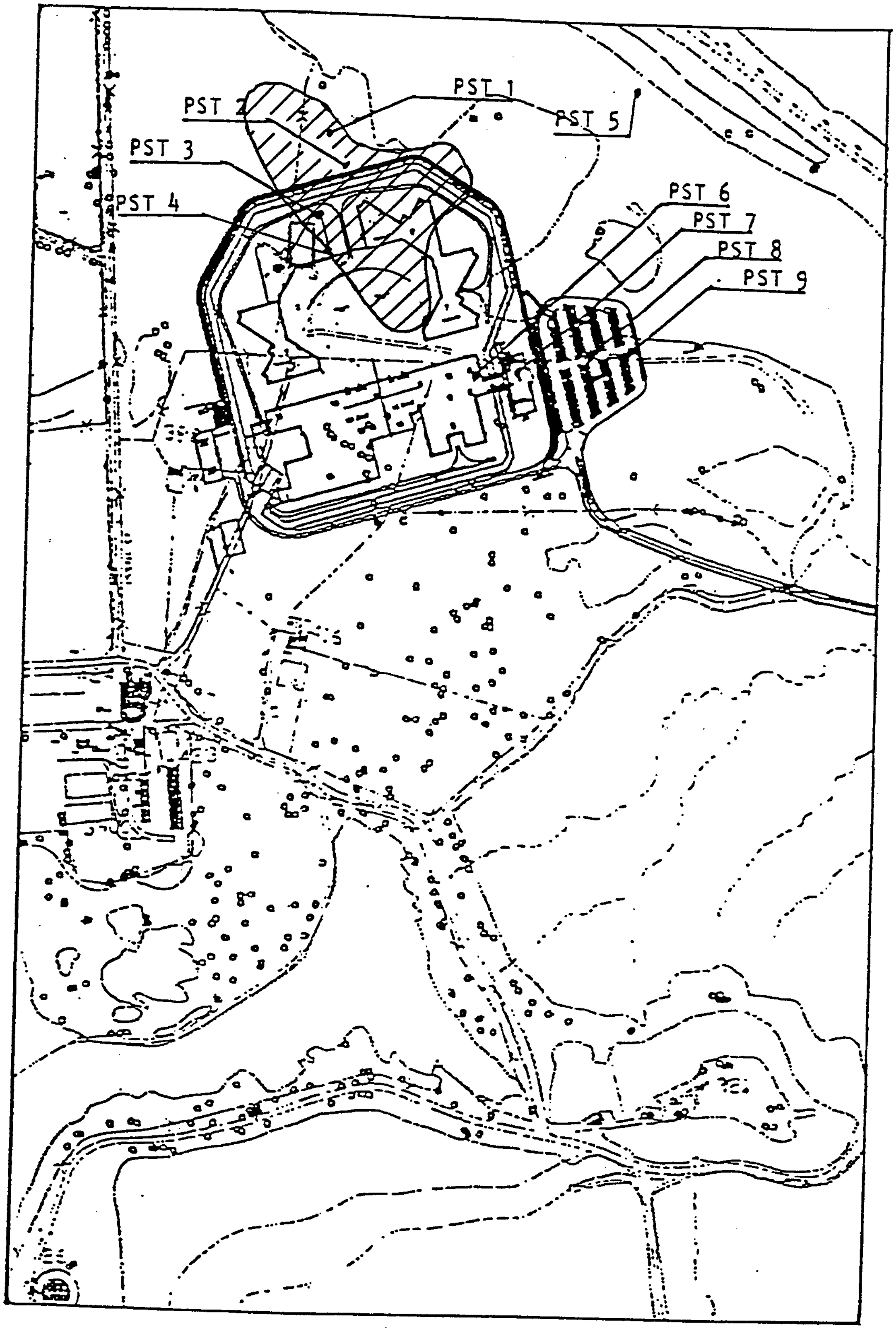

Figure 1.3. Location of DB site, Area A (hachured) and Phase II positive shovel tests with respect to 35% Redesign of the U.S.D.B. PST 5=isolated find spot, PST6-7 are in Area C, PST 8-9 in Area B.

Phase III-NRHP Evaluation: The Phase III investigation was contracted to Burns and McDonnell Engineers and, through a subcontract, to KUMA. It entailed six days of fieldwork in July 1995 and resulted in the excavation of units totaling $6m^2$, five of which were in Area A, and 35 shovel tests of which 24 were positive. The shovel tests indicated the horizontal extent of the site, particularly on the larger ridge. The test units indicated prehistoric cultural deposits consistently extend to a depth of at least 60cm. The bimodal distribution of the mass of chipped stone and ceramic artifacts in four of the five units on the main ridge reflected at least two stratigraphically distinct components. Culturally and/or temporally diagnostic artifacts, though few in number, suggested these components were attributable to Late Archaic (Nebo Hill phase?) and to Middle Woodland (Kansas City Hopewell) and/or Late Prehistoric (Steed-Kisker phase) occupations.

No other stratified upland sites in northeastern Kansas had been excavated nor had any with deposits of Archaic, Middle Woodland, and Late Prehistoric components in such a context in the Lower Missouri Valley. Archaeological investigation of this site promised to shed light on a dark corner of prehistoric culture history and process in general and on problems concerning settlement-subsistence patterns, regional and interregional cultural interaction, and technological change in particular. For these reasons, the Phase III report concluded with a recommendation that the site be considered eligible for placement on the NRHP.

The following working hypotheses were presented as a guide to future investigation of the DB site (Logan 1995b:55):

1) The lower prehistoric component extends from ca. 40-60cm below surface;

2) The lower prehistoric component is attributable to the Nebo Hill phase;

3) The upper prehistoric component extends from the surface to a depth of ca. 40cm;

4) The upper prehistoric component is attributable to either or both the Kansas City Hopewell variant and the Steed-Kisker phase.

Phase IIIA-Data Recovery Plan: Data collected during the Phase III investigation were not sufficient to present a Data Recovery Plan (DRP). Thus, more intensive investigations were undertaken for three weeks in October 1995 (Logan 1996a). These included: 1) remote sensing survey (magnetometry and ground penetrating radar) in Area A; 2) manual excavation of small blocks and trenches totaling $33.4m^2$ on and around its summit, and; 3) backhoe excavation of trenches to recover geomorphological data.

Remote sensing survey did not identify prehistoric cultural features due to: 1) operational equipment error, 2) the relatively high frequency of historic metal debris throughout the plowzone that distorted the magnetic field, and/or 3) the scarcity of features such as pits or hearths that would register as anomalies. Manual test excavations totaling $33.4m^2$ (see Fig. 6.1, chapter 6 for their locations) and analyses of the vertical distribution of selected cultural materials (lithics, ceramics, and daub/burned earth) confirmed the presence of at least two stratified occupations. The upper component(s), found from near-surface to a depth of 30-40cm, yielded pottery indicative of a Late Prehistoric occupation and, more tenuously, of Middle Woodland activity. The upper 20cm had been disturbed by plowing. Daub from this stratum occurred on the crest of the ridge. This material and a feature, then tentatively identified as a hearth but now interpreted as modern burning of a tree root system (see chapter 5), suggested remains of a house structure might be preserved on the summit below the plowzone. The lower component, 30/40cm-60cm bs, yielded chipped stone (bifaces) and groundstone tools compatible with a Late Archaic affiliation. One projectile point, a small fluted lanceolate of possible Paleoindian age, was recovered from a depth of 59-60cm.

Geomorphic investigation revealed Peoria (Late Pleistocene) loess at a depth of 1.3m. This material is capped by a buried soil, suggested to be the Brady geosol that dates to the Pleistocene-Holocene transition. Given recovery of at least one point of Paleoindian age, it was suggested that Phase IV investigation include further exploration of the site's potential for containing evidence of late Pleistocene occupation. The buried soil is welded to the lower portion of the surface soil, developed in Bignell (Holocene) loess. Both horizons contain prehistoric components. Charcoal collected from the upper portion of the loess, the B horizon of the Brady soil, and from both cultural strata provided a preliminary baseline chronostratigraphy.

The DRP presented: 1) an overview of the relevant prehistoric cultures of the Lower Missouri Valley and adjacent regions; 2) a discussion of research problem domains, including taxonomy, chronology, geography, settlement patterns, subsistence economy, cultural relations, and technology; 3) hypotheses derived from the discussion and a review of data required to test them; and 4) a schedule of tasks and their implementation, milestones and other essentials for Phase IV (mitigation) investigation of the site.

Report Organization

The physical setting of the DB site is described in the following chapter. The cultural deposits span the late Pleistocene and Holocene epochs and may reflect adaptive responses to changes in this environment. Thus, the record of regional, environmental change from the terminal Ice Age through various shifts in Holocene climatic episodes is reviewed. Site specific data that document some aspects of these dynamics are presented in chapters 3 and 4. In the former, William C. Johnson describes and interprets the site's sediment and soil stratigraphy, making use of radiocarbon based chronology and magnetic, carbon isotope ratio, and soil/sediment (e.g., particle size, organic matter, $CaCo_3$) analyses. In chapter 4, Steven R. Bozarth presents the results of his analyses of opal phytoliths extracted from a stratigraphic profile and selected groundstone wash samples. His contribution thus complements, from a biological perspective, the environmental reconstruction presented by Johnson and the functional interpretation of certain groundstone artifacts described in chapter 11. Chapter 5 is an outline of the regional culture history that focuses primarily on those periods relevant to the DB site. The strategies and methods employed during the field and laboratory phases of the Phase IV investigation are described in chapter 6. In chapter 7, the excavation is described with respect to site stratigraphy, the documented natural and cultural features and their implications for interpretation of site activities, and the radiocarbon dates obtained from cultural remains are presented.

Chapters 8 through 13 are devoted to analyses and interpretations of artifact assemblages. The first of these focuses on the ceramic artifacts, which support attribution of the uppermost prehistoric cultural deposits to the Steed-Kisker phase of the Late Prehistoric period. In chapter 9, Ginny Hatfield presents detailed morphological and typological analyses of the chipped stone artifacts. This chapter is key to verification of Paleoindian and certain Archaic occupations (Middle and Late), given the absence of radiocarbon dates for some of them. Analyses of the sources and relative frequencies of raw materials, primarily chert, used in the manufacture of chipped stone tools provide insight to technological preferences, the range and mobility of past populations, and changes in procurement strategies through time. These aspects of the chipped stone assemblage are examined by Janice McLean in chapter 10. Groundstone artifacts, so abundant at the DB site, are described and interpreted in chapters 11 and 12. In the first of these, Margaret Beck describes sources of glacial till in the site's vicinity, presents the results of her own experimental use of unmodified cobbles from one such source, and interprets the attributes of use wear on some tools that are useful for determining their function. She also discusses the apparent ad hoc use of many cobble manuports at DB and the transport of others that do not exhibit any evidence of subsequent use. In chapter 12, Beck and Ann Begeman describe groundstone artifacts made of sandstone, scoria/clinker, and ferrous oxide. The biological assemblage is the subject of chapter 13. The sparse and poorly preserved faunal remains are discussed in the first part. In the second part, Mary Adair interprets macrofloral remains as evidence of Archaic and Late Prehistoric subsistence patterns.

Matt Hill analyzes the various assemblages with regard to their spatial context in chapter 14. His work is critical to understanding the vertical distribution of diagnostic artifacts within strata that have experienced sedimentation, soil formation, erosion, and bioturbation. He also demonstrates the problems and promise of inferring activity areas and structural remains from the horizontal distribution of cultural debris that reflect a palimpsest of multiple occupations representing a variety of prehistoric periods and cultures.

Chapter 15 is a synthesis of data from the DB site viewed from the perspective of the following problem domains: taxonomy, chronology, geography, settlement patterns, subsistence economy, cultural relations, and technology. Hypotheses presented in the Data Recovery Plan are tested, where possible, and revised in the light of new information. Finally, chapter 16 is a summary of the findings and of the significance of the DB site. The site points to the archaeological potential of the Lower Missouri Valley uplands, particularly with respect to buried sites. The research presented here exemplifies how exploration of such sites can enhance our understanding of continuity and change in past human adaptations.

Chapter 2

Environmental Context

Brad Logan

Introduction

The environmental setting of the Fort Leavenworth area, on both regional and local scales, was richly varied with respect to several resources essential to prehistoric cultures. Sources of cherts, quartzites, and sandstone for chipped-stone and groundstone implements and limestone for hearths were a short distance from the DB site. A mosaic of prairie and woodland in both uplands and lowlands were habitats of diverse floral and faunal species. The physical environment of the Fort Leavenworth reservation in general and of the DB site in particular is described here with respect to physiography, geomorphology, climate, vegetation and fauna. Given the fact that the cultural deposits at the DB site span late Pleistocene to late Holocene time, particular emphasis is placed on climatic change and the corresponding dynamics of the biological component of the DB environs. This same emphasis on environmental change is evident in the following chapter, where the soil/sediment matrix of the cultural horizons, as well as the general geoarchaeological context is described. Paleoenvironmental information derived from phytolith analyses is presented in chapter 4. The structural geology of the region as it concerns lithic resources at DB is the subject of separate chapters. Chert sources and types are described in chapter 10; groundstone sources and types are covered in chapter 11.

Physiography

The Fort Leavenworth reservation 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. 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 59m but generally less than 8m) to produce a distinctive topographic region (Caspall 1970:46), but the loess accumulation thins into a veneer over Kansan till southward to the Kansas River (Frye and Leonard 1952:208-210). Erosion of loess-till deposits in northeastern Kansas has resulted in undulating, hilly terrain on the uplands. In the study area, the land near divides is fairly smooth, with rounded hills and shallow swales like the upland setting of the DB site. Near the main stream the land is broken and steeply dissected. Deepening of valleys has exposed Pennsylvanian bedrock. Elevation on the reservation ranges from 225m (740ft) at low water on the Missouri River to 330m (1,083ft) on Government Hill (Brumwell 1941:3). The elevation of the upland ridges on which the DB site is located ranges from 273m (896ft) to 284m (934.5ft) above mean sea level.

Geomorphology

The DB site is on a western bluff of 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 reservation locality it meanders eastward in a conspicuous loop 1.0 to 1.3 km (1.25 to 1.5 mi) wide. 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 after survey of a reservation for the Delaware, an eastern Indian group that immigrated to northeastern Kansas. The latter survey was undertaken to officially register the boundaries of Fort Leavenworth (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 1980a:32). Reid (1980a) has suggested these attributes prevented development of riverine biomass sufficient for reliable subsistence by some prehistoric cultures, specifically Kansas City Hopewell. However, the maps mentioned above demonstrate the general stability of the river meander in the DB site area 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 have provided, during some periods, sufficient aquatic/floodplain resources for prehistoric groups in the site's vicinity. The resource potential of such a habitat is discussed in later sections of this chapter.

Prior to dam and levee construction, the Missouri River bottoms were subject to severe floods. Even had these not altered the course of the meander described above, such floods, poor drainage and attendant mosquito infestation would have discouraged lowland settlement during certain times of the year. These factors may explain the location of some prehistoric sites, such as the DB site, in an upland setting nearly 50m (160ft) above the Missouri River valley. That such floods did not entirely preclude lowland occupation in the vicinity of the reservation is demonstrated by numerous and extensive prehistoric occupations in nearby Salt Creek valley (Witty and Marshall 1968). At the same time, the geomorphic context of some of these sites attests the severity of floods over time. For example, 14LV316, a Kansas City Hopewell site located near the confluence of the Missouri River and Salt Creek (Witty and Marshall 1968:41-44), is buried by alluvium to a depth of three meters. This site is only 1100m northwest of DB (Fig. 1.1).

The attraction of the DB ridge for human settlement is still apparent, though with one exception, a handy source of fresh water. The Missouri River and Salt Creek, while within sight, were still several hundred meters away, across hilly or steep terrain. It is likely that the nearest source of potable water was one or more upland springs, though none currently flows in the site's vicinity. On August 3, the Phase IV excavation crew was visited by Mr. H. B. Timberlake, Jr. then 86 years young, whose farm residence is opposite the reservation boundary from the DB site. His property has been in his family for more than 130 years, so Mr. Timberlake is an excellent informant for local history and geography. When asked about nearby sources of water, he informed the author that prior to World War II and the fencing of the reservation, his family was free to collect from a spring that flowed 400m southeast of the ridge that is Area B of the site. This source no longer exists, though water in its draw has been impounded in the largest of three cattle ponds near the site. It is possible that this spring served the inhabitants of the DB site and may explain the presence of scattered lithic debris in shallow deposits at Area B.

Climate

The current climate of northeastern Kansas is continental, characterized by large diurnal and annual variations in temperature, and described as moist subhumid (Thornthwaite 1941). Precipitation, which occurs most frequently from April to September in the form of intermittent 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). The clash of warm, moist air masses from the Gulf of Mexico and cold, dry, polar air sometimes results in intense, flood-producing storms. Temperatures range from average lows of ca. 20°F. and highs in the 40s during the winter to lows of ca. 60°F. and highs in the 90s during the summer. Precipitation ranges from <4" throughout the winter to 12-15" during the spring, 12" during the summer, and <6" during the autumn (Zavesky and Boatright 1977:76). Table 2.1 provides data on total precipitation at stations near the project area.

Table 2.1* Total Annual Precipitation 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
September	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

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

Variations from one station to another during the year given (1978) in Table 2.1 illustrate how local convectional storms affect local moisture availability. Convectional storms did not always dominate regional precipitation patterns during the Holocene. Geomorphic evidence of climatic change, in the form of generally synchronized periods of erosion, sedimentation, and landscape stability, has been documented in Iowa (Bettis et al. 1984), Illinois (Hajic 1990), Missouri (Ahler 1973; Hoyer 1980; Thompson and Bettis 1980), southwestern and southcentral Kansas (Mandel 1994; Artz 1983), and northern Oklahoma (Artz and Reid 1984). One suggested contribution to these patterns is change in atmospheric circulation patterns. During the early and mid Holocene these were dominated by increasingly warm and dry conditions caused by increasing summer insolation and stronger surface zonal air flow. The consequent restriction in northward flow of moist tropical air from the Gulf of Mexico brought about a period of aridity that was first defined, from data in the American Southwest, as the Altithermal (Antevs 1955). This climatic regime in the mid-continent, where it is referred to as the Hypsithermal (Deevey and Flint 1957), prevailed ca. 8,000-5,000 BP. During the late Holocene, the circulation pattern shifted to mixed zonal and meridional dominance. That these shifts from frontal to convectional storm dominance affected landscape evolution in northeastern Kansas is seen in geomorphic evidence from the Delaware River valley (Johnson 1990; Mandel et al 1991) and the lower Kansas River Valley (Johnson and Martin 1987).

It is likely that the climatic changes sketched above affected human adaptations in the Central Plains-Midwest. These broad patterns, and more specific episodes described below, undoubtedly affected the distribution of habitats in the region and, to some extent, the adaptations of associated human populations. The Paleoindian occupation of the DB site occurred during a time of cool, dry conditions called the Pre-Boreal and Boreal. Significant late Pleistocene-Holocene climatic episodes (Baerris and Bryson 1965; Bryson et al. 1970) that correlate with periods of occupation at the DB site include: the Pre-Boreal and Boreal (ca. before 9650 to 8450 BP), which correlate with the Folsom and Dalton occupa-tions at DB; the Atlantic (ca. 8450-4680 BP), or Hypsithermal, a major period of increased aridity that corresponds to the Middle Archaic occupations; the Sub-Boreal (ca. 4680-2890 BP), a cool period of forest expansion that corresponds to the early Late Archaic (Nebo Hill phase) period; the Sub-Atlantic (ca. 2890 BP- 1600 BP), a moist period that corresponds to the terminal Archaic occupation; the Neo-Atlantic (ca. 1600-700 BP), a drier period that correlates with the major period of Kansas City Hopewell occupation at the Quarry Creek site and Late Prehistoric occupation at the Zacharias site (see chapter 5 for discussion of these sites); and the Pacific (ca. 700-300 BP), a time of increased aridity that correlates with the Steed-Kisker phase occupation at DB.

Vegetation

On a regional scale, Fort Leavenworth is within the northeastern oak-hickory forest (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*). Much of the wooded land on the reservation, such as that just north of the DB site, 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. Most of the wooded terrain south of the DB site is logged upland forest consisting of red oak, black oak, white oak and walnut (Burns and McDonnell 1992). Floodplain vegetation within the broad meander of the Missouri River north of the DB site includes a remnant of the floodplain oak-hickory forest now largely lost to Euroamerican clearing and areas of more typical floodplain softwoods (elm and cottonwood) and floodplain savannah (sedge and willow) (Brumwell 1941).

The uplands of the reservation include both grassland and woodland communities (Brumwell 1941). These communities form an ecotone, established in northeastern Kansas after the Hypsithermal 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° to 45° N. Lat. and ranges from east to west in the case of some species, such as bur oak, as much as 1,600 kilometers. Shelford (1963:306-307) estimates that within the region of at least 932,400km^2 that contains interspersed climax forest and climax prairie, approximately four million hectares are covered by forest-edge vegetation. 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 easternmost 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.

Evidence 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 under which they developed. Within the project area 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). The DB site is located in an area mapped as Ladoga silt loam, suggesting its dominate cover during the recent past has been forest or mixed woodland-prairie.

Table 2.2. Dominant Plant Species of Northeastern 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 the 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 .... communities goes on in the shrubby edge that separates them.

As mentioned in the previous section, globally synchronous climatic shifts occurred throughout the Holocene (Bryson et al. 1970). These may have correlated with cultural adaptations in the Great Plains (Wendland and Bryson 1974; Lehmer 1970; Wedel 1970; Bozell 1995). Evidence of forest invasion onto prairie soils during the Neo-Boreal has been found in Missouri (Logan 1979; Howell and Kucera 1956; Reeder et al. 1983) and Iowa (Dick-Peddie 1952; Loomis and McComb 1944). Given the evidence of past climatic fluctuations in the Midwest ecotone region, we can assume that similar periods of forest recession have occurred in the Fort Leavenworth area. Paleoclimatic fluctuations have been inferred from the pollen spectra at Muscotah and Arrington marshes, in the Delaware River basin, 40km (25mi) west of DB (Gruger 1973). These inferences are summarized below insofar as they pertain to the cultural periods that are represented at the site.

During the late Pleistocene, the region was part of an ecotone of two major biomes, the spruce forest of eastern North America and the montane conifer parkland that dominated the west and southwest. The pollen data from Muscotah and Arrington marshes reveal the presence of open vegetation, with some pine, spruce, and birch trees and local stands of alder and willow from at least 23,000 to 15,000 BP. An ecotone of grassland and deciduous woodland was established by at least 11,000 BP. It is not known how long it took for this ecotone to replace the coniferous forest biome that dominated northeastern Kansas during the Woodfordian stage of the Wisconsinan glaciation. An unconformity occurs between zones 2 (Woodfordian) and 3 (early Holocene) at Muscotah Marsh that precludes more accurate reconstruction of this important process. It is unfortunate from an archaeological point of view as well, since it is known that the region was inhabited by Clovis hunter-gatherers during that crucial transition period. The fact that the process had been essentially completed by 11,000 years ago suggests that the Folsom hunters represented at the DB site by at least two projectile point fragments (see chapter 9) inhabited an ecotone composed of plant communities more like that of the Holocene.

An abrupt increase in Ambrosia and Franseria pollen marks the transition from zone 3 to 4 at Muscotah, reflecting expansion of the prairie community. This phenomenon occurred throughout the Midwest during the mid-Holocene (McAndrews 1966; King 1980). In northeastern Kansas, this prairie interval is dated ca. 9930$\pm$300 BP. The time transgressive nature of the change is indicated by dating of prairie expansion in Minnesota and South Dakota ca. 8000 BP. (McAndrews 1966) and in southeast Missouri ca. 8700 BP (King and Allen 1977). Zone 4 pollen frequency curves demonstrate the dynamic nature of the prairie-woodland ecotone. In zone 4a, grasses and deciduous trees are both represented, although the latter account for only about 20% of the pollen. Zone 4b reflects a decided regression of woodland components of this ecotone. Trees disappeared from the uplands and low values of some types of arboreal pollen suggest that the Delaware River floodplain "dried out over extensive areas" (Gruger 1973:245). This phenomenon would have occurred in the nearby Salt Creek Valley as well.

Zone 4c reflects a period of forest expansion and eventual approximation of the ecotone that existed during deposition of zone 4a. The transition from the prairie interval to initial forest encroachment represented in zone 4c is dated 5100±250 BP., a time that serves to mark the end of the Hypsithermal episode. Although the time transgressive nature of this episode is reflected by dating of this process in Minnesota ca. 4000 BP. (McAndrews 1966), in southeast Missouri it occurred at approximately the same time, ca. 5000 BP. (King and Allen 1977). The post-Hypsithermal prairie-woodland ecotone was essentially that seen by late Holocene inhabitants of the DB site. However, the subsequent climatic episodes described in the previous section would have affected the distribution of woodland and grassland communities.

An analog of the ecotone as it may have appeared during much of the late Holocene in the site area is provided by Brumwell's (1941) map of the plant associations of Fort Leavenworth (Fig. 2.1). The map also provides a model of the catchment of the DB site, or that area within which its 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 vegetation communities within easy reach of the site's prehistoric 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 throughout most of the Holocene.

Fauna

The plant communities described above provided habitat for a wide array of animal species. Brumwell's (1941) inventory of the Fort Leavenworth fauna lists 12 species of amphibians, 36 species of reptiles, and 37 species of mammals. It does not include such animals as bison, elk, grizzly and black bear, mountain lion, gray wolf, and otter, species that were noted in the region during early historic time but have been extirpated. A more accurate reflection of the Holocene woodland-prairie-riverine environment of the Lower Missouri River valley is provided by faunal remains from local prehistoric sites in that area. Animals identified at the Renner, Young, Aker and Trowbridge sites, all Kansas City Hopewell occupations, are presented in Table 2.3.

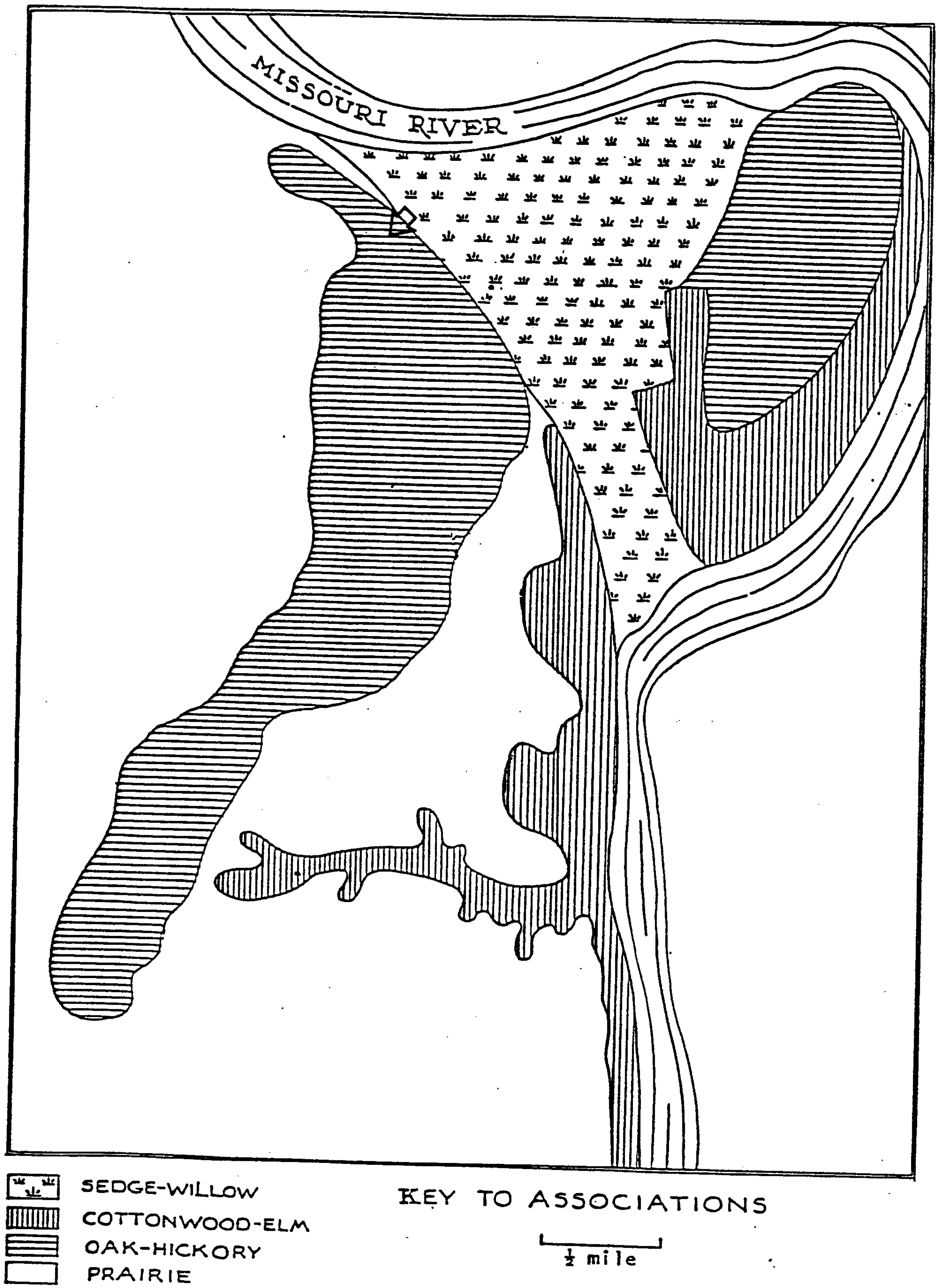

Figure 2.1. Vegetational Associations of the DB Site Catchment. Site (14LV1071) is at arrow tip. Modified from Brumwell (1941).

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

Species	Name	Renner[1]	Young[2]	Trowbridge[3]	Aker[4]	Quarry Creek[5]
Mammalia						
Bison bison	Bison	x	x		x	
Cervus canadensis	Wapiti	x	x	x	x	
Odocoileus virginianus	White-tailed deer	x	x	x	x	x
Procyon lotor	Raccoon	x	x	x	x	x
Castor canadensis	Beaver	x	x	x	x	x
Ursus americanus	Black bear	x				
Canis sp.	Wolf/dog/coyote	x	x	x	x	
Vulpes fulva	Red fox	x			x	
Urocyon cineroargenteus	Gray fox			x		
Lynx rufus	Bobcat	x	x		x	x
Mustela vison	Mink					x
Sciurus niger/ carolinensis	Fox/gray squirrel	x		x		x
Sylvilagus floridanus	Cottontail		x	x	x	x
Mephitis mephitis	Striped skunk		x		x	
Ondatra zibethicus	Muskrat				x	
Marmota monax	Woodchuck		x		x	

Table 2.3 (continued)

Species	Name	Renner[1]	Young[2]	Trowbridge[3]	Aker[4]	Quarry Creek[5]
Geomys bursarius	Plains pocket gopher		x	x		
Scalopus aquaticus	Eastern mole		x			
Oryzomys palustris	Rice rat		x	x		
Neotoma floridana	Woodrat			x		
Perognatus hispidus	Pocket mouse			x		
Aves						
Meleagris gallopavo	Turkey	x	x	x	x	x
Tympanuchus cupido	Grouse			x	x	
Branta canadensis	Canada goose	x				
Buteo jamaicensis	Red-tailed hawk	x				
Anas platyrhynchos	Mallard				x	
Fulica americana	American coot					x
Grus americana	Whooping crane				x	
Pisces						
Lepisoteus osseus	Gar		x	x	x	x

Table 2.3 (continued)

Species	Name	Renner[1]	Young[2]	Trowbridge[3]	Aker[4]	Quarry Creek[5]
Ictalurus punctatus	Channel catfish		x	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. 5) Logan and Banks 1993

The number of some species increases along tallgrass-woodland edges. 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 that depended to a significant extent on such edge game as white-tailed deer. The deer population in Kansas is monitored and controlled today by Kansas Wildlife and Parks. 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 Knsas are known to support a high density and distribution of deer, according to a recent study by the Kansas State Cooperative Extension Service (cited in Corps of Engineers 1981:77). The Missouri River Valley in the Fort Leavenworth area supported a larger population of this game and other edge species 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 Hypsithermal, that resulted in the expansion of prairie at the expense of woodland may have reduced the number of deer and also affected their population density and distribution.

In the Lower Missouri River valley, white-tailed deer were consistently favored over prairie game such 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). The late Holocene bias toward deer may have reflected the relatively low population density of bison in the tallgrass community along the Lower Missouri Valley during post-Hypsithermal time. For example, skeletal remains of late Holocene bison are less frequently found in alluvial deposits of the Kansas River than those of early Holocene age. 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 historic Euroamerican explorers and settlers (Logan 1985). The contrast may be attributable to the prairie expansion that occurred during the Hypsithermal and subsequent forest encroachment on prairie during the Sub-Boreal (Rogers and Martin 1983).

Though faunal remains from DB are sparse (see chapter 13), it is likely that deer, the dominant species at Quarry Creek (Logan and Banks 1993), was the favored game animal of late Holocene occupants of the site. However, if DB was occuppied during the mid-Holocene Hypsithermal episode, it is possible that bison populations were greater and that they were exploited more frequently at that time. In this context, it warrants mention that elements of bison were more abundant at the Logan Creek site, type site of the Logan Creek complex that dates to the mid-Holocene climatic maximum (Kivett 1959). Since this complex may be represented at DB (see chapter 9), research questions concerning a correlation between changes in the physical environment vis-a-vis game species and Archaic adaptations are relevant (these are discussed in chapter 15).

Similarly, the evidence of late Pleistocene-early Holocene hunters at DB, identified as those of the Folsom and Dalton complexes, raises the issue of faunal associations of the habitats present near the site during Pre-Boreal and Boreal time. For example, if the transition to the Holocene ecotone had occurred by the time of these occupations, what changes had occurred in the presence and distribution of Pleistocene megafauna? During the late Wisconsinan, the Lower Missouri River Valley was part of an ecotone of montane conifers and open grasslands. This is reflected in the fossil remains of Ice Age megafauna from the region, including those of the *Symbos-Cervalces* faunal province, associated with Pleistocene spruce forests in eastern North America (Martin and Neuner 1978), such as American mastodon (*Mammut americanum*), woodland musk ox (*Symbos cavifrons*), woodland peccary (*Mylohyus*), and stag-moose (*Cervalces*). West of the Missouri River, remains of animals of the *Camelops-Navahoceras* faunal province, associated with montane conifer parkland, are more frequently found. These include mammoth (*Mammuthus*) and camel (*Camelops*). When did these species become extinct in the region and how did this affect the adaptations of local Paleoindian populations? Conventional wisdom holds that Folsom groups were hunters of bison (*Bison bison antiquus*) and that Dalton groups were the earliest hunters of the woodland-riverine fauna favored to varying extent by all subsequent prehistoric cultures. Can that distinction characterize the Folsom and Dalton activities at DB? While the artifacts of these cultures from the site are too few to shed light on this problem, the fact that buried evidence of them occurs in upland settings in the region indicates further research might do so.

Chapter 3

Geoarchaeology

William C. Johnson

Physical Setting

The DB site (14LV1071), situated on the western bluffs of the Missouri River, has been exposed to the indirect influences of the Pleistocene glacial periods and is located close to the glacial boundary of northeastern Kansas (Aber 1988, 1991). In its role as a sluiceway (conduit of glacial meltwater), the Missouri River transported large quantities of fine glacial sediments from the ice fronts to the north. Persistent, high velocity winds transported these fine sediments from the Missouri River valley bottoms up onto the bluff, resulting in thick deposits of eolian silt, or loess. Deposition of loess has not been continuous; periods of surface stability occurred and are marked by soil formation. Consequently, the late-Quaternary stratigraphy consists of loess deposits with interspersed soils. Wisconsin-age glacial activity to the north began to wane after the Last Glacial Maximum, about 18,000 years ago, but significant loess deposition persisted until 11,000 to 10,000 years ago. Small amounts of loess accumulated during the post-glacial period (Holocene), but accumulation rates were sufficiently slow that the eolian silt was often incorporated into the soil through pedogenesis.

Given the cultural attributes of the site (e.g., view, topographic prominence, proximity to food and water, productive soils/sediments), it is apparent why prehistoric occupation occurred, and climatic amelioration at the end of the Wisconsinan glacial period and beginning of the Holocene would have made the site quite hospitable. The site is located on a hilltop, or knoll that is the divide for drainage basins to the east, southeast, southwest, and northwest (Fig. 3.1). To the north and northeast, the site is bound by high energy drainages associated with the valley wall bluff of the Missouri River valley. Consequently, the site has been subjected to erosion and slope processes associated with the headward extension of the drainages. Given a fairly stable baselevel for the Missouri River for most of the Holocene and bedrock control, headward extension of the drainages has been conservative. Topography of the site has therefore likely been approximately the same since the early Holocene, that is, the knoll was established early and persisted. Nonetheless, erosion has occurred on the top and flanks of the knoll periodically, as evidenced by truncation of a buried soil (this chapter) and artifacts subjected to erosional slope processes (Chapter 14). Presence of tree and grass cover for the latter part of the Holocene has stabilized the site, permitting continued accumulation of a thin Holocene loess mantle and surface soil development. Critical to the site's survival has been, of course, minimal historical disturbance until now, which was limited to deforestation and shallow plowing.

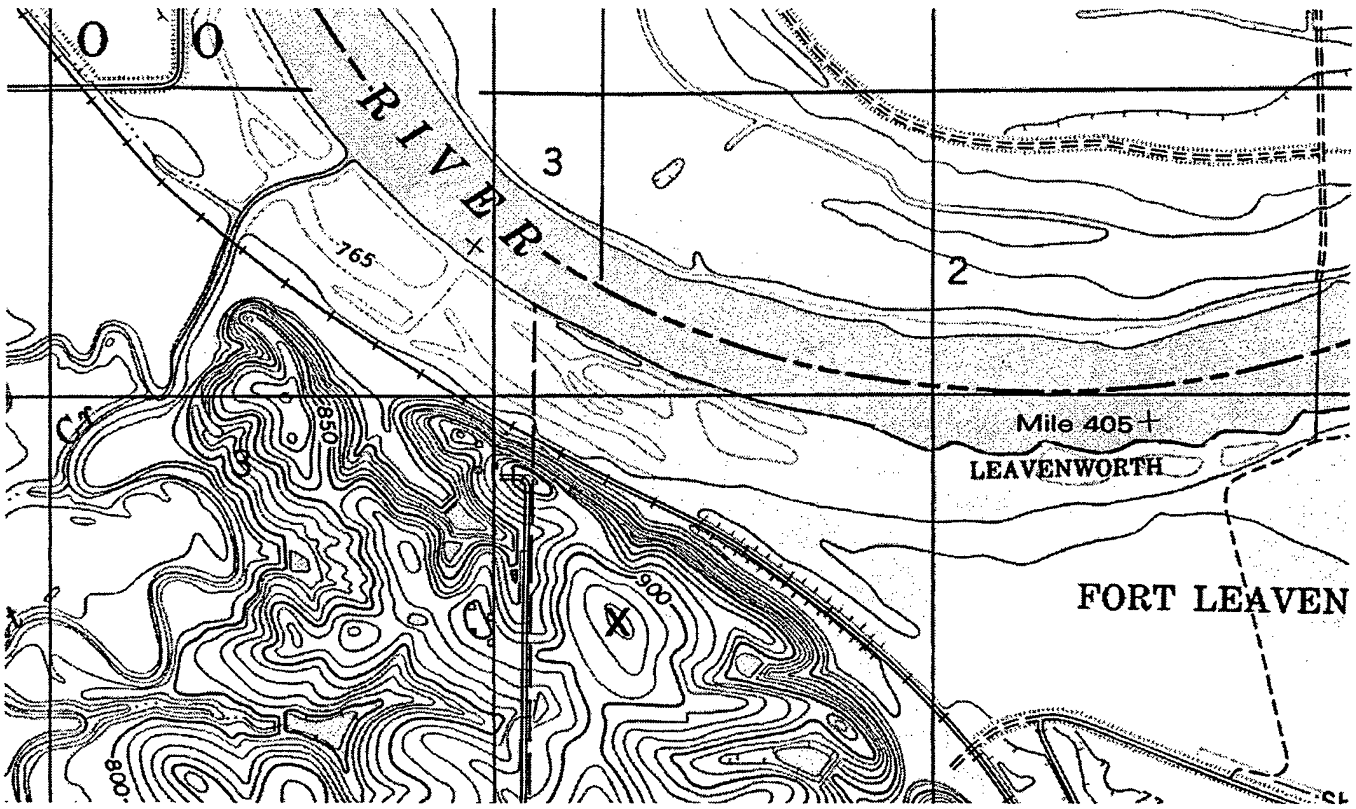

Figure 3.1. Area topographic map showing the DB site (X) and the adjacent Missouri River valley. (source: Weston, Missouri United States Geological Survey 7.5' topographic map)

Late-Quaternary Stratigraphy and Environmental History

On the basis of machine coring, backhoe trenching and hand augering, loess thickness at the site was determined to be in excess of 10m. Although the thickness of loess is unknown in this thick band paralleling the Missouri River valley, Frye and Leonard (1949) reported approximately 23m of loess overlying till and outwash at Iowa Point in Doniphan County and 59m penetrated in a drill hole within Brown County. Leonard and Frye (1954) record fossil mollusks with a forest affinity in the loess and attribute this relatively narrow corridor of thick loess to the trapping effect of trees growing along the river valley.

Given regional stratigraphic information, the site likely contains loess deposits dating from the pre-Illinoian glacial periods, with the bulk dating from the two most recent glacial periods, the Illinoian and Wisconsinan (Frye and Leonard 1952; Bayne and O'Connor 1968). The lithostratigraphic and pedostratigraphic units of relevance to this study include the late-Wisconsinan Peoria loess, Pleistocene-Holocene transition soil (regionally known as the Brady soil), Holocene-age loess (regionally the Bignell loess), and the surface soil (Fig 3.2).

Due to the chronology and depositional environment of the loess landscapes in the region, latest Peoria loess and the Brady soil formed in its upper meter or so have the potential to contain Paleoindian (e.g., Clovis) materials. The addition of Bignell loess mantle has served to bury and preserve possible subsequent cultural activity by Archaic, Woodland, and other peoples.

In order to fully appreciated the changes in climate and influences on the cultural environment, a review of the regional stratigraphy and environments is presented. The discussion is organized into three sections: Late Pleistocene (Wisconsinan), Late Pleistocene-Holocene transition, and Holocene.

Late Pleistocene (Wisconsinan Stage)

Late Wisconsinan loess deposits mantle much of upland surface of the region covering the central Great Plains from the North Dakota/South Dakota border to that of Kansas and Oklahoma and provide a terrestrial record of late Quaternary climate. Thickest deposits lie adjacent to the Missouri River and its major tributaries (Ruhe 1983).

Leverett (1899) first proposed the name Peoria for an interglacial period between the Iowan and Wisconsinan glacial stages. When Alden and Leighton (1917) demonstrated the Peoria was younger than the Iowan, usage shifted to that of a loess, rather than of a weathering interval. Within the Midcontinent, several names have been used for post-Farmdalian loess. Ruhe (1983) preferred the term "late Wisconsin loess" because of the uncertainties in the stratigraphic equivalency from one region to another.

The Peoria loess is typically eolian, calcareous, massive, light yellowish-tan to buff silt that overlies the Loveland loess or an approximate equivalent of the Gilman Canyon Formation. Based on conventional and accelerator radiocarbon ages, deposition of the late-Wisconsinan Peoria loess

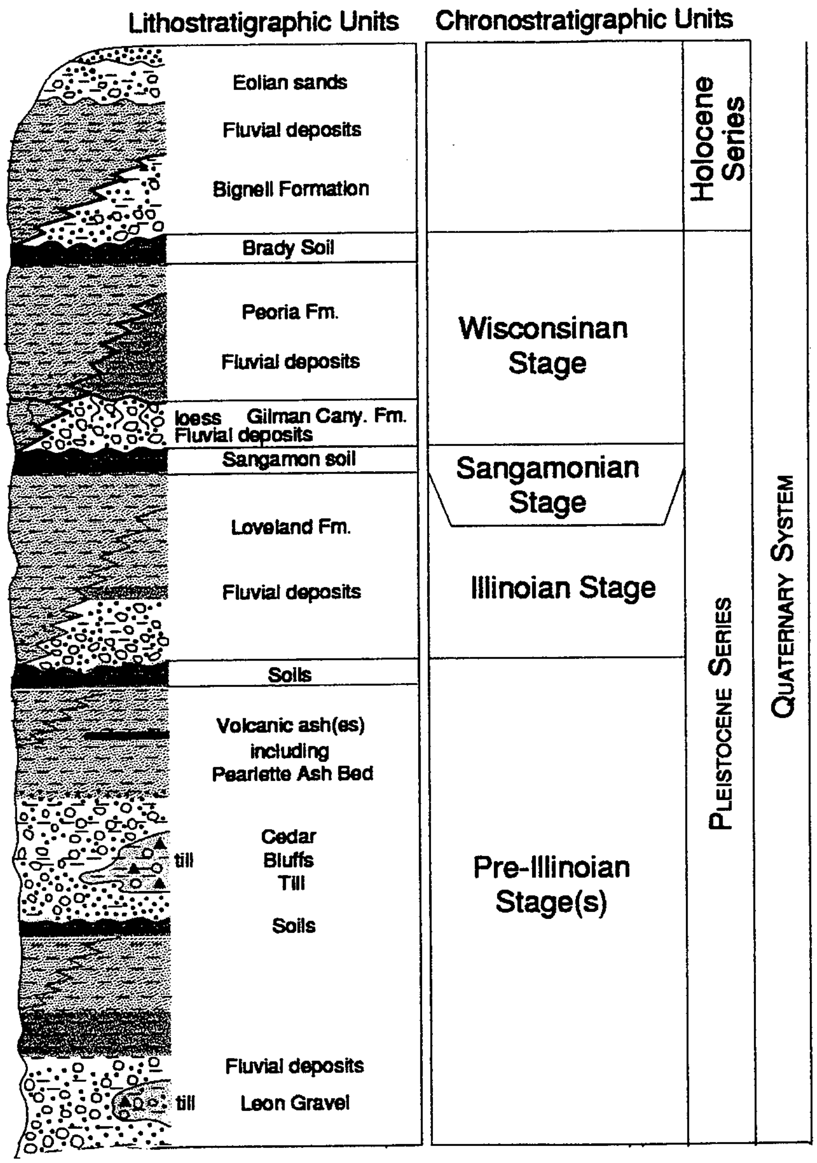

Figure 3.2. Stratigraphic succession for the Quaternary System of Kansas. (source: Kansas Geological Survey 1998)

in Kansas and Nebraska began about 19.5-21 ka. In cold and arid conditions of the late Wisconsin, a high depositional rate was probable; at the Bignell Hill type section in southwestern Nebraska, for example, the sedimentation rate for the late-Wisconsinan Peoria loess averaged 5.7 mm/year (Johnson 1993). This rapid deposition rate seems to be comparable to marine records and rapid enough to preserve high-resolution data for the late-Wisconsinan environmental changes. The rate of accumulation for the Peoria loess was certainly variable, but apparent annual laminae are present at many localities near the Platte River valley of Nebraska, including the Bignell Hill and the Eustis ash pit sites (Johnson 1993). Loess accumulation rates decreased as the regionally-expressed Brady soil began developing between 10.6 and 10.1 ka.

The lack of any well developed, buried soils or other unconformities suggests that Peoria loess in the region represents a nearly continuous deposit and that the faunal zonation reflects a change in the rate of deposition. Evidence that Peoria loess deposition was at least to some extent episodic has emerged from western Iowa (Daniels et al. 1960; Ruhe et al. 1971), central Kansas (Arbogast 1995) and southwestern Illinois (McKay 1979), where deposits exhibit dark, organic-rich bands that are thought to represent incipient soils formed during periods of slower deposition. One of the few indications of soil development recognized is that of a Bt horizon in the Medicine Creek valley (May and Holen 1993); interestingly, the soil has a probable Paleoindian association (May 1990, 1991). Other indications of soil development in the Peoria loess come from the magnetic data obtained at Fort Riley, Kansas (Johnson 1996). Differential abundance and preservation of fossil mollusks in the loess have also been cited as evidence of episodic loess deposition (Frankel 1957).

Ruhe (1983) noted three major features of late-Wisconsinan (Peoria) loess: thinning downwind from the source area, decreases in particle size systematically away from the source area, and marked time transgressiveness at its base. The last feature is problematic and causes correlation problems. Ruhe (1969) realized a decrease in the age of the soil under the loess from 24,500 yr BP near the Missouri River to about 19,000 yr BP eastward across southwestern Iowa. A decrease from 25,000 to 21,000 yr BP was noted for the base of the loess along a transect in Illinois (Kleiss and Fehrenbacher 1973). The top of the loess also seems to be time transgressive, ranging from about 12,500 yr BP in Illinois (McKay 1979) to about 14,000 yr BP in central Iowa (Ruhe 1969). The loess thickness decreases gradually with distance to the south and southeast of the Platte River valley. Except for the loess of the Loess-Drift Hill area in southeast Nebraska, loess south of the Platte was deposited rather evenly on a nearly level surface of old alluvial sands and gravels. In the Loess-Drift Hill area of southeast Nebraska and in most of the area north of the Platte River, the loess mantles a previously dissected and hilly topography.

Despite the attention given to the Peoria loess in central Great Plains, the source of the silt is not completely certain. From their review of available data, Welch and Hale (1987) concluded that a single source was not likely for all loess deposits in Kansas and that the loess was derived from a combination of three sources: glacial outwash river flood plains, present sand dune areas, and fluvial and eolian erosion of the Ogallala Formation. The Platte River undoubtedly contributed massive quantities of loess during glacial stages, as presumed (Swineford and Frye 1951). Loess is thickest immediately south of the Platte River Valley, which suggests that the alluvium in the valley was the source of the loess, at least for those deposits adjacent to the valley (Kollmorgen 1963). Some local thickening of loess occurs to the southeast of the Platte River wherever streams enter from the Sand Hills to the northwest. With prevailing northwesterly winds, these locally thick deposits are probably partially derived from alluvium brought into this valley by these streams. In addition, nonglacial rivers in western Kansas and Nebraska probably contributed substantially more to the volume of loess in the area. Local loess deposits in excess of 23m have been measured along the southeastern bluffs of the Arikaree and Republican Rivers (Swineford and Frye 1951). Swineford and Frye (1951) concluded that the Arkansas River carried too sandy a sediment load to act as a major loess source and suggested that most of the loess deposited south of the Arkansas River in southwest Kansas was derived from northern sources. Thick accumulations also prevail adjacent to the Missouri River valley, as at the DB site

In Nebraska and Kansas, radiocarbon and thermoluminescence dating indicates that Peoria loess in those areas correlates temporally with the Peoria loess of Iowa, Illinois, and Indiana (e.g., Johnson et al. 1993; May and Holen 1993; Martin 1993; Maat and Johnson 1996). However, much of the loess in Kansas and Nebraska occurs upwind of or distant from late-Wisconsinan continental glacial outwash sources. In addition, some of the thickest deposits of loess in Nebraska occur upwind of the Platte River (Swinehart 1990). Flint (1971) pointed out that the volume of loess on the Great Plains is surprisingly high if it was all generated from glacial outwash derived from the Rocky mountains. At the present time, the source of loess in the Kansas and Nebraska portion central Great Plains is unknown, and more than one source may be involved (Welch and Hale 1987).

Little is known about the environmental conditions in the central Great Plains during Peoria loess deposition. Early studies, however, postulated that loess likely accumulated under dry conditions (e.g., Schultz and Stout 1948). Evidence from modern depositional environments suggests, however, that well-vegetated rather than barren surfaces favor loess deposition (Martin 1993). Additionally, the rich land snail fauna of Peoria loess in the Great Plains implies deposition on a vegetated surface (Leonard 1952; Austl. 1988; Wells and Stewart 1987).

Leonard (1952) subdivided the Peoria loess of Kansas into four zones on the basis of the molluskan fauna assemblages present. The *basal zone* is equivalent to a leached interval above the Gilman Canyon Formation and is void of molluskan material. The *lower molluskan zone*, or Iowan, produced an assemblage containing 14 species, 2 of which are diagnostic of the zone. A *transitional zone*, located between the upper and lower faunal zones contains elements of both assemblages and does not imply any abrupt changes in the depositional environment, although the depositional rate may have slowed somewhat. The *upper molluskan zone*, or Tazewellian, contains 26 species, 14 of which do not occur in the lower zone. Because of the relative youth of the Peoria loess, little of the upper zone has been removed from the upland.

Recent findings indicate that trees were present in the central Great Plains during Peoria loess deposition, although the distribution and density of tree cover is unknown. Wells and Stewart (1987) recovered *Picea glauca* (white spruce) cones, needles, and wood from Peoria loess at several sites in south-central Nebraska; radiocarbon ages on the wood range from 14,700 to 13,000 yr BP

(Johnson 1989). They also reported charcoal in Peoria loess at two locales in north-central Kansas. At the Coyote Canyon site in south-central Nebraska, bands of charcoal near the base of the Peoria loess afforded additional radiocarbon ages which range from 21,250 to 19,730 yr BP (Martin 1993). At the nearby Sindt Point site, Johnson also reports an additional age of 21,440 yr BP for the *Picea* (spruce) charcoal.

An upland pollen record from southeastern Kansas suggests that a *Populus* (aspen) parkland was present during the late Pleistocene (Fredlund and Jaumann 1987). Watts and Wright (1966) conclude that *Picea* was the dominant vegetation cover in the Nebraskan Sand hills until 12,500 yr BP, when it was gradually replaced by *Pinus* (pine) and herbaceous vegetation. Recent surveys of the Midcontinent pollen record by Webb et al. (1983) and Baker and Waln (1985) postulate parkland vegetation with treeless openings on the central Great Plains during the late Pleistocene.

Many of the age determinations on the Peoria loess were made from *Picea* remains, indicating a cool, moist environment. For example, a radiocarbon age of 18,830 yr B. P. on *Picea* charcoal was obtained from the Woodfordian/Peoria-age deposits near Bloomington, Franklin County, Nebraska (May and Holen 1993). Although radiocarbon data documents the burial of vegetative material throughout the Woodfordian, two temporal clusters of ages appear from the limited data: 18-17 ka and 14-13 ka. The 18-17 ka time interval represents the Last Glacial Maximum, and the 14-13 ka interval represents the time of major deglaciation (Ruddiman 1987). By interpreting ice-core data from Greenland, Paterson and Hammer (1987) recorded a dramatic decrease in atmospheric dust content from about 13 ka; this period of reduced atmospheric dust may relate to the time of relative surface stability and tree establishment. May (1989) identified deposition of the Todd Valley Formation in the South Loup River of central Nebraska at about 14 ka; the Todd Valley was subsequently buried by loess. Furthermore, Martin (1990) identified entrenchment in the Republican River of the south central Nebraska at about 13 ka, after which valleys were filled with late Peoria loess.

Regarding climatic modeling of the late Pleistocene, Kutzbach (1987) summarized the behavior of the North American jet streams during the late Wisconsin. In July, the split flow around the North American ice sheet modeled at 18 ka persisted to 15 ka, with almost no changes having occurred. By 12 ka, two important changes appeared: first, the northern branch of the jet moved south, over and along the southern flank of the ice sheet, and merged with the southern branch over the northeastern United States. The second change was the reduced intensity of the North Atlantic extension of jets. The jet at 9 ka followed about the same track as at 12 ka, but with weakened intensity. At 6 ka and thereafter, only a single jet core was simulated over Alaska and Canada, and winds were weak compared to reconstructions of earlier periods. Specifically, the modern single jet core of July follows generally the same track as the northern branch of the split jet in July during the glacial maximum.

In January, like July, the split flow around the North American ice sheet and the intense North America/North Atlantic jet cores at 18 ka persisted to 15 ka with almost no change. At 18 ka the simulated temperatures over the continent were much lower than at present, especially over the elevated and highly reflective ice sheets (COHMAP Members 1988). By 12 ka, the flow had adjusted to single core of high velocity winds that followed the west-coast-ridge, east-coast-trough pattern of today, and the jet maximum was almost as strong as at 18-15 ka.

The north central region, from the Rockies to the Appalachians and from immediately south of the ice sheet to 40°N, had summer temperatures of 16°C at 18-15 ka, about 7°C below present. Precipitation was less than present at 18-15 ka (colder, with storm track shifted south of the region) and precipitation-minus-evaporation was slightly increased at 18-15 ka (evaporation decreased more than precipitation).

Late Pleistocene-Holocene Transition

The last deglaciation was a period of intense and rapid climatic changes that affected the global climate from about 20,000 to 5,000 yr BP. Paleoclimatologists have reconstructed global variations, including chemical composition of the atmosphere (30% increase in CO_2 and CH_4 and decrease in dust content, etc.), temperature of the atmosphere and surface of the ocean (mean global change of about +4°C), and major reorganization of the ocean circulation and sea-level rise of about 120 meters, followed by slow rebound of the continents below the ice caps.

The transition between the Last Glacial Maximum and the present inter- or postglacial episode has drawn much attention from investigators for many decades. At first, the last deglaciation was believed to have been a simple, unidirectional shift, but more recent detailed studies revealed that it was a two-step process (Duplessy et al. 1981; Broecker et al. 1989). During the last deglaciation, intervals of rapid warming between about 13 ka and 11 ka and at about 10 ka were separated by a distinct, brief, cool climate episode occurring between about 11 ka and 10 ka.

Between about 12ka and 9ka, the climate and vegetation of central North America underwent dramatic changes (Wright 1970; Webb et al. 1983, 1993). Spruce trees had been replaced by widely distributed deciduous trees in northeastern Kansas, and deciduous trees persisted until about 9ka when grasslands expanded (Webb et al. 1983). It is clear that megafaunal extinction and dissolution of disharmonious faunas began about 12ka, and the mesic conditions under which the regionally-expressed Brady soil developed persisted until about 8ka, when the modern climate first appeared. Changes in vegetation and faunal assemblages at this time reflect a shift to warmer and drier conditions with increased seasonality (COHMAP Members 1988) and stronger zonal air flow at the surface (Kutzbach 1987). This was a time of major atmospheric circulation change within the central Great Plains, as well as elsewhere.

The beginning of the Holocene, about 10 ka (Hopkins 1975), is a time of dramatic environmental change and attendant stratigraphic discontinuities. In general, this boundary is considered only geochronometric without specific stratigraphic reference, although a stratotype in Sweden has been proposed for the boundary (Mörner 1976); the Swedish unit has a reported age of 10,000±250 yr BP (Fairbridge 1983). According to Richmond and Fullerton (1986), a stratigraphic boundary of regional extent of the Pleistocene-Holocene boundary age has not been identified in the

United States, and that major climatic or environmental changes at 10,000 yr BP are documented only locally (Watson and Wright 1980). This contention seems faulty, however, on the regional and subcontinental scale in that research of the last several years in the central Great Plains has identified the Brady soil (Schultz and Stout 1948) as a major pedostratigraphic marker (e.g., Johnson and Martin 1987; Johnson and Logan 1990; Johnson and May 1992).

Brady Soil: Classically, the Brady soil was associated with the upland loess deposits, but recent investigations have identified a contemporaneous soil in upland eolian sands and in alluvial valley fill (Johnson and May 1992). It therefore appears that the Brady soil development represents a time of extensive, broad-scale landscape stability. The Brady soil represents the most important break in sedimentation recorded since development of the cumulic soil of the Gilman Canyon Formation (>20,000 yr BP), and also marks the position of a distinct faunal discordance (Frye and Leonard 1955). At least the early and perhaps all of the Brady soil-forming interval coincides with the Younger Dryas cold interval of the North Atlantic region.

The Brady soil was first named and described by Schultz and Stout (1948) at the Bignell Hill type locality, a loess sequence exposed along a road cut in the south valley wall of the Platte River of western Nebraska. The soil is developed within the Peoria loess and is overlain by the Bignell loess. The name was subsequently adopted by researchers in Kansas (Frye and Fent 1947; Frye and Leonard 1949, 1951; Frye et al. 1949). The soil is regionally extensive only in the northwestern and west central parts of Kansas, and even there it occurs discontinuously on the landscape. Frye and Leonard (1951) and Caspall (1970, 1972) recognized Brady development in northeastern and other parts of Kansas. Without the overlying Bignell loess, the Brady soil does not exist; the modern surface soil has incorporated post-Bradyan loess fall into its profile. The Brady soil is typically dark gray to gray-brown and better developed than the overlying surface soil within the Bignell loess. Strong textural B horizon development and carbonate accumulation in the C horizon are typical, although it occasionally displays evidence of having formed under poorer drainage conditions than have associated surface soils (Frye and Leonard 1951). Feng (1991) noted that the Brady soil, as expressed in Barton County, is strongly weathered both physically and chemically.

Until recently the age of the Brady soil had been uncertain, even at the type section: Dreeszen (1970) reported two ages of 9160 and 9750 yr BP, both of which were believed to be too young because of contamination, and Luttenegger (1985) reported an age of 8080 yr BP without any stratigraphic context. Since these earlier studies, additional radiocarbon ages have been reported from the Brady soil at the type locality and elsewhere (Table 3.1). For example, Johnson (1993) reported two ages of 10,670 and 9240 yr BP on the lower and upper 5 cm, respectively, of the Brady A horizon at the type section, and Souders and Kuzila (1990) dated a core at a site in the Republican River valley and reported an age of 10,130 yr BP. Similar ages from the eolian phase have been obtained in south-central Nebraska and north-central and central Kansas. Ages of the alluvial phase of the Brady from Nebraska and Kansas correspond well with the ages of the eolian phase. According to age data, soil development began at about 10.5 ka and ended 9-9.5 ka, suggesting a soil forming interval of greater than 1000 years.

Table 3.1. Brady soil radiocarbon ages[1]

Sample	Age[2]	Source
Nebraska		
Bignell Hill (type section)		
n.a.	8,080±180	Lutenegger 1985
W-234	9,160±250	Dreeszen 1970
W-1676	9,750±300	Dreeszen 1970
Tx-7425	9,240±110	Johnson 1993
Tx-7358	10,670±130	Johnson 1993
North Cove		
west		
Tx-6319	10,550±160	Johnson 1989
Tx-6112	10,220±140	Johnson 1989
Tx-6320	10,270±160	Johnson 1989
east		
Tx-6321	11,530±150	Johnson 1989
PITT-824	11,025±90	Martin and Johnson 1995
Prairie Dog Bay		
DIC-3310	10,140+110, -120	Cornwell 1987
Tx-5909	10,360±130	Martin, 1990
PITT-825	9,020±95	Martin and Johnson 1995
Naponee		
Beta-33939	10,130±140	Souders and Kuzila 1990
Kansas		
Speed		
Tx-6626	8,850±140	Johnson 1993
Tx-6627	10,050±160	Johnson 1993
Barton County		
Tx-7045	9,820±110	Feng 1991
Tx-7046	10,550±150	Feng 1991

[1] ages obtained from the upland Brady soil, i.e., developed in loess

[2] most ages have been corrected for the effects of isotopic fractionation

Arbogast (1995, 1996a) obtained several Brady era radiocarbon ages from soils buried within the eolian sand of the Great Bend Sand Prairie. Following a period of instability after a short period of stability during the Last Glacial Maximum, soil formation occurred at the Pleistocene/ Holocene boundary, which correlates temporally with the loessal Brady soil. Two radiocarbon ages of 10,330 ± 100 and 10,360 ± 100 yr BP were obtained at Wilson Ridge, a lunette in the Great Bend Sand Prairie (Arbogast 1996b).

Significant deglaciation did not begin until 14 ka and ended by 6 ka. This conclusion is validated by maps of ice area, by marine $\delta^{18}O$ records, and by terrestrial and marine records (Ruddiman 1987; Crowley and North 1991). With increased summer insolation during the termination, the mass imbalance of ice sheet would have increased. Ice sheet decay may also have been affected by a number of processes. For example, CO_2-induced air temperature changes were apparently sufficiently large to cause disintegration of the extensive marine-based ice sheet on Eurasia. Broecker et al. (1988) suggested that changes in the coupled ocean-atmosphere circulation in the North Atlantic were responsible for the changes.

The structure of deglaciation within this 8,000-year interval is uncertain. There is evidence supporting: (1) a smooth deglaciation model with fastest ice wastage centered on 11 ka; (2) a two-step deglaciation model with rapid ice wasting from 14 to 12 ka and 10 to 7 ka, and a mid-deglacial pause with little or no ice disintegration from 12 to 10 ka; and (3) a Younger Dryas deglaciation model with two rapid deglacial steps as in (2) above, interrupted by a mid-deglacial reversal with significant ice growth from 11 to 10 ka. The critical data supporting the smooth deglaciation model are maps of Laurentide ice area based on radiocarbon-dated glacial deposits. Although there are subtle suggestions of more rapid retreat at or near the time of the two steps mentioned above, these curves indicate a steady progressive retreat of North American ice, with significant oscillations in retreat rate only at local spatial scales. Some marine $\delta^{18}O$ curves also show a smooth progressive decrease toward Holocene values.

The step deglaciation model is also supported by some marine $\delta^{18}O$ records (Mix 1987). In addition, the distinctive patterns of change in sea-surface temperature of the North Atlantic Ocean and in Greenland ice-core $\delta^{18}O$ values also show abrupt step-like warmings at 10 ka and approximately 13 ka; these warmings might be associated with step-like decreases in Laurentide ice volume. Regionally integrated rates of pollen change in eastern and central North America also show a rapid change centered on 13.7 and 12.3 ka. (Ruddiman 1987).

The Younger Dryas deglaciation model is suggested by sea-surface temperature cooling between 11 and 10 ka in the North Atlantic Ocean. At least early and perhaps all of Brady pedogenesis coincides with an abrupt and brief cool interval correlative with the classic Younger Dryas cold interval of the North Atlantic region.

Holocene

Using a modified version of the Blytt-Sernander scheme of climatic episodes, Bryson and

Wendland (1974) produced a model that subdivided the Holocene into the pre-boreal, Boreal, Atlantic, sub-Boreal, sub-Atlantic, Scandic, neo-Atlantic, and Pacific episodes. For example, during the Atlantic episode (8450-4680 yr BP), the wedge of modified Pacific air that characterizes the grassland climate was expanded northeastward into central Minnesota and eastward towards the Atlantic seaboard (Bryson et al. 1970). This model has become antiquated, but provided a launching point from which to begin examining the climatic nature of the Holocene.

According to recent model simulations, by around 9 ka summer insolation had increased but was still secondary in influence to the shrinking Laurentide ice sheet (COHMAP members 1988). The glacial anticyclone persisted in eastern North America, but was much smaller than at 12 ka. With the Pacific subtropical high gaining strength adjacent to the west coast of North America, northwesterly winds replaced westerly winds along the coast in the Northwest. The Midcontinent was still cooler and more moist than at present in July. By the early Holocene (9 ka), the ice had wasted appreciably, the jet stream was no longer split, orbital parameters were favoring increased temperatures, and zonal flow was dominating (Kutzbach 1987).

For the Altithermal (c. 6 ka), model results produced mean summer temperatures 2° to 4°C higher than present (COHMAP members 1988) and annual precipitation up to 25 % less than at present in the region (Kutzbach 1987). Surface westerly winds in the midcontinent were stronger than today, with warmer and drier conditions prevailing. Since 6 ka, simulation indicates that westerly flow has weakened and summer temperatures have decreased.

Throughout the early and middle Holocene, loess was deposited on the uplands of Kansas and Nebraska. This loess, the Bignell, seems to be best expressed adjacent to river valleys, making the DB site an ideal setting for its deposition. Bignell loess, first described and named at a bluff exposure on the south side of the Platte River valley in western Nebraska (same for the Brady soil), is typically a gray or yellow-tan, massive silt, calcareous and seldom more than 1.5m thick (Schultz and Stout, 1948). Although it is often somewhat less compact and more friable than the underlying Peoria loess, no certain identification of the Bignell loess can be made without the local presence of the Brady soil; the Bignell appears to be at least partially weathered at some localities which indicates that it was derived, in part, from a pre-weathered surface such as the Brady soil, perhaps eolian and alluvial phases alike. Bignell loess does not form a continuous mantle on the Peoria deposits of the region; instead, it occurs as discontinuous deposits that are most prevalent and thickest adjacent to modern-day river valleys, often within depressions on the Peoria/Brady surface. Timing of Bignell loess deposition is uncertain, but radiocarbon ages from several sites in the region indicate deposition occurred at variable intensities throughout the Holocene up to within the last 1,000-2,000 years (Johnson 1993; Johnson unpublished data).

Palynological documentation of vegetation and climatic change within the Holocene presents some special challenges (Fredlund and Jaumann 1987). These problems are, at least in part, the result of the taxonomic limitation of pollen analysis. Many major grassland pollen types encompass entire families of plants (Fredlund 1991), and, consequently, large changes within grasslands can occur but not be readily apparent within the pollen record (Wright et al. 1985). This taxonomic limitation explains the lack of clear palynological definition of the middle-Holocene climatic drying in the central Great Plains. Because of the limited records and inability to differentiate grass pollen, little Holocene vegetational change is apparent in the fossil pollen record (Baker and Waln 1987).

Abundant palynological evidence exists for middle-Holocene eastward migration of the prairie/forest ecotone. Several palynological studies from areas peripheral to the central Great Plains document middle-Holocene expansion of the prairie (e.g., Brush 1967; Watts and Bright 1968; Durkee 1971; Van Zant 1979). Barnosky and others (1987) subsequently documented the eastward ecotonal shift between about 8,000 and 6,000 years ago through a review of data from the northern Great Plains. Using pollen/climate transfer functions, Bartlein et al.(1984) estimated that precipitation in the Minnesota area was about 20% less during the middle Holocene than it is today, but that temperature was only slightly higher.

In Nebraska, a paleoecological record comes from Sears' (1961) study of Hackberry Lake in the north-central part of the Sand Hills. A radiocarbon age indicates that organic deposition began at this site about 5,040 yr BP, and the sediments also record a fluctuating dominance of prairie vegetation that persists to the present, but with no discernible record of the Altithermal. Since the sand dunes that enclose the Hackberry Lake basin are well-preserved barchan and barchanoid-ridge dunes that indicate prevailing wind directions to the southeast, this site appears to represent a post-Altithermal stabilization of the dunes. On the southwestern margin of the Sand Hills at Swan Lake, Wright and others (1985) analyzed a core with a basal radiocarbon age of about 8,000 yr BP. Sedimentation in Swan Lake appeared to be continuous to the present, and pollen analysis indicated a prairie vegetation with minor fluctuations of herbs and grasses throughout this time, but no Altithermal signal.

Two sites in Kansas provide palynological information for the Holocene: Muscotah Marsh (Grüger 1973) and Cheyenne Bottoms (Fredlund 1995). The Holocene portion of the record at Muscotah Marsh in northeastern Kansas contains unconformities and lacks close-interval radiocarbon ages, but clearly portrays middle Holocene prairie expansion and contraction. At Cheyenne Bottoms in central Kansas, the Holocene is markedly different from the late-Pleistocene Farmdalian grassland-steppe assemblage: lower *Artemisia* percentages and lower relative frequencies of arboreal pollen types characterize the Holocene. These differences suggest that the Holocene regional upland vegetation in the Holocene lacked the sage component which was so important during the Farmdalian. The Holocene vegetation also lacked diversity of tree and shrub taxa regionally present during the Farmdalian. Of all tree and shrub pollen taxa identified, only *Ulmus* (elm) and *Celtis* (hackberry) are more common during the Holocene. Fredlund (1995) also divided the Holocene into four microzones based on changes in the local pollen signal. The latest Pleistocene-earliest Holocene zone (>9,690 yr BP), through its abundance of diatoms and gastropods, suggests increasing moisture at the site. The soil developed above this zone appears to correlate temporally with the Brady soil. The high relative frequencies of *Cheno-Am* type pollen throughout the Holocene are associated with the existence of mudflats periodically exposed as fluctuations of water levels occurred within the basin. In the middle Holocene (ca. 8,500 to 3,700 yr BP), frequencies of *Cheno-Am* pollen types decreased significantly, suggesting more stable, perhaps lower, water levels. The increase in *Ambrosia* (ragweed) pollen during the middle Holocene indicates less fluctuating and lower water levels. The late Holocene (> 3,700 yr BP) was characterized by a return to fluctuating water levels and exposed mudflats.

The timing of the Holocene dry/warm interval appears to vary geographically. In Minnesota the maximum of Altithermal warmth and dryness occurred between about 8,000 and 4,000 yr BP, peaking at 7,200 yr BP (Wright 1976). In the northwestern United States most sites register greatest drought in the early Holocene, although at some sites it was delayed until the middle Holocene, concurrent with the Midwest (Barnosky et al. 1987). In the Southern High Plains, widespread eolian activity began in some areas by 9,000 yr BP and culminated 6,000-4,500 yr BP, probably because of warmer, drier conditions that reduced vegetation cover (Holliday 1989).

Using stable oxygen and carbon isotopes from lacustrine and soil carbonates collected at Fort Hood in north-central Texas, Humphrey and Ferring (1994) demonstrated that mesic conditions continued until 7500 yr BP, except for a brief drying period between about 12,000 and 11,000 yr BP The slow replacement of cool-season plants by warm-season plants at Fort Hood agrees with an extended warming and drying climatic transition during the early Holocene.

By the middle Holocene, drying had reached a maximum according to most studies. Northwestern Texas was experiencing conditions of maximum temperatures, minimum precipitation, and eolian activity between 6000 and 4500 yr BP (Holliday 1985, 1989; Pierce 1987). Values of $\delta^{13}C$ derived from buried soils in this region revealed a shift from -23‰ in the early Holocene to -15‰ in the middle Holocene (Haas et al. 1986), that is, a shift in dominance from cool-season C_3 grasses to warm-season C_4 grasses. Based on enriched $\delta^{13}C$ values in soil carbonate from their Texas study, Humphrey and Ferring (1994) identified a middle-Holocene xeric episode, although the $\delta^{18}O$ values from these same carbonates did not indicate a significant temperature change.

Limited $\delta^{13}C$ data from the Sargent site, an upland loess exposure in southwestern Nebraska, suggest a gradual increase in dryness through the Holocene. Opal phytolith data display an overall decrease in the cool-season C_3 grasses and attendant increase in warm-season C_4 short grasses through the Holocene, and a decrease in the C_4 tall grasses between about 8,000 and 4,000 yr BP (Bozarth 1992). Similarly, $\delta^{13}C$ data derived from the correction of radiocarbon ages obtained from soils buried in alluvial fill of the central Great Plains (Johnson et al. 1996) also indicate a gradual increase in C_4 plants from about 12,000 yr BP through the Holocene, but these data are relatively noisy, however, due to the edaphic conditions encountered on bottomlands.

Methodology

A suite of field and laboratory methodologies was used to conduct the geoarchaeological investigation at the DB Site. Stratigraphic studies and associated sampling were carried on a core (13m) extracted near the archaeological excavations, a series of seven backhoe trenches excavated within and off the site, and selected walls of the archaeological excavations (Fig 3.3). The trenches

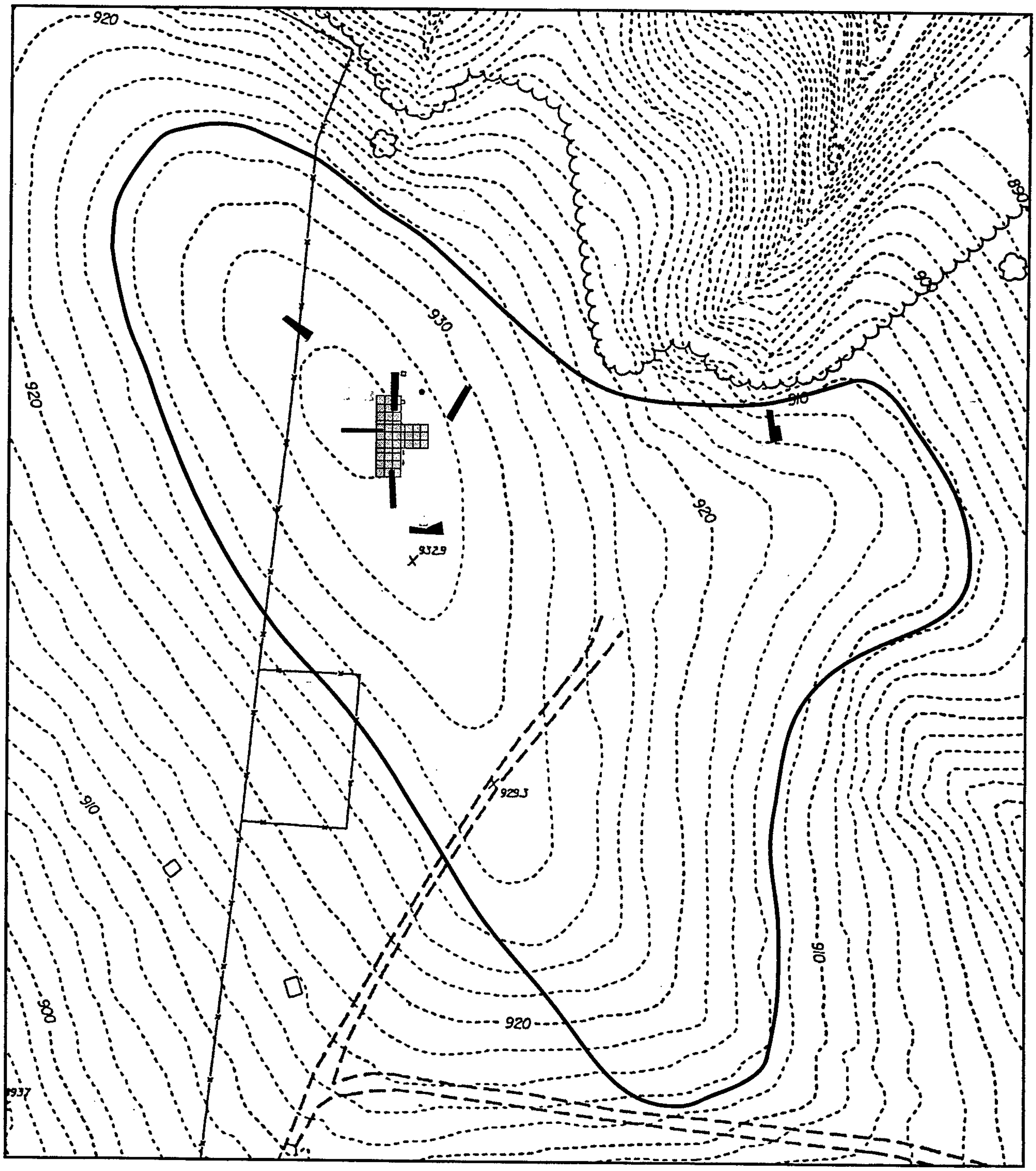

Figure 3.3. Medium-scale topographic map of the DB site illustrating the location of trenches relative to the slope and excavation units. (source: U.S. Army Corps of Engineers)

were located to represent the variation in excavation block stratigraphy and that of the hillslope areas of the site, as defined. Also, several cores were extracted as part of a reconnaissance study of the stratigraphy. Exposures were described and sampled in the field for laboratory analyses, whereas the core was sampled in the laboratory.

In the laboratory, standard physical and chemical procedures were employed to characterize the sediments and soils of one of the trenches excavated. These procedures included particle size determination, pH, and organic matter content. Samples were collected for radiocarbon dating and were prepared prior to submission to the laboratories. On the same trench, stable isotope ratio analysis ($^{13}C/^{12}C$, expressed as $\delta^{13}C$) was employed to characterize the vegetation and associated climate of the site; these data also provide information on the vegetation record to compare with data from the phytolith analyses (Chapter 4). Rock magnetic analyses, employing up to four parameters, were carried out on the core and seven trench profiles in order to (1) identify stratigraphic units based upon their regional signatures, (2) identify and characterize soils, and (3) search for evidence of habitation surfaces.

Sediment Analyses

Particle-size distribution of the samples was determined using the hydrometer method. After removal of organic matter and carbonate, 50gm of sample was place in a dispersant solution, mixed ultrasonically, and then placed in a hydrometer cylinder. Measurements were made at specified intervals with a soil hydrometer to obtain the percentages of sand, silt, and clay.

The pH of sediment and soils was determined using an electronic meter fitted with a glass electrode. A volume of about 40ml of clastic material was placed in a 50ml beaker, which was then moistened with distilled water. Measurements were taken on the sediment-water slurry after a one-hour equilibration period.

Organic matter was determined using the Walkley-Black method, a titration technique. After the dried and pulverized sediment or soil sample was treated with a potassium dichromate and sulfuric acid solution (oxidizer), it was titrated with ferrous sulfate using ferroin indicator. The volume of ferrous sulfate solution required in the titration, a measure of the amount of dichromate present in excess of that required to oxidize the organic matter, is used to calculate the percentage of organic carbon. The percentage of organic matter was obtained by using a multiplier of 1.724 (soil OM contains about 58% OC).

Samples for radiocarbon dating were submitted to the University of Texas-Austin Radiocarbon Laboratory (Tx) and to the Radiocarbon Laboratory of the Illinois State Geological Survey (ISGS). The samples were first prepared in the soils laboratory of the Department of Geography. The procedure was that of Johnson and Valastro (1994), as described above. Those samples submitted to the Illinois State Geological Survey laboratory were, however, not pretreated with HCl; at the radiocarbon laboratory, the samples were boiled for one hour in a 1N HCl solution in order to remove not only $CaCO_3$, but also any dolomite present.

Stable Carbon Isotopes

There are few quantitative techniques in use today for paleoecological reconstructions in terrestrial depositional systems. One recently adopted approach to quantitative reconstructions is to estimate the proportion of C_3 (cool-season) to C_4 (warm-season) plants once present at a site using carbon isotopes from the bulk carbon content in sediments, primarily in buried soils. The natural difference in the stable carbon isotopic composition of C_3 and C_4 plant species provides an opportunity to assess the long-term stability of plant communities and climate of a given region (Troughton et al. 1974; Stout et al. 1975). The basis of this approach is that during photosynthesis C_4 plants discriminate less against $^{13}CO_2$ than C_3 plants (Vogel 1980; O'Leary 1981). This difference in carbon isotope fractionation during photosynthesis results in a characteristic carbon isotope ratio in plant tissue that serves as a diagnostic indicator for the occurrence of C_3 and C_4 photosynthesis. The $\delta^{13}C$ values of C_3 plant species range from approximately -32 to -20‰, with a mean of -27‰, whereas $\delta^{13}C$ values of C_4 species range from -17 to -9‰, with a mean of -13‰. Thus, C_3 and C_4 plant species have distinct, non-overlapping $\delta^{13}C$ values and differ from each other by approximately 14‰ (Nordt et al. 1994).

Site specific factors should be borne in mind when interpreting $\delta^{13}C$ data from soil humates. For example, the 17,000 yr BP buried soil on the north flank and crest of the dune at Wilson Ridge in the Great Bend Sand Prairie (17,180 ± 240, Tx-7824: 16,520 ± 200, Tx-7825) yielded a $\delta^{13}C$ value of -11.9‰. During the Last Glacial Maximum, the dune temporarily stabilized and a soil formed. A $\delta^{13}C$ ratio of -11.9 ‰ suggests that warm-season plants dominated, a finding contradictory with regional late-Wisconsinan mesic climatic conditions. This may, however, been a site-specific, or edaphic response. Following landscape stability, the soil was buried by sand, presumably during another period of increased aridity and prevailing northwesterly winds (Arbogast 1995, 1996b).

Approach: The procedure utilized is identical to that used for the preparation of soil and sediment samples for ^{14}C humate dating, which renders the results compatible with those obtained in the course of age correction for the effects of isotopic fractionation (Johnson and Valastro 1994). A total of thirty-eight 300 to 400gm samples collected from contiguous 5cm intervals of the exposure in Trench 1 were prepared for $\delta^{13}C$ analysis. Samples were first disaggregated in 4-liter beakers filled with distilled water. They were then skimmed with a 60-mesh screen to remove floating organic debris. Next, the samples were washed through a 230-mesh screen with distilled water into a second beaker in order to remove the sand and coarse silt fractions; the fine fraction remaining is assumed to contain the adhering organic carbon. The samples were then treated with concentrated HCl in order to remove the inorganic carbon contained within the carbonate. This step is particularly important because of the prevalence of limestone bedrock in the study area and the significant amounts of calcium carbonate transported in with the loess. Following distilled water washes and oven-drying (100°C) in 4-liter beakers, the samples were pulverized and packaged in sterile polyethylene bags. They were then submitted to Geochron Laboratories for stable carbon isotope ratio analysis.

Rock Magnetic Analyses

The primary carriers of magnetism (iron oxides, iron sulphides and manganese oxides) usually comprise less than 5% of the sediment mass. Magnetic minerals are, however, common in terrestrial materials and extremely sensitive to environmental conditions. Since it is extremely difficult or near impossible to separate out these minute magnetic minerals in order to study them, the bulk magnetic characteristics of the sediments are usually characterized by one of the bulk properties, magnetic susceptibility, which is measured using a non-destructive technique. Magnetic susceptibility (χ or MS) is a measure of the extent to which a sample becomes more strongly magnetized when a small alternating magnetic field is applied, or simply the ratio of the induced magnetism to the strength of the applied field.

Whereas susceptibilty provides information on magnetic concentration, a related parameter, frequency dependence of magnetic susceptibility (FD), provides information on magnetic grain size. FD is the percent difference between susceptibility measured at a low-frequency applied field compared to its measurement at an applied field with a higher frequency. Unfortunately, FD measured using only fixed low and high frequencies, as is the case with existing instrumentation, will discriminate only a portion of the total superparamagnetic (very small magnetic material) population. With the instrumentation available in our laboratory, only the presence of grains between approximately 18 and 20 nm (nanometers) in diameter (very fine clay fraction) can be detected. Even so, FD values are typically much higher in soils than in intervening loess intervals, reflecting abundant pedogenic material. Accordingly, this parameter is particularly useful in defining soil Bt horizons.

Although susceptibility is largely a product of magnetic mineralogy and concentration, other factors come into play. Some of these factors include size and shape of the magnetic grains, frequency of the applied field, and sample size and shape. By controlling for the latter variables, controls on susceptibility reduce to magnetic grain size and shape, in addition to magnetic mineralogy. Magnetic grains fall largely into three groups, but not exclusively on the basis of size: multidomain, single domain, and superparamagnetic (largest to smallest). Since grain shape has so little influence on the susceptibility, variations in shape are easily accommodated in the algorithms employed. Magnetic susceptibility is controlled mainly by the volume of ferrimagnetic minerals in the sediments being analyzed. Magnetite is almost always the most important of the magnetic minerals.

The potential sources of the magnetic minerals in the sediments include the geologic materials (in this study, late-Quaternary loess), organic matter, atmospheric deposition, and groundwater. Unlithified Quaternary sediments carry with them the magnetic signature of the original bedrock source(s). For example, unweathered sediments (i.e., containing primary ferrimagnetic minerals) will usually consist of large multidomain grains and thereby produce very low FD values (e.g., <1%). Organic matter has an impact through dilution of the magnetic mineral concentration and other yet not fully understood processes, all of which reduce the susceptibility, but have little effect on FD. Calcium carbonate accumulations have much the same effect on the former magnetic parameter. Through dust (dry or wet) deposition or precipitation of dissolved material, the atmosphere provides a source of magnetic material. Tephra deposition from a volcanic eruption is a common example found in the Quaternary record, and, more recently, airborne microscopic debris resulting from industrial and urban activity. Groundwater may precipitate iron (e.g., groundwater laterites), and, under proper pH conditions, iron minerals may precipitate in lakes to become incorporated into the sedimentary record.

Weathering and pedogenesis bring about dramatic changes in the magnetic character of sediments, the processes that make application to this study possible. Chemical and biochemical changes in unconsolidated sediments affect magnetic properties through the release, via weathering, of magnetic grains from previously existing sediments, the release of iron in ionic form from iron-bearing minerals, modification of the amount of diluting substances such as calcium carbonate and some clays, and formation of magnetic through the activities of bacteria and algae, especially magnetotactic bacteria. Further, physical weathering through its mechanical change in size, shape, and associated sorting of magnetic grains may affect bulk magnetic characteristics under certain circumstances. Fire has an appreciable effect on the magnetic susceptibility in that hematite is variably altered to magnetite and maghemite during combustion; buried burned surfaces, for example, show up dramatically in the susceptibility measurements, as does the related phenomenon, lightening strikes, albeit rarely. Pedogenesis, which involves chemical and physical weathering, has a major impact on the susceptibility and FD. All well-drained soils tend to exhibit a high susceptibility signal, whereas poorly drained/gleyed soils usually have low susceptibility values due to dissolution of the ferrimagnetic minerals under the reducing conditions. The array of susceptibility and FD patterns in soils is varied, for example, some exhibit a general bulge in susceptibility over the entire soil and a high in FD within the B horizon where the fine secondary clay minerals are concentrated.

Approach: Samples were collected in the field from freshly exposed profiles or from cores extracted and transported to the laboratory in clear butyrate plastic liners. The individual magnetic samples were collected in numbered, demagnetized, 4-cm^2 plastic cubic containers with lids. The sample interval varied slightly, but averaged 40 per meter. These cubes were pressed by hand or driven with a rubber-coated, dead-blow hammer into the exposure or core to obtain the required amount of sediment. In the laboratory, the cubes were cleaned on the outside, sorted, air dried, weighed, and placed in wooden trays prior to measurement.

Susceptibility and FD measurements were obtained using a Bartington magnetic measurement system consisting of a Model MS2 susceptibility meter and a 36mm-cavity, dual-frequency sensor (MS2B). As each sample was measured, data were entered into a database program (Microsoft Excel and Sigmaplot) for subsequent analysis and presentation. Specifics of the procedure are presented in the literature provided with the instrumentation package (Bartington Instruments, 1995) and in Gale and Hoare (1991). The facility is located in this investigator's laboratory within the Department of Geography at the University of Kansas. Samples from the deep core extracted on-site were also subjected to saturation isothermal remanent magnetization (SIRM) and anhysteretic remanence magnetization (ARM) analyses. SIRM is the remanence remaining after a strong direct field is applied to a sample; this parameter, like susceptibility, in a measure of the magnetic concentration, or abundance of magnetic minerals in the loess/soil sequence. ARM is the magnetic remanence induced in a sample when a small direct field is applied with simultaneous subjection to a steadily decreasing alternating field. ARMs are more sensitive to magnetic grain size than SIRM. Both types of analyses were conducted in the low-temperature paleomagnetic laboratory in the Department of Geology.

Results and Discussion

The following examines the site stratigraphy, erosion and pedoturbation, and the chronostratigraphic-pedostratigraphic relationships.

Site Stratigraphy

A modern soil is relatively well developed at the site and is presently classified as the Ladoga Series, an upland mollisol developed in the loess parent material. Ladoga soils are characterized as having high available water-holding capacity, moderately slow permeability, a silt loam texture, and a range of brown colors; and is well suited for woodland, pasture and cultivation of grains. Soil pedons at the site correspond relatively well to the representative profile described in the Soil Survey of Leavenworth and Wyandotte Counties (Zavesky and Boatright 1977, p. 24). A small portion of the site, located on the steep flanks of the knoll to the northeast, is mapped as the Knox Series, a silt loam soil developed on steep slopes of the dissected loess uplands along the Missouri River valley.

The many trenches, archaeological excavations, and cores extracted from the site during the field sessions at DB revealed the relatively consistent nature of the stratigraphy throughout the site. In terms of lithostratigraphy, the site is developed within and on loess. Specifically, the prehistoric and historic cultural material is situated within the upper part of a buried soil and the overlying Holocene-age Bignell loess. The total accumulation of loess during the Holocene is unknown, but was probably somewhat greater than that present today, with some naturally and culturally accelerated erosion occurring periodically. The entire Holocene loess body present has undergone remarkable modification due to surface and buried soil development (e.g., pedoturbation, weathering) and historic cultivation.

The Peoria loess, beneath the Bignell, is capped by a well developed buried soil, which is taken to be the Pleistocene/Holocene transition soil, the Brady. Soil horizon development occurs in the upper meter or more of the Peoria, the upper part of which is contaminated with prehistoric cultural material. Weak C horizon development extends down to about a depth of 3m. The primary complexity of the site stratigraphy, from the geoarchaeological perspective, lies in the apparent disturbance of the Brady A horizon prior to burial by Bignell loess, welding of the surface soil to the underlying Brady soil, and pedoturbation.

The pedo-, chrono-, bio- and magnetostratigraphic information obtained from the 13m-long core and the profiles from seven trenches and two excavation squares are presented below, with locations of the sample sites provided on Figure 3.4.

Core: Several cores were extracted from within and along the periphery of the excavation

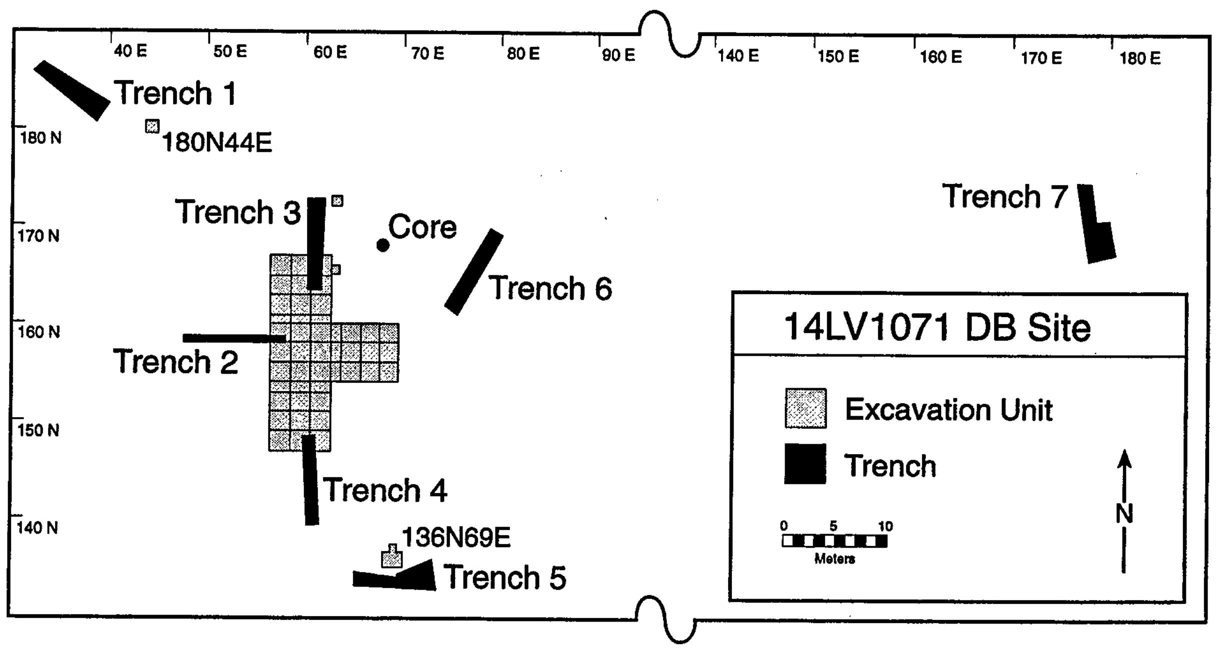

Figure 3.4. Large-scale map identifying core, trenches, and excavation units discussed.

area for the purpose of stratigraphic correlation and definition of the site, but only the 13m-long core underwent laboratory analysis. The objective of extracting a long core was to define the vertical extent of middle Wisconsin, late Wisconsin, and Holocene loesses. Coring was stopped when the middle Wisconsin Gilman Canyon Formation was penetrated, which was near the limit of the available coring machine. The Gilman Canyon, as noted in the stratigraphic overview, consists of a loess with a soil overprint, is readily recognized in the field, and typically rests unconformably on the Sangamon soil of the Last Interglacial. The additional depth of the Illinoian and pre-Illinoian loesses at the site is yet unknown, but beyond the scope of this study.

Rock magnetic analyses were conducted on the core in order to ascertain if the climatic signal present is similar to those records extracted from loess sequences located farther west in Kansas and Nebraska, away from the local effects of the Missouri River. Four parameters were selected in order to examine the concentration of magnetic material and the size of those grains (Fig 3.5). Within the formation, the concentration of magnetic minerals is least in the lower, relatively unaltered loess at the bottom of the core. The soil (mollisol) of the Gilman Canyon clearly stands out, however, as having both high concentrations of magnetic minerals and a large quantity of the fine grained magnetic material. These two indications signify appreciable pedogenic weathering. Over 100 ^{14}C ages from the central Great Plains (Johnson 1993, unpublished data) reveal that pedogenesis within this loess occurred from about 36 to 20 ka. Furthermore, the two maxima, or "humps" visible in all four parameters represent the two periods of strongest pedogenesis.

Above the Gilman Canyon, in the lower Peoria loess (c. 9.5-7.5m), the four parameters indicate slight weathering, likely the waining Gilman Canyon soil formation diluted by increasing rates of loess deposition, that is, a transition into the high rates of loess deposition associated with the late Wisconsin climate and high rates of loess flux. All magnetic parameters are low in the Peoria loess, testifying to the low rates of weathering during high rates of loess deposition within this 10,000 year period. The minor fluctuations in the curves, especially susceptibility and SIRM, reflect incipient soil development. Surface soil development (including the Brady soil to which it is welded) is visible in the upper 75cm of the core, where values of all parameters are elevated to a level equal to or exceeding those of the Gilman Canyon Formation.

The rock magnetic signatures of the long core from the DB site correlate very well with those obtained from the loess sequences to the west. When compared with the 18m-long record of susceptibility from the Eustis ash pit in southwestern Nebraska, for example, similar patterns emerge (Fig 3.6). Various attributes illustrated include the relatively low values for the lower Gilman Canyon, the bimodal elevation in the soil of the same unit, the diluted pedogenesis of the lower Peoria loess, the low values of the Peoria, and, of course, the surface soil increase. This site comparison, and others not depicted here, clearly indicate that the climatic history of the DB site was not unduely effected by proximity to the Missouri River valley and was similar to that of the central Great Plains as a whole.

<u>Trench 1</u>: The extraction of paleoenvironmental information was restricted to a single profile exposed in Trench 1 in order to maximize the benefits and correlations among data sets, within the

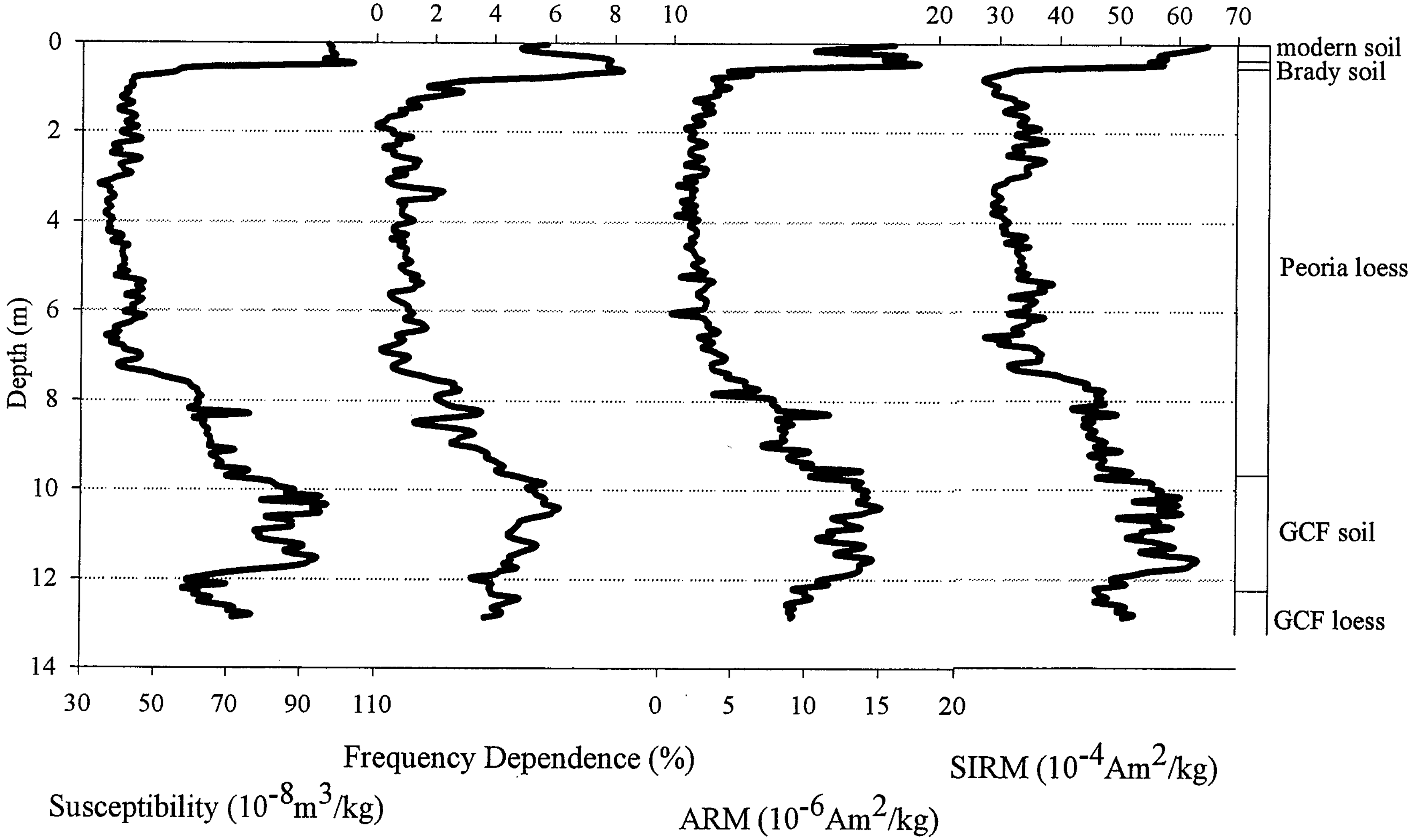

Figure 3.5. Rock parameter data and stratigraphy from the 13m-long core.

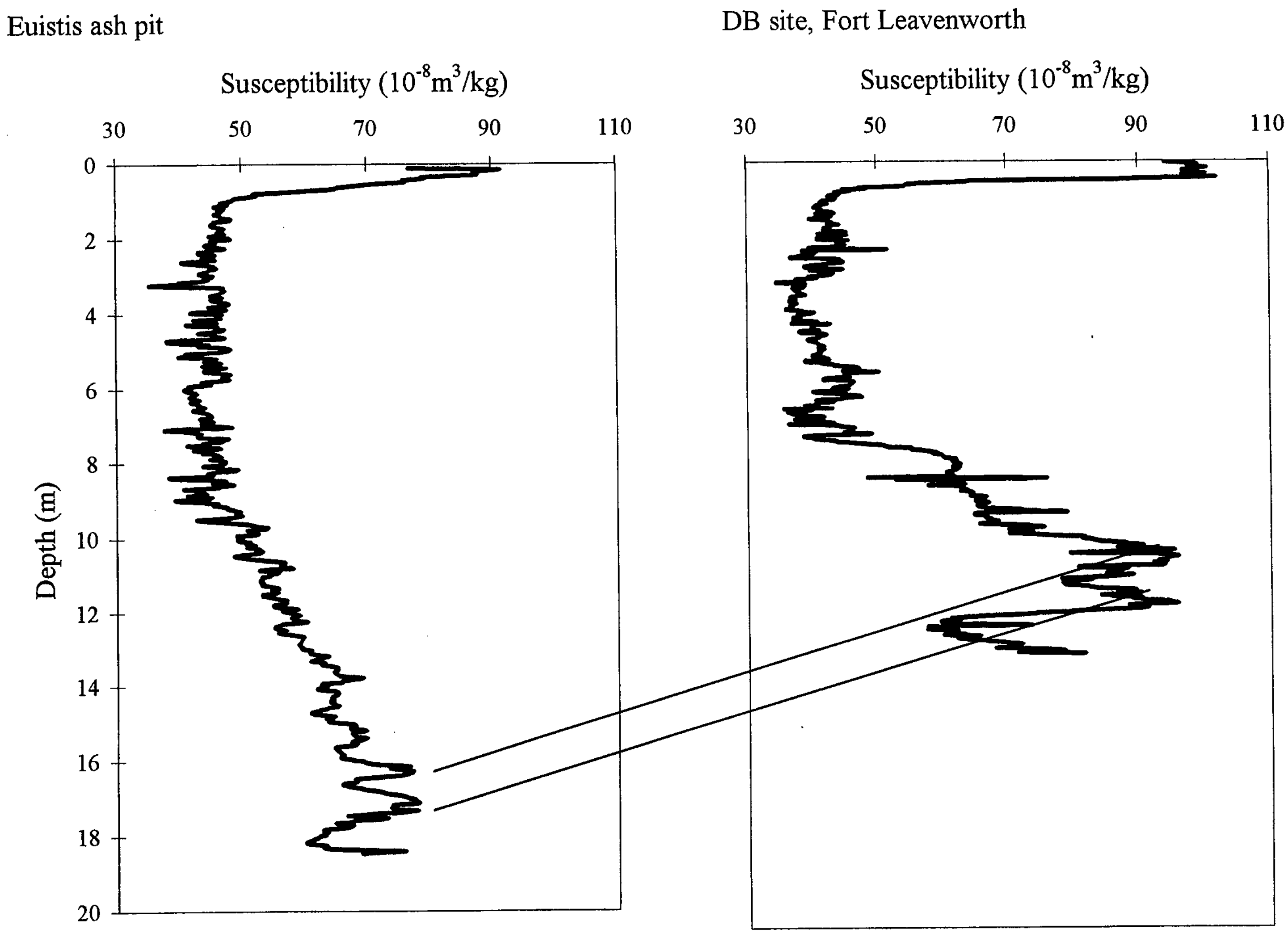

Figure 3.6. Comparison of magnetic susceptibility from the Eustis ash pit in southwestern Nebraska with that from the 13m core from the DB site. The two straight lines correlate the two modes of soil formation within the Gilman Canyon Formation between the two sites.

the funding and time constraint of the project. Trench 1, located on the northwest extreme of the site (Fig. 3.4), provided the most complete and best expressed litho- and pedostratigraphy realized. The buried soil is well expressed and apparently uneroded at this trench location (Fig. 3.7). Standard physical and chemical analyses were conducted on the 2.4m profile in order to characterize the individual units and provide base line data for the rock magnetic, opal phytolith (Chapter 4), isotopic and other studies (Fig 3.8). Organic matter content is relatively low throughout, except in the Ap horizon (plow zone in A horizon), especially the less disturbed lower portion. Values of pH are relatively uniform except for the lower values at the top where partial leaching of carbonates has occurred and at about 140-160cm where carbonates have accumulated at the base of the B horizon and within the loess of the uppermost C horizon. Particle size is dominated by silt and to a lesser extent by clay due to the loessal nature of the parent material. Sand (very fine and fine) varies at the expense of silt and presumably reflects changes in source material and wind conditions during deposition. The soil description of the profile sampled within the trench (Table 3.2) indicates a buried A horizon (2Ab) and associated argillic B horizons (2Bt1b and 2Bt2b) developed within the Peoria loess.

Rock magnetic analyses conducted on the profile included susceptibility and frequency dependence (Fig. 3.9). Both parameters indicate both the surface and Brady soils. Parameter values for the Ap horizon are low due to the dilution of the magnetic minerals by organic matter. Frequency dependence best illustrates the degree to which the two soils are welded. The same parameter also maintains high values to about one meter because of the fine magnetic material in the Brady B horizon. A concentration of $CaCO^3$ at the base of the 2BCb dilutes the magnetic signal, producing the extremely low values in frequency dependence. The short duration increases, or "peaks" in both parameters at about 160 and 195cm very likely indicate incipient soil development in the Peoria loess that was not visually detectable in the field. Overall, each of the soil horizons correspond very well with unique segments of the magnetic curves, for this profile and those of the other trenches.

The profile was radiocarbon dated at close interval in order to provide the necessary absolute time control for the other analyses. Samples were collected within 5cm intervals at a spacing of 5 to 10cm from a depth of 220cm to 35cm (Table 3.3). Ages range from 10,540 yr BP in Peoria loess at the bottom of the profile to 1,990 yr BP in the B horizon of the surface soil.

Stable isotope ratio analysis of organic carbon for the sediments and soils was conducted on contiguous 5cm-thick samples collected from the same profile position as the radiocarbon samples. The resulting 38 assays resulted in $\delta^{13}C$ values that characterize the nature of the vegetation change through time as the loess was deposited and soil formation proceeded (Table 3.4). Stable isotope ratio analyses also result from the correction of radiocarbon ages (Table 3.3). Consequently, a high-resolution isotopic curve is possible with the exclusively $\delta^{13}C$ samples, and a lower-resolution curve from the radiocarbon age-generated $\delta^{13}C$ data (Fig. 3.10): the two curves have been superimposed to demonstrate their coincidental nature. Since the assays were conducted by two different laboratories, some of the differences are due to machine and extraction differences. The high-resolution curve is a much better rendition of reality, or the details of vegetation change; it closely matches similar curves from elsewhere in the region (Johnson unpublished data). The late Pleistocene,

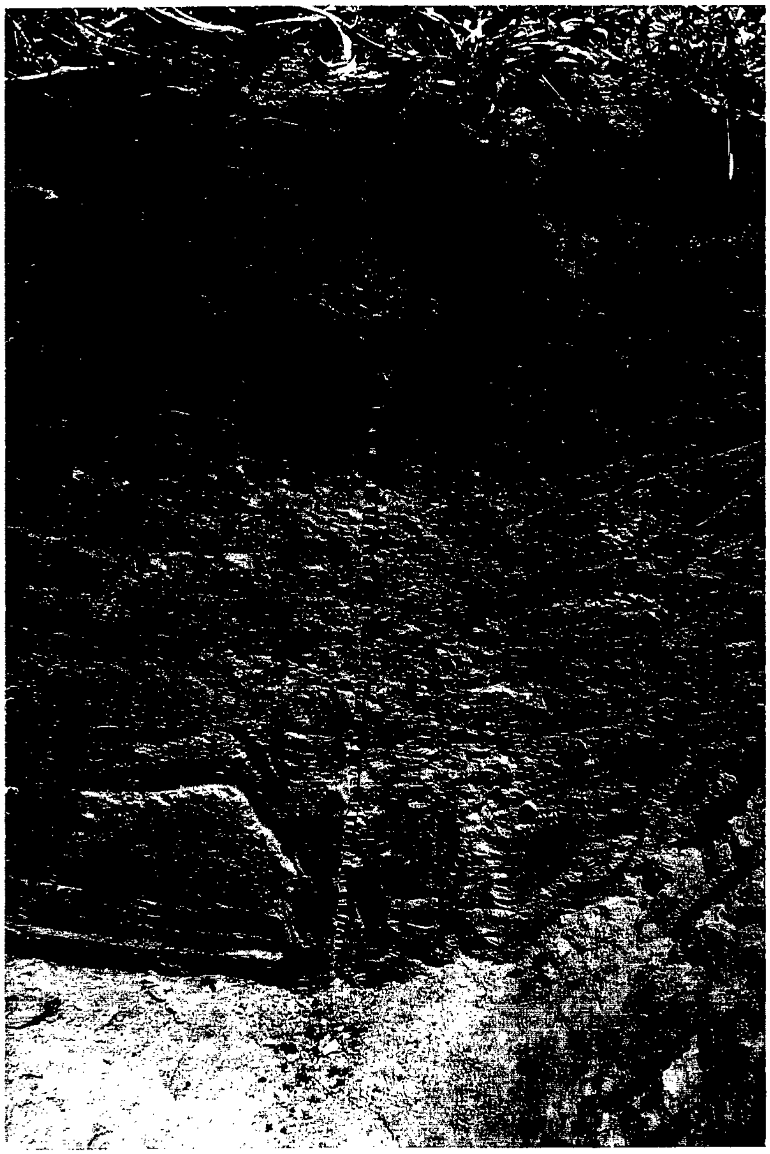

Figure 3.7. Sampled profile in Trench 1. The dark band in the upper part of the profile is the buried A horizon.

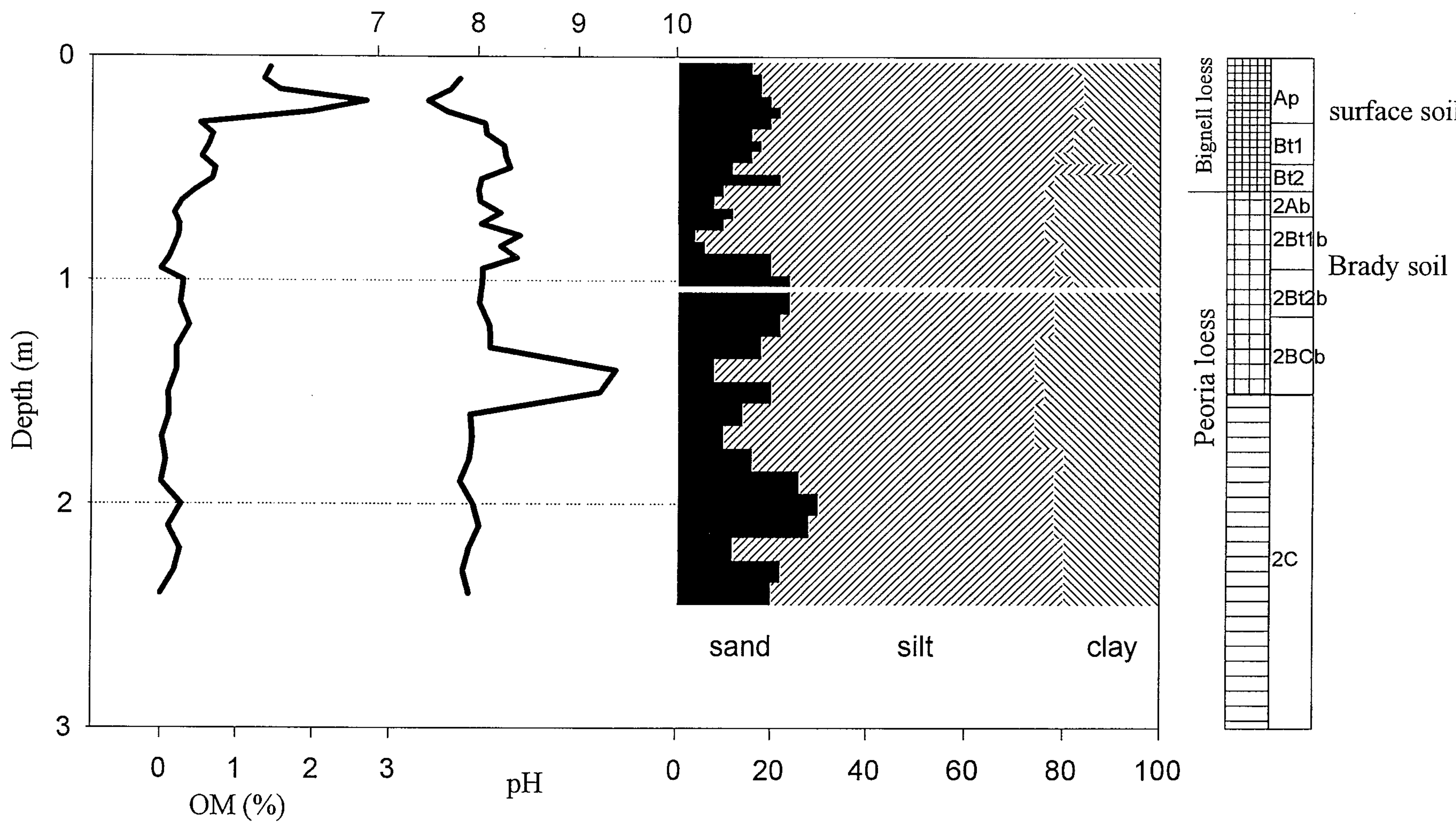

Figure 3.8. Organic matter content, pH, particle size data, and soil stratigraphy from Trench 1.

Table 3.2. Soil Profile Descriptions

Trench 1 depth	horizon	description
0-26	Ap	silt loam; grayish brown (10YR 5/2) dry; weak, fine granular to thin, weak platy structure; very friable; abrupt, many fine and medium rootlets; smooth boundary
26-48	Bt1	silt loam; brown (10YR 5/3) dry; weak, fine subangular blocky structure; firm; faint to distinct, discontinuous clay films; clear, smooth boundary
48-60	Bt2	light silty clay loam; brown (10YR 5/3) dry; weak, medium subangular blocky structure; firm; abrupt, smooth boundary
60-72	2Ab	silty loam; dark grayish brown (10YR 4/2) dry; weak, fine to medium granular to subangular blocky structure; friable; many fine rootlets; clear, smooth boundary
72-93	2Bt1b	silty clay loam; yellowish brown (10YR 5/4) dry; moderate, fine to medium subangular blocky structure; firm; distinct, continuous clay films; gradual, smooth boundary
93-119	2Bt2b	silty clay loam; brown (10YR 5/3) dry; weak, medium subangular blocky structure; firm; faint, discontinuous clay films; gradual, smooth boundary
119-149	2BCb	silt loam; pale brown (10YR 6/3) dry; weak, coarse blocky structure; friable; gradual, smooth boundary
149-207	2C1	silt loam; light brownish gray (10YR 6/2) dry; weak, coarse prismatic structure; friable; gradual smooth boundary
207-230+	2C2	silt loam; pale brown (10YR 6/3) dry; massive structure; very friable to loose; few open pores

Trench 2 depth	horizon	description
0-20	Ap	removed
20-56	Bt	silt loam; yellowish brown (10YR 5/4) dry; weak, fine subangular blocky structure; firm; distinct, discontinuous clay films; clear, smooth boundary
56-94	2Btb	silty clay loam; brown (10YR 5/3) dry; moderate, fine to medium subangular blocky structure; firm; distinct, continuous clay films; gradual, smooth boundary

Table 3.2. Soil Profile Descriptions (con't.)

94-128	2BCb	silt loam; light yellowish brown (10YR 6/4) dry; weak, medium subangular blocky structure; friable; gradual, smooth boundary
128-210	2C1	silt loam; light brownish gray (10YR 6/2) dry; weak, medium to coarse prismatic structure; friable; diffuse, smooth boundary
210-258+	2C2	silt loam; weak, medium to coarse subangular blocky structure; pale brown (10YR 6/3) dry; friable to very friable; many open pores

Trench 3

depth	horizon	description
0-20	Ap	removed
20-36	A	silt loam; dark brown (10YR 4/3) dry; weak, fine granular structure; friable; common, very fine rootlets; clear, smooth boundary
36-42	AB	silt loam; brown (10YR 5/3) dry; weak, fine subangular blocky structure; firm; clear, smooth boundary
42-53	Bt	light silty clay loam; brown (10YR 5/3) dry; weak, fine subangular blocky structure; firm; faint, discontinuous clay films; abrupt, smooth boundary; horizon yielded hearth (feature 5)
53-75	2Ab	silt loam; dark grayish brown (10YR 4/2) dry; weak to moderate, medium granular structure; friable; few, very fine rootlets; clear, smooth boundary
75-93	2Bt1b	silt loam; yellowish brown (10YR 5/4) dry; weak to moderate, medium subangular blocky structure; firm; distinct, continuous clay films; gradual, smooth boundary
93-107	2Bt2b	silty clay loam; brown (10YR 5/3) dry; weak, medium subangular blocky structure; firm; distinct, discontinuous clay films; gradual, smooth boundary
107-143	2BCb	silt loam; pale brown (10YR 6/3) dry; weak, medium to coarse blocky structure; friable to firm; gradual, smooth boundary
143-195	2C1	silt loam; light brownish gray (10YR 6/2) dry; weak, medium, prismatic structure; friable; few open pores; diffuse, smooth boundary
195-221+	2C2	silt loam; light brownish gray (10YR 6/2) dry; massive; very friable; many open pores

Table 3.2. Soil Profile Descriptions (con't.)

Trench 4 depth	horizon	description
0-20	Ap	removed
20-44	Bt	silt loam; brown (10YR 5/3) dry; weak, fine subangular blocky structure; firm; distinct, discontinuous clay films; clear, smooth boundary
44-78	2Btb	light silty clay loam; yellowish brown (10YR 5/4) dry; weak to moderate, fine subangular blocky structure; firm; distinct, continuous clay films; gradual, smooth boundary
78-117	2BCb	silt loam; pale brown (10YR 6/3) dry; weak, coarse blocky structure; friable; gradual, smooth boundary
117-143+	2C	silt loam; light brownish gray (10YR 6/2) dry; weak, medium prismatic structure; friable

Trench 5 depth	horizon	description
0-21	Ap	heavy silt loam; grayish brown (10YR 5/2) dry; weak to moderate, medium granular structure; friable; common very fine and fine rootlets; abrupt, smooth boundary
21-45	Bt	silty clay loam; brown (10YR 5/3) dry; weak, fine subangular blocky structure; firm; faint to distinct discontinuous clay films; clear, smooth boundary
45-73	2Btb	heavy silty clay loam; yellowish brown (10YR 5/4) dry; moderate, f fine to medium subangular blocky structure; firm; distinct, continuous clay films; gradual, smooth boundary
73-103	2BCb	silt loam; light brownish gray (10YR 6/2) dry; weak, coarse subangular blocky structure; friable; gradual, smooth boundary
103-176	2C1	silt loam; pale brown (10YR 6/3) dry; weak, coarse prismatic structure; friable; gradual, smooth boundary
176-200	2C2	silt loam; pale brown (10YR 6/3) dry; weak, coarse prismatic structure; very friable; many open pores

Table 3.2. Soil Profile Descriptions (con't.)

Trench 6 depth	horizon	description
0-18	Ap	silt loam; gray (10YR 5/1) dry; weak, medium granular structure; friable; common, very fine to fine rootlets; abrupt, smooth boundary
18-38	Bt	light silty clay loam; brown (10YR 5/3) dry; weak, fine subangular blocky structure; firm; faint to distinct, discontinuous clay films; clear, smooth boundary
38-65	2Btb	silty clay loam; yellowish brown (10YR 5/4) dry; weak to moderate, fine to medium subangular blocky structure; firm; distinct, continuous clay films; gradual, smooth boundary
65-82	2BCb	silt loam; pale brown (10YR 6/3) dry; weak, medium blocky to subangular blocky structure; friable; gradual, smooth boundary
82-152	2C1	silt loam; pale brown (10YR 6/3) dry; weak, medium prismatic structure; friable; clear, smooth boundary
152-250+	2C2	silt loam; pale brown (10YR 6/3) dry; weak, coarse prismatic structure; very friable

Trench 7 depth	horizon	description
0-25	Ap	light silty clay loam; grayish brown (10YR 5/2) dry; weak to moderate, thin platy structure; friable; common, very fine to fine rootlets; clear, smooth boundary
25-49	Bt1	silty clay loam; brown (10YR 5/3) dry; weak, fine subangular blocky structure; firm; distinct, continuous clay films; gradual, smooth boundary
49-72	Bt2	silty clay loam; brown (10YR 5/3) dry; weak to moderate, medium subangular blocky structure; firm; distinct, discontinuous clay films; gradual, wavy boundary
72-96	BC	silt loam; light yellowish brown (10YR 6/4) dry; weak, coarse blocky structure; friable; gradual, smooth boundary
96-141	C1	silt loam; light yellowish brown (10YR 6/4) dry; weak, medium prismatic structure; friable; gradual, smooth boundary
141-178	C2	silt loam; pale brown (10YR 6/3) dry; weak, coarse prismatic structure; friable; diffuse, smooth boundary; few open pores
178-210+	C3	silt loam; pale brown (10YR 6/3) dry; weak, coarse prismatic to massive structure; friable; common open pores

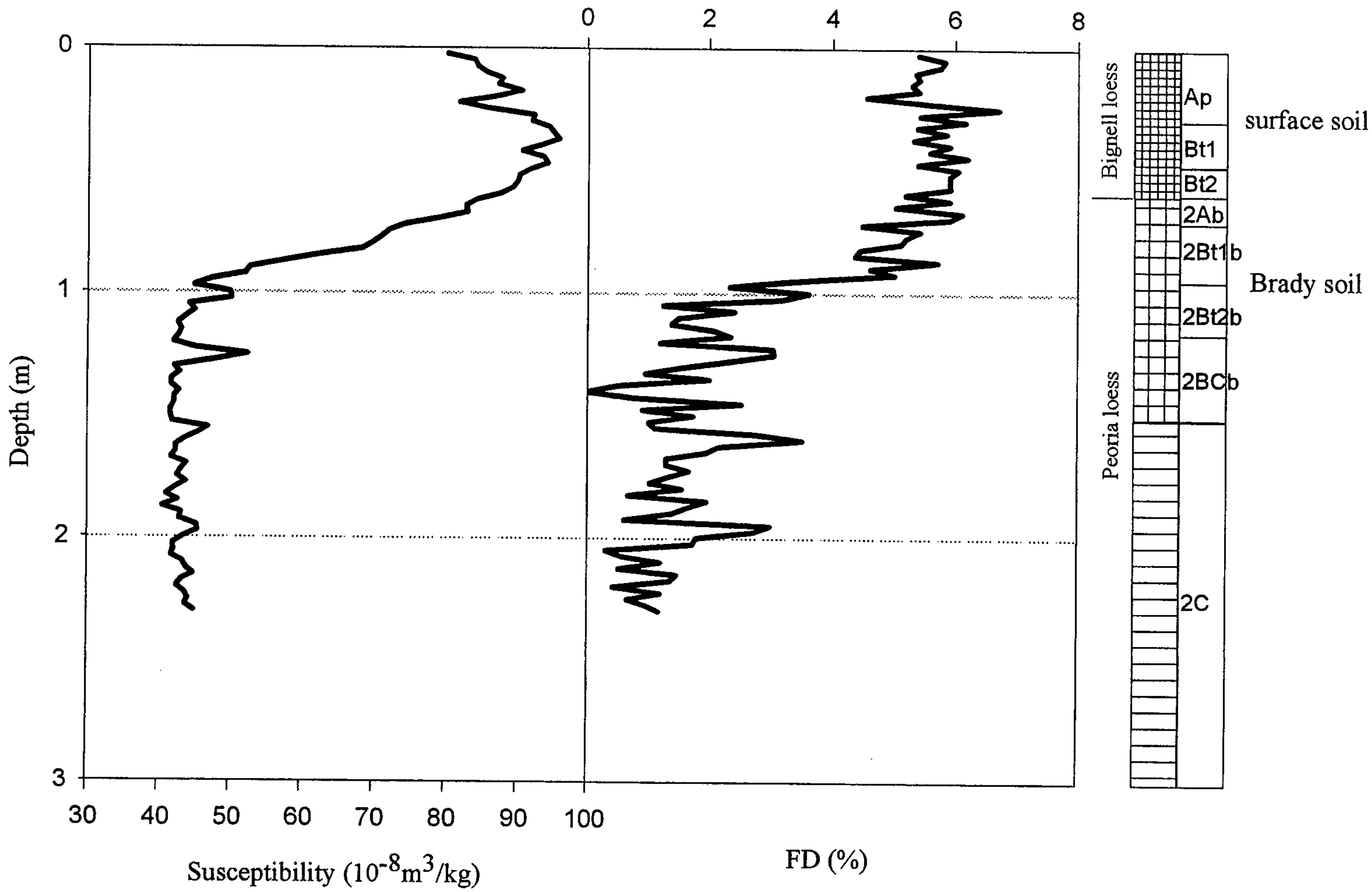

Figure 3.9. Rock magnetic data from Trench 1.

Table 3.3. Radiocarbon Ages[1]

Site	Depth (cm)	Organic C source	Geologic/ soil unit	Field no.	Lab. no.	Uncorrected age (yr BP)	$\delta^{13}C$ (‰)	Corrected age[2]	Calibrated age[3]
136N69E	85-90	total humates	Bignell loess	DB85	Tx-8548	3,760±60	-18.5	3,860±60	4,264
136N69E	180-190	total humates	Peoria loess	DB180	Tx-8549	10,330±120	-24.4	10,340±120	12,214
180N44E	150-160	total humates	Peoria loess	DB150	Tx-8547	8,100±90	-23.5	8,120±90	8,991
Trench 1	35-40	total humates	Bignell/Bt1	DB1-17	ISGS-3588	1,910±110	-19.9	1,990±110	1,931
	40-45	"	Bignell/Bt1	DB1-16	ISGS-3587	1,910±100	-19.5	2,000±100	1,938
	45-50	"	Bignell/Bt2	DB1-15	ISGS-3586	2,290±70	-19.1	2,390±70	2,354
	50-55	"	Bignell/Bt2	DB1-14	ISGS-3585	2,550±70	-18.4	2,650±70	2,756
	55-60	"	Bignell/Bt2	DB1-13	ISGS-3553	2,630±70	-18.6	2,730±70	2,792
	60-65	"	Peoria/2Ab	DB1-12	ISGS-3557	2,970±70	-18.0	3,090±70	3336,3286,3274
	65-70	"	Peoria/2Ab	DB1-11	ISGS-3551	3,440±90	-18.7	3,540±90	3,830
	80-85	"	Peoria/2Bt1b	DB1-10	ISGS-3558	3,860±70	-18.5	3,960±90	4,413
	95-100	"	Peoria/2Bt2b	DB1-9	ISGS-3554	5,590±90	-19.5	5,680±90	6,456
	110-115	"	Peoria/2Bt2b	DB1-8	ISGS-3559	6,010±80	-20.6	6,080±80	6,899
	125-130	"	Peoria/2BCb	DB1-7	ISGS-3583	8,170±110	-21.9	8,220±110	9206,9120,9098 9061,9056
	140-145	"	Peoria/2BCb	DB1-6	ISGS-3572	8,850±130	-22.2	8,900±130	9,912
	155-160	"	Peoria/2C1	DB1-5	ISGS-3571	9,9590±150	-22.7	9,630±150	10,888, 10,729
	170-175	"	Peoria/2C1	DB1-4	ISGS-3570	10,470±160	-23.8	10,490±160	12,408
	185-190	"	Peoria/2C1	DB1-3	ISGS-3584	10,410±180	-24.1	10,430±180	12,336
	200-205	"	Peoria/2C1	DB1-2	ISGS-3568	10,490±210	-23.9	10,510±190	12,431
	215-220	"	Peoria/2C2	DB1-1	ISGS-3573	10,500±210	-22.7	10,540±210	12,464

[1] stratigraphic ages only, i.e., exclusive of those obtained in the cultural investigations
[2] corrected for the effects of isotopic fractionation; $\delta^{13}C$ values wrt PDB standard
[3] calibrations made using CALIB 3.03c (Stuiver and Reimer 1993)

Table 3.4. Stable Isotope Ratio Analyses (C) from Trench 1

Geochron Lab. no.	Field no.	Depth (cm)	$\delta^{13}C$ ($^0/_{00}$)[1]	
CR-91908	DB1-1/215	215-220	-24.5	
CR-91909	DB1-2/210	210-215	-23.5	-24.0[2]
CR-91910	DB1-3/205	205-210	-23.6	
CR-91911	DB1-4/200	200-205	-24.0	
CR-91912	DB1-5/195	195-200	-22.9	
CR-91913	DB1-6/190	190-195	-23.2	
CR-91914	DB1-7/185	185-190	-24.8	
CR-91915	DB1-8/180	180-185	-24.2	
CR-91916	DB1-9/175	175-180	-21.3	
CR-91917	DB1-10/170	170-175	-24.6	
CR-91918	DB1-11/165	165-170	-23.7	
CR-91919	DB1-12/160	160-165	-24.1	
CR-91920	DB1-13/155	155-160	-23.5	
CR-91921	DB1-14/150	150-155	-24.0	
CR-91922	DB1-15/145	145-150	-23.8	
CR-91923	DB1-16/140	140-145	-23.9	
CR-91924	DB1-17/135	135-140	-22.4	
CR-91925	DB1-18/130	130-135	-22.1	-22.0
CR-91926	DB1-19/125	125-130	-22.1	
CR-91927	DB1-20/120	120-125	-20.7	
CR-91928	DB1-21/115	115-120	-21.2	
CR-91929	DB1-22/110	110-115	-20.6	
CR-91930	DB1-23/105	105-110	-19.9	
CR-91931	DB1-24/100	100-105	-19.7	-20.1
CR-91932	DB1-25/95	95-100	-19.8	
CR-91933	DB1-26/90	90-95	-19.6	
CR-91934	DB1-27/85	85-90	-19.2	
CR-91935	DB1-28/80	80-85	-18.8	
CR-91936	DB1-29/75	75-80	-19.2	
CR-91937	DB1-30/70	70-75	-17.8	
CR-91938	DB1-31/65	65-70	-17.7	
CR-91939	DB1-32/60	60-65	-18.3	
CR-91940	DB1-33/55	55-60	-18.2	
CR-91941	DB1-34/50	50-55	-17.9	
CR-91942	DB1-35/45	45-50	-18.3	
CR-91943	DB1-36/40	40-45	-19.6	-19.2
CR-91944	DB1-37/35	35-40	-19.8	
CR-91945	DB1-38/30	30-35	-19.9	

[1] wrt PDB standard

[2] duplicate preparations and analyses (replication check)

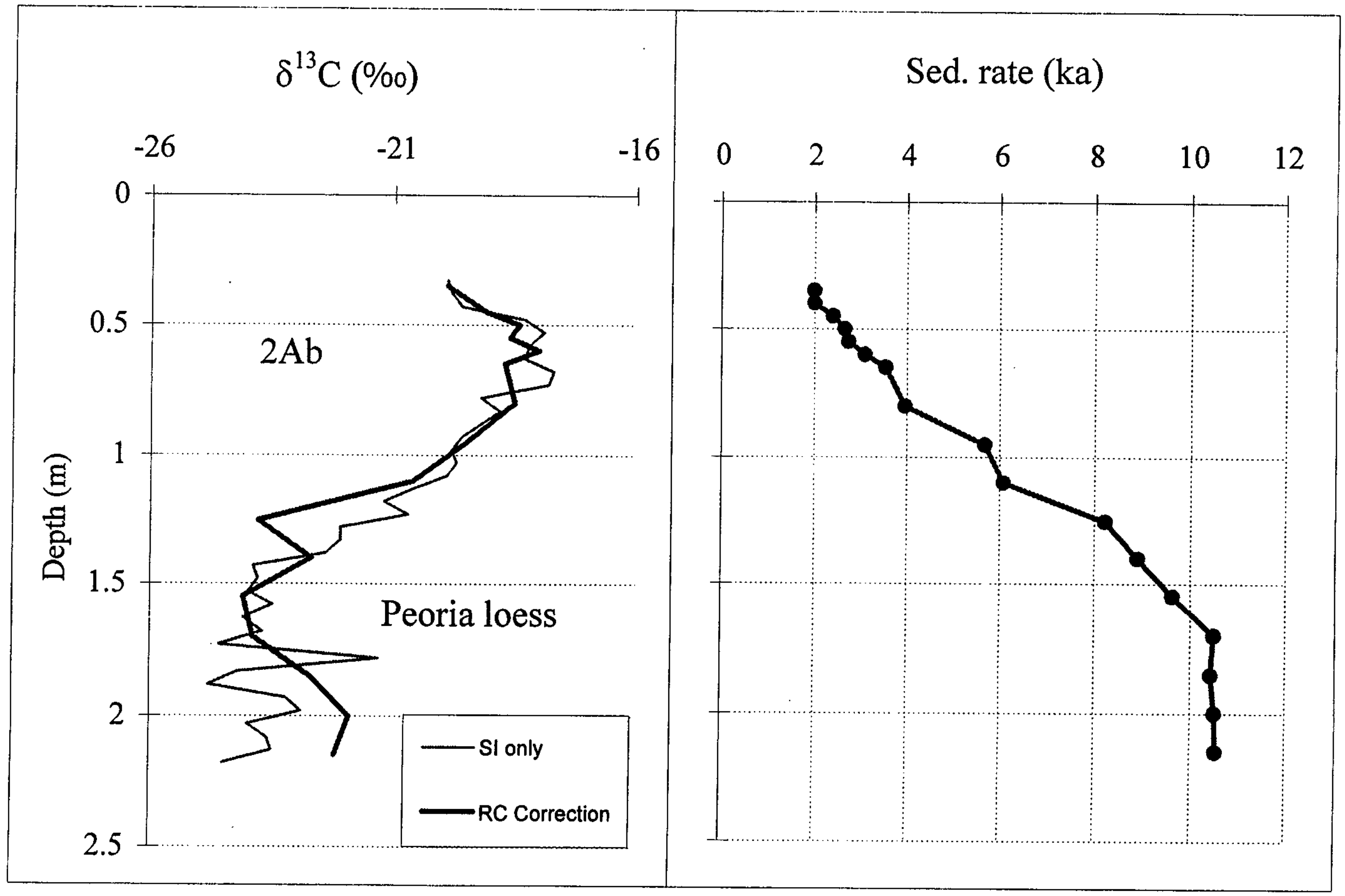

Figure 3.10. $\delta^{13}C$ data and the sedimentation curve for Trench 1.

including Brady time, was characterized by the short-term fluctuations indicated. Overall, the curves indicate nicely the dominance of the cool season C_3 grasses (and likely scattered trees) during the late Pleistocene and into Brady soil development. Gradually, however, the vegetation begins to include increasing numbers and densities of the warm season C_4 grasses. Although sampling was terminated immediately below the Ap horizon to avoid interpretation problems, the curve begins to drop slightly. This C_4 maximum may be expression of the low moisture of the middle Holocene, the climatologically defined Altithermal (Antevs 1955).

Using the radiocarbon ages (Table 3.3), a sedimentation curve was generated (Fig 3.10). Sedimentation rates of the loess were inversely proportional to the degree of pedogenesis, and reflect the prevailing climate. The relatively high rates of Peoria loess accumulation during the late Wisconsinan are evident, as is the slow down associated with the beginning of Brady soil development. Minor variations in the curve may be real or an artifact of radiocarbon age dating (e.g., contamination).

Data from the high-resolution stable isotope ratio analysis of carbon and opal phytolith analysis (Chapter 4; % pooids, i.e., C_3 grasses) were used to produce curves representing the C_3-C_4 plant relationship through time. Superposition of the two curves produces a coincidental pattern, demonstrating the utility of the two approaches and the fact that two proxies of vegetation (and associated climate) have indicated identical scenarios for the pattern of environmental change at the DB site since the late Pleistocene (Fig 3.11).

Trenches 2 through 7: In order to thoroughly investigate the site stratigraphy, six other trenches were excavated (Fig 3.4). Although no radiocarbon dating was done, soil stratigraphy was documented, and close-interval sampling was conducted for rock magnetic studies. Two magnetic parameters were measured on all samples, susceptibility and frequency dependence. Major similarities are evident, but each trench profile reveals unique variations, many of which are interpretable in a cultural or environmental context. These magnetic "vignettes" also provide an impression of the microvariation in the relationship between the two soils within the site area as the soil toposequence expresses itself.

Trench 2 is oriented east-west off the west side of the main excavation area (Fig. 3.4). Because this trench is located off the main excavation square, the Ap was stripped prior to investigation. Erosion stripped the Brady soil of it's A horizon prior to final burial by the Bignell loess; the eroded soil is represented by a 2Btb and underlying horizons (Table 3.2). Magnetic analyses of the profile yielded curves reminiscent of Trench 1, in that the soil zone is rendered by elevated parameter values (Fig 3.12). The Brady soil B horizon is less well expressed at this location, but still present. Peoria loess also exhibits pronounced variations, some of which may be due to changes in magnetic mineral influx, carbonate dilution, and incipient soil development.

Trench 3, running north-south from the north end of the excavation blocks (Fig. 3.4), was mechanically stripped of its Ap horizon, but yielded the buried soil (Table 3.2). In particular, this was the only trench or excavation, other than Trench 1, to contain any of the buried A horizon (Fig. 3.13).

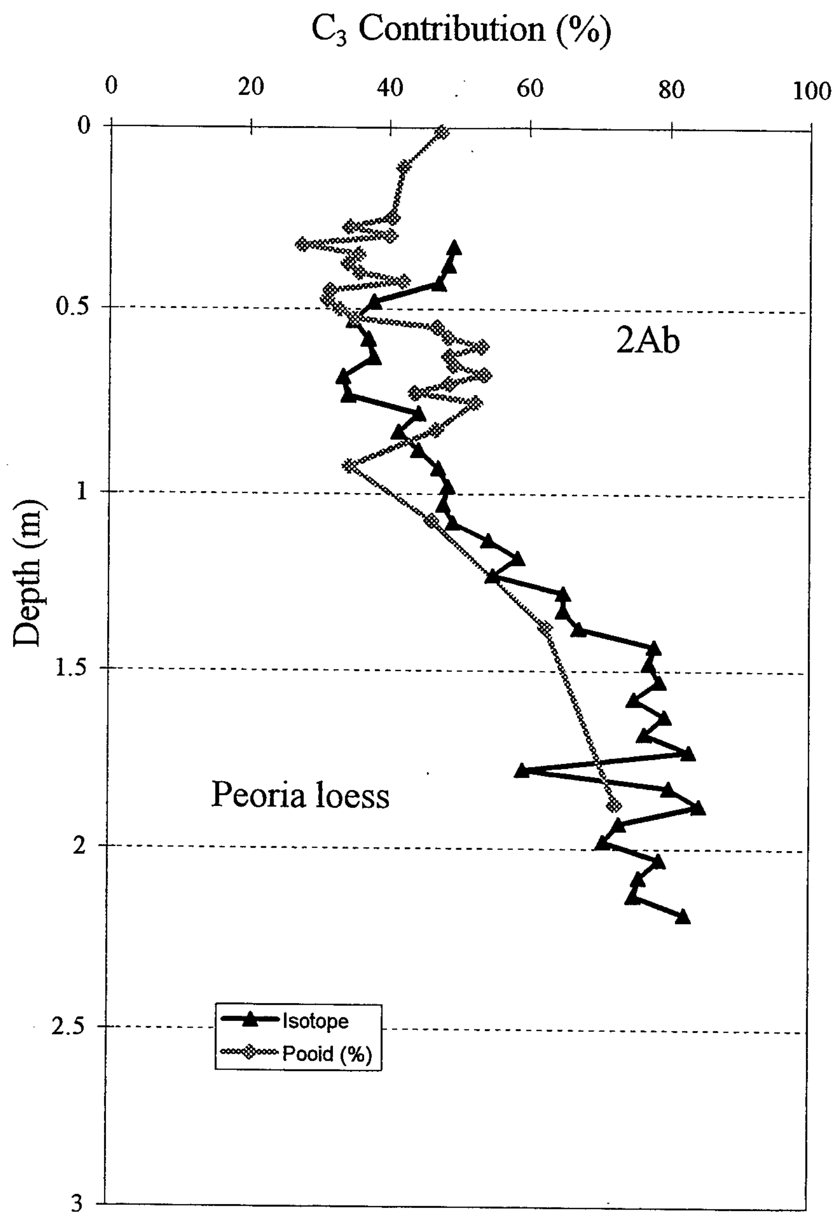

Figure 3.11. A comparison between C3 data derived from opal phytoliths (Pooid Family) with $\delta^{13}C$ data for Trench 1.

DB site, Trench 2

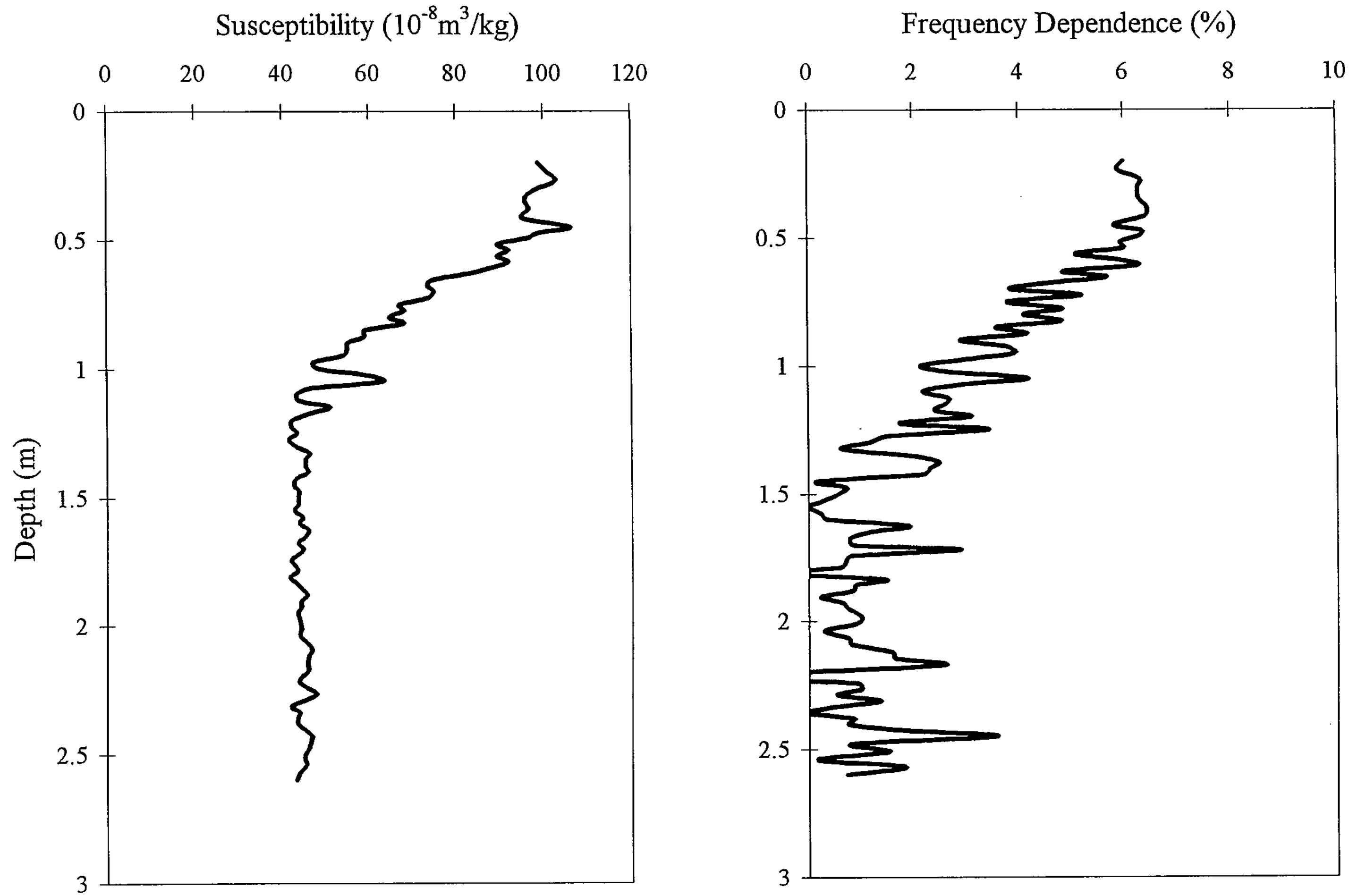

Figure 3.12. Rock magnetic data from Trench 2.

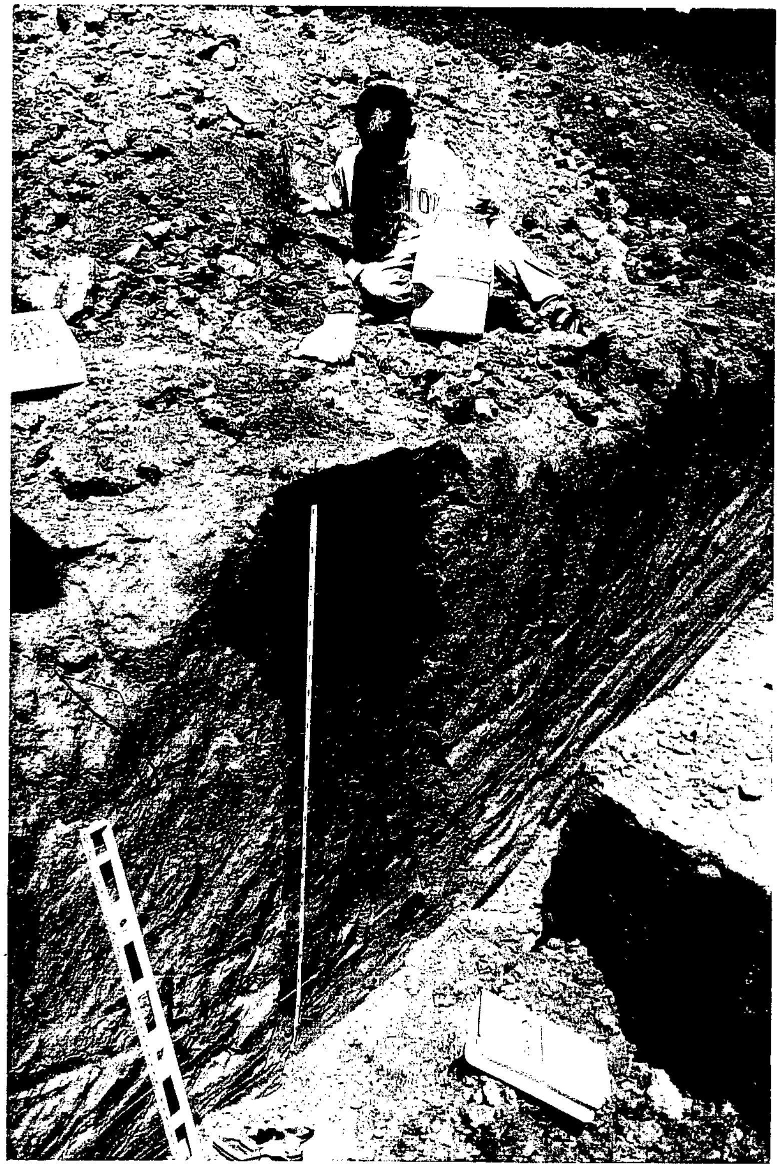

Figure 3.13. Profile exposed in Trench 3. The dark band in the upper part of the exposure is the buried A horizon.

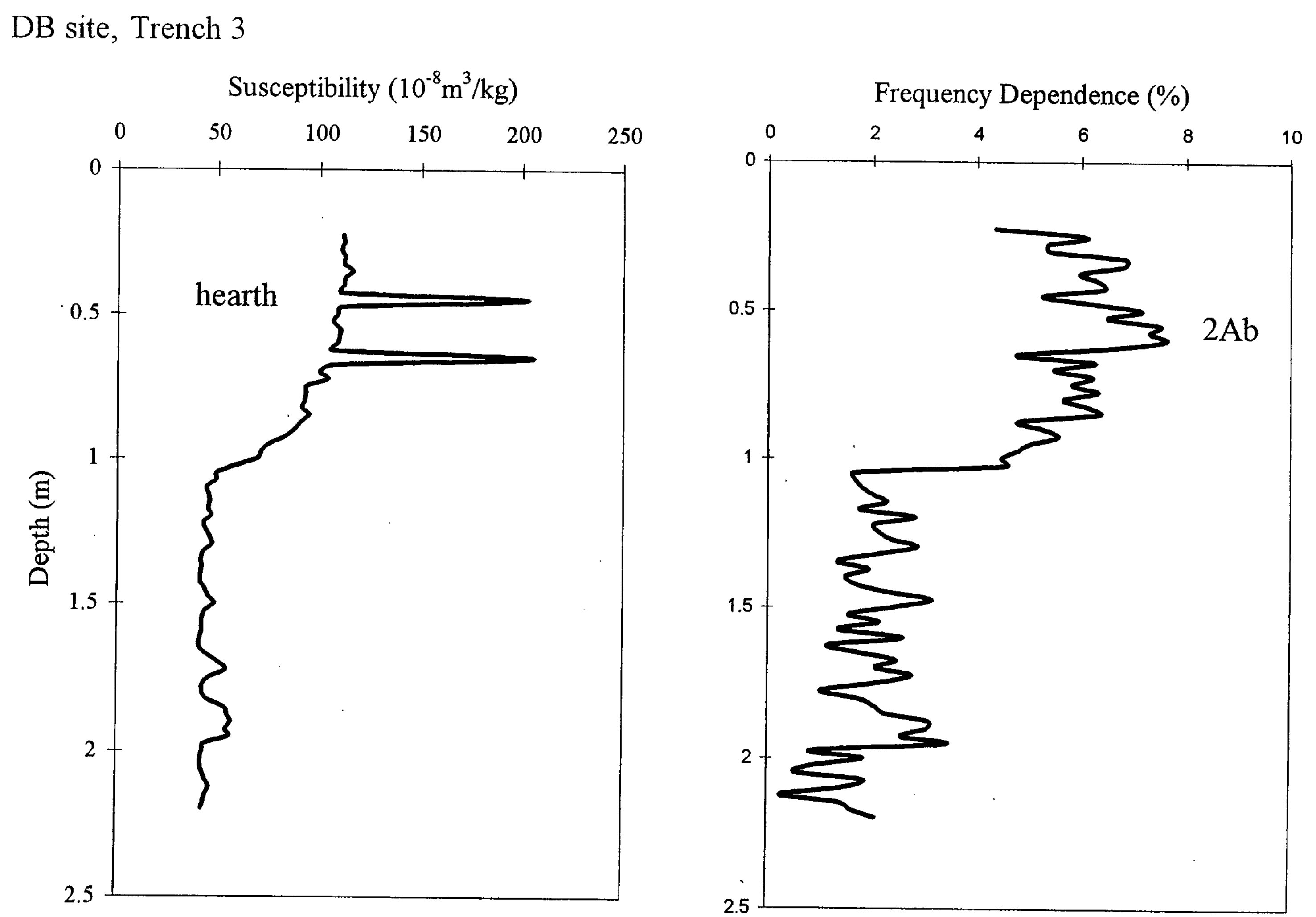

Figure 3.14. Rock magnetic data for Trench 3.

The two magnetic curves produced some unusual responses (Fig 3.14). The Brady B horizon is well developed here and individual subhorizons are detectable in the frequency dependence curve. Most notable are the two spikes in susceptibility that occur within the upper 70cm. These narrowly defined maxima are almost certainly due to fire/burning; evidence comes from the narrow stratigraphic definition and extremely high susceptibility values recorded. The upper spike is associated with the level producing the greatest concentration of prehistoric cultural material. Specifically, the adjacent excavation unit, 165-166N/61E, produced feature 5, a hearth containing charcoal and plant macrofossils that dated around 2,500–2,600 yr BP (Table 7.1). Although not from within the hearth, the magnetic response represents the scattered ash and ferrous oxide. The lower spike was from below the cultural zone, but nonetheless represents a burning event(s). Seasonal prairie fires do not create these spikes in susceptibility. Perhaps this signal relates to a Paleoindian fire that was unrecorded by archaeological investigations; fires were certainly common on these primary occupation surfaces in the central part of the site. The only other possibility for this lower spike would be a lightning strike, a feature occasionally detected in magnetic investigations elsewhere in the central Great Plains by this investigator. The Peoria loess again exhibits variability due to one or more of the factors noted above.

Trench 4, on the opposite end of the excavation area from Trench 3 (Fig. 3.4), was also mechanically stripped prior to investigation, but still retains the surface soil B horizon and the underlying eroded Brady soil (Table 3.2). Magnetic data provides extremely nice definition of the Brady soil Bt horizon (Fig 3.15). Frequency dependence, exhibited as three individual "square waves," articulates the welded surface and Brady B horizons from the 2BCb and 2C horizons below. Only the uppermost C horizon in the Peoria loess was sampled in this shallow trench.

Trench 5, south of the excavation area (Fig. 3.4), was not mechanically stripped prior to sampling and, like trenches 2 and 4, exposed an eroded Brady soil (Table 3.2). Magnetic data illustrate how well the two soils have welded at some locations (Fig. 3.16). Also evident is the vertical extent of the Ap horizon, BC horizon (73-103cm), and C horizon (>103cm). Of note is how well the Ap horizon (0-21cm) has been turned by the plow, i.e., the low magnetic signals at the base of the plow layer represent the dilution of the signal by the inverted sod. Also, the spike in susceptibility at about 42cm is indicative of fire, but the signal is weaker here than at Trench 3, (i.e., 130 vs 200+10-8m3/kg). This depth corresponds, as in Trench 3, to level of cultural concentration. Below, the noise typical of the C horizon and Peoria loess is evident here as well.

Trench 6, east of the excavation area (Fig. 3.4), retains the Ap horizon and the anticipated buried Bt horizon (Table 3.2). Magnetic curves exhibit a few features (Fig 3.17). Here the B horizons of both soils are separated by a narrow dip in susceptibility, but otherwise are represented by the elevated values noted at the other sites. The drop in susceptibility at about 1m appears less conspicuously in other profiles at DB, but is exhibited remarkably at many sites throughout the central Great Plains. A likely interpretation of this feature is that, although loess accumulation rates were dropping at the end of the Pleistocene, the rate of accumulation increased dramatically for a short period (ca. 1,000 years) in response to the short-lived return to glacial conditions. This period is the Younger Dryas climatic event discussed above. Variance within the C horizons and Peoria loess is

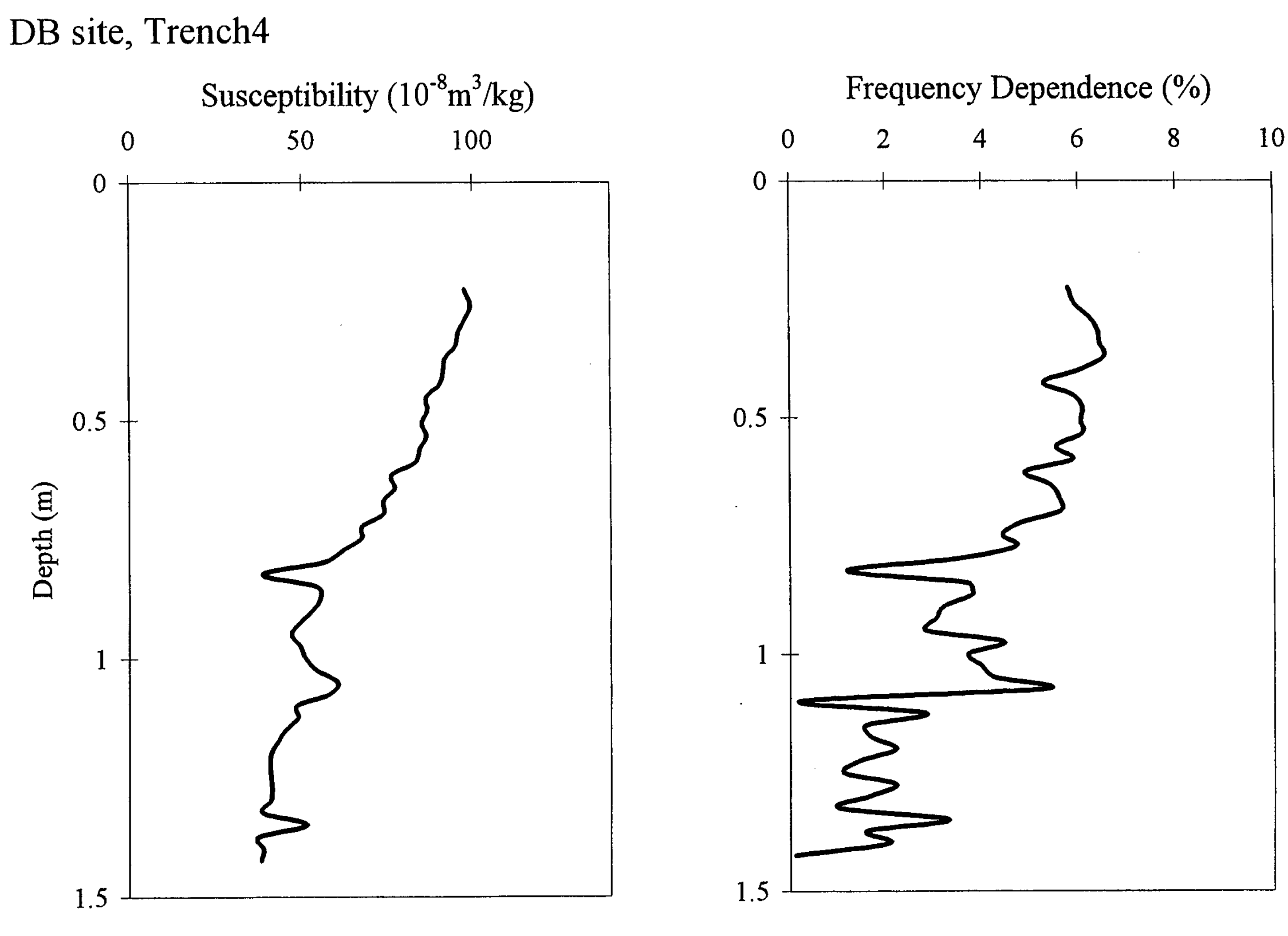

Figure 3.15. Rock magnetic data from Trench 4.

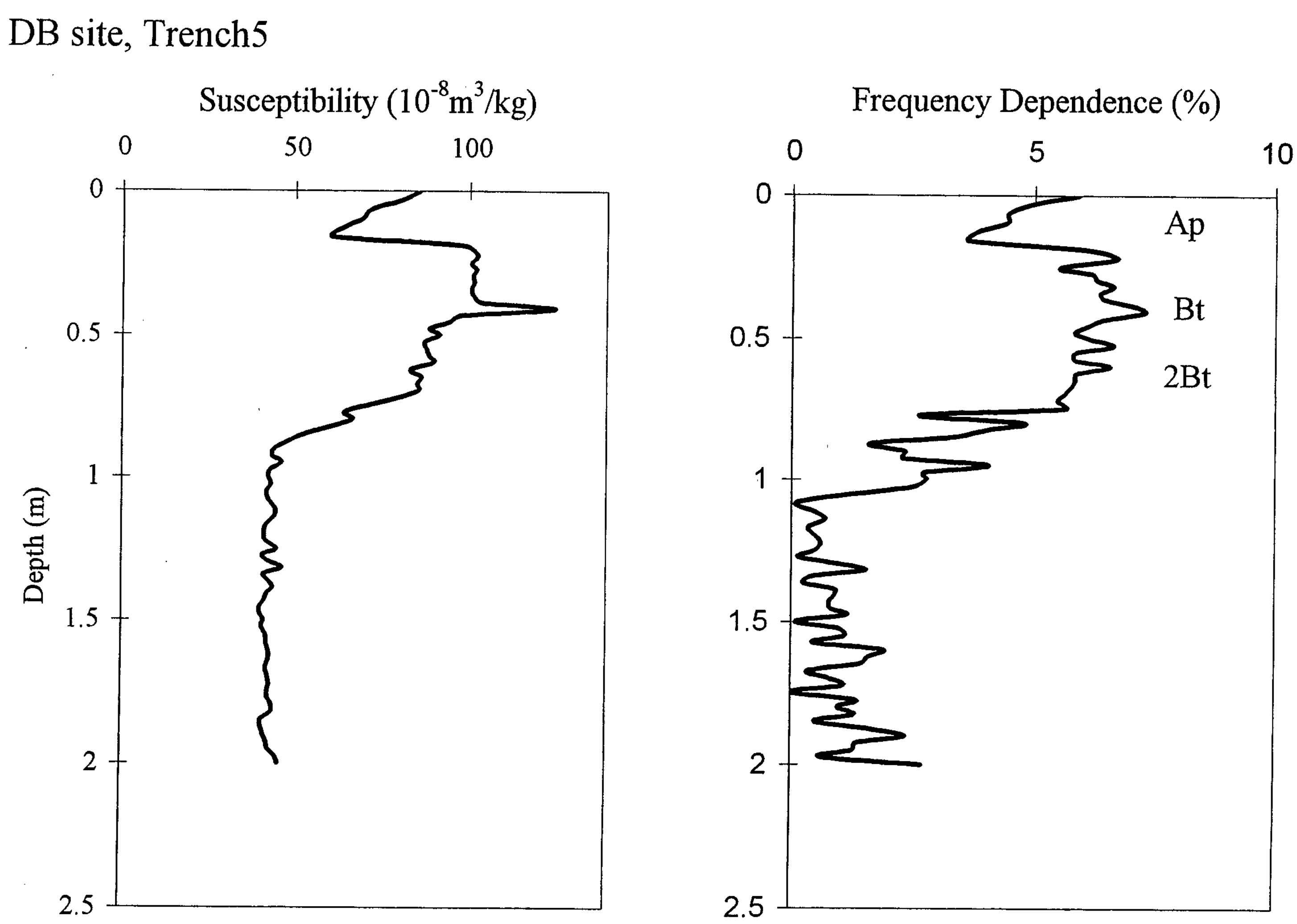

Figure 3.16. Rock magnetic data from Trench 5.

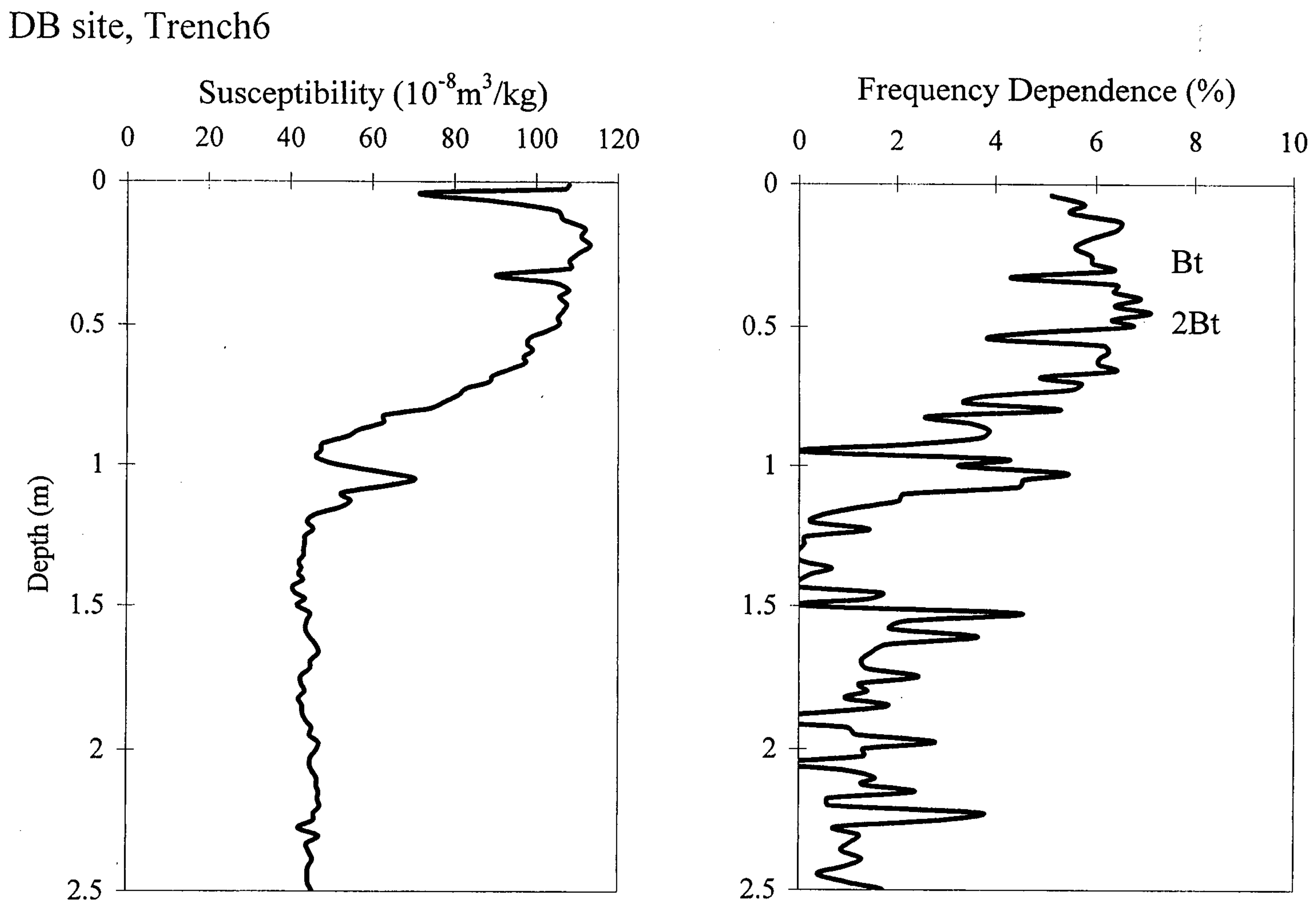

Figure 3.17. Rock magnetic data from Trench 6.

particularly high in this profile; carbonate and incipient soil development are likely responsible.

The location of Trench 7 is unique in that it is located about 100m east and downslope of the site (Fig. 3.4). Although it was anticipated that the trench would expose uninterpretable colluvium eroded from the adjacent knoll where the site is located or at least an overthickened solum, the horizonation was similar to that of the other trenches in terms of solum depth (c. 1m) but different in that no buried A or B horizon was present (Table 3.2). The magnetic curves were similar to the others (Fig 3.18), in that the Ap horizon was underlain by Bt and BC horizons. This relationship suggests that the present topography is very similar to that of the late Pleistocene and that very little material has washed off the crest of the site, at least in the direction of this trench. The buried soil was either limited to the crest of the knoll, where the surface was sufficiently stable to permit pedogenesis, or eroded entirely from the adjacent slopes, leaving only a remnant at the top, that is, the buried Bt horizon.

<u>180N/44E and 136N/69E</u>: As part of the archaeological testing and survey phase of the DB site project conducted in October 1995, two excavation blocks were deepened with a backhoe in order to expose the underlying culturally sterile loess. Neither excavation unit had been mechanically stripped, only plowed in the pre-1950 era. Although no detailed soil descriptions were made, the exposed soil profiles were very similar to the proximal trenches documented a year later.

Excavation unit 180N/44E, in the vicinity of Trench 1 (Fig. 3.4), produced magnetic curves very similar to those generated from the latter (Fig. 3.19). An Ap horizon is not readily identifiable due to the decades of healing. The overall elevation of parameter values in the upper meter represents the Bt horizons of the surface and buried soil. The shift in frequency dependence at about 48cm depth is the break between the surface soil B horizon and the buried B horizon, a depth that corresponds very closely to that in Trench 1. Both parameters illustrate, as at Trench 1 and to a greater extent at Trench 6, the perturbation in the lower Brady soil related to the Younger Dryas climatic event.

Unit 136N/69E, located adjacent to Trench 5 (Fig. 3.4), produces a somewhat attenuated magnetic signature (Fig. 3.19), particularly in frequency dependence. With the exceptions of the Ap horizon and the evidence of burning (susceptibility spike), Trench 5 magnetics are very similar to those of this excavation unit. The buried B horizon is well expressed in the frequency dependence curve at about 45 to 63 cm.

As part of this preliminary study, radiocarbon ages were determined for both excavation units. Without charcoal or botanical macrofossils, total organic carbon in the humates was dated (Table 3.3). The upper C horizon of 180N/44E dated to 8,120±90 yr BP. Similarly, the lower C horizon sampled in 136N/69E produced an age of 10,340±120 yr BP. A second age of 3,860±60 yr BP was derived from the lower BC of the buried soil within 136N/69E.

Geomorphic History

As Peoria loess deposition waned, pedogenesis was initiated and lasted for a sufficiently long

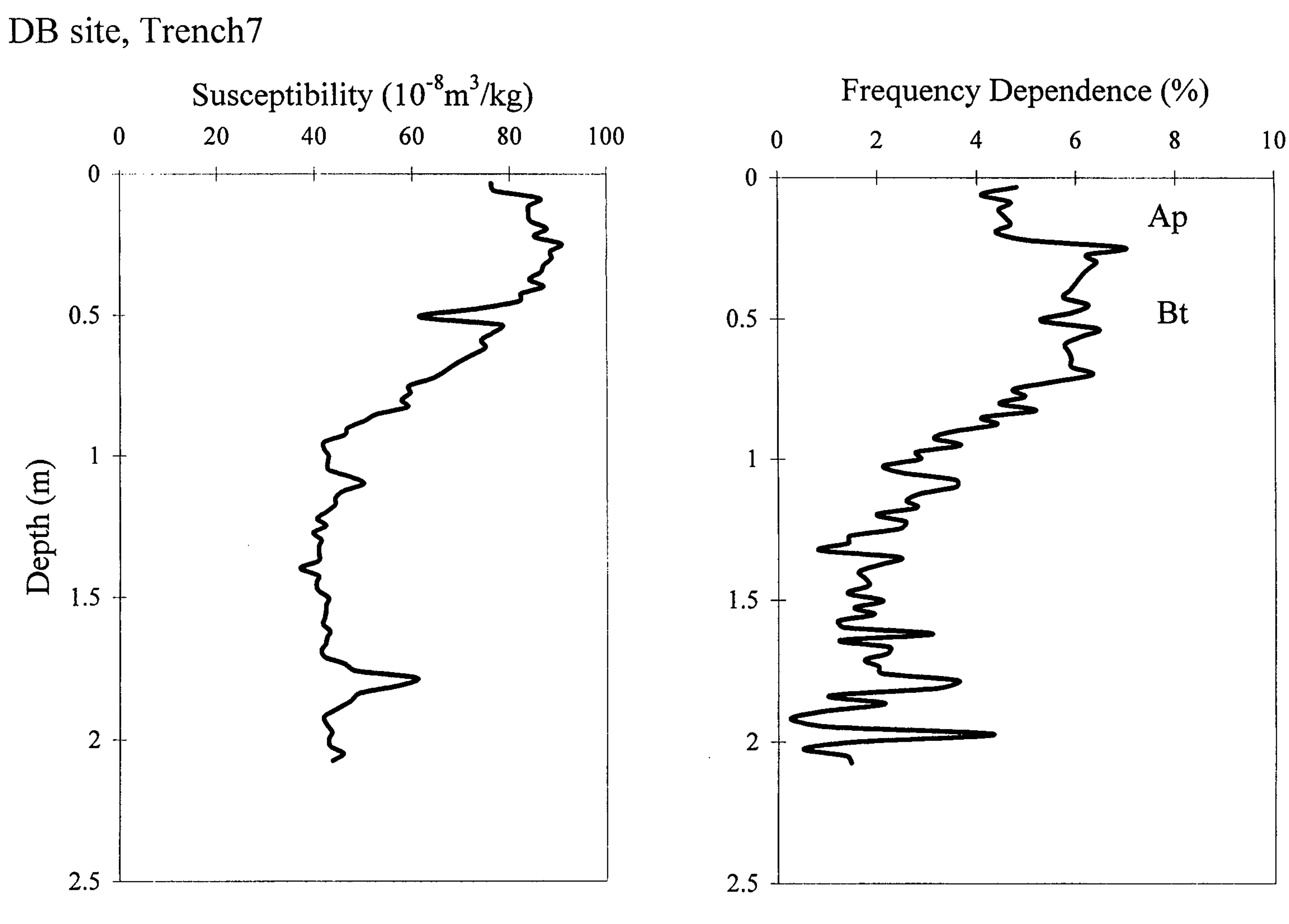

Figure 3.18. Rock magnetic data from Trench 7.

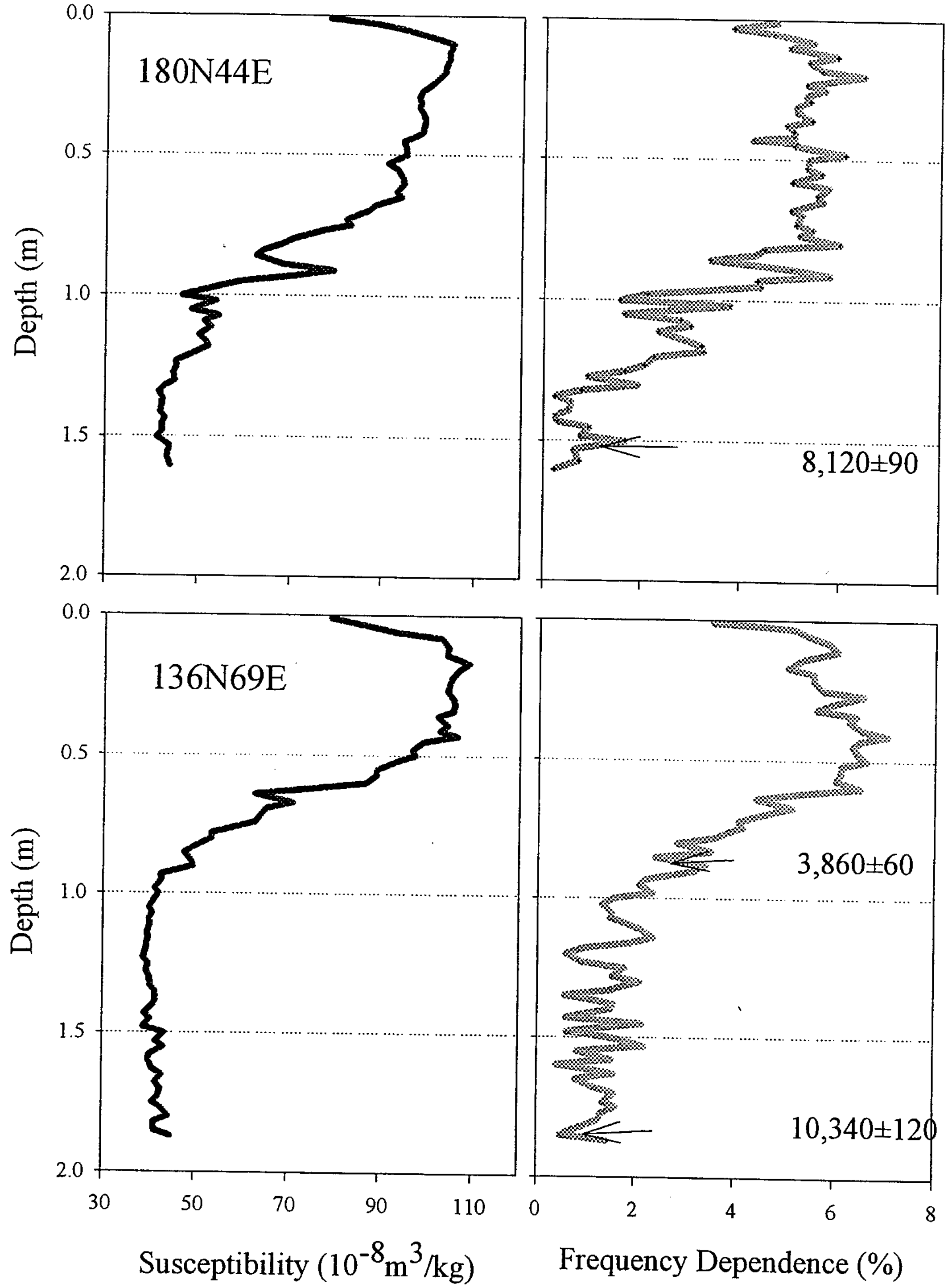

Figure 3.19. Rock magnetic data from excavation units 180N/44E and 136N/69E.

time to permit development of argillic B horizons. Based on radiocarbon ages from the Brady soil elsewhere in the region (Table 3.1), pedogenesis lasted for 1,000 to 1,500 years. The site then became destabilized and erosion of the surface began. This event must have taken place early because of the Folsom, Dalton, and Plainview projectile points associated with the eroded surface; the points may, however, have been left as lag during the erosion, or even have been deposited during the period of erosion. The A horizon was removed over much of the study area, with material moving down the flanks of the knoll. This horizon was preserved on the north and northwest sides of the site, as evidenced in the profiles from Trenches 1 and 3. Also, during excavation, scattered blotches of the Ab horizon were visible, indicating that small, thin pockets of the A horizon were preserved or washing into depressions on the surface. Erosional processes likely included water (sheet wash) due to the slopes, wind due to prominent exposure, and gravitational displacement along the slopes.

The Bignell loess began accumulating shortly after the period of erosion, burying the Paleoindian materials; loess was likely being fluxed into the site even during erosion of the Brady soil. This flux of loess continued at least throughout the Archaic and Middle Woodland cultural periods, as evidenced by the burial of this material. Although the site is characterized by net deposition during the Holocene, Bignell loess was also being washed and deflated from the knoll. Evidence for secondary deposition of the loess is the orientation of Archaic artifacts parallel to the downslope direction to the north (Chapter 14).

Post-burial redistribution of the artifactual material through pedoturbation has created noise in the archaeological model of the site. The original 3-dimensional distribution of artifacts has been disrupted by a combination of processes. These mechanical and botanical shifts in the soil and sediment matrix are due to argilliturbation, bioturbation, and graviturbation. Argilliturbation is the shift of soil particles and peds (and artifacts) due to the shrink-swell of expandable clays upon wetting-drying. The loess in this region has a moderate to high shrink-swell potential (Zavesky and Boatright 1977). Bioturbation, subdividable into faunalturbation and floralturbation, has certainly been another major source of displacement at the site. Faunalturbation involves mixing through the burrowing of vertebrates (e.g., mammals and reptiles) and invertebrates (e.g., ants and earthworms), whereas floralturbation ranges from the intrusion of grass and tree roots to radical mixing (or inversion) of the soil through tree-throw. Graviturbation consists of slow mass wasting where material is moved downslope by wind, water, and gravity. The steeper the slope, the more intense the graviturbation processes. All of these post-burial disturbance processes have been operating at the DB site, resulting in a mixing of the artifactual material. Because these processes are a time function and discriminate against the smaller artifacts, the Archaic material at the DB site has undergone the greatest mixing. For an in-depth discussion of the pedoturbative processes, see Chapter 14.

Chronostratigraphy vs. Pedostratigraphy

Throughout this chapter, the buried soil has been considered to be the Brady soil of the Pleistocene-Holocene transition. However, radiocarbon dating of samples from Trench 1 and from the two profiles of the testing phase indicate ages too young for the Brady soil (Table 3.3); rather than ages 8-10ka, the ages range from about 3ka up. Ages obtained from the Peoria loess are consistent with those obtained from the uppermost Peoria loess elsewhere in the central Great Plains. It appears that the unanticipated ages from Trench 1 are not a function of laboratory error because similar ages were obtained during the testing phase from other profiles by a different radiocarbon laboratory. For example, the age of 3,860±60 yr BP obtained in 136N/69E by the University of Texas Radiocarbon Laboratory compares extremely well with an age of 3,960±90 yr BP obtained from a similar stratigraphic position in Trench 1 by the Illinois State Geological Survey Radiocarbon Laboratory.

Several explanations exist for the apparent inconsistency between the chronostratigraphy and the pedostratigraphy. First, the buried soil may not be the Brady soil, but rather some post-Brady soil. This appears very unlikely for a number of reasons. The soil is formed in the upper Peoria loess and exhibits an extremely well developed B horizon observed elsewhere in the region only as part of the Brady soil. The Brady soil has a unique magnetic signature throughout the central Great Plains, and that same signature is present at the DB site. The B horizon clearly contains a Late Pleistocene vegetation signal, found in both the opal phytolith and $\delta^{13}C$ data sets. Further, the presence of Paleoindian artifacts in the B horizon of the soil indicates appropriate antiquity of the soil.

Another possible but unlikely explanation for the anomalous radiocarbon ages is that the B horizon of the buried soil may, in fact, represent two buried soils, that is, the lower part of the buried B horizon could be the remnant of a truncated Brady soil and the upper part of the B horizon from a post-Brady soil welded to it. This scenario is unlikely because of the integrity of the magnetic signal, the presence of Paleoindian material in the upper part of the B, and the unlikely chance that the Brady would be truncated in the same fashion at all localities where trenching, excavation and coring was done. Also, field evidence does not support such an interpretation.

A third possible explanation relates to contamination. Prehistoric cultural activity throughout the site may have been so intense and temporally continuous that the Brady soil was contaminated by younger, anthropogenically produced organic carbon. This source of contamination is unlikely for a number of reasons, including the fact that the distribution of artifacts denies such an intense and uniform distribution of activity, and the ages are too organized in their stratigraphic sequence.

Natural sources of contamination explain the age problem. Younger organic carbon from surface horizons has been translocated to the Brady soil; clay within the buried Bt horizon would serve to trap the downward moving detrital carbon. Such migration of organic carbon has been realized elsewhere in the central Great Plains by this investigator and is a perennial problem when dating the organic carbon contained in soil humates (Martin and Johnson 1995). Another source of contaminating younger carbon would come from the grass roots that have penetrated to the buried soil and subsequently died and decayed in place. Pedoturbation of the soil and sediments may have also resulted in a net movement of younger carbon-bearing material downward. When dating soil and sediment humates, proximity to the surface and modern root zone is always problematic. AMS dating of charcoal, unless it was associated with an intact cultural feature, would not likely solve the dating problem because detrital charcoal is moved through pedoturbative processes as well.

An example of the extent to which contamination has occurred in the soil zones is apparent in a comparison of cultural AMS and conventional humate ages. Botanical macrofossils from a cultural feature were radiocarbon dated with AMS to produce ages around 2,500 yr BP (e.g., 2,480±50/NSRL-3436). Approximately the same age (e.g., 2,650±70/ISGS-3585) was obtained at a lower stratigraphic position, that is, the 2Bt2b horizon of the Brady soil. The former should date to about 10,000 yr BP.

Influx of the amount of organic carbon necessary to shift the ages to the extent suspected at the DB site is small; very little young carbon is needed to decrease the age of older samples (Taylor 1987). Consequently, the $\delta^{13}C$ data sets obtained are viable because the amount of carbon translocated was too small to bring about significant changes in these values.

Cultural Record within Upland Loess Deposits

Potential for burial of cultural material has been well documented in the central Great Plains, but this has been done only for the valley landscape position. Existence of buried soil surfaces and their ages are illustrated in a number of studies (e.g., Johnson and Martin 1987; Johnson and Logan 1990; Mandel 1994, 1995) and in a database of alluvial radiocarbon ages (Johnson et al. 1996). It is becoming increasingly apparent, however, that the loess-mantled uplands of the central Great Plains contain a significant buried archaeological record.

Because loess has been deposited throughout much of the Holocene, a significant but discontinuous layer of Bignell loess can be identified on the uplands. The discontinuous nature of the Bignell loess may be a result of Holocene erosion, but appears to be largely due to preferential deposition. Preserved deposits of Bignell loess are most common along bluff tops of large river valleys. The Platte River valley of western and central Nebraska is a good example; the type locality of the Bignell loess is located on the south valley wall in southwestern Nebraska (Schultz and Stout 1945). Fortuitously, the bluff tops above major river valleys appear also to have been preferred by aboriginal peoples (e.g., DB site).

Holocene loess deposits have produced archaeological material elsewhere in the region. At the Hermann Site in east-central Missouri along the Missouri River, abundant archaeological material was retrieved from the Holocene loess deposited on the eroded 2Bt1b horizon, much like at the DB site (Schmits 1983). Ongoing geoarchaeological research by this investigator at the Fort Riley Military Installation in east-central Kansas has resulted in the recognition of a substantial Holocene loess mantle (e.g., Johnson et al. 1997). The Bignell loess is thickest (c. 2m) on the upland immediately adjacent to the Republican and Kansas River valleys. At one such site, Sumner Hill, backhoe trenching exposed in situ artifacts immediately above the Brady soil, at about 195cm. Consequently, it is becoming increasingly apparent that we must not exclude the uplands when searching for buried archaeological materials.

Chapter 4

Opal Phytolith Analysis at 14LV1071

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Introduction

Project Goals: The purpose of this study was two-fold. The primary goal was to reconstruct the paleoenvironment of the area during the late Pleistocene and Holocene using phytolith analysis. Phytoliths were also studied to identify cultivated or wild edible plant remains that might be present on grinding stones.

Phytolith Formation: Growing plants typically absorb water containing dissolved silica through their roots. Microscopic silica bodies are subsequently produced by the precipitation of hydrated silicon dioxide ($SiO_2 \cdot nH_2O$) within the plant's cells, cell walls, and intercellular spaces. Silica bodies which have characteristic shapes and sizes are called *opal phytoliths* (Wilding and Drees 1971). The term phytolith is derived from the Greek words *phyton*, meaning plant, and *lithos*, meaning stone. Opal is the common name for amorphous, hydrated silica dioxide. Opaline bodies formed in plants without specific shapes are simply plant opal.

Phytoliths form in most plants and are produced in a multitude of shapes and sizes. Many phytolith types are specific to particular groups of plants. However, both related and unrelated species may produce some of the same distinct types (Blackman 1971; Rovner 1975). A phytolith type is considered "characteristic" if it is common in one specific taxon but also produced in very limited amounts in one or more other taxa. A phytolith type is "diagnostic" if its shape and/or size are specific to a particular taxon. Fortunately, many phytoliths are resistant to weathering and are preserved in most soils for long periods of time.

Phytolith Stability: The dissolution and stability of phytoliths in soils and sediments is not fully understood. Laboratory experiments demonstrate, however, that the solubility of silica is a function of temperature, particle size, pH, and the presence of a disrupted surface layer. Studies show that the solubility of amorphous silica increases linearly with temperature from 0°C. Particle size is another factor affecting stability as opal dissolution is greater with a decrease in size (Wilding et al. 1977, 1979). Pease (1967) experimentally determined that there appears to be a slight increase in phytolith solubility in the range of 5.0 to 8.5, an added increase between pH 8.5 and pH 9.0, and a large increase beginning at pH 9.0. Opal stability is also a function of the presence of certain metallic ions and sesquioxides. The adsorption of

Al and Fe ions onto the surface of opal will decrease silica dissolution due to the formation of relatively insoluble silicate coatings. The presence of sesquioxides may increase dissolution of phytoliths due to the adsorption of monosilicic acid (Wilding et al. 1977).

Morphology and Taxonomy: Monocotyledons, particularly the Poaceae, produce a wide variety of morphologically distinctive phytolith forms. The most taxonomically useful types of grass phytoliths are silicified short cells that range in size from 10 to 35 μm long. Several types of trapezoidal circular, rectangular, and elliptical short cells are diagnostic of the Pooideae (Brown 1984; Twiss 1987; Bozarth 1992b), a grass subfamily adapted to cool temperatures and high available soil moisture (Twiss 1987). Saddle-shaped bodies occur most commonly in the Chloridoideae (Brown 1984; Twiss 1987; Mulholland and Rapp 1992), a grass subfamily that flourishes in areas with warm temperatures and low available soil moisture. Saddle-shaped phytoliths are similar in appearance to double-edged battle axes formed by two opposite convex edges and two opposite concave edges. However, a few saddle-shaped phytoliths have only one concave side (Brown 1984).

Bilobate and cross-shaped phytoliths are formed in the Panicoideae (Brown 1984; Twiss 1987; Mulholland and Rapp 1992), a grass subfamily that thrives in warm temperatures and high available soil moisture (Twiss 1987). Bilobates with indented, concave, or pointed lobes are formed only in the Panicoid subfamily. Bilobates with raised lobes edges and round or flat ends which are symmetrical in side view are also formed only in the Panicoids (Bozarth 1992b).

Bilobate phytoliths with raised lobe edges and round ends are also formed in three-awn grasses (*Aristida* spp.), a genus in the Chloridoid subfamily (Gould and Shaw 1968). However, bilobates formed in *Aristida* differ from Panicoid bilobates in that the raised edges on the top (the longer part) slope down at the ends. In addition, they are asymmetrical in side view as the top is more concave than the bottom (Bozarth 1992b). Needlegrass (*Stipa* spp.), a genus in the Pooid subfamily (Gould and Shaw 1968), also produces bilobates (Bozarth 1992b). These bilobates differ from those produced in Panicoids and *Aristida* by not having raised lobe edges. Many have a small lobe on one side in the middle. Unlike most Pooids, *Stipa* species grow in dry areas (Pohl 1968).

There are several other types of phytoliths in addition to short cells produced in grass. Long cells are relatively large (30 to 150 μm long) elongate bodies with smooth or wavy edges (Twiss 1987). Bulliform cells are large keystone shaped-cells. Trichomes are silicified prickly-hairs composed of two parts, an outer sheath and an inner core. The outer sheath dissolves soon after being deposited on the soil, while the inner core remains well preserved. Silicified stomata are taxonomically useful at various levels, but are typically not well preserved. Dendriforms are cylindrical rods of varying length with protrusions or spines radiating from a central core. Asteriforms are roughly spherical spiky phytoliths. Scutiform phytoliths are saucer-shaped bodies that have a unique, slanted apex. Piperno (1988) reported that the three latter types are apparently formed only in grass floral bracts.

Non-grass monocots also produce numerous taxonomically valuable phytoliths. Sedge (*Cyperus*) produces distinctive phytoliths in the form of cone shaped-bodies with round wavy margins. These phytoliths occur both singly and in multiples. Truncated cones with multiple peaks and round wavy bases are formed in bulrush (*Scripus pallidus*). Both of these phytolith types appear to be diagnostic of the genera that produce them (Bozarth 1995).

Several types of phytoliths are formed in woody dicotyledons (deciduous shrubs and trees) and herbaceous dicotyledons (forbs and weeds). The two most common types of diagnostic dicot phytoliths are flat or cupped polyhedrons with 5-8 sides and anticlinal cells (Rovner 1971; Wilding and Drees 1971; Geis 1973; Wilding et al. 1977; Bozarth 1992a). Anticlinal cells have wavy, undulating walls with the appearance of jigsaw-puzzle pieces. Most of these polyhedral and anticlinal phytoliths consist only of silicified cell walls and are not well preserved in sediment (Wilding and Drees 1974; Bozarth 1992a). Other phytolith types formed only in dicots include branched elements with spiral thickenings and honeycomb-shaped assemblages (Geis 1973; Wilding and Drees 1973, 1974; Bozarth 1992a).

Several species of arboreal dicots produce opal spheres that range in size from 1 to 50 μm (Wilding and Drees 1973, 1974). Opal spheres are also produced in conifers (Klein and Geis 1978), but are much smaller (3 to 8 μm). Opaque opal spheres have been extracted from the A horizon of several forested soils in Ohio demonstrating that they are well preserved (Wilding and Drees 1973, 1974). Wilding and Drees (1973) also reported opaque bladed forms (which appear to be opaque platelets), in white oak (*Quercus alba*). Similar particles were observed in isolates from a soil formed under deciduous forest.

Spiny spheres are commonly formed in neotropical palms (Piperno 1988; Bozarth 1993a), but they have not been reported in temperate vegetation. However, the association of spiny spheres with deciduous tree phytoliths in a late Pleistocene and Holocene loessal site in Nebraska (Bozarth 1992b) suggests that they are also formed in this, or an associated, group of plants.

Phytolith analysis of 14 dicot species and one cactus native to the Central Great Plains shows that diagnostic phytoliths are only rarely formed in edible fruits and nuts. Most of the fruits and nuts studied were from trees and shrubs, including shagbark hickory (*Carya ovata*), hackberry (*Celtis occidentalis*), persimmon (*Diospyros virginiana*), black walnut (*Juglans nigra*), sandhill plum (*Prunus angustifolia*), wild plum (*P. americana*), choke cherry (*P. virginiana*), currants (*Ribes odoratum*), elderberry (*Sambucus canadensis*), white oak (*Quercus alba*), and burr oak (*Q. macrocarpus*). Other reference species include two forbs, devil's claw (*Proboscidea louisianica)* and ground cherry (*Physalis virginiana)*, a wild grape (*Vitis riparia*), and a cactus prickly pear (*Opuntia microrhiza*). Of these 15 species, diagnostic phytoliths were formed only in hackberry fruits. These phytoliths, produced in the fruit stone, are in the form of platelets with irregular edges and echinate (spiny) sculpturing on one side (Bozarth 1987b).

Subsequent to this study, four additional samples from economic species were analyzed: nuts and bracts from hazelnut (*Corylus americana*), achenes from marsh elder (*Iva annua*), and achenes with bracts from Pennsylvania smartweed (*Polygonum pensylvanicum*). No taxonomically useful phytoliths were found. Furthermore, previous unpublished studies indicate that Palmer's pigweed (*Amaranthus palmeri*), rough pigweed (*A. retroflexus*), and lamb's quarters (*Chenopodium album*) do not produce diagnostic phytoliths.

Other dicots produce phytoliths diagnostic at various taxonomic levels. Opaque platelets with systematic perforations and certain types of segmented hairs are diagnostic of Asteracaee (the Sunflower family). Flat polyhedrons with 5-8 sides that are filled with coarse verrucae (bumps) appear to be unique to Ulmaceae (the Elm family) (Bozarth 1985a, 1992a). Certain types of stalked verrucate phytoliths are specific to hackberry, mulberry (*Morus*), false nettle (*Boehmaria*), or nettle (*Urtica*). Elongate verrucate phytoliths with one or both ends tapering to a point are unique to clearweed (*Pilea*) (Bozarth 1992a). Phytoliths with deeply scalloped surfaces of contiguous concavities are diagnostic of squash and wild buffalo gourd (*Cucurbita* spp.) (Bozarth 1987a).

Several types of phytoliths are produced in the pine family (Pinaceae). Silicified, irregularly-shaped, polyhedral cells are the most common taxonomically useful Pinaceae phytolith. This type of phytolith is produced in red spruce (*Picea rubens*), black spruce (*P. mariana*), white spruce (*P. glauca*), Engleman spruce (*P. engelmannii*), and jack pine (*Pinus banksiana*) (Norgren 1973; Klein and Geis 1978; Bozarth 1988, 1993b). Blocky polyhedra with smooth surfaces and at least eight non-parallel sides are characteristic but not diagnostic of Pinaceae, because they are also produced, although relatively infrequently, in grasses (Bozarth 1993b).

In contrast to smooth polyhedrons, polyhedrons with bordered pit impressions on the surface are unique to the Pinaceae. This type of phytolith is abundant in pine (*Pinus*), spruce (*Picea*), Douglas-fir (*Pseudotsuga menziesii*), and less commonly in larch (*Larix*), hemlock (*Tsuga*), and fir (*Abies*) (Klein and Geis 1978). Douglas-fir needles produce distinctive, branched, silicified particles (Brydon et al. 1963). This same type of phytolith was also reported in Douglas-fir by Garber (1966) as irregular shapes with spiny processes and by Norgren (1973) as amoeboid bodies with tapering, conical protrusions. Thin plates with wavy margins on all four sides are formed in needles of white spruce and appear to be unique to that species. Phytoliths with spiny irregular bodies are commonly formed in needles of jack pine and appear to be diagnostic of that species (Bozarth 1993b).

Applied Phytolith Research in the Great Plains: Phytoliths are largely a "decay in place" fossil (Rovner 1975) and represent the vegetation of a site at the time of deposition (Piperno 1988). Opal phytoliths can be isolated from buried sediment samples and analyzed to reconstruct the paleoenvironment for a particular area. This has been successful on a number of sediment types, including loessal sites in Nebraska (Fredlund et al. 1985; Bozarth 1991b, 1992b; Johnson 1993), Kansas (Bozarth 1984a; Johnson and Bozarth 1996), and Texas (Bozarth 1995), as well as alluvium in Kansas (Bozarth 1986a, 1990a) and Texas (Bozarth 1995). Regional fossil phytoliths were first recognized by Twiss et al. (1969) in buried soils in north-central Kansas but the paleoenvironments were not reconstructed.

Phytolith analysis has also been used to identify cultigens and other economic species in prehistoric archaeological sites. Phytolith analysis was first applied to Great Plains paleoethnobotanical studies by Bozarth (1984b) who identified sunflower-like phytoliths in sediment samples collected in features at 25DX3, a Central Plains Tradition village in northeast Nebraska. These silicified, multi-celled hair bases are commonly formed in the disks of common sunflower (*Helianthus annuus*) and domesticated sunflower (*Helianthus annuus* var. *macrocarpa* (Bozarth 1986b).

Additional taxonomic classification demonstrated that diagnostic phytoliths are formed in the rinds of selected varieties of squash (*Cucurbita* spp.) (Bozarth 1985b, 1986b, 1987a) and in the pods of common beans (*Phaseolus vulgaris*) (Bozarth 1986b, 1990b). Squash phytoliths (scalloped spheroids) were recovered at 25DX3 (described above)(1986b) and 3CT50, a Late Woodland site in northeast Arkansas (Bozarth 1985b, 1987a). Bean phytoliths (silicified hooked hairs) were identified in an isolate from 14MN328, a Great Bend aspect village located in central Kansas (Bozarth 1989a, 1990b).

Mulholland (1986, 1987) reported two types of phytoliths characteristic of maize, one in chaff and the other in leaves and husks, which could be used as indicators of maize in archaeological sites in North Dakota. Extensive taxonomic research by Bozarth (1989a, 1989b, 1993c) demonstrated that maize cobs produce diagnostic phytoliths. Based on these studies, maize was identified in two features at 14MN328 (described above).

As previously reported, most archaeological phytolith analyses reconstruct paleoenvironments or plant subsistence strategies. However, other types of studies can be done with phytoliths. For example, at the Hatcher site (14DO19), a Late Prehistoric habitation structure in northeastern Kansas, a study of phytoliths from a daub concentration demonstrates that panicoids (tall-grasses) and pooids (cool-moist season grasses) were the most common grasses used in construction at the site (Bozarth 1987c). A phytolith analysis of prehistoric bison tooth calculus and impacta from sites in Kansas and Oklahoma demonstrates that this type of study can be used to reconstruct the diet of prehistoric bison in the central Great Plains (Bozarth 1993d).

<u>Methodology</u>: Phytoliths were isolated from 32 samples, one from the surface of a nearby oak-hickory forest for use as a modern analog, 27 from Trench 1 for paleoenvironmental reconstruction, and four from ground stone washes to identify economic species. The following sediment samples were processed from Trench 1 (Figs. 4.1-4.3): two 2.5cm thick samples from the Ap, 10 contiguous 2.5cm thick samples in the Bignell loess, 10 contiguous 2.5cm thick samples in the Brady A horizon, three 5cm thick samples in the Brady B horizon, and two 5cm thick samples in the Peoria loess.

Four ground stones were processed by Margaret Beck (chapter 11) in such a way as to create artifact washes. First, the artifacts were placed in clean plastic bags immediately after being excavated in the field. Once the artifacts were in the archaeology lab, the loose sediment was removed. Artifact surfaces were then cleaned with a stiff bristle brush while spraying with

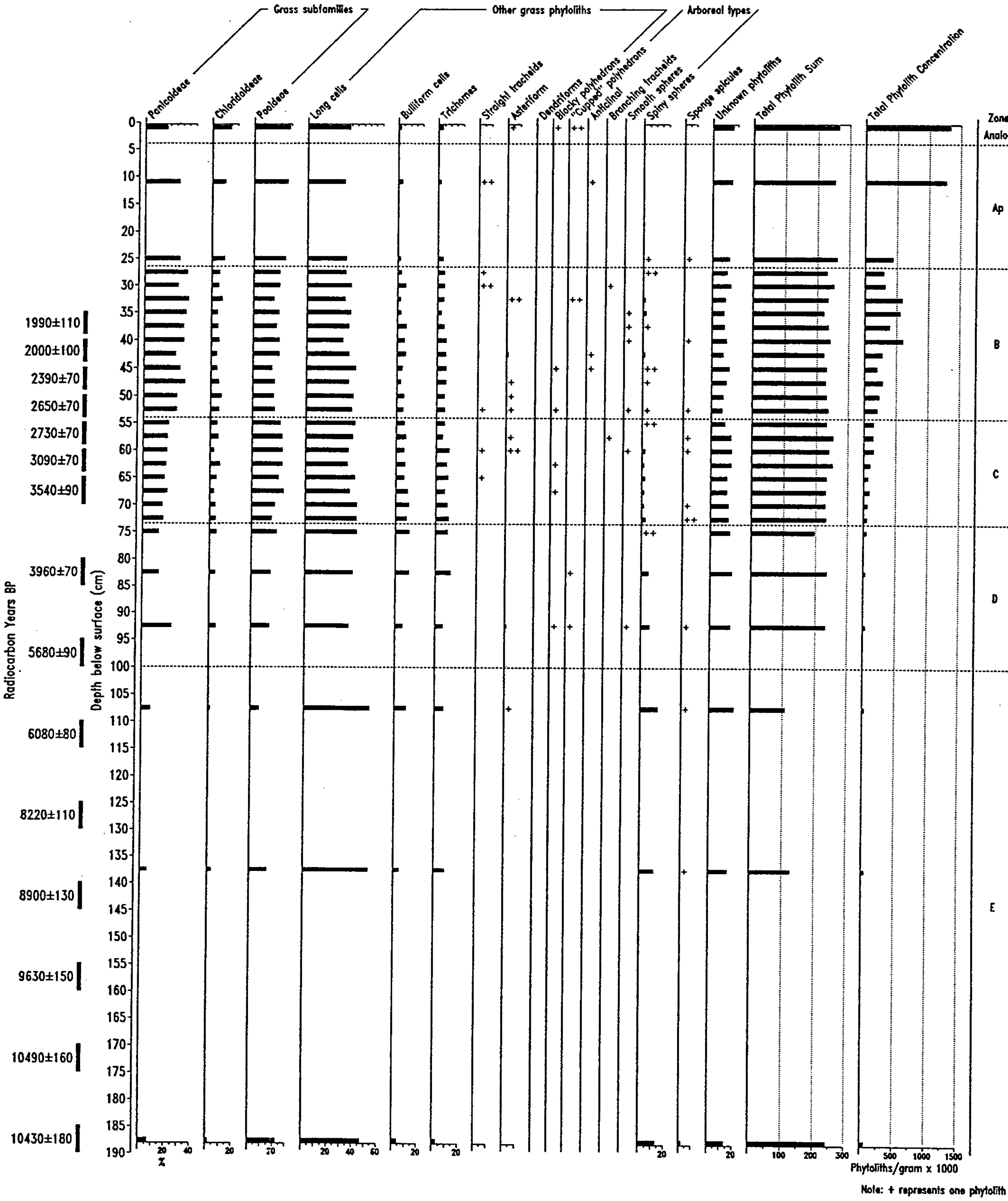


Figure 4.1. Frequencies of Phytolith Types and Sponge Spicules for Modern Analog and Trench 1 Samples at 14LV1071.

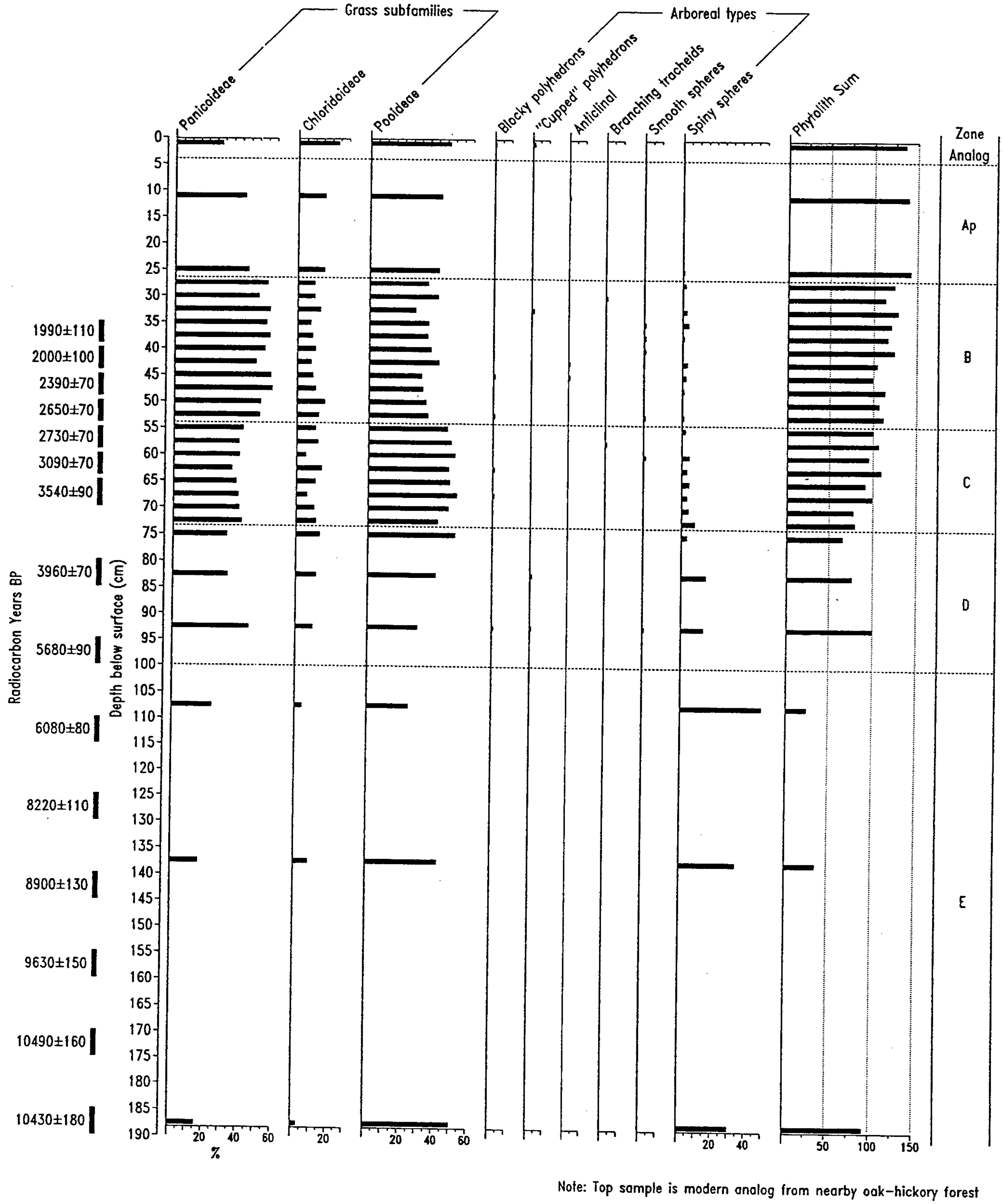


Figure 4.2. Frequencies of Grass Short Cells and Arboreal Type Phytoliths for Modern Analog and Trench 1 Samples at 14LV1071.

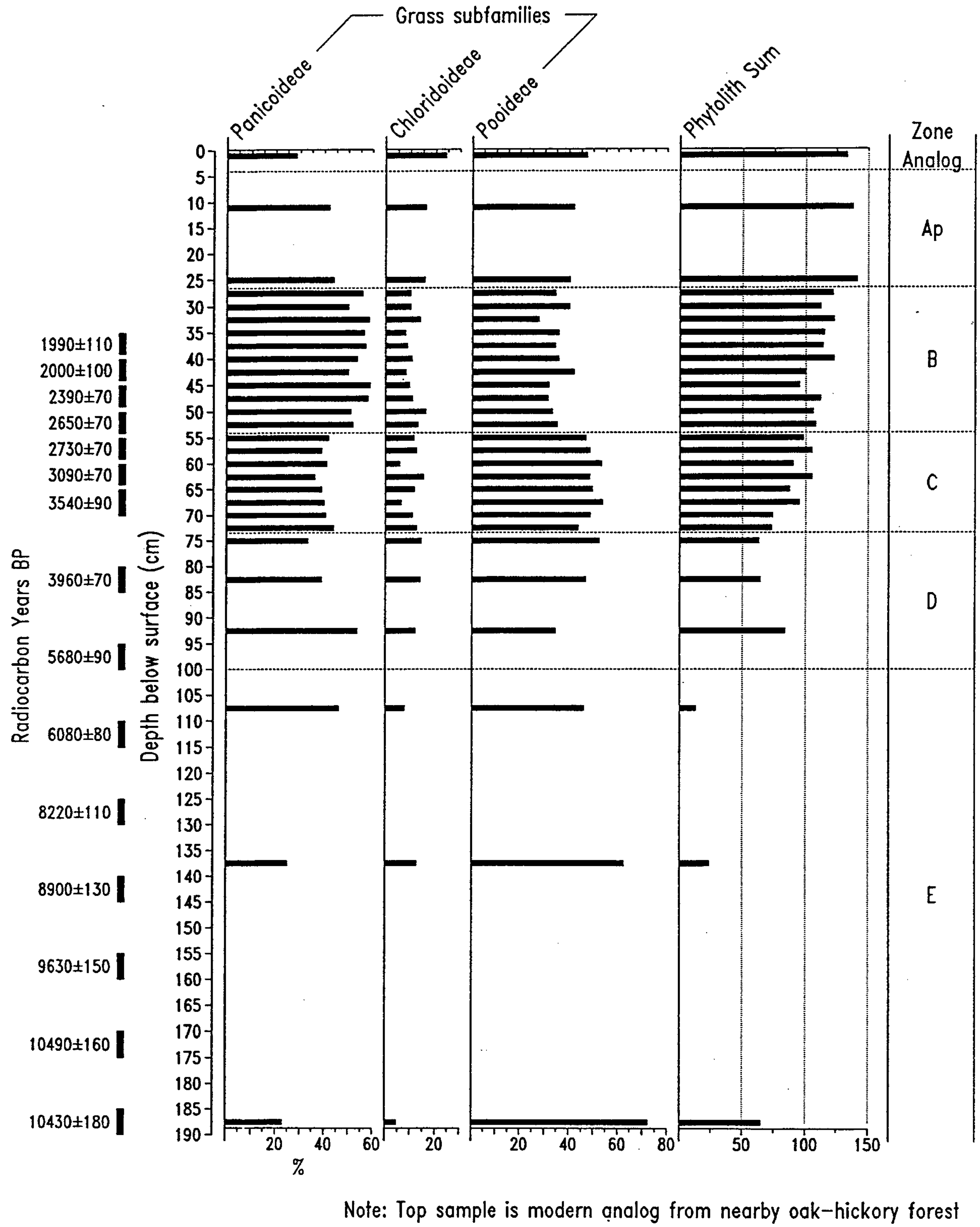


Figure 4.3. Frequencies of Grass Short Cells in Modern Analog and Trench 1 at 14LV1071.

a stream of distilled water. The water-sediment mixture was then stored in a water tight container until processed (Bozarth 1991a).

Phytoliths were isolated from 5gm samples using a procedure based on heavy-liquid (zinc bromide) flotation and centrifugation (Bozarth 1991a). This procedure consists of five basic steps: 1) removal of carbonates with dilute hydrochloric acid; 2) removal of colloidal organics, clays, and very fine silts by deflocculation with sodium pyrophosphate, centrifugation, and decantation through a 7-μm filter; 3) oxidation of sample to remove organics; 4) heavy-liquid flotation of phytoliths from the heavier clastic mineral fraction using zinc bromide concentrated to a specific gravity of 2.3; 5) washing and dehydration of phytoliths with butanol; and 6) dry storage in 1-dram glass vials.

A representative portion of each phytolith isolate was mounted on a microscope slide in immersion oil under a 22x40mm cover glass and sealed with clear nail lacquer. Each isolate was then counted and scanned with a petrographic Zeiss microscope at a magnification of 625X. Counting consisted of classifying a minimum of 200 phytoliths at the most specific level possible. At least 200 additional phytoliths were scanned for economic species in the four ground stone washes.

Estimates of phytolith concentration were made using an indirect method reported by Piperno (1988). A known number of exotic spores (i.e., *Lycopodium*) were added to each sample after oxidation. The concentration of phytoliths (per gram) was computed as follows:

Phytolith conc. = no. of phytoliths counted x (total no. exotics added / no. exotics counted) / 5

Concentration permits an evaluation of the phytolith production, preservation, and sedimentation rate for a given sample interval.

Phytoliths were classified according to a convention that has been developed and used in other reports and publications. An extensive reference collection of plants native to the Great Plains has been developed in the palynology laboratory through field collection, research plots, solicited samples, and specimens supplied by the University of Kansas Herbarium. The phytolith reference collection consists of phytoliths extracted from complete or representative aerial portions of the following: 1) 25 species of 20 genera of 11 tribes of six subfamilies of the Poaceae (grass); 2) 11 species of four genera of four non-grass monocot families; 3) 65 species of 62 genera of 11 families of herbaceous dicots; 4) 20 species of 18 genera of 13 families of woody (mostly arboreal) dicots; 5) 14 species of seven genera of five families of gymnosperms; and 6) two species of Equisetum. These reference materials include all the dominant species in the study area as reported by Kuchler (1974).

An unknown group consists primarily of phytoliths too poorly preserved to be classified any other way. There were a few other phytoliths included under this heading that were stuck under the cover glass and could not be rotated for three-dimensional viewing, thereby precluding positive taxonomic classification.

The phytolith data were presented in computer generated diagrams using *Tilia* and *Tiliagraph* software (Grimm 1992). Three diagrams were created for the data from the Trench 1 samples: frequencies of all phytolith types and sponge spicules are shown in Figure 4.1, frequencies of the more specific grass short cells and arboreal type phytoliths are shown in Figure 4.2, and frequencies of only the grass short cells are represented in Figure 4.3. Phytolith data from the ground stone washes are presented in Figure 4.4.

Results

Trench 1: Phytolith preservation was adequate for analysis in all of the 27 samples studied in Trench 1 and the modern analog collected in the nearby oak-hickory forest. There were five apparent paleoenvironmental zones based on the phytolith data from Trench 1. Zone E represents a warming trend as evidenced by an increase in Panicoid grasses (a subfamily adapted to warm temperatures and high available soil moisture) and a decrease in Pooid grasses (a subfamily that thrives in cool moist environments). There is no evidence for increasing aridity, as the Chloridoids (a subfamily that flourishes in warm temperatures where available soil moisture is low) do not increase in this zone which corresponds to the upper Peoria loess and part of the lower Brady B horizon. The frequency of spiny spheres is greatest at this depth, indicating that deciduous trees were growing on the site.

An increase in the frequency of Pooids and a decrease in Panicoids in Zone D, which corresponds to the upper Brady B horizon, indicate a period of increasingly cooler weather. This reverse in climate appears to coincide with the Younger Dryas, a time of major cooling which occurred at about 11,500 yr BP (Paterson and Hammer 1987). A coincident decrease in spiny spheres suggests that fewer trees were growing in the area.

Zone C represents a stable environment as evidenced by only minor fluctuations in the phytolith data. The vegetation apparently consisted primarily of a grassland dominated by Pooid and Panicoid grasses indicative of relatively cool-moist conditions. It was during this time that the Brady A horizon formed.

Zone B is characterized by a sharp increase in Panicoids, along with a decrease in Pooids, indicating a sudden warming that coincides with the start of the Bignell loess deposition. It is interesting to note that conditions were apparently not significantly drier, i.e., the frequency of Chloridoid phytoliths does not change significantly during the times in which the Brady A horizon developed and the Bignell loess was deposited.

The Ap Zone is difficult to interpret given the mixing that resulted from historic plowing and the addition of phytoliths from introduced cultivated species. However, the primary historic vegetation at the site apparently consisted of tallgrass prairie, as neither of the two samples in this zone closely match the modern analog collected in a nearby oak-hickory forest.

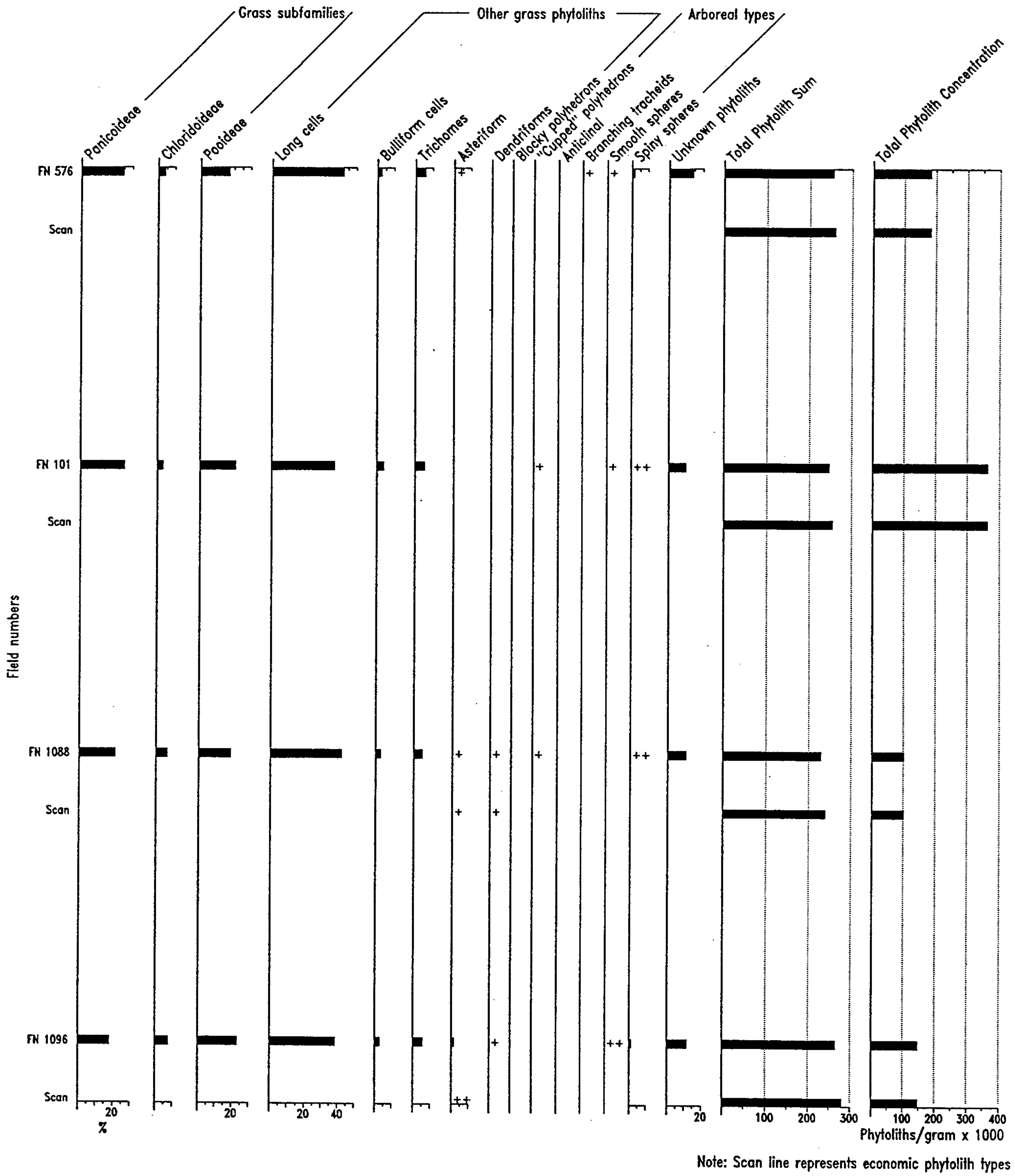


Figure 4.4. Frequencies of Phytolith Types from Groundstone Washes at 14LV1071.

Ground Stone Washes: All four ground stone washes yielded adequate numbers of phytoliths for analysis (Fig. 4.4). The most interesting data are from FN 1096 (collected at a depth of 20-30cm bg; 40-50cm bs) which yielded asteriform and dendriform phytoliths. The relatively high frequencies of these two rare types of phytoliths formed only in grass floral bracts indicate that the stone was used to grind native grass seeds. Elevated frequencies of these two types of phytoliths were also found in FN 1088 (collected at 20-30cm bg; 40-50cm bs) suggesting that it may also have been used to grind grass seeds. The lack of additional evidence regarding plant subsistence is not unexpected given that diagnostic phytoliths are not produced in most fruits and nuts.

Summary

A total of 27 sediment samples collected in Trench 1, in addition to a modern analog from the nearby oak-hickory forest, were analyzed for phytoliths to reconstruct the vegetative history and paleoenvironment at the DB site. A comparison of the phytolith data to the stratigraphy demonstrates a close correlation between the phytolith record and the local loess sequence for the late Pleistocene and Holocene.

Five different paleoenvironmental zones were identified. The lowest, Zone E, represents a warming trend and corresponds to the upper Peoria loess and lower Brady B horizon. The phytoliths in Zone D, which includes most of the upper Brady B horizon, indicate a period of increasing cooler weather which appears to coincide with the Younger Dryas. The phytoliths in Zone C represent a stable, relatively cool-moist environment in which the Brady A horizon formed. Zone B is distinguished by a sudden warming which coincides the start of the Bignell loess formation. Conditions remained relatively warm, but apparently not significantly drier than during the time in which the Brady soil developed, throughout the rest of Zone B. The historic vegetation at the site apparently consisted of tallgrass prairie as neither of the two samples in Zone A closely match the modern oak-hickory forest analog.

Analysis of four ground stone washes indicates that one, and possibly two, of the artifacts were used to grind native grass seeds. Analysis of additional reference materials may provide some indication of the grass species which were processed at the DB site.

Chapter 5

Regional Culture Historical Overview

Brad Logan

Introduction

Diagnostic artifacts from the DB site attest its occupation by groups of several different cultures that adapted to the Lower Missouri River Valley from Late Pleistocene to Late Holocene time. Cultures of the Paleoindian, Archaic, Middle Woodland, and Late Prehistoric periods, which are broadly defined on the basis of characteristics reflecting these adaptations, are represented at the site. This chapter presents an overview of the culture historical context of the Lower Missouri Valley and adjacent regions that makes it possible to place the cultures as they are expressed at DB in context. More specific discussion of some of these cultures as they relate to problem domains and research questions presented in the Data Recovery Plan (Logan 1996a:84-100) is found in chapter 15.

Paleoindian

The earliest evidence of humans in the region coincides with the late Wisconsinan glaciation some 12,500 years ago. At that time the Great Plains was populated with nomadic bands of hunter-gatherers that were dependent to some extent on now extinct large animals such as mammoth and bison (subspecies *antiquus*). Paleoindian sites with associations of skeletal remains of these animals and the tools used to dispatch and butcher them, such as those found in the western Great Plains (Frison 1991; Haynes 1964, 1969, 1970; Rogers and Martin 1984; Wormington 1957) and, to a lesser extent, in the eastern Great Plains and Midwest (Graham et al. 1981), are unknown in the Lower Missouri and Kansas River valleys. However, there is evidence in the form of temporally diagnostic projectile points that these big-game hunters were in the area. Isolated finds of Paleoindian points (Clovis, Folsom, or Plano types) have been recorded throughout Missouri (Chapman 1975) and Kansas (Brown and Logan 1987). In the latter state they have been recovered in Tuttle Creek reservoir near Manhattan (Solecki 1953; Schmits 1978), in the Delaware River basin (Witty 1964; Reichart 1972), in the lower Kansas River valley (Rogers and Martin 1982, 1983; Wetherill 1995), near Highland in Doniphan County (Wedel 1959:175-176), and on Plum Creek a few km from the DB site (Witty and Marshall 1968; Logan 1981b).

Most relevant here are the concentrated finds of Paleoindian points in the Bonner Springs area along the Lower Kansas River and the more isolated occurrences near Highland and on Plum Creek. Particularly numerous in the Bonner Springs area are Dalton points (Wetherill

1995:42-58) that point to the westward extension of a woodland-riverine adaptation more prevalent in the Eastern Woodlands (Goodyear 1982; Myers and Lambert 1983; Wood and McMillan 1976). The nature of this adaptation, to a deciduous woodland habitat, and the appearance of a groundstone technology (grinding stones and adzes) that attests exploitation of plant food and material resources have prompted some archaeologists to consider Dalton a transitional Paleoindian-Archaic culture. Less frequent are discoveries in the region of Folsom and Plano projectile points, which on the High Plains have been found in contexts that testify to specialized bison hunting (Hofman 1996:55-74). It is peculiar that no Folsom points have been recovered from the gravel bar deposits near Bonner Springs that have otherwise yielded a surprising number of Clovis and Plano projectiles. Points of these complexes have been recovered in disturbed contexts elsewhere in northeastern Kansas, in particular near Highland, about 60km (37mi) north of the DB site. In his discussion of about a dozen of these artifacts, Wedel (1959:176) attributes them to big game hunters who occupied the region "8 or 10 millenia ago" and, anticipating sites that DB now strongly indicates are, indeed, present, states:

> What is needed now ... is a discovery of fluted and other early point types in situ, with geologic and paleontologic contexts that will permit their placement in time and with artifact associations from which can be determined the local complex to which they belong. The glaciated northeast section of Kansas in which these pieces were found would seem a likely area for eventually discovering such associations.

Though they are sparse, the material remains of Paleoindian occupation in the region can be placed in a paleoenvironmental context that is well described from geomorphological, paleontological, and palynological data (chapter 3; Johnson and Park 1996). Thus, the growing body of Paleoindian evidence can be fruitfully explored with respect to variability in human adaptations to late glacial landscapes. Problems of human-megafaunal interactions (mammoth-mastodon hunting, bison herd manipulation, group mobility, Pleistocene extinction, etc.), lithic material procurement and technology, culture change, and inter-regional relations can be addressed (Hofman 1996:41-83). While the few finds of Paleoindian projectile points from the DB site (chapter 9) may provide little data to address some of these questions, their presence in a buried, well described geomorphological context in an upland setting points to the great potential for such research (Logan and Johnson 1997).

Early-Middle Archaic

The beginning of the Archaic period coincides with the beginning of the Holocene epoch. The global environmental shifts that occurred at the end of the Pleistocene, including abrupt vegetational changes and megafaunal extinctions, required adaptive responses by human populations. In the eastern Great Plains, this response entailed the adoption of a foraging lifeway by small, dispersed groups of hunter-gatherers dependent on modern wild plant and animal resources. These groups responded to seasonal availability of these resources in their various habitats across the landscape by shifting occupations among strategically located campsites. While not as highly mobile as the Paleoindian settlement-subsistence pattern, the

Archaic pattern in the region Plains was not sedentary. This is indicated by the lack of storage facilities, distinctive habitation structures, and a developed ceramic technology. With the demise of late Pleistocene megafauna some 10,000 years ago, the hunters of the Great Plains targeted modern game such as deer, elk, and bison and a greater dependence on wild plant foods. Cleland (1976) has described the Paleoindian to Archaic subsistence shift as a change from a focal economy to one more accurately described as diffuse. Archaic settlement sites indicate a shift toward seasonal exploitation of resources in local microenvironments and, in the lower Missouri and Kansas River region, at least by the Late Archaic, the establishment of an annual round focused on forest-riverine and upland prairie resources.

Post-Pleistocene readaptation was strongly influenced by the Hypsithermal climatic episode. As noted in chapter 2, this regime of increasing aridity occurred in the Central Plains ca. 9,000-5,000 BP. In northeastern Kansas, this episode brought about an expansion of prairie and a corresponding recession of the upland and/or riverine woodlands (Gruger 1973). Perhaps as a response to this environmental change, Archaic hunter-gatherers adopted an economic strategy based on the use of a wide variety of plant and animal resources available in aquatic, floodplain forest, and floodplain prairie communities (Schmits 1978).

The earliest radiocarbon dated Archaic occupations in northeastern Kansas, at the Sutter site (14JN309; Katz 1971, 1972) in Jackson County and the earliest of two components at the Cut-Bank site (14JF409; Logan 1990b:257-262) in Jefferson County, occurred ca. 8800-7400 BP, prior to or early in the Hypsithermal. Neither component has been assigned to specific cultural complexes, though the former bears affinities to the Frederick and McKean complexes of the northwestern Great Plains. At both sites, skeletal remains of bison suggest that animal was the primary target of these Archaic hunter-gatherers. The presence of artifacts of non-local cherts at the Cut-Bank site points to the procurement of this material at locales in the Flint Hills and High Plains of Kansas and suggests groups at this time were still fairly mobile.

It must be remembered that the Hypsithermal was the climax of a warming trend, and concomitant expansion of prairie habitat, that was initiated soon after the retreat of the Wisconsinan ice sheet. The beginning of this trend can be seen in the Dalton culture described above. Archaic adaptations may have developed gradually over a long period from the beginning of the Holocene without markedly severe change at the Hypsithermal "boundary" of 9,000 BP. An apparent occupational hiatus of some 1500 years (ca. 7500-6000 BP) in the archaeological record throughout much of the Great Plains is coincident with the peak of this episode. This hiatus has been attributed to the prevalent arid conditions but is as likely due to fluvial geomorphic processes affecting site visibility either through burial or erosion (see discussion in Mandel 1987a:IV-12). Indeed, deeply buried Archaic occupations at sites such as Cherokee, in western Iowa, point to continued, if more geographically restricted, activities in the region (Anderson et al. 1980:265-266).

Whatever the affects of the Hypsithermal on Archaic lifeways, the well-documented occurrence of that climatic episode has colored much of the research about coincident human adaptations and their relationship to environmental factors. It has given many interpretations of that period a deterministic cast, all too easily assumed given the paucity of information about regional and inter-regional cultural relations (other than circumstantial evidence provided by the wide geographic range of similar projectile point styles). Moreover, the affect of the Hypsithermal on alluvial sedimentation and erosion in lowland settings bears directly on the problem of Archaic site preservation or removal.

Taxonomic units for the Early and Middle Archaic period that are relevant here are Logan Creek (ca. 7500-6000 BP), Blue Springs (6700-6450 BP), and Jacomo (5700-5200 BP). The last two complexes are known from only a few sites in the Little Blue River drainage, Jackson County, Missouri (Schmits and Bailey 1989:230-231). The Logan Creek complex is very poorly known in Kansas (Brown and Simmons 1987) and, indeed, is not yet well defined from the few excavated sites that have been assigned to it.

Logan Creek: The Logan Creek complex is based on data from a few sites in valleys tributary to the Missouri River in eastern Nebraska and western Iowa. Despite the number of sites assigned to it, it remains poorly described. In particular, data from the type site, Logan Creek (25BT3), remain largely undescribed. One of the most recent discussions of the complex (Thies and Witty 1992) is essentially a summary of the data given in the short, unpublished manuscript by Kivett (1959), who defined the complex. Review and publication of these data are critical to further understanding of Logan Creek. As an example of how some misunderstanding of diagnostic artifacts may occur, the photographs of "plano-convex", notched scrapers in Thies and Witty (1992:146) show the invasively retouched side of what could be taken for reworked, bifacial points (Hofman 1996:83, 84). Such recycled artifacts have been found at the DB site and could be inferred as support for a Logan Creek affiliation. However, Morrow (1984:94) presents both faces of a Logan Creek scraper from Iowa that illustrates the unifacial nature of this tool. Had more detailed description of such artifacts been available from the type site assemblage, the inference of scrapers recycled from damaged projectile points and potential taxonomic misassignment could be avoided.

The type site is located in Burt County, northeastern Nebraska, where excavations in the 1950s and 1960s by the Nebraska State Historical Society revealed eight cultural zones in stratigraphic sequence within an alluvial fan (Kivett 1959; Mandel 1995). Kivett (1959) defined the Logan Creek complex on the basis of material from the four lower zones (A-D), which contained hearths, shallow circular pits, and post molds. Bison bone was particularly common, suggesting this animal was the primary game animal. Chipped stone tools included small to medium size, side-notched points with triangular blades and concave or straight bases; plano-convex, side-notched scrapers; crudely flaked lanceolate blades; grinding stones and metates; grooved scoria abraders; and bone tools such as ribs with spatula-like, serrated ends, awls, tubular bone beads, and a fishhook; ferrous oxide; and an "abundance of pink quartzite from glacial till commonly used for hearths, usually in a broken and cracked condition" (Kivett 1959:4).

The Logan Creek site was compared to the Simonsen (13CK61), Hill (13ML62), and Turin sites (13MN2) in western Iowa, all of which were assigned to the complex (Kivett 1959).

All three sites yielded side-notched dart points with straight to concave bases. Only one such point was found at Turin, in the pelvic region of a fully flexed, ochre-stained burial that also contained *Anculosa* shell beads (Fisher et al. 1985). Hill and Simonsen provided more evidence of the importance of bison hunting. The remains of more than 25 bison from the latter site, which was in alluvial terrace fill along the Little Sioux River, were identified taxonomically as *Bison occidentalis* (Frankforter and Agogino 1960; Agogino and Frankforter 1960). Indeed, Simonsen was initially described as a Paleoindian bison kill. However, given the mid-Holocene age of the site and of the Logan Creek complex in general, that affiliation and the bison taxonomic identification are no longer tenable. Indeed, the latter concern may not even be relevant. Bison taxonomy remains problematic and the trend has been toward synonomy, lumping all late Pleistocene and Holocene bison in the same species and reserving use of terms such as "antiquus" and "occidentalis" for subspecies (Wilson 1974). Contemporary bison from the Cherokee Sewer site, discussed below, are assigned to *Bison bison*, subspecies indeterminate (Pyle 1980:179-181).

Other more recently investigated sites assigned to the complex include Cherokee Sewer in western Iowa and Spring Creek in southwestern Nebraska. The former site is well described and includes at least two components in the stratified deposits of an alluvial fan (Anderson and Semken 1980). Bison remains are plentiful here as well and they are associated with the side-notched points considered diagnostic of the Logan Creek complex. Cultural Horizon I at the site, which yielded five side-notched points, was assigned to the Middle Archaic period. Cultural Horizon II, which contained 22 points of which ten were side-notched, was assigned to the Early Archaic period. Cultural Horizon III contained ten lanceolate and stemmed points and it was assigned to the Late Paleoindian period. Horizon I dates ca. 6000-6300 BP; Horizon II to 7500 BP these levels range from ca. 6000 to 7500 BP; Horizon III dates ca. 8500 BP. All three components are interpreted as late winter bison processing camps.

Anderson and others (1980) provide a list of "firsts" evident at Cherokee Sewer. Among them is the first appearance of the side-notched dart point in Iowa. Horizon IIIa yielded one such artifact among more prevalent stemmed and lanceolate forms. The first milling stones appear in Horizon II at 7200 BP. That groundstone technology had occurred earlier is noted by the earliest full-grooved axe in Zone 7 at the Simonsen site, dated ca. 8430 BP. The clinker abrader appears at Cherokee in Horizon II. Here the authors note that "such items were obtainable only through trade or travel to the Missouri River basin where they could be found in alluvial deposits downstream from the burning lignite beds in the Dakotas" (Anderson et al. 1980:266). Finally, the first evidence of domestication of the dog on the eastern border of the Great Plains is found in Horizon I (Middle Archaic).

The Spring Creek site (25FT31) is located on the second terrace at the confluence of Red Willow and Spring Creeks in Frontier County, Nebraska. It was excavated by the Nebraska State Historical Society in 1961-1962 (Grange 1980:12-47). This investigation recovered 276 stone and bone artifacts, most of them chipped stone. They include 21 projectile points, most of which are side-notched forms but they include a few lanceolates. Other chipped stone tools include knives, scrapers and choppers. None of the scrapers is described as notched, though three are bifacially worked. The majority are generic end scrapers. The groundstone assemblage includes a grinding slab to which "fragments of red pigment adhere" (Grange 1980:38) and four manos. Worked bone consists of bison ulna picks, a scapula pick, bison long bone fleshers, a shaft wrench (bison rib), bone abrader, awls, rib and split rib flakers, and a spatula made from a bison scapula. While the faunal remains include deer, fox, antelope, beaver, cottontail, pintail, goose and other remains that are probably intrusive, the great majority are bison. Only one radiocarbon date was obtained from the site that indicates its occupation ca. 5680±160 BP. The site is interpreted as a general purpose base camp with hearths, piles of waste bone and one possible storage pit. Grange (1980:47) suggests the site was occupied "early in the Altithermal period of climatic change" and that the Logan Creek and Simonsen sites were occupied prior to that change. However, this interpretation is not consistent with current dates of the Altithermal (Hypsithermal) episode for the Central Plains of ca. 9000-5000 BP (see chapter two), which would embrace all three sites, with Spring Creek occurring nearer its end. Grange (1980:47) also suggests that the more recent date of the site vis-a-vis Simonsen and Modoc Shelter may reflect westward movements of Plains Archaic populations.

Blue Springs: The Blue Springs phase was defined, probably prematurely, by Schmits and Bailey (1989) on the basis of limited data from three sites, 23JA143, Coffin (23JA200), and 23JA86, in the Little Blue River Valley, Jackson County, Missouri. Most of the information was obtained during excavation of 23JA143 in 1983-1984 by Environmental Systems Analysis (ESA) (Schmits et al. 1989). The geographic range of the phase is limited to the Little Blue River and its temporal range is defined by only two dates from 23JA143 (6580±120 and 6660±100 BP). It is characterized by "small side-notched projectile points similar to those recovered from early Archaic sites in northeastern Nebraska ..., northeastern Iowa..., and eastern Kansas. The Blue Springs phase appears to have been part of an early Middle Archaic small side-notched point tradition that probably extended over most of the eastern Prairie Plains during the seventh millenia B.P." (Schmits and Bailey 1989:230).

Most of the data on which the taxon rests comes from 23JA143, with some comparative data from Coffin. The Middle Archaic component at the former site was buried 3.0-3.4m below the T1 terrace along a cutbank of the Little Blue River. The recovery of ten small side-notched points in conjunction with the radiocarbon dates led Schmits and others (1989) to compare the assemblage with those of the Cherokee Sewer and Logan Creek sites. Lacking, however, were hafted scrapers like those from Logan Creek, which Schmits and others (1989:107) describe as "a side-notched stemmed bifacial scraper. Some of these appear to be made from reworked scrapers, while others appear to have been initially used as scrapers". Again, there appears to be some difference in the interpretation of the scrapers from Logan Creek, that is, whether they are bifacial or unifacial (or both) and purposefully made as scrapers or recycled from another tool type. Factors that distinguish the site, and therefore the Blue Springs phase derived from it and Coffin, are the lack of notched, stemmed scrapers and the tendency toward the production of small bifaces" (Schimts et al. 1989:107). Though 30 scrapers were found at 23JA143, and therefore may represent a fair sample of scraper variability for the site's Archaic occupants, the absence of stemmed scrapers should not be inferred as evidence of their absence from their technological repertoire.

The settlement-subsistence pattern of the Blue Spring phase is based on the lowland site, 23JA143, the ridge top site, Coffin, and to a lesser extent, the bluff slope site, 23JA86. It remains to be seen just how representative are these few sites within one restricted area of the total range of settlement variability of Middle Archaic populations throughout the Lower Missouri River basin. Subsistence was based on the hunting of woodland and edge game, primarily white-tailed deer, though bison remains were also recovered from 23JA143. Slope and lowland plant foods, especially black walnuts and hickory nuts, were used, as were to a lesser extent such starchy plants as chenopods, ammania, portulaca and purslane. Schmits and Bailey (1989:235-237) suggest the Blue Springs phase is characterized by warm season occupation of lowland and upland settings, with the extraction of resources from the latter followed by transport of goods to longer, more extensively settled bottomland camps. This pattern of extensive, warm season occupation of lowland camps differs from the Nebo Hill phase settlement pattern (see below).

Schmits and Bailey (1989:237) admit that "further data from other sites will be needed to document the full range of Blue Springs phase settlement-subsistence patterns". Given the limited number of sites and their restricted geographic location, the restriction of temporal data to two dates from one site, and the lack of control for variability with respect to it formal criteria, the Blue Springs phase taxon should only be considered hypothetical. The establishment by archaeologists of phases from such limited data is not desirable as the taxa tend to become rooted in the literature, too often without foundation (Logan 1996b:17).

Jacomo: The Jacomo phase is also located, indeed presently limited to, the Little Blue River valley in Jackson County, Missouri (Schmits 1989a; Schmits and Bailey 1989). It is based on data from just two sites, one of them a mortuary (23JA277) that contained remains of three adults and no cultural material. Thus, its association with the phase is based soley on the radiocarbon date of 5420±210 BP that shows contemporaneity with Cold Clay (23JA155), the primary type site. Cold Clay, excavated in 1983 by ESA, has been dated ca. 5550-5590 BP. Artifacts from that site that are considered diagnostic of the phase include medium to large expanding stemmed and corner-notched projectile points, some of which compare favorably to those of the Helton phase components at the Koster site in the Lower Illinois River Valley (Cook 1976). Cold Clay is a lowland occupation that contained evidence of a more limited array of activities than 23JA143. Hearth features were not present, though diffuse charcoal and ash was found, and activity areas could not be defined, perhaps because of "post-occupational disturbance or the limited area of the site excavated" (Schmits and Bailey 1989:237). The 1983 block excavation at the site covered a 5x9m area (Schmits 1989b:12) of the component, which was at a depth of 1.8-2.7m in a terrace fill.

The lithic assemblage from the Cold Clay site consists of 12 projectile points that display considerable variability. They include four corner-notched, two straight stemmed, four expanding stemmed, one side-notched, and one lanceolate forms. Other bifacial chipped stone artifacts are two knives, one scraper, 50 blanks and preforms and 45 fragments. Unifaces include four scrapers, seven edge-modified cores, 375 edge modified flakes, and 35 modified chunks. More than 8,000 pieces of lithic debris, including cores, flakes, chunks, chips and shatter, were also recovered. Only five groundstone artifacts were found, a metate fragment, mano-nutting stone, sandstone abrader, and two cobble fragments. Faunal remains were limited to small pieces of burned bone, a few of which were identified as deer and turtle. Plant remains were limited to 16 chenopod seeds and eight nutshell fragments. The site was interpreted as a settlement devoted primarily to lithic tool manufacturing and pigment processing. This activity is inferred to have occurred during the summer and fall.

Again, the data from the single habitation site on which the Jacomo phase is based is so limited as to render the taxon at this stage hypothetical. Yet taxa should not be offered as hypotheses, rather they should be meaningful sets of spatial, temporal, and formal data derived from a sample reflective of the total variability of the phenomenon being abstracted by the archaeologist. In this light, definition of the Jacomo phase was woefully premature. We are told that the "Jacomo phase subsistence patterns appear to have been focused on a narrow range of resources, primarily deer and nuts" (Schmits and Bailey 1989:237), yet the deer part of this inference is based on three molars and a pisiform. A more daring interpretation follows: "The presence of a few ground stone tools at 23JA155, such as a mano and metate, indicates at least minimal usage of floral resources during the late Middle Archaic". Given the general definition of the Archaic adaptation, this assumption could have been drawn even in the absence of such data. Finally, given a sample of one habitation from a lowland setting, we are told that the "Jacomo phase appears to represent an adaptation to the lowlands of the environment of the Little Blue River with lesser emphasis on the upland locales that were utilized during the subsequent Late Archaic period" (Schmits and Bailey 1989:237). In fact, with the data then at hand one could only strictly infer that the lowlands were inhabited at least once. In short, the data were so limited, coming from an excavated area of 45m^2 at one site, that no attempt to define a settlement-subsistence pattern should have been made.

Late Archaic

The Late Archaic period, to which the lower component at the DB site has been assigned, corresponds to the Sub-Boreal (post-Hypsithermal) climatic episode (Wendland and Bryson 1974), which was more mesic than the Hypsithermal but with less effective moisture than the early Holocene (King 1980:11). During this episode, the oak-hickory woodland community again became established on some upland terrain in northeastern Kansas and northwestern Missouri (Gruger 1973). The Late Archaic occupation of the DB site belongs to this period of woodland expansion.

At least four archaeological cultures are relevant to the Late Archaic occupation of the DB site, the Nebo Hill, Black Vermillion, Munkers Creek, and Walnut phases. The Nebo Hill and Munkers Creek phases show technological parallels to Late Archaic cultures of the Eastern Woodland, particularly to the Sedalia complex of eastern Missouri (1980) and the Titterington phase of the Lower Illinois River Valley (Cook 1976). This connection appears to have been established at least by this time (Reid 1984a; Johnson 1992), though some evidence of earlier contact has been inferred from Helton phase-like projectile points at the Cold Clay site (Schmits

1989b). Artifacts such as side-notched projectile points from the pre-ceramic horizon at the DB site may be additional evidence of earlier, Middle Archaic contact. This research problem is discussed in more detail in chapter 15.

Nebo Hill: Sites of the Nebo Hill phase include the Nebo Hill type site (23CL11), on a blufftop overlooking the Missouri River in Clay County, Missouri (Reid 1983, 1984a); the Sohn site (23JA110), a campsite on a terrace along the Little Blue River (Reeder 1978, 1980); the extensive upland sites of Turner-Casey (23JA35) and 23JA170, also in the Little Blue valley (Brown and Ziegler 1985; Schmits 1981); and the Doherty site (14MM27), a campsite on a terrace in the upper Marais des Cygnes basin in Miami County, Kansas (Blakeslee and Rohn 1986; Deel 1992). Sites of the Nebo Hill phase have also been recorded in the Stranger Creek and Little Walnut Creek basins west and north of the Fort Leavenworth reservation respectively (Logan 1981b, 1985, 1986).

The Nebo Hill complex is characterized by a variety of chipped-stone and groundstone tools and the earliest known pottery in the region (Reid 1984a). The most distinctive artifacts of the lithic assemblage are finely retouched, lanceolate bifaces that served as dart points and cutting tools (Shippee 1948, 1964), bifacial hoes, bifacial gouges, three-quarter grooved axes, rectangular celts, rectangular and ovate manos, and fiber-tempered pottery (Reid 1983:14-17). Side-notched and corner-notched dart points also occur as a minor element of the assemblage. The Nebo Hill folk practiced a seasonally-determined settlement pattern with late summer through fall occupation of blufftops by aggregates of bands that utilized the resources of the nearby upland forest and prairie communities, as well as the floodplain and aquatic zones. Primary dependence was on deer and black walnuts. During winter months the groups apparently dispersed into small, lowland camps (Reid 1984a).

Black Vermillion: The Black Vermillion phase is represented at the Coffey site (14PO1), which yielded evidence of the practice of a diffuse economy (sensu Cleland 1976) in the Big Blue River basin north of Manhattan, Kansas. This site was occupied during the late Hypsithermal, a time of initial woodland re-expansion about 5055 to 5270 BP (Schmits 1978:85). At the time of its occupation, the site was near the margin of an oxbow lake. Faunal and floral remains reflect the occupants' utilization of varied resources from upland prairie and lowland woodland-aquatic habitats. Artifacts recovered include lanceolate bifaces, basal-notched and corner-notched projectile points, gouges, axes, groundstone manos, and metates. Several artifacts from the lower component at the DB site compare well with the groundstone and chipped-stone assemblages from the Coffey site. These include manos and metate fragments, an expanding base drill, and a basal-notched point. The lanceolate bifaces from the Coffey site, including a medial fragment similar to one from the DB site, are thick with a biconvex cross-section comparable to Nebo Hill points. Interestingly, the only contrast between this phase and the Munkers Creek phase is slight differences in projectile point morphology. This is a classic example of the kind of taxonomic splitting that should be avoided. Thus, the status of this phase should be evaluated in the light of future information from other Archaic sites in the Central Plains.

Munkers Creek: Witty (1982:218-219) assigns the cultural zones in Horizon III at the Coffey site to the Munkers Creek phase. This complex, as defined by Witty (1982), is recognized at sites containing habitation features such as hearths, shallow pits and postholes in association with such diagnostic artifacts as Munkers Creek dart points; Munkers Creek knives (elongate, asymmetrical bifaces with occasional evidence of "sickle polish"); gouges and chipped stone axes. Although the Munkers Creek phase is distinct from the Nebo Hill complex in its lack of any ceramic pottery technology, the earliest examples of the use of fired clay as an artistic medium date to the Munkers Creek phase. These examples consist of small human effigies recovered at the William Young site, type site of the phase, in the Council Grove Lake area (Witty 1982:124-126). Sites of the phase generally occur in floodplain settings along major streams in the Flint Hills and western Osage Cuestas of eastern Kansas. Tools and food remains indicate a generalized hunting and gathering economy characteristic of other Plains Archaic adaptations.

Based on radiocarbon dates from the Coffey and William Young sites, the temporal span of the Munkers Creek phase was suggested to be from 5450-4950 BP (3500-3000 BC; Witty 1982:219). The younger of two Archaic components at the Cut-Bank site in the Delaware River Valley has yielded diagnostic artifacts of the Munkers Creek phase, including one knife of Permian chert, and a radiocarbon date of 5710±100 BP (Logan 1990b). This site suggests the phase was geographically more extensive, including northeastern Kansas, and temporally longer lived. Additional support for a longer temporal span is provided by a date of 5850±135 BP from Horizon III-8 at the Coffey site (Schimts 1978:85).

Walnut: The Walnut phase was defined primarily on the basis of data from one of several stratified components at the Synder site in the El Dorado Lake area, Butler County, Kansas (Grosser 1973). Originally interpreted as the expression of a Late Archaic population in the Flint Hills province of eastern Kansas (Grosser 1973, 1977), it has recently been attributed to an Early Woodland occupation of the region (Johnson 1992; see next section). The Walnut phase component at Synder was buried 40-80cm below a terrace fill along the Walnut River. Data used to define the Walnut phase were obtained from excavations at the site by the University of Kansas, Museum of Anthropology in 1968-1971.

The Walnut phase dates ca. 3200-2000 BP. Its lithic assemblage is characterized by projectile points, small ovate bifaces, heavy duty bifaces, scrapers, and retouched and utilized flakes. The most frequent, and distinctive, projectile points are small, triangular, corner-notched points, called Walnut Corner-Notched, that were suggested to have been the earliest evidence of use of the bow and arrow (Grosser 1977:47-48). However, it has also been suggested that the width of the hafting element, measured between the notches, of these points is more indicative of the diameter of a dart shaft than that of an arrow shaft (Logan 1996b:52; Note: Shott [1997b] suggests shoulder width is a more reliable attribute for this purpose). The absence of ceramics from the Walnut phase component at this and other Flint Hills sites supports an inference of Late Archaic adaptation. Johnson (1992) suggests, however, that this may reflect limited use of pottery during this time and its consequent scarcity or relatively low probability of encountering it in the archaeological record.

Early Woodland

Bowlin: The Bowlin phase was proposed by Schmits and Bailey (1989: 240-241) for an Early Woodland period manifestation in the Little Blue River Valley, Jackson County, Missouri. They suggest that the phase dates ca. 2200-2550 BP. It is based on information from five sites, Traff (23JA159; Wright 1980), Bowlin Bridge (23JA38; Peterson 1982), 23JA36 and 23JA40 (Ziegler 1985a, 1985b), and McPherson (23JA243; Donham 1982). The latter site is located on the Blue River, immediately west of the Little Blue River Valley. In addition to these sites, others now thought to represent an Early Woodland occupation of the Kansas City locality include 14JO46, along Cedar Creek, a tributary of the lower Kansas River Valley, and 14BN26 (Logan and Hedden 1990; Johnson 1992).

Early Woodland artifacts include contracting-stemmed and corner-notched projectile points. Sand-tempered, cordmarked, sometimes textured, pottery comparable to the Liverpool series of the Black Sand culture in the Lower Illinois River Valley appears in some site assemblages. The lack of pottery at some sites may reflect poor preservation of ceramics, such as has been suggested for the fiber-tempered pottery of the Nebo Hill phase (Reid 1984b), or that the Early Woodland populations of the region were still relatively mobile and made relatively little use of ceramics.

None of the sites attributed to the Early Woodland period has yielded evidence of a sedentary lifeway. Storage pits are unknown and sites such as Traff and 23JA40, which had more evidence of intensive settlement that the others, had only hearth features. Two such features at the latter site also yielded several clay objects and balls that may have had something to do with food cooking (Ziegler 1985b:177, 179). All of the sites excavated thus far are located in lowland settings. Schmits and Bailey (1989:241) suggest that this "appears to represent a shift in settlement patterns back towards emphasis on lowland environments seen during the Middle Archaic period". However, there is no reason to believe the uplands were not the scene of periodic occupation. This can be inferred from the remains of hardwood resources of the slopes and uplands, including black walnuts and hickory nuts, at some of the lowland sites. Traff yielded bison remains that also point to upland prairie exploitation (Wright 1980).

Johnson (1992) has suggested that the presence of an Early Woodland culture in the Kansas City locality, and elsewhere in eastern Kansas if the Walnut phase is additional evidence of an Early Woodland adaptation, is due to continued contact, through trade or diffusion, with Woodland populations to the east, particularly those of the Lower Illinois Valley.

Middle Woodland

The Middle Woodland period in the lower Kansas River basin is represented by the Kansas City Hopewell complex (ca. 2000-1350 BP); Wedel 1943, 1959; Johnson 1976a, 1976b, 1979, 1981). The Kansas City Hopewell differed in several dramatic respects from their Late Archaic and Early Woodland predecessors. Proficient exploitation of woodland-riverine resources is reflected by village settlements that appear to have been occupied on a permanent basis. These villages (e.g., the Renner [23PL1] and Young [23PL4] sites) are generally situated near the mouths of Missouri River tributaries. Smaller, short-term camps, probably ancillary to the village, are located in its vicinity (Johnson 1976b). Other major sites of this complex are Aker (23PL43), a village site on the floodplain east of Leavenworth; Kelley (14DP11, Katz 1969), a small camp on Squaw Creek in Doniphan County, Kansas; Trowbridge (14WY1, Bell 1976), a major village in the interfluve region near the confluence of the Kansas and Missouri rivers; and Perry (14JF314), a village site in the Kansas River valley south of Perry, Kansas.

Most relevant to any Middle Woodland occupation of the DB site are the Quarry Creek (14LV401) and McPherson (14LV356) sites, major Kansas City Hopewell occupations just 2.3 km south (Logan 1993; Wagner et al. 1989). Indeed, the discovery of the DB site was the direct result of a survey undertaken to test the hypothesis that prolonged occupation of these sites would have entailed resource procurement in their vicinity (Logan 1995b).

Artifacts diagnostic of Kansas City Hopewell include large, elongate ceramic jars with subconical bases. This ware changed through time in parallel (though with a time lag) with nearly identical pottery of the Havana Hopewell and the Weaver phase of the Lower Illinois Valley. The vessels are tempered with sand, grit, sherd, or a combination of these materials (Katz 1974). Exterior surfaces are plain, and rims and shoulders are decorated with a variety of designs, including cross-hatched incisions, rocker-stamped marks, hemiconoid punctates, or lip notches (Wedel 1943, Chapman 1980). Analysis of the temporal variation of these designs has resulted in their chronological seriation (Johnson and Johnson 1975). Lithic artifacts include corner-notched and contracting-stemmed dart points, blocky end scrapers, drills, gouges, chipped-stone and groundstone celts and axes, and utilized bladelets. Changes in projectile point technology and style also follow those of the Hopewell of the Lower Illinois Valley (Montet-White 1968; Bell 1976). Broad bladed Snyders bifaces are replaced in frequency by relatively large Norton, Manker, and Steuben Corner-Notched points. These points were gradually supplanted by medium-sized Manker, Steuben, and Ansell points and eventually complemented with Scallorn arrow points after 1500 BP (Montet-White 1968; Bell 1976:31-35; Johnson 1979:90, 1992:134).

Faunal remains, such as turkey bones and deer metapodials and antlers, were also modified for use as awls, punches, beamers, and flaking tools. While a variety of wild game contributed to Kansas City Hopewell subsistence, deer, raccoon and turkey appear to have been the staples (see chapter 2). Wild plant foods, including oily and starchy plants, were intensively exploited, a pattern that may have led to the domestication of indigenous plants among Woodland cultures of the Eastern Woodlands (Smith 1992). Limited evidence of maize at some sites may also reflect formative agriculture (Adair 1996).

Sedentary occupation of village sites is suggested by the presence of trash-filled storage pits and thick midden deposits. The Quarry Creek site is one example of such an occupation (Logan

1993). Stone-lined, earth-covered burial mounds located on blufftops near some of the larger settlements are another salient feature of this complex (Wedel 1943; Shippee 1967; Larsen and O'Brien 1973; Tjaden 1974). 14LV335, located on the Quarry Creek-Salt Creek interfluve 1.1 km from the DB site, is believed to be one such mortuary site (Logan 1995b).

Late (Plains) Woodland

This period is not represented at the DB site and is only briefly described here because the presence of Late Woodland ceramics at the nearby Zacharias site (Logan 1990a) attests a representative population in the vicinity. This period is characterized by an adaptation that differs from that of the Middle Woodland period with respect to settlement-subsistence patterns and some aspects of lithic and ceramic technology. Smaller, more dispersed and less sedentary groups occupied smaller settlements. The agricultural component of the subsistence pattern was more fully developed, particularly with respect to tropical cultigens. Pottery is cordmarked and exhibits less decorative treatment, though vessels retain the elongate, conoidal shape of Middle Woodland ceramics. Projectile points include both corner-notched dart points and corner-notched (Scallorn) arrow points. Though more than a dozen Late (Plains) Woodland complexes have been identified in Kansas, Nebraska and Missouri (Johnson n.d.; Adair 1996), the one most relevant to the Fort Leavenworth area is the Grasshopper Falls phase.

Grasshopper Falls was defined by Reynolds (1979, 1981) on the basis of three excavated sites in the Perry Lake portion of the Delaware River Valley. Several other sites in that and adjacent drainages have since expanded the data base (Williams 1986; Reynolds 1987; Baugh 1991; Logan and Fosha 1991). The core area now includes the Dissected Till Plains of northeastern Kansas. The phase remains poorly dated but it temporal span appears to be ca. 1500-1000 BP. The subsistence pattern reflects a hunting and gathering economy with some evidence of agriculture that included maize, sunflowers, and marshelder (Adair 1991). Houses were oval shaped structures of pole framework with an internal hearth, though extra-mural hearths situated between paired houses are more common. Pits features, often containing cultural debris, are present but they are neither as large nor bell-shaped as those of later farming cultures. Pottery vessels are densely grit-tempered, medium to large wide-mouthed jars with conical bases, exterior cordmarking, rare decoration generally limited to a single line of tool impressions on the rim. Other artifacts include projectile points as noted for Plains Woodland cultures in general, scrapers, drills, axes, gouges, celts, mullers, grinding stones, sandstone abraders, and hammerstones.

The Grasshopper Falls phase is represented by ceramic sherds and a few Scallorn points at the Zacharias site (14LV380; see below) in Salt Creek Valley, 4.8km southwest of the DB site. One radiocarbon date of A.D. 775-962 (one sigma calibrated age range) from charcoal at that site supports a Plains Woodland occupation. However, the direct association of Woodland ceramic ware with Steed-Kisker and Pomona wares at the site suggests this occupation may have occurred during a time of transition from a Woodland to a Plains Village (Late Prehistoric) lifeway (Logan 1990a; Logan and Ritterbush 1994:6).

Late Prehistoric (Plains Village)

Cultures of this period (ca. 1100-450 BP) are distinguished from those of the Woodland period not only by distinctive lithic and ceramic assemblages but by evidence of an increasing reliance on domestic plant foods, including corn, beans, squash, and sunflowers. Although the degree of reliance on cultigens has not been satisfactorily quantified, it is believed to have been significant (Wedel 1959:627; Adair 1988). The practice of small scale horticulture in combination with continued dependence on hunting and gathering led to a more sedentary lifestyle than that of earlier Woodland groups.

Archaeological complexes of this period that figured in the culture history of the Lower Missouri Valley in the Fort Leavenworth area are the Steed-Kisker and Nebraska phases and the Pomona variant. Evidence of interaction between or among populations of these cultures is apparent from the association of ceramic wares diagnostic of two or more of them at some sites in the region. Ceramic wares of both Pomona and Steed-Kisker were found at the Keen site (14JF303) in the Perry Lake area (Witty 1983) and Zacharias (Logan 1988a, 1990b). The latter site is a logical model for comparison to the Late Prehistoric component at 14LV1071. Interaction between Steed-Kisker and Nebraska phase people in the Fort Leavenworth area is likely. For example, abundant remains of these two archaeological complexes have been found in association at the Cloverdale site in Buchanan County, Missouri (Feagins 1993:16-17; Shippee 1972; Chapman 1980:159). Scattered finds of Nebraska phase wares have also been documented at Late Prehistoric sites in northeastern Kansas (Logan 1985, 1988a).

Steed-Kisker Phase: The Steed-Kisker phase was first recognized in the Platte River valley in northwestern Missouri (Wedel 1943) and is now known from several settlement and burial sites in the Kansas City locality (Calabrese 1969; Shippee 1972; Chapman 1980:156-160; O'Brien 1978a, 1978b; McHugh et al. 1982; Logan 1985, 1988a, 1990b). Its temporal range has been variously interpreted. O'Brien (1993:47) dates the phase ca. A.D. 1000-1250. Logan and Ritterbush (1994:2) place it ca. A.D. 950-1400. Certain ceramic traits compare to those of Middle Mississippian cultures of eastern Missouri and western Illinois. Some consider the phase to be the result of a migration of peoples from those areas (Chapman 1980:156; O'Brien 1993) and others consider the Mississippian traits to be little more than a veneer over a typical Central Plains Tradition manifestation that developed locally (Henning 1967).

Steed-Kisker settlements consist of remains of one or two shallow, subrectangular pit houses located on terraces along tributary streams of the Missouri, Platte, and Little Platte rivers. At least one Middle Mississippian-like wall-trench structure has also been excavated. That Steed-Kisker populations were largely sedentary is indicated by trash-filled storage pits and the presence of extensive burial grounds near some settlements. Hunting, gathering, and agriculture are reflected in the lithic tools, faunal, and floral remains.

At the present time, only one other upland Steed-Kisker habitation has been excavated. This is Cloverdale (23BN2), in Buchanan County, Missouri ca. 38.5 km north of DB. That portion of the site of concern here is on a ridge 61m (200ft) above Cloverdale Creek, a tributary of the Missouri River. The site also includes a large settlement on a terrace along this stream. An associated mortuary site, 23BN20, is on another nearby ridge. The upland habitation consists of a single lodge that was excavated by R. B. Aker, the late avocational archaeologist of Parkville, Missouri (Feagins 1993). The structure was rectangular in outline, 21x17 ft in size, and included a central fireplace and one pit feature near the north wall (Chapman 1980:159; Shippee 1972:14-15; Feagins 1993:17). The nearby lowland settlement includes a mixture of cultural material indicative of both the Nebraska and Steed-Kisker phases and is believed to have been associated with the upland lodge. Recent research by Greatorex (1997) suggests these wares may have been produced by a single population. Chapman (1980:159) reports that the ceramic assemblage from the upland component, called Cloverdale House 1, consisted only of Platte Valley Plain and Steed-Kisker Incised sherds, both diagnostic of the Steed-Kisker phase.

Steed-Kisker ceramics include shell-tempered bowls and jars with plain surfaces, a variety of incised lines or scroll designs, and appendages such as lugs or loop handles. Also characteristic of the phase are clay pipes, animal and human effigies, small, triangular, side-and basal-notched arrowpoints, small end scrapers, alternately beveled knives, groundstone celts and axes, sandstone shaft abraders, groundstone pipes, and worked hematite. Burials include extended, flexed, and bundle skeletal remains and associated grave goods, such as bowls and arrowpoints.

Nebraska Phase: The Nebraska phase was the first complex of the Central Plains tradition (CPt) recognized by archaeologists (Brown 1966, 1967; Blakeslee and Caldwell 1979; Blakeslee 1978, 1990; Billeck 1993; Krause 1969, 1982, 1989). The geographic range of the Nebraska phase extends along the Missouri River trench primarily in Nebraska, southward from Thurston County, but with an important locality along Keg and Pony Creeks near Glenwood, Mills County, Iowa (Anderson 1961; Brown 1967; Hotopp 1978a, 1978b; Blakeslee and Caldwell 1979; Billeck 1993). The southernmost extent of the phase is in Doniphan County, Kansas and Buchanan County, Missouri (Wood 1969; Feagins 1988). However, at least one site (14JO46) as far south as Johnson County, Kansas has been attributed to a Nebraska phase occupation (Logan and Hedden 1990). Radiocarbon dates for the Nebraska phase range from about A.D. 1000 to 1450 (Blakeslee 1990:29) in Nebraska and A.D. 1000 to 1250 in the Glenwood locality (Billeck 1993).

One of the hallmarks of the Nebraska phase is the rectangular or sub-rectangular lodge constructed of post supports and pole framework centered on a pit hearth and covered with earth or daub. Pits extending below the floor of these structures were used to store foodstuffs and other goods. Though some sites appear to have several such lodges, it is as yet debated whether these were contemporaneously occupied habitations of extensive villages (Gradwohl 1969) or serially occupied farmsteads (Blakeslee 1990).

The subsistence pattern is like that of the Steed-Kisker phase, characterized by hunting and gathering of wild animals of the prairie-woodland-riverine habitats, gathering of wild plant resources, and a significant reliance on the cultivation of domesticated plants (Adair 1988). Blakeslee (1990) suggests that Nebraska people practiced slash-and-burn gardening. This depleted soil, requiring relatively frequent moves along tributaries and resulting in a serial lodge occupation settlement pattern.

Ceramics include both shell-tempered and grit-tempered bowls and jars with lug and strap handles and rim-incised designs. Distinctive wares include McVey, Beckman and Swaboda pottery (Gunnerson 1952; Ives 1955; Anderson and Anderson 1960). A rim sherd of one type of Beckman ware has been found at DB (see chapter 8). Seriations of Nebraska phase ceramics have been established by Blakeslee and Caldwell (1979) and Billeck (1993). Both of these sources are major revisions of Nebraska phase spatial, temporal, and developmental parameters. Lithic artifacts are similar to those of the Steed-Kisker phase and other CPt complexes.

The extent of Mississippian influence on the development of the Nebraska phase has been the subject of considerable research. Several researchers have noted the diffusion or introduction of certain traits from Mississippian cultures in Nebraska phase ceramics (Strong 1935; Ives 1955; W. Wedel 1959:129-130; Anderson 1961; Brown 1967). Henning (1967) suggests such influence was indirect and channeled through the Steed-Kisker phase, which had established a pattern of cultural interchange. McNerney (1987) reviews the effigy complex and some exotic ceramic vessels from Nebraska sites. He sees a connection between the Nebraska phase and populations of the sourthern section of the central Mississippi Valley subarea, Caddoan area, and Spiro-Southeastern Ceremonial complex.

Pomona Variant: The Pomona variant was first defined as a focus (Witty 1967) and more recently redefined as a variant with four phases (Brown 1985). The taxonomic integrity of these phases has been questioned (Logan and Hedden 1993:25-26; Logan and Beck 1996b:64). The core area of the Pomona variant, as far as it is currently known, was limited to eastern Kansas, although it has been suggested that western Missouri served as a resource area at certain times.

Ceramics are one of the most salient traits of Pomona material culture. These consist of globular bowls and jars with high, straight or flaring rims, generally undecorated, though sometimes bearing oblique incisions across the lip and/or incised or trailed lines around the rim. Surfaces may be plain or cordmarked and temper varies, though more frequently consisting of crushed sherd (grog), sand, or crushed shell. This last tempering agent was more frequently employed in the northeastern Kansas portion of the Pomona culture area (Brown 1985). The ceramic assemblage from the DB site includes at least one relatively thin, cordmarked sherd with sand temper. This sherd is comparable to Pomona ware, such as that from the nearby Zacharias site (Logan 1990b).

Pomona lithic assemblages are virtually indistinguishable from those of other Late Prehistoric cultures in the Central Plains. Bone tools are rare, though this has been attributed to "climatic factors and the basically acidic soils of eastern Kansas" (Reynolds 1987:30). The most striking difference between Pomona and the CPt and Steed-Kisker phase is the absence of rectangular lodges (Witty 1978, 1981; Blakeslee and Rohn 1986). When they are definable (which is too rarely), Pomona houses appear to have been oval structures, usually about 25x15ft. Post mold patterns are irregular, and the frames were apparently covered with thatch and clay. These structures generally lack interior hearths (Reynolds 1987:32).

Pomona apparently developed directly from local Late (Plains) Woodland groups in eastern Kansas (Brown 1985:429), perhaps the Greenwood (O'Brien 1984:64) and/or Grasshopper Falls phases (Reynolds 1987:24, 26; Johnson 1991). Witty (1981) suggests that Pomona may represent the survival of Woodland populations who added agriculture to a hunting-and-gathering subsistence base, although Blakeslee and Rohn (1986:1292) "do not view Pomona as a Plains Woodland survival into the Middle Ceramic period, at least not to a greater extent than is true for the Central Plains tradition." Johnson (1991) has suggested that the Pomona variant is ancestral to the historic Kansa, a proposal viewed critically by others (Henning 1993; Logan and Hedden 1993; Vehik 1993).

Brown (1985) has suggested that the Pomona settlement pattern was a continuation of the Plains Woodland and Late Archaic patterns in the same region. This was characterized by a shift between upland, warm weather settlements and lowland, cold weather sites. Our knowledge of the former sites has been hampered by the bias toward investigation of sites on terraces. Seasonal abandonment of sites to pursue game in the mixed grass prairie to the west of the Pomona domain and in the Ozark Highland to the east (i.e., resource areas) has also been proposed as part of the settlement-subsistence pattern. Witty (1978) suggested that the Pomona variant is a late Plains Woodland complex that was contemporaneous with CPt groups in eastern Kansas.

Chapter 6

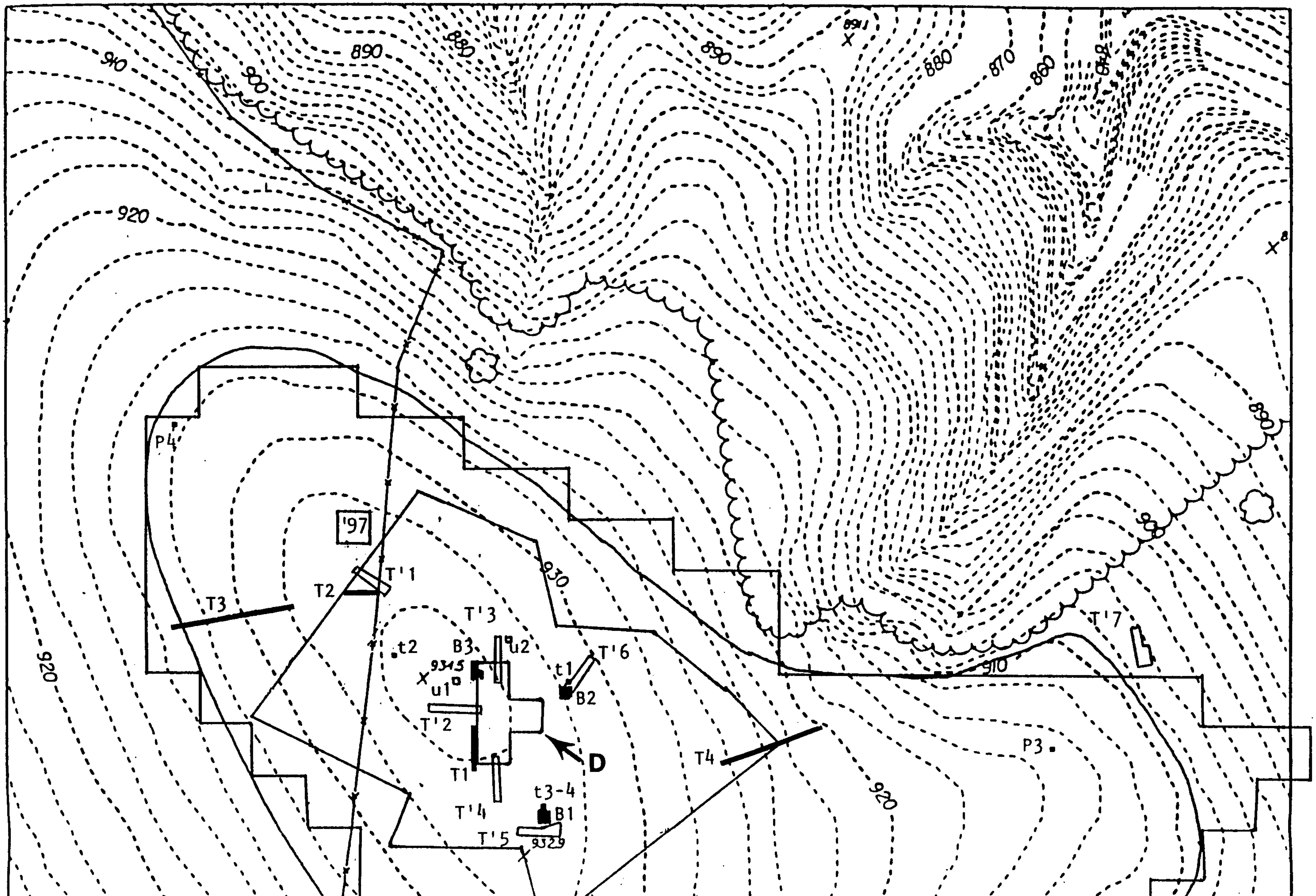
Methods of Investigation

Brad Logan and Margaret E. Beck

Introduction

The various strategies and methods, in field and laboratory, of the Phase IV investigation are described in this chapter. These followed closely the recommendations of the Scope of Work (SOW) and the Data Recovery Plan (DRP; Logan 1996a), though as is clear in the following sections, additional methods beyond those recommended were employed. The extent of excavations also exceeded that called for in the SOW, which mandated excavation of "no less than $50m^2$ to a depth of no less than 70cm within the core area" of Area A. The DRP had recommended excavation of $150m^2$, a figure determined by the Kansas City District, U.S. Corps of Engineers and the Kansas State Historic Preservation Office, in a target area approximated by grid coordinates 139-171N/44-76E (based on a grid established during Phase IIIA investigations). That area appeared to be the best for revealing all cultural components within a contiguous set of excavation units and for maximizing the opportunity to obtain the most information about them. This proved to be the case, particularly with respect to the more spatially restricted Late Prehistoric component. The completed block excavation covered an area of $163m^2$ to a depth of at least 60cm b.s. in the target area. Figure 6.1 shows the locations of all excavations from Phase III, IIIA and IV investigations. (Note: slight discrepancies in the locations of some excavations shown on this map and those in previous reports [Logan 1995b, 1996a] are attributable to the polar-plotting of all units on the latter and the Cartesian-plotting of all units on Figure 6.1. The revised version, which incorporates all excavations within the site's grid system, is most accurate.)

The following sections take the reader through each step of the fieldwork phase of the project and describe the laboratory procedures, including the sorting, identification, analysis and curation of the recovered data. Fieldwork, including site set-up and final monitored mechanical stripping, was conducted from May 17 to August 5, 1996. Laboratory work, including report preparation, began August 19, 1996 and was completed May 5, 1997. Throughout that time, the Principal Investigator conducted periodic surveys (at least once each month) of the graded area after heavy rains or snowmelts in order to collect additional functionally or culturally diagnostic artifacts.



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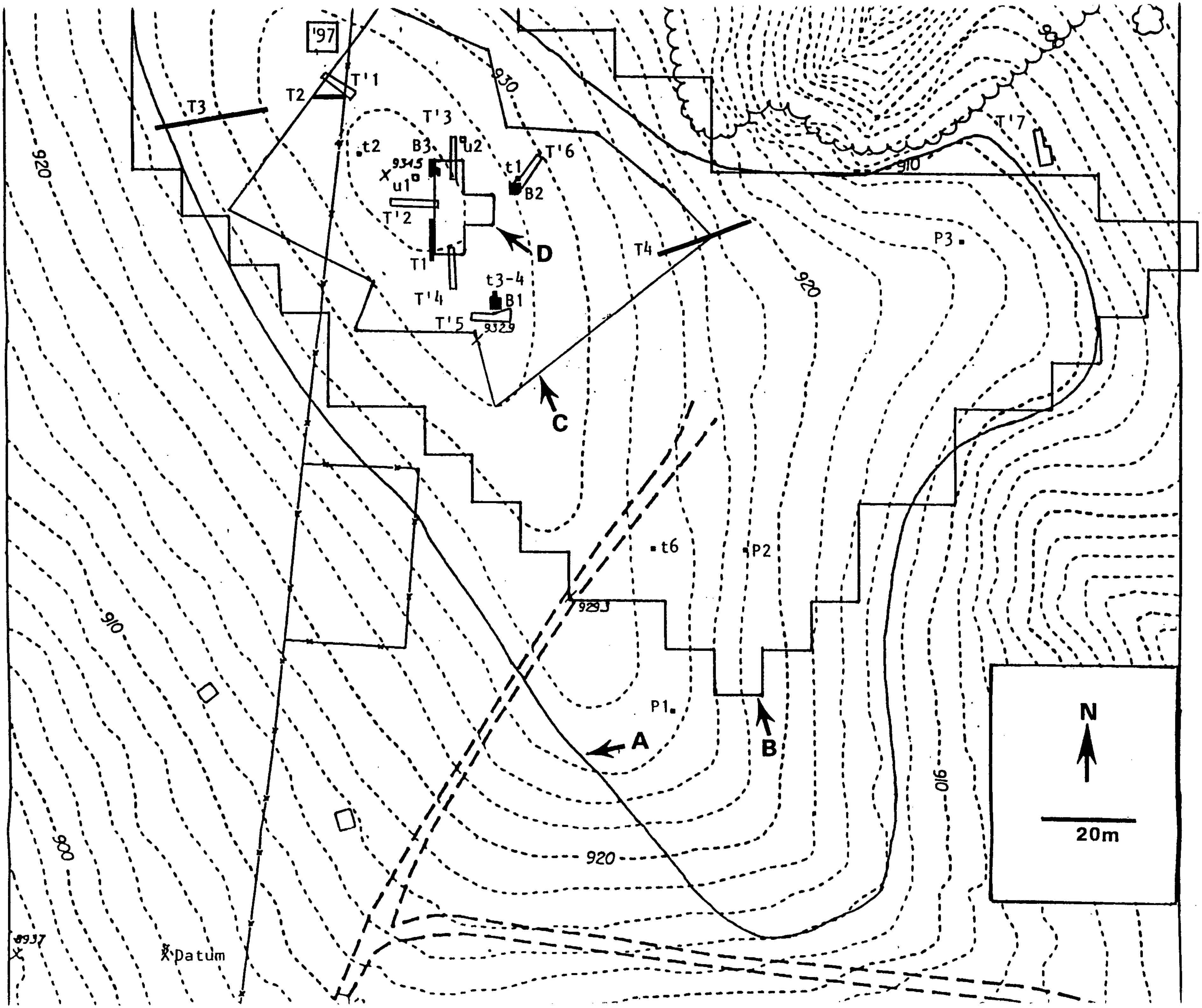

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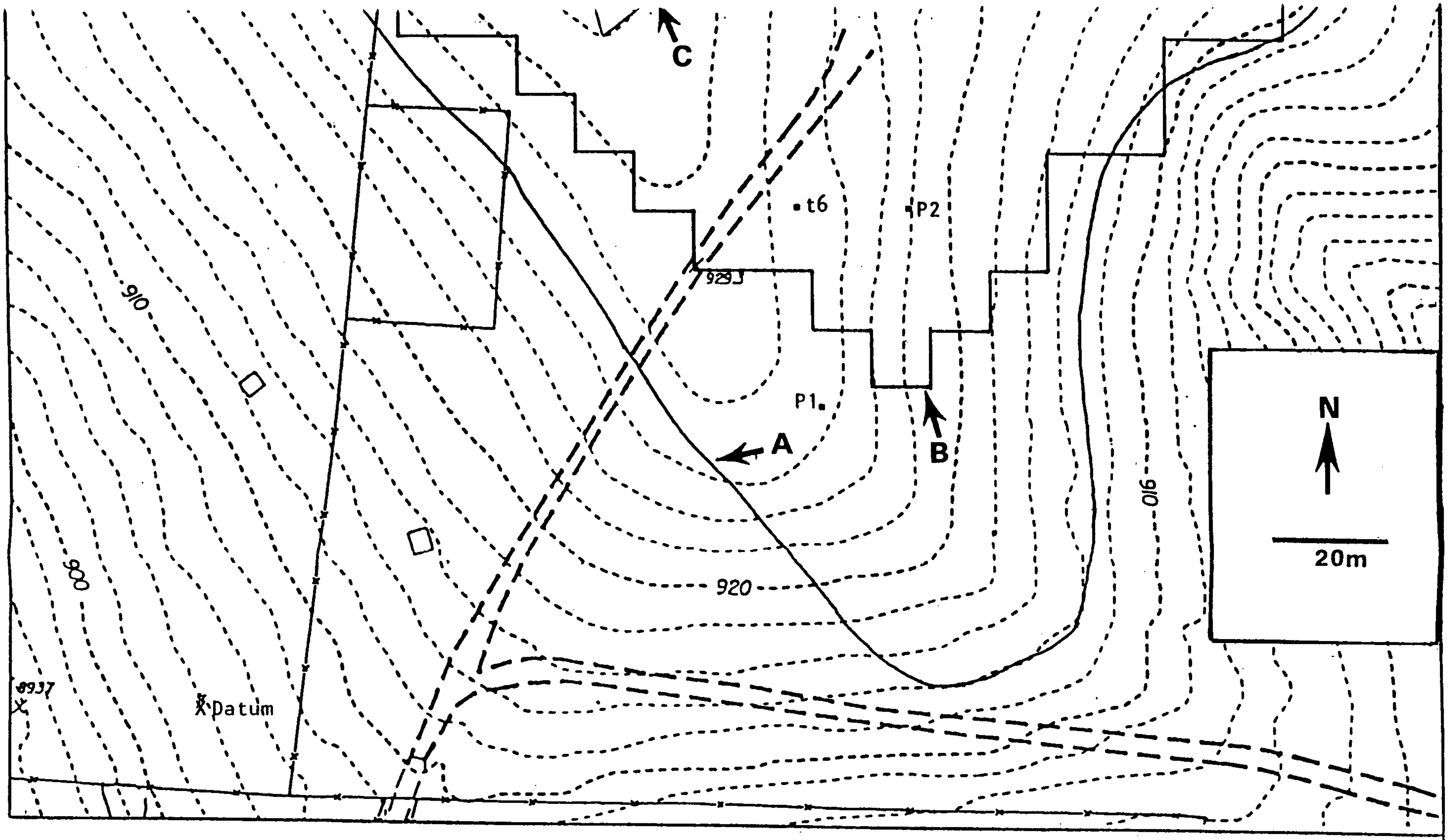

Figure 6.1. Map showing the locations of 1995 (solid symbols) and 1996 (open symbols) excavations at the DB site. A: estimated limits of Area A; B: extent of plowed and surface-grid collected area; C: limits of mechanically stripped area; D: 1996 block excavation. Phase III test units- t; Phase IIIA test blocks- B, peripheral units-P, trenches- T (T1&2 were manually dug; T2 was subsequently trenched with a backhoe; T3&4 were backhoe excavations). Phase IV test units- u, backhoe trenches- T'. The open square labeled '97 is the block excavation of the 1997 Kansas Archaeological Field School, the results of which are not detailed in this report.

Fieldwork Phase

General: The fieldwork phase occurred from May 28 to August 5, during which time the number of personnel in the field ranged from 5 to 20 persons with a mean of 16.6. The number of persons in the lab during that time ranged from none to six with a mean of 3.0. The total number of person-hours devoted to fieldwork was 5,946 and to lab work was 1,133. This total does not include the hours of two consultants, Prof. William C. Johnson and Dr. Steven Bozarth, who conducted geomorphological and phytolith-sampling tasks respectively at various times during the fieldwork. The total does include the time worked by Mr. Doug Kolom, who served throughout the project as both excavator under the PI's direction and as geomorphological assistant in the field and lab under Johnson's direction. The PI participated in fieldwork on 39 of the 45 days.

Surface Exposure: Phase III and IIIA investigations demonstrated that Area A had been under cultivation prior to its conversion to pasture for the USDB Farm Colony's beef program. Test excavations had revealed a plowzone that averaged 20cm in depth. Archival research at the Frontier Army Museum on the reservation indicated the land had been lightly wooded prior to 1908, when the Farm Colony was established. Apparently, the site area was cleared shortly thereafter and it was plowed at least intermittently from the 1920s to the 1940s. Aerial photographs taken during the latter decade show the site area under cultivation at that time. This research also established that trash from the post was dumped in Areas B and C of the site. Intensive surface-grid collection of Area A (see below) revealed that this practice included the eastern portion of the spur ridge and, to a much lesser extent, the main ridge as well.

Because the cultural deposits in Area A had been disturbed by plowing and because the ground at the time of investigation was obscured by grass, the first step of the fieldwork phase entailed plowing to enhance surface visibility there. An area of ca. 17,700m^2 that covered all but the southeastern slope of the main ridge was plowed to a depth of ca. 20cm by trustee laborers of the Farm Colony on May 20-21. The latter area was excluded because shovel tests and test excavations had revealed little prehistoric material and because it had been extensively disturbed by construction of an agricultural terrace.

The target area was flagged and surveyed by a team of three persons on May 21. The soil was dry and visibility was not ideal for surface survey. Thus, only a few dozen artifacts were collected and a half dozen items were piece plotted. Control elevations on the plowed surface in the target area were taken with an EDM total station (Fig. 6.2). On May 22, an area of ca. 1,600m^2 was stripped at thin (ca. 4-5cm) intervals with a road grader. This activity was monitored by a team of two persons (Fig. 6.2). Subsequent checking of final elevations in the graded area against the control points indicated that an average of 20cm ($\pm$3cm) had been removed in this manner. The greatest control of plowzone removal proved to be in the block excavation area, which was laid out adjacent to Trench 1 of the Phase IIIA investigation. Trench 1 had yielded relatively abundant and varied remains from both the Late Prehistoric and Archaic levels. Consequently, further exploration adjacent to that excavation was promising. Moreover, excavation of the block adjacent to the trench provided good control of the depth of

Figure 6.2. above) Mapping of elevation control points on the plowed surface from 165N/75E (note that the soil around the mapping point, preserved from Phase IIIA, has not been disturbed), view northwest; below) Monitoring of plowzone removal, view north-northwest.

plowzone removal in that area. The known depths of excavated units in the trench that were exposed along the western profile of the southern 1/3 of the block indicated that exactly 20cm of soil had been removed.

Given the vertical control provided by Trench 1 for the block excavation, the depth provenience with respect to ground surface of all artifacts in the block and test units of 1996 is considered accurate when 20cm is added to their known depth below the grade. Throughout this report, the depth designation **"bs"** refers to an artifact's or feature's provenience with respect to the original surface; the designation **"bg"** refers to its depth below the graded surface; the **elevation** of an artifact or feature refers to its height above the site datum, which was located well down slope of the site area (Fig. 6.1; ON/OE, 0.0m assumed elevation). This datum had been established during Phase IIIA.

A few items exposed during the grading task were plotted. The most significant artifacts consisted of a concentration of shell-tempered body sherds and a side-and-basal notched arrow point that were in a daub-and-charcoal rich matrix at the base of the plowzone in 149N/59E (Fig. 6.3). The area of these finds was included within the initial excavation block. By chance, the cluster of artifacts was centered within the first sub-block (for definition of sub-blocks, see Excavation below) when it was laid out along the eastern edge of Trench 1 of the Phase IIIA investigation. Subsequent excavation revealed several rim and body sherds that ultimately formed the largest vessel fragment of Platte Valley ware recovered (Fig. 6.3; see chapter 8, Fig. 8.2). Indeed, that area yielded the greatest number of sherds within the block.

Intensive Surface Collection: On May 28, the first full-crew day of the fieldwork phase, the plowed area of ca. 17,700m^2 was gridded into 10x10m units and all visible prehistoric artifacts, a total of 3,548 items, were collected. A different criterion was followed for historic debris, which was particularly abundant on the eastern portion of the lower ridge spur. Rather than collect all evidence of the historic component, which was not considered significant in the NRHP evaluation of the site (Logan 1995b:53), a random sample of all artifact categories (e.g., whiteware, stoneware, silverware, glass, metal, bone, etc.) was recovered from each unit. This was sufficient for documentation of the range of 20th century debris. The resulting assemblage is valuable for future research concerning this activity and its point of origin on the reservation. Historic material was sorted, identified and quantified in the lab during the fieldwork phase and this information is available in the archives of the KUMA Archaeological Collections. Here it is worth noting that the debris appears to derive largely from kitchen/cuisine sources. There is a noticable abundance of artifacts related to food preparation, serving, and consumption, such as tableware and bone, much of the latter exhibiting machine-cutmarks. In accordance with the SOW and in keeping with the precedent set between KUMA and Fort Leavenworth during the Quarry Creek site project, all historic artifacts from the Phase IV investigation are curated on the post at the Frontier Army Museum.

The distribution of prehistoric artifacts in the gridded area confirmed that the summit of the ridge contained the greatest density of this material (Fig. 6.4), which more accurately reflects the Late Prehistoric component. Test excavations during Phase III and IIIA suggested the lower

Figure 6.3. above, left) Cluster of body sherds and arrow point (latter is a few cm above trowel) found during plowzone removal; above, right) Cluster of rim and body sherds found below those shown in photo to left, during block excavation; below) Rim sherd with handle found below sherds shown in photos above. See Figure 8.2 for illustration of vessel reconstructed from these sherds.

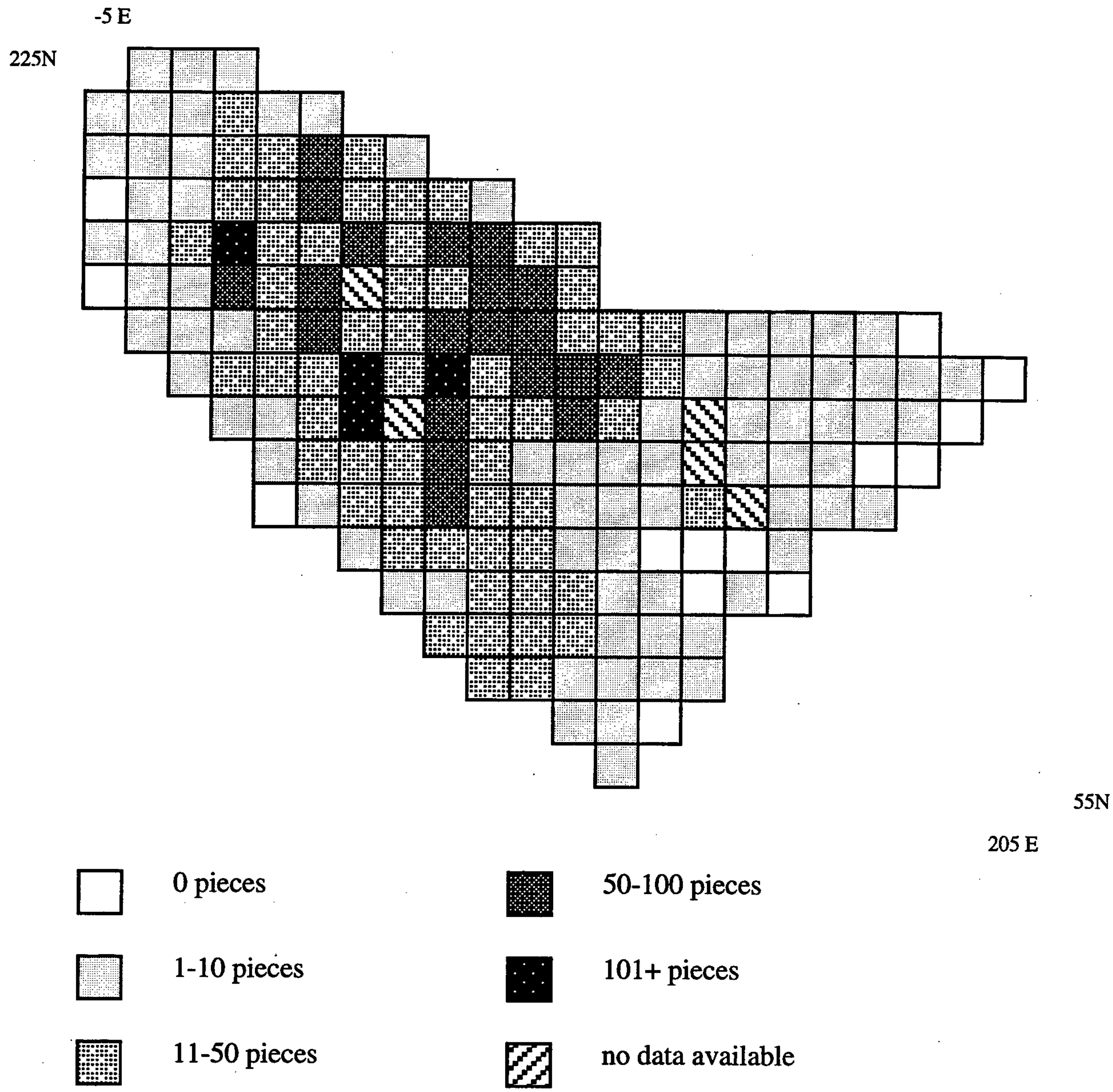

Figure 6.4. Density plot of prehistoric artifacts (chipped stone and pottery) from the gridded surface collection (10x10m grid).

levels (preceramic horizon) mirrored this distribution. The flanks of the ridge contained low quantities of prehistoric material, generally less than 30 items per $100m^2$. One of the surface collection units that contained the greatest number of artifacts (n=112) included the pottery mentioned above. That evidence, in conjunction with the other criteria mentioned above, supported selection of that unit as the location of the initial block excavation.

Excavation: Testing of hypotheses presented in the DRP required certain methods of data acquisition. A critical step in data recovery was recognition and documentation of the different components and their stratigraphic association. Precise recording of the provenience of all artifacts above a specified size was essential. Dimensional data not only included the traditional x, y and z coordinates of artifacts (i.e., northing, easting and depth with respect to datum) but also their orientation (dip, strike and direction). These latter data may document site disturbance processes, such as treefall and rodent burrowing, and the stratigraphic integrity of the deposits. Comparisons of components can only be valid insofar as we account for or filter out natural site formation factors such as soil inversion, freeze-thaw sizing affects and faunalturbation (Wood and Johnson 1978). Cultural activities may also have resulted in mixing. For example, construction of shelters, such as the semi-subterranean lodges generally found at Steed-Kisker habitations, may have disturbed underlying Archaic deposits. In order to determine, if possible, how these activities affected the formation of the DB site, precise plotting of larger pieces of cultural debris was required (see chapter 14).

Precise contextual documentation of artifacts and features was mandatory for delineation and interpretation of site activities. The spatial relations of site "furniture" (e.g., hearths, anvils, metates, etc.; Binford 1979), structures, middens, and activity areas must be clarified in order to translate the static material record into a dynamic view of the cultures represented. Tests of most hypotheses and eventual interpretation of cultural relations, settlement-subsistence patterns, etc. follow from, and therefore depend upon, contextual information that is accurately drawn. Thus, at DB, items $\geq$2.5cm along the major axis were plotted with an EDM transit, assigned a unique field number (FN), and bagged separately. A total of 1,645 FNs was assigned during Phase IV. Of these, 1,413 were manually excavated pieces and 232 were assigned to artifacts plotted during mechanical stripping of the site (see below).

The basic excavation units within the block were 2x2m in area. The only exceptions were three sets of three balk units, each 2x1m in area, that were located between four sub-block squares. Sub-block squares were 6x6m in area, an expanse determined by the size of the quonset style tent that shielded them from sun and inclement weather (Fig. 6.5). When a sub-block was completed, the crew lifted the tent over the next area and the balks served as support for the ends of the shelter. Balks were excavated when they were no longer necessary for support. All units were dug by shovel skimming and troweling in ten cm levels, the arbitrary depth used during all previous investigations at DB. This interval was compatible with the nature of soil horizonation (see chapter 3) and maintaining it facilitated comparison of level data between projects. Geomorphologic investigation during Phase IIIA revealed two soils: 1) a surface soil that extends to at least 40 cm, and 2) a buried soil, the surface of which is generally difficult to determine because its A horizon has been extensively eroded and its B

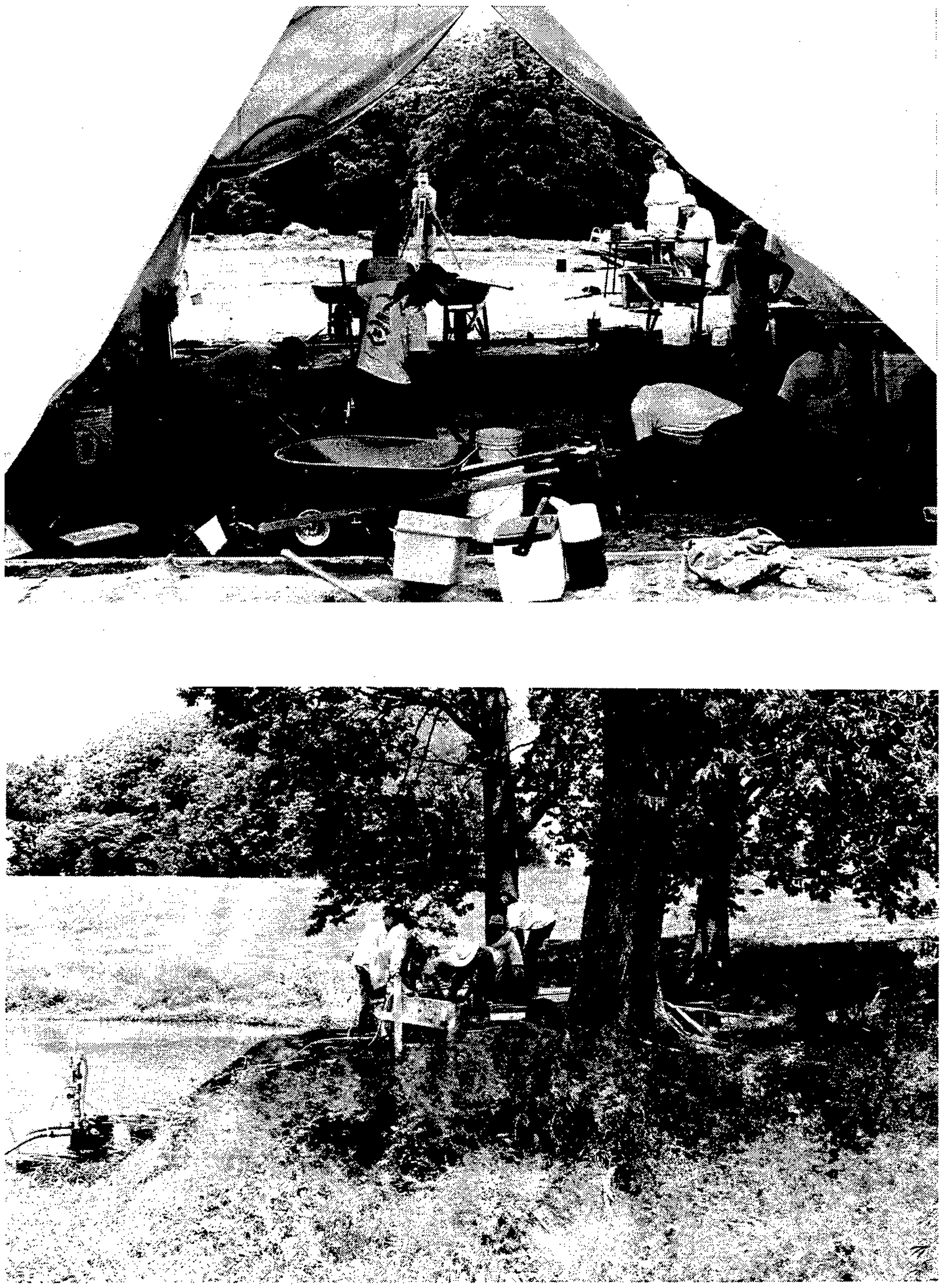

Figure 6.5. above) Excavation of sub-block 147-153N/57-63E, view north. below) Waterscreen station, view west.

horizon is welded to that of the surface soil. As the two soils are difficult to distinguish, but generally correlate with cultural components, manual excavation in ten cm increments was considered sufficient for stratigraphic control. The only deviations from the ten cm interval were six units dug to depths of 45cm bg (65cm bs), the final levels of which were five cm thick, sufficient to complete excavation of cultural deposits in those units (see chapter 7).

Fill Processing: Subsistence problems, and those related to them, can be addressed only to the extent that floral and faunal remains are preserved and sampled. Preservation is beyond the control of the archaeologist (conservation, however, is within it). Sampling procedures must be systematic and tailored to the demands of the cultural deposits. At DB, this required water screening of excavated fill and collection of other soil for flotation. Dry screening of all non-feature fill through 1/4" mesh hardware cloth was done during Phases III and IIIA. Following a dry spell, soil at the site was more difficult to dig in October than in July 1995. This resulted in shovel and trowel damage to some artifacts. Even more detrimental was the damage caused to fragile material such as ceramics, charcoal and daub during dry screening. Water screening is less abrasive and, at DB, proved to be less time-consuming due to the aid of water pressure (rather than human muscle) in removing the soil matrix from artifacts. Water screening also allowed more complete recovery of small cultural material. This proved to be critical in the delineation and interpretation of such phenomena as Late Prehistoric structures, represented at DB only by the distribution of daub, and some activity areas that were reflected by the extent of charred faunal and floral remains (see chapter 14).

Each waterscreen sample contained a metal disk and strip of safety flagging that were labeled by the excavator with a sample field number (SFN). SFNs were logged at the block excavation and checked in at the waterscreen station. Each sample was transported in wheelbarrows that were shuttled in a pick-up truck to the station at a stock pond 200m southwest of the ridge (Fig. 6.5). The waterscreen apparatus, designed and constructed for this project, consisted of two plyboard platforms each 4x8ft in size and one ft high, fronted by two screen supports that held six 30x30x12" boxes with bottoms of 1/4" mesh hardware cloth at an angle of about 20°. Smaller trays (30x30x2") with 1/8" or 1/16" (the former mesh proved to be more durable) mesh cloth rested on a shelf below each larger box for recovery of finer material. Water was drawn from the pond with two 5 horse-power water pumps with Briggs & Stratton motors and ejected from two 1" diameter hoses and two 3/4" garden hoses. While all four hoses were used to spray fill in the larger boxes, the latter were more useful for final cleaning of material from the fine mesh screens. All material from each sample was removed from the screens, wrapped in a cheesecloth square, and dried on a nylon line stretched between nearby trees. All samples were transported to KUMA at the end of each working day. A crew of five to seven persons processed an average of 60 waterscreen samples each day for a total of 2,701.

While waterscreening is superior to dryscreening, the use of high water pressure it entails is not as gentle toward floral and faunal remains as flotation. For that reason, systematic sampling for the latter technique was done. Samples were standard measures of fill (4.5gl, 17lt) taken from the southwestern quadrant and center of each level of all sub-block units (2x2m) for this process (one was taken from the southwestern corner only of 2x1m and 1x1m sub-block units and two outlying test units). All fill from features was collected for this method of water separation. Flotation was done primarily with the Dausman Flote-Tech system, which was more effective in separating charred plant remains from heavier materials, including bone, small sherds, and microdebitage. A few samples were processed with the traditional SMAP process (Watson 1976), but that proved to be less efficient in separating organic and inorganic matrials (cf. Hunter and Gassner 1998). A total of 377 flotation samples was collected and processed during the project. Floral remains from selected flotation and waterscreen samples are described and interpreted by Adair in chapter 13.

Mechanical Stripping: As recommended in the DRP, one of the final tasks of the fieldwork phase was monitored mechanical stripping of the site. Since the site was scheduled for machine grading as part of the construction of the new Disciplinary Barracks, the senior author (Logan 1996a) suggested that this activity be done under the supervision and monitoring of archaeologists during Phase IV. Stripping the soil from the site in thin intervals would reveal artifacts and features beyond the block excavation that could then be documented and salvaged. This step in projects that target endangered sites is also recommended in the "Treatment of Archeological Properties: A Handbook" by the Advisory Council on Historic Preservation (November 1980, p. 27).

Mechanical stripping was done by J&D Excavating of Basehor, Kansas, which was subcontracted by Burns & McDonnell Engineers. A total of 50 hours of work was conducted with a blade grader on July 24-26, 30-31, and August 2 and 5 (Fig. 6.6). The time available for grading was sufficient to shave in relatively close vertical intervals that portion of the site on the highest part of the ridge, where test excavations during Phase III and IIIA had indicated that cultural deposits were greater. Grading revealed one feature, a hearth indicated by discolored soil and only a few small pieces of burned limestone (see chapter 7), and many artifacts. Working from east to west in odd-shaped transects whose shape and orientation were dictated by the presence of the block excavation and the nature of the ground, the grader removed soil in relatively thin (ca. 2cm) strips over a ca. 3,200m^2 area. Scraped surfaces were closely inspected by a team of surveyors that followed the grader. Selected artifacts, including all that were considered functionally, temporally, or culturally diagnostic, were pin-flagged and mapped with the EDM total station. Point provenience data were limited to the x, y, and z coordinates (i.e., northing, easting, and elevation); it was believed that orientation, dip and strike information would not be reliable since even "in situ" artifacts may have been moved by the downward pressure of the grader. Several of these artifacts, particularly the chipped stone tools and pottery, are described in later chapters of the report.

In addition to the mapped artifacts, all other visible cultural material in the mechanically stripped area was collected and saved by transect. Despite the fact that this grab material lacks depth provenience, that their horizontal provenience is limited to transects of varying size, and that they are temporally or culturally undiagnostic, we were loath to abandon any artifacts that might someday, through new analytical techiques, yield some information of value about the site. This fate seemed preferable to the alternative- complete removal or loss through future construction activities.

Figure 6.6. above) Blade grader strips area around the block excavation, view south to Hancock Hill, August 5, 1996. below) Sandstone anvil or metate, foreground by trowel, view southwest to block excavation (background), August 2, 1996. As this artifact was fractured in place, it was plaster-jacketed for removal to KUMA.

It is notable that mechanical stripping did not reveal any type of cultural feature that had not theretofore been documented at the site. Indeed, the only features noted were a few dark, amorphous stains of A horizon fill within voids that had been left by rodent burrowing or tree growth and the one cultural feature noted above. Thus, we believe that the manually excavated areas accurately reflect the nature of the archaeological deposits at the site. The stripping did yield some artifact types that were not recorded in the block or test excavations. For example, the only metates and anvils recovered were mapped in the stripped area (Fig. 6.6; chapters 11, 12). Of the seven axes and two celts in the DB assemblage, only one axe was found through manual excavation, in Trench 1 of Phase IIIA (Logan 1996a). A unique artifact mapped in situ in the graded area is an incised hematite celt (chapter 12). Two Paleoindian points were also mapped in the graded area (chapter 9).

Laboratory Phase

Archaeological Assemblages: Laboratory work, including washing, sorting, preliminary artifact identification, and flotation, took place during the fieldwork phase. A Lab Director worked daily at KUMA with a team that varied from one to three persons. Water screen samples (SFNs) were logged in, rinsed, spread on trays to air-dry, labeled, and bagged in zip-lock bags. Piece plotted artifacts (FNs) were washed (unless reserved for other specialized analyses, see below), dried and stored in the same kind of container. The material collected from the surface grid was completely processed, including the assignment of catalog numbers, during the fieldwork phase.

Intensive laboratory work began August 19 with a team of five persons under the immediate, daily direction of Margaret Beck and the overall supervision of the PI. The team sorted material from the water screen samples, identified the piece plotted artifacts, and processed flotation samples through the Dausman Flote-Tech machine. Sorting of waterscreen samples was also accomplished with the help of a few volunteers at KUMA, who devoted more than 100 hours to this activity. Final review of sorted items and the assignment of catalog numbers to them was done by Beck in order to insure consistency of artifact identification. Volunteers also worked with the regular lab crew in labeling artifacts with catalog numbers for final curation. All cataloged items were entered with provenience information into a computer data base (Excel software) that facilitated statistical and graphic manipulation during subsequent assemblage analyses.

The following information was recorded on a Material Analysis Form for each waterscreen sample: analyst (i.e., sorter), analysis time, date of sorting, provenience of sample, SFN numbers (all SFNs from a unit/level were combined for sorting), excavators' names or initials and dates of excavation. Since minute particles of some material, such as daub and charcoal, could only be completely sorted over many hours time and since this process would yield diminishing masses of material per category (and, therefore, less information), waterscreen samples from each unit/level were sorted for no more than four hours. Less time was spent if it was deemed adequate to sort all but the smallest pieces. The following categories of cultural material were recognized: debitage, edge modified debitage, bifaces/points, unifaces, cores, groundstone/hammerstone, ceramics, daub, historic, heat-altered rock, unburned bone, burned bone, wood charcoal, charred plant remains (i.e., seeds, nutshells, maize kernels), shell, ferrous oxide, sandstone, limestone, quartz, quartzite, pebbles, fossils, coal, scoria, and unknown. The mass of each category, including that of the balance of the unsorted sample (which was curated), was determined to the nearest 0.1gm on an Ohaus C305S digital scale. Counts were recorded only for items $\geq$2.5cm in size (i.e., those items that should have been piece plotted). This material was then available for more detailed assemblage analyses by individual researchers.

Piece plotted artifacts were identified according to the following <u>categories</u>: lithic, ceramic, groundstone, daub, burned earth, faunal, floral, historic, unmodified, other/unknown. At a lower hierarchical level, data entries then included the following <u>types</u>: Lithic- flake, non-flake, core, tested piece, biface, uniface; Ceramic- rimsherd, bodysherd, handle, appendage; Groundstone- mano, metate, nutting stone, abrader, hammerstone, axe, celt; Faunal- bone, teeth, shell; Floral- wood charcoal, other plant remains; Historic- glass, ceramic, coal, bone, concrete, metal, brick, or other general/specific functional identification.

The above categories and types of cultural material of both waterscreen and piece-plotted samples were then divided into the following categories for analysis: ceramics, chipped stone, groundstone, biological remains. Each of these categories is described and interpreted in separate chapters herein. In each, the analyst recognizes more detailed types of artifacts based on more specific morphological, functional and/or typological criteria. The artifact computer catalog was then modified to include those specific identifications.

<u>Specialized Analyses</u>: Mitigation of the DB site required a multidisciplinary, phased approach in order to tap its potential for yielding information about: 1) the time of its occupations, 2) the relationship between its cultural and natural strata, and 3) the nature of changes in the physical environment of the DB ridge and its impact on cultural adaptations.

Analysis of biological remains can provide information about season of site occupation, preferential utilization of certain habitats within the DB catchment, and the nature of the physical setting with respect to flora and fauna in general. This information in turn can be compared among the components at the site and to that from other sites in the region to interpret settlement-subsistence patterns and, in conjunction with environmental data, result in greater understanding of processes of regional culture change. Paleoenvironmental data at DB were obtained through geomorphological and phytolith analyses. Analyses of soil-sediment, soil magnetic, chemical, carbon isotope, and chronostratigraphic data described by Johnson (chapter 3) provide the necessary framework within which the development of prehistoric cultures can be seen as part of an ecosystem. Analysis of soil samples for opal phytoliths by Bozarth (chapter 4) also contributed to this framework by tracking changes in the vegetational communities of the DB ridge from the Late Pleistocene to the Holocene.

Phytolith analyses also contributed to the functional interpretation of plant food processing tools and expanded our knowledge of Archaic activities. As noted above, certain artifacts, particularly groundstone tools, recovered during excavation were not immediately washed but evaluated for their potential value for microscopic analysis of plant remains. In chapter 11, Beck details how the identification of some phytoliths on selected groundstone items added to our understanding of plant gathering and processing at DB. Plant macrofossils, represented by diffuse charred nutshell fragments, maize kernels, pieces of wood charcoal and other floral remains, were also examined by Adair (chapter 13) in order to interpret subsistence activities and seasonality of site occupation.

Another specialized analysis essential to interpretation of the site was radiocarbon dating. Such dates were obtained on humates from bulk soil and sediment samples from Trench 1 (Fig. 6.1) in order to obtain chronostratigraphic control of the depositional and pedogenic evolution of the DB ridge, particularly with reference to the soils that contain cultural material. These dates were provided by the Radiocarbon Laboratory at the Illinois State Geological Survey, University of Illinois. In chapter 3, Johnson interprets the problematic results of these assays. Additional dates (AMS) were obtained on remains of plant annuals, including maize, black walnut and hickory nut, from cultural deposits. These dates were provided by different laboratories in order to cross-check accuracy. AMS assays were required because no samples of organic material sufficient for standard dating were recovered at the site during Phase IV excavations. The AMS method is desirable, when it can be afforded, because it permits dating annual plants, as compared to charcoal from the old or inner wood from long-growing trees. Three samples were submitted to Beta Analytic of Miami, Florida, which submitted them after processing to the University of Kiel, Kiel, Germany. Three samples were also submitted to the Laboratory for Accelerator Radiocarbon Research, University of Colorado, which submitted them after processing to the Center for Accelerator Mass Spectrometry, Lawrence Livermore National Laboratory, Livermore, California. AMS dates are discussed in chapter 7.

Chapter 7

Excavation of the DB Site

Brad Logan

Introduction

The Phase IV block excavation covered an area of $163m^2$ on the highest portion of the DB ridge. As noted in the previous chapter, it was initiated in one of the surface-collection grid units that had yielded the highest density of cultural material. Figure 7.1 shows the final depths to which all units in the block were dug *below the graded surface*. The block was dug in four $36m^2$ (6x6m) sub-blocks each separated by a $6m^2$ (6x1m) balk. The balks provided stratigraphic control but were more essential for support of the tent that shielded the sub-blocks during their excavation. Once they were fully exposed and no longer necessary for tent support, they were reduced in ten cm levels following the procedures described in chapter 6. Sub-Blocks 1-3 were oriented with the long axis north-south, forming with their balks a 6x20m block with a one meter unit extension on the north to expose a hearth feature (see Feature 5 below). In order of excavation these sub-blocks are: 1) 147-153N/57-63E, 2) 154-160N/ 57-63E, and 3) 161N-167N/57-63E. The fourth sub-block was located adjacent to Sub-Block 2.

The area excavated during Phase IV exceeded that recommended in the DRP ($150m^2$) primarily because a "third component" inferred from non-diagnostic artifacts found below 60cm bs in smaller test blocks during Phase IIIA was determined to be the result of downward dislocation of artifacts through bioturbation (see <u>Disturbance Processes</u> below). Diagnostic artifacts found lower than 40-45cm bg (60-65cm bs) in the block included pottery that had obviously been moved from the upper component. Thus, it was not deemed necessary to dig all units below 40cm bg. Since the block did not have to be excavated to greater depth, it could be expanded laterally.

The direction of block expansion was determined on the basis of various criteria. Movement northward from Sub-Block 1 was desired since the block would then incorporate part of Test Block 3 of Phase IIIA on the highest part of the ridge. Test Block 3 had revealed a feature (F.3; see <u>Features</u> below) that had been initially interpreted as a hearth. However, closer examination of associated cultural material and evaluation of radiocarbon dates obtained from it indicated it was of historic origin. Still, other artifacts from the upper and lower levels in that test block suggested that both preceramic and ceramic age components were present and could be fruitfully explored in that area.

Two $1m^2$ units (164N/53E and 172N/63E) were also dug west and north of Sub-Block 3 in order to explore the potential in those areas. The relative paucity of cultural material and

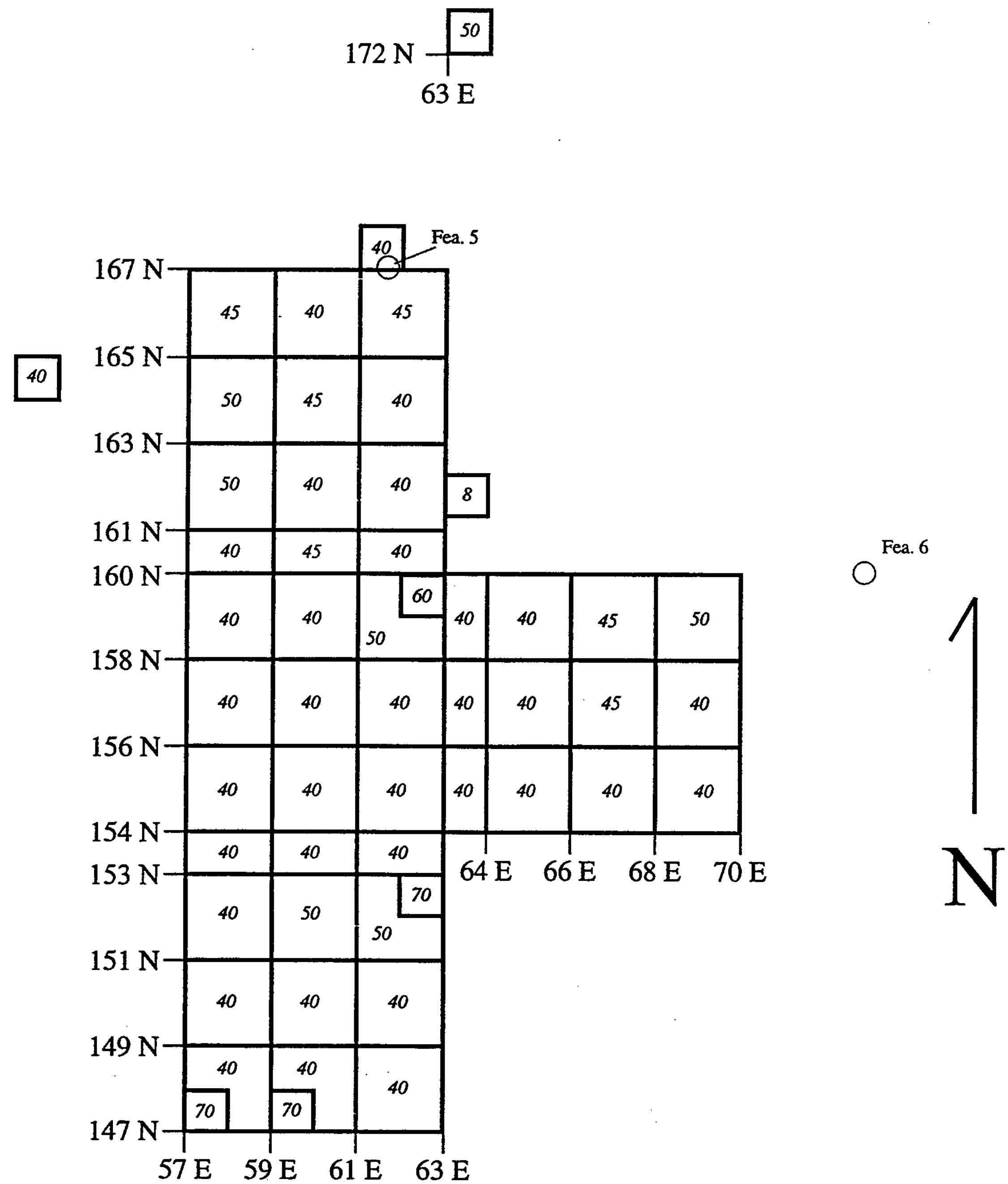

Figure 7.1. Sketch map of block and test excavations showing sub-block and balk units. Numbers in units give final depth below the graded surface (bg). In order to know the depth below surface of all units, add 20cm to the depth bg.

absence of any features in the tests suggested moves in these directions would not be rewarded substantially. Indeed, these findings reinforced the perception of a drop-off in some hallmarks of the Late Prehistoric component (e.g., daub and pottery) that was noted during excavation of the third sub-block. Consequently, neither northward nor westward expansion of the block seemed prudent. A map of all piece-plotted sherds in the block indicated that most had been located along the eastern wall of Sub-Block 2. This suggested that expansion eastward from that area would be rewarded with more evidence of the Late Prehistoric component. A concentration of larger till cobbles in Levels 3 and 4 (20-30, 30-40cm bg) of unit 158N/61E (see Fig. 7.2) also suggested such a move might reveal a comparable density of material associated with the preceramic components. For these reasons, Sub-Block 4 was dug from 154N to 160N and from 63E to 70E. This decision was rewarded with the delineation of a daub concentration that straddled Sub-Blocks 2 and 4. Definition of this concentration contributed significantly to interpretation of the structure and nature of the Late Prehistoric (Steed-Kisker phase) component (chapters 14-15).

Stratigraphy

Because the A horizon of the buried Brady soil had been eroded from the block excavation area and because the B horizon of that soil had subsequently become welded to that of the modern soil, it was difficult to discern any soil stratigraphy other than the obvious contrast between the modern Ap and the underlying B horizon. The B horizon exhibited comparable color and structure throughout its profile. Thus, the use of the term stratigraphy here is based on archaeological, rather than pedological, evidence. During the excavation, the general vertical distribution of two types of cultural material provided a rough measure of the cultural stratigraphy. Daub was more plentiful in the upper level (0-10cm) of each unit and somewhat less so in the second level (10-20cm). When daub was found below 20cm bg, it was generally in a disturbed context, such as a root cast, filled cradle, or krotovina (i.e, a filled rodent burrow; Wood and Johnson 1978:318). Conversely, artifacts of till-derived material, referred to as "groundstone" during the excavation, were more numerous in the lower levels and only rarely encountered in the uppermost level. The presence of quartzite and other till artifacts at greater depths was also documented throughout the graded portion of the site (Fig. 7.2).

It is unlikely that the differential distribution of till-derived materials is attributable to any natural process. Indeed, cryoturbation, or frost-heaving, more effectively thrusts larger items such as groundstone toward the surface than smaller items. This reflects the positive correlation between the greater surface area of these items and their upward movement through the swelling of expansive soils by frozen water. If this process had occurred at DB, we would have encountered many more cobbles in the upper levels, rather than vice versa.

A cultural transformation process called the "size effect" (Baker 1978) also predicts the occurrence in higher frequency of larger artifacts, particularly groundstone and other cobble tools, on the surface or in the upper levels of stratified sites. This is due to the greater visibility of these items (augmented by the quicker burial of smaller items through trampling, etc.) after

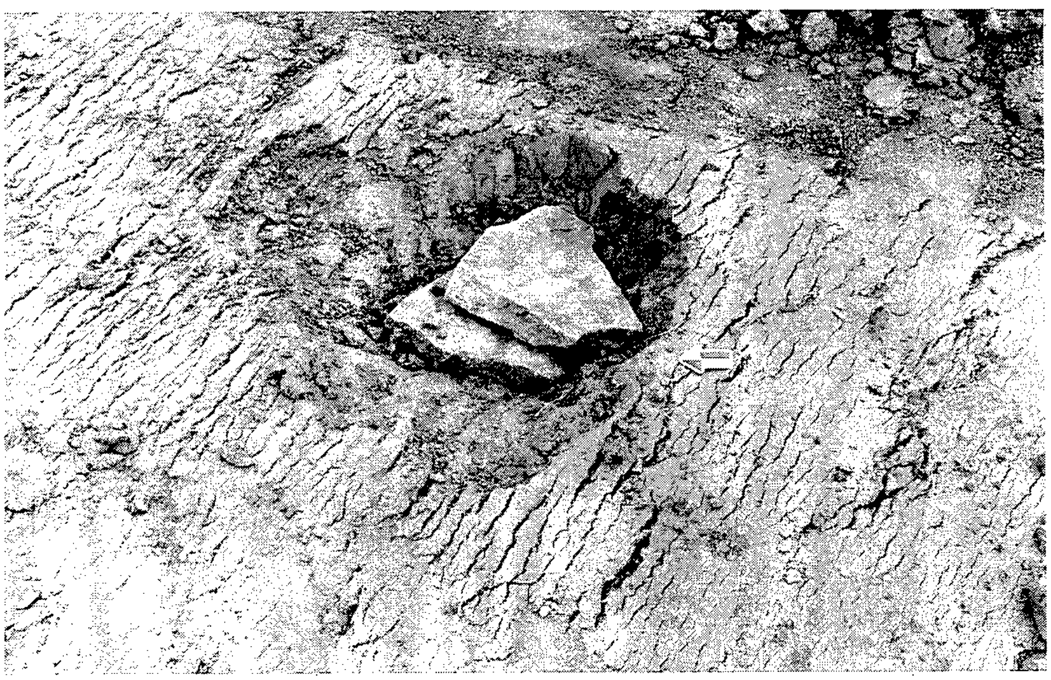

Figure 7.2. above) Cobble artifacts at base of Level 3 (30cm bg; 50cm bs), 158N/61E. below) Quartzite slabs (metate fragments) encountered during mechanical stripping. As exemplified by these photos, till material, particularly quartzite, was more plentiful in the lower (pre-ceramic) levels throughout the site.

their use and discard or loss and subsequent scavenging and recycling by later site visitors. Thus, these larger items are preferentially "moved up" stratigraphically through the actions of site occupants, not natural processes. However, this process does not appear to have happened at the DB site, at least with respect to the Late Prehistoric component (it may well have occurred during the preceramic occupations). Indeed, the fact that few cobbles were recovered from the upper level of the block excavation (see chapter 14) suggests either that they had been effectively buried by Bignell loess and shielded from scavenging by ceramic-age occupants or, less likely, that the later people had no use for them.

While burrowing animals may differentially transport artifacts of different sizes, with larger items moving downward (see Hill, chapter 14), it is unlikely that the wide range of metamorphic stones (pebbles, cobbles and slabs) dispersed throughout DB were more so thoroughly carried to the preceramic horizon from the ceramic horizon. Rodents would have had to target, almost systematically, these objects. Given their somewhat scattered distribution, it would have been far easier for rodents to burrow around them than under them. Thus, we are left with the inference that the preceramic occupants of the site abandoned many more artifacts of till-derived material than the those of the ceramic-age components, that the latter left evidence of a structure of wattle-and-daub construction whereas the former did not, and that the vertical distribution of these materials reflects the stratigraphic integrity of the cultural material from these two broadly-defined cultural horizons.

At the same time, the erosion of the Brady soil and the lack of significant aeolian deposition (or the preservation of such) between 11,000 and 2400 BP (see chapter 3) precluded formation of stratified deposits within the preceramic horizon (ca. 40-60cm bg). Temporally diagnostic, chipped stone artifacts indicate the site was occupied during this time by hunter-gatherers of the Paleoindian, Middle and Late Archaic periods. However, with the exception of the few Paleoindian points (and it might be argued that the sample of them is too small to be statistically meaningful), the vertical distribution of these diagnostics shows considerable mixing. Thus, the preceramic horizon per se at DB has little stratigraphic integrity. It reflects collapsed stratigraphy at best or, depending on when the erosion of the Brady A horizon occurred, that the material deposited during these periods was never stratified. If the prehistoric occupations prior to deposition of the Bignell loess occurred on an eroding, stable, or slowly accreting surface, then periodic visitations by hunter-gatherers would have resulted in cultural disturbance processes, such as the trampling and scuffling of middens and other debris, the accidental or intentional dismantling of hearths or other exposed features, and the scavenging of site "furniture" (sensu Binford 1978b:339, 1979:264-5) such as manos and metates (see chapter 11). This erasure or rearrangment of the archaeological signature of previous occupations by later inhabitants results in the creation of a "palimpsest, or the aggregated result of numerous small independent events" (sensu Binford 1981:204). Such artifact accumulations create problems for archaeologists who try to discern the structure of discrete occupations. This aspect of the site is explored by Matt Hill in chapter 14.

Disturbance Processes

As if the "palimpsest" problem were not enough to give us pause in our attempt to infer site structure of the lower levels, evidence of bioturbation was also found throughout the block excavation. However, natural disturbance was not so pervasive that cultural deposits were homogenized. Rather, some stratigraphic integrity was evident in the vertical distribution of cultural remains, particularly with regard to those of the oldest (Paleoindian) and most recent (Late Prehistoric) components. More detailed discussion of the relative integrity of the site stratigraphy is found in chapter 14. This section is a more general discussion of the nature and variety of natural disturbance processes documented during Phase IV.

Disturbance processes (Wood and Johnson 1978) most prevalent at DB were caused by plant growth/decay and animal burrowing. Previous investigations at the site (Logan 1995b, 1996a) had revealed areas, sometimes greater than $2m^2$, where A horizon soil had filled cavities in the welded B horizons (see chapter 3). These features were probably the result of the decay of tree root systems or the uprooting of trees by windthrow and subsequent in-filling of "cradles" (Wood and Johnson 1978:329). Such displacement of soil, of course, affects artifacts contained therein. One such "feature" (Fig. 7.3; see Feature 4 below) was documented during Phase IV.

Krotovinas were also noted. Figure 7.3 shows an example of one such natural feature that provides evidence of the vertical displacement of artifacts. In this case, the dark soil fill of the burrow includes a rimsherd and body sherd (with part of a handle) of Steed-Kisker pottery, a flake scraper, and a piece of debitage. The original provenience of these items was the A horizon of the modern soil, which was at least 30cm higher in the profile. At a depth of ca. 60cm bs (42cm bg), these Late Prehistoric items had come to rest a few cm below the lowest preceramic level. Just as the burrowing of rodents moved more recent material downward, the removal of subsoil by the animals transported older artifacts upward. This probably accounts for our recovery in the upper levels of some chipped stone tools that are considered diagnostic of the Archaic and Archaic/Woodland periods (see chapters 9, 14).

Features

Phase IV excavations at DB revealed only two cultural features, both hearths or clusters of hearth debris. Documented as Features 5 and 6, they are described below. Features 1 through 3 were recorded during previous investigations. Feature 1, recorded during Phase III (Logan 1995b), was an area of disturbance by tree growth and decay that was subsequently filled with A horizon soil. Feature 2, found in undisturbed soil about 20cm from Feature 1, was a cluster of contiguous quartzite artifacts, including two manos, an expedient cobble, and a hammerstone. Feature 3, found during Phase IIIA testing, was an ash filled basin. Initially thought to be a hearth, it yielded recent C14 dates and historic nails (Logan and Beck 1996a).

Two areas of natural disturbance encountered during Phase IV were designated Feature 4. The first, centered at 151N/61E and extending into the adjacent four units, was encountered 0-10cm bg (20-30cm bs). It initially appeared as a circular stain of A horizon fill about 50cm

Figure 7.3. Natural Disturbance Features. above) Filled tree cradle; below) Krotovina with Late Prehistoric artifacts, including a rimsherd of Steed-Kisker Incised ware, bodysherd of Platte Valley Plain with handle base, flake end scraper and debitage. Menu board refers to depth below graded surface at unit datum.

in diameter within the B horizon. The amorphous boundary of the stain (Fig. 7.3) and its shallow nature (less than three cm thick) indicate tree growth and decay. The same feature number was later given to a similar, smaller stain initially recognized as a half-circle about 12cm in diameter in the southwestern portion of 163N/57E at 30cm bg (50cm bs). It was first thought to be a postmold that had been cross-sectioned by the western profile of the block and truncated by the plowzone (it appeared on the wall at a depth of 10cm bg, 30cm bs). Its profile mimicked that of a tapering post; one edge was vertical to a depth of 40cm bg and the other (southern) tapered. However, excavation of the feature to a depth of 85cm bg (105cm bs) revealed a narrowing, s-shaped profile that indicated it was a deep krotovina.

Features 5 and 6, the only ones of cultural origin encountered during Phase IV, are described and interpreted below.

Feature 5: This feature, interpreted as a hearth, consisted of a roughly circular concentration of pieces of burned limestone with a total mass of 1236.1g that covered an area of about 40x40cm in units 165-166N/61E (Fig. 7.4). It was first encountered at the extreme northern end of the block excavation in in the lower half of Level 3 (20-30cm bg; 40-50cm bs), unit 165N/61E. Indeed, had the block been established just ten cm further south, or had the creators of the feature made it just that much further north, our excavation would have missed it entirely, in which case it would likely have been encountered during mechanical scraping of the site. The decision to expand the block eastward had been made when the small cluster of burned limestone that proved to be the southern edge of the feature was exposed. Complete exposure of Feature 5 required excavation of a one meter square unit- 166N/61E. This small window precludes interpretation of activities around the northern half of the hearth, though as Hill (see chapter 14) suggests, taphonomic factors restrict such interpretation for the lower levels of the block excavation in general.

No diagnostic artifacts were found in direct association with the feature. The fill within and around the burned stones, about five samples (ca. 22.5gl, 85lt), was collected for flotation and it yielded 3.47g of debitage, 5.0g of ferrous oxide, 1.0g of burned bone, 0.5g of charcoal and burned nutshell, 0.1g of mussel shell, and 0.1g of burned earth/daub. Two of the burned nutshell fragments provided AMS radiocarbon dates (see following section). The resulting assays support a terminal Archaic affiliation for the hearth. The soil matrix of the stones showed no evidence of burning. Given the absence of oxidized/burned earth and ash, it might be interpreted as a pile of hearth debris redeposited from a campfire located elsewhere. However, it is intriguing that the stones could have remained so contiguous and come to rest in such a circular pattern through dumping, let alone have survived the kind of trampling and dispersal that appears to have been the fate of other midden debris at the site. From their ring-like formation and the nearly sterile interior defined by the stones, it appears that they may have been set to support a container of some kind for cooking. The lack of burned earth and ash may be attributable to post-depositional surface wash and wind erosion. Support for the in situ nature of the latter comes from the uppermost of two spikes in the magnetic susceptibility of the soil profile from backhoe Trench 3, which was purposefully excavated through 166N/61E after removal of Feature 5. Johnson (chapter 3 herein) attributes these to fire/burning. The

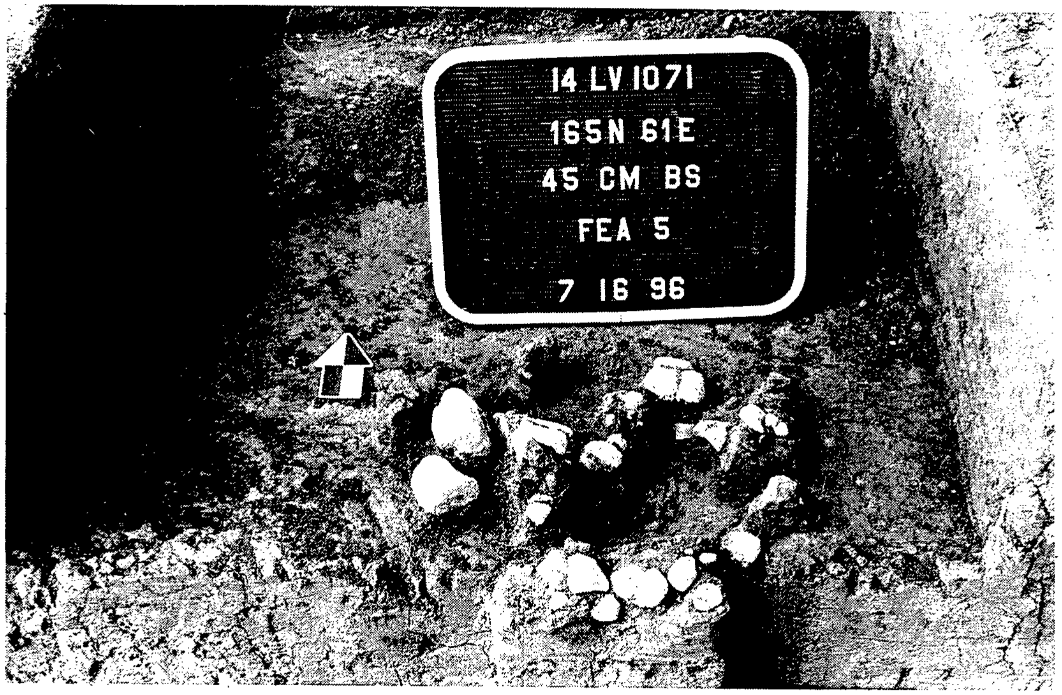

Figure 7.4. above) Feature 5, 45cm bs; below) Feature 6, following excavation after its initial exposure by the grader. Scored line indicates extent of "ash" or powdery calcium carbonate. Note the darker soil of a root cast through the right portion of the feature.

uppermost spike was ca. 45cm bs, the level of the hearth. (The second spike, 65-70cm bs, is beyond the level of manual excavation at 166N/61E and the general depth of in situ cultural deposits at DB. It cannot be attributed to any cultural activity).

Hearths at the Late Archaic, Nebo Hill site offer comparative insight to Feature 5. For example, Reid (1984:56) interprets as fireplaces areas that contain burned earth, charcoal, and burned bone but that lack hearthstones. Some of these are the same size as Feature 5. One limestone hearth at Nebo Hill was more extensive, though it appears to have been partially dismantled. Reid (1984a:60-61) suggests is was initially built up from a foundation ca. $75cm^2$ and used as a family's cooking hearth, an interpretation that can be applied to the DB feature.

Feature 5 was exposed, covered with damp paper towels, jacketed with plaster bandages and removed to KUMA for excavation. Though it was hoped that more charcoal or burned plant remains might be found beneath the stones, none was found. The stones and associated material were within a soil matrix 20cm thick as measured from the surface of the highest stone to the base of the lowest. Thus, the feature extended from ca. 40 to 60cm bs (20-40cm bg), roughly spanning the pre-ceramic horizon.

Feature 6: This feature, exposed during mechanical stripping of the site, was about 12m southeast of Feature 5 (Fig. 7.1). It consisted of eight pieces of burned limestone and diffuse ash or powdery calcium carbonate that eroded from the stones (Fig. 7.4). This material covered an area 50x50cm and extended six cm below the graded surface. The eastern portion had been disturbed by a tree root. The contents of the feature matrix, which yielded four flotation samples (ca. 18gl, 68lt), included 266.9g of burned limestone and 3.0g of debitage. It is difficult to infer the function of this feature, given the paucity of material it yielded. It is either the remnant of a hearth that had experienced post-occupational disturbance and weathering or debris cleaned from a hearth located elsewhere. Its position was mapped and its depth is estimated to have been 45-55cm bs, comparable to that of Feature 5.

Discussion: The paucity of features at DB suggests that all prehistoric occupations were relatively brief. This is what we would expect if the site had been targeted for short-term, seasonal exploitation of its hardwood resources. While natural and cultural disturbance processes may have eradicated or blurred activity areas and affected the general site structure, it is unlikely that they would have effectively erased such features as pits and house remains. Rather, the lack of storage facilities and structural features attests a series of brief encampments. This is in keeping with the greater mobility characteristic of Paleoindian and Archaic settlement patterns. What is intriguing is that the relative brevity of occupation applies to both the preceramic and ceramic components. In particular, the Late Prehistoric (Steed-Kisker phase) component is characterized by a small artifact assemblage (see following chapters) and evidence, restricted to daub, of a structure of wattle and daub construction. No definite postmolds, storage pits, or hearth were directly associated with the daub concentrations in the block excavation, though traces of an extramural hearth and activity areas were delineated nearby (see chapter 14). The evidence points to one or two rather modest, grass-covered shelters that were occupied briefly, perhaps during a single season. The Late Prehistoric occupation does not appear to have been repeated. There is no clear evidence of periodic use of the ridge during the Steed-Kisker phase comparable the Archaic components.

Thus, the duration of all prehistoric occupations appears to have been short, sufficient to exploit nearby woodland resources. If nuts were the major resource, then camps would have been occupied during late summer and autumn when they were available. As the catchment model shown in chapter 2 indicates, valley and bluff woodlands, upland prairie, and bottomland aquatic habitats were also handy. It is unlikely any groups favored the exposed ridge during the cold seasons (winter-early spring); sheltered lowlands were probably preferred. The DB site, thus, reveals some common aspects of the settlement-subsistence patterns of groups generally contrasted with respect to their relative mobility or sedentism (see chapter 15, Settlement Patterns, for further discussion).

Radiocarbon Dates on Cultural Material

The brief occupations and taphonomic processes that account for the paucity and poor preservation of features at DB also resulted in the deposition and preservation of fairly small, scattered amounts of organic debris (see chapter 13). Despite waterscreening, which enhanced the preservation and recovery of such delicate material, the total mass of burned wood, nutshells, maize, seeds and other plant matter from the Phase IV excavations (exclusive of flotation samples) is only 205.4g, an average of 1.24g per square meter (all levels). Only one unit-level (156N/68E, 20-30cm bg) yielded more than ten gms of burned plant remains and only nine contained more than three gms. Obviously, these small and disparate amounts are not sufficient samples for standard radiocarbon dating. However, the use of accelerator mass spectrometry (AMS), which requires small samples of organic material because the technique entails direct counting of ^{14}C atoms, made it possible to obtain C^{14} dates from individual pieces of burned nutshells and maize kernels. The method requires $\leq$1/1000th the sample mass necessary for conventional ^{14}C dating and eliminates some problems of the latter. These include the submission of composite samples that might lump organics from different occupations, and the dating of charcoal from the inner wood of long-lived plant species. One disadvantage is the greater cost. Funding for half of the AMS dates (and for all of the standard dates on humates described in chapter 3) was provided by KUMA.

Six samples of charred plant material were submitted to two laboratories for AMS dating (Table 7.1). The preparatory labs, Beta Analytic of Miami, Florida and the University of Colorado-INSTAAR AMS ^{14}C Laboratory, submitted the prepared graphite samples to the accelerator facilities at the University of Kiel, Kiel, Germany and Lawrence Livermore National Laboratory, Livermore, California respectively. The samples were symmetrical, that is, they were paired from the same level, unit-level, and feature such that the assays from one lab provided a check on those from the other. This controlled any difference in sample preparation procedures between the laboratories that might result in significantly different assays.

Table 7.1. DB site AMS Radiocarbon Dates and Statistical Tests.

Lab No.	Unit/Level	Species	Uncor. ^{14}C	Delta ^{13}C	Cor. ^{14}C	Calibrated*
Beta-101874	Fea. 5 50-60cm b.s.	*Juglans nigra*	2490±70	-26.9o/oo	2460±70	BC 768 (750, 746, 526) 405
Beta-101875	156N/68E 50-60cm b.s.	*Juglans nigra*	2590±50	-25.8o/oo	2580±50	BC 803 (793) 767
Beta-101876	160N/57E 20-30cm b.s.	*Zea mays*	420±40	-7.4o/oo	710±40	AD 1281 (1290) 1300
NSRL-3434	149N/57E 20-30cm b.s.	*Zea mays*	530±60	-8.0o/oo	550±60	AD 1320 (1408) 1430
NSRL-3435	156N/68E 50-60cm b.s.	*Juglans nigra*	2610±50	-27.9o/oo	2620±50	BC 810 (801) 790
NSRL-3436	Fea. 5 50-60cm b.s.	*Carya sp*	2470±50	-24.6o/oo	2480±50	BC 770 (755, 686, 540) 420

Tests for Significant Difference

1) Beta-101874, 101875; NSRL-3435, 3436; ISGS-3585

Pooled Mean Age: 2559
Square Root of Variance of Pooled Mean Age: 26
Test Statistic T': 7.51
Xi^2 (.05): 9.49
Result: Samples are statistically the same at 95% level.

2) Beta-101876, NSRL-3434

Pooled Mean Age: 660
Square Root of Variance of Pooled Mean Age: 34
Test Statistic T': 4.72
Xi^2 (.05): 3.84
Result: Samples are statistically different at 95% level.

3) Beta-101876, NSRL-3434 (doubled one sigma)

Pooled Mean Age: 661
Square Root of Variance of Pooled Mean Age: 67
Test Statistic T': 1.22
Xi^2 (.05): 3.84
Result: Samples are statistically the same at 95% level.

Calibrated Averages*

1) Radiocarbon Average Feature 5: 2473±42
   Calibrated Average: BC 765 (754, 694, 535) 420

2) Radiocarbon Average 156N/68E, Level 4: 2600±36
   Calibrated Average: BC 805 (797) 786

3) Radiocarbon Average Feature 5 & 156N/68E, Level 4: 2545±27
   Calibrated Average: BC 791 (775) 607

4) Radiocarbon Average Maize Dates: 660±34
   Calibrated Average: AD 1294 (1302) 1388

5) Radiocarbon Average Maize Dates (doubled one sigma): 660±67
   Calibrated Average: AD 1286 (1302) 1397

*All calibrated dates are one sigma (intercepts) ranges (Stuiver and Pearson 1993; Pearson and Stuiver 1993). Calibrations and tests done with CALIB 3.0.3. (Stuiver and Reimer 1993).

Discussion: The C^{14} dates of samples from the lower levels of the block excavation are remarkably consistent, not only with each other but also with that obtained from the humate content of a bulk soil sample taken from the same depth (50-55cm bs) in Trench 1 (ISGS-3585; see chapter 3). A t-test of all five dates demonstrates that they are statistically the same (Table 7.1). The only difference between the soil sample and the cultural plant remains is that the former was acquired from the uneroded A horizon (2Ab) of the buried soil and the latter were within its B horizon. That difference, of course, is due more to natural circumstance than culture and we can be assured that all five dates record relative contemporaneity for the surface that was occupied ca. 600-800 BC and shortly thereafter buried by Bignell loess.

The 600-800 BC age range was obtained by rounding the average of the four assays from Feature 5 and 156N/68E, 50-60cm bs. It is intriguing that of these dates, the younger pair is from the hearth and the older pair from the unit-level. One is tempted to interpret this as evidence that the hearth post-dates deposition of the burned walnut shells a few meters to its southeast and that the site was occupied more than once during that age range. However, the fact that there is no statistical difference among all four dates precludes such speculation. Radiocarbon dates, after all, are probabalistic statements and here the same probability for the true age of each assay applies to all.

A comparison of means of maize samples from the Late Prehistoric component indicates they are statistically different. However, the discrepancy is overcome by doubling the one sigma values, an approach recommended by some archaeologists (Don Blakeslee, Wichita State University, personal communication). When that is done, the average indicates the Steed-Kisker occupation occurred ca. A.D. 1300-1400.

The AMS dates as a whole provide significant insight to the chronology of the Archaic and Late Prehistoric occupations of DB. The terminal Archaic assays from the lower levels of the block excavation now fill a critical gap in regional prehistory. The 14th century ages of the maize dates support revision of the temporal range of the Steed-Kisker phase. These implications, and others, of the radiocarbon assays and age ranges are explored in more detail in relevant sections of the following chapters and, particularly, in chapter 15.

(Note: AMS dates from INSTAAR were provided with Delta ^{13}C values but without final correction. According to Dr. Tom Stafford of INSTAAR [personal communication], Livermore had been given estimated values, based on the identified plant species, and true values were "within two parts per mil of the estimate". Thus, the conventional dates would have less than 0.2% error, yielding corrected dates 10-20yrs older. The author has corrected the date based on maize, which had a slightly greater difference between estimated and determined Delta ^{13}C values, by 20 years and the dates based on woody plant remains by 10 years.)

Chapter 8

Ceramic Assemblage

Brad Logan

Introduction

The pottery assemblage from the DB site is small when compared to those from nearby excavated ceramic-age sites. For example, excavation of $102m^2$ at the Zacharias site in Salt Creek Valley, 3.4km southwest of DB, yielded 340 analyzed sherds (47 rims and 293 body sherds) of associated Steed-Kisker phase, Pomona variant, and Plains Woodland wares (data on file, Office of Archaeological Research (OAR), KUMA). Excavation of $33m^2$ of the Quarry Creek site, 2.1km south of DB, provided more than 7,685 sherds (137 rims, 7,548 body sherds; total mass=17,286gms) of Kansas City Hopewell ware (data on file, OAR, KUMA), of which 99 rims and 81 body sherds have been analyzed (Cook 1993). In contrast, excavation of $167m^2$ and mechanical stripping of ca. $3{,}500m^2$ at DB yielded 165 sherds (22 rims, 143 body sherds; total mass=1,663gms) of sufficient size ($\geq$2.5cm along the greatest dimension) for analysis. This sample is 89.1% of the total mass (1,867.44 gms) of pottery recovered.

Of the analyzed sherds, 40 have point provenience within the block excavation, 62 have unit/level context therein, 48 were piece plotted beyond the block, and 15 were collected at random from the surface of the plowed or graded areas of the site. The total number of these sherds from the block (n=102) provides a per $1m^2$ ratio of .61. Given that the block was dug in that portion of the site with the greatest general artifact density and included the area around the largest vessel fragment exposed in the graded area, we can see that pottery is fairly sparse at DB. The limited nature of the sample suggests that ceramic-age occupations were relatively brief and/or by small groups. Despite the small sample, it substantiates the Steed-Kisker affiliation of the Late Prehistoric component identified in previous reports (Logan 1995b:53-56, 1996a:75-101). It provides more tenuous support for the presence of a Middle Woodland component hypothesized therein.

In the following section the ceramic assemblage is described with respect to its attributes. The rim sherds are described in detail as they provide more insight to cultural affiliation. In the final section, the pottery is discussed with respect to its cultural affiliation, site function, chronological and geographical seriation, and as possible evidence of the interaction of Late Prehistoric populations in the Lower Missouri Valley.

Assemblage Description

Classifications of ceramics may focus on attributes or type-varieties, different levels of criteria that are generally believed to convey cultural information of use to archaeologists. The element adopted here is the attribute, "the smallest qualitatively distinct unit involved in classification" (Dunnell 1971:49). As discussed below, archaeologists have frequently used some attributes to discriminate the ceramics of cultural taxa in the Lower Missouri Valley region. It is suggested that the previous use of some attributes as significata may not be valid, particularly with respect to small assemblages, such as that from DB, that exhibit notable variation in attribute associations. However, presentation of these fundamental data is more practical for the DB assemblage because the low number and fragmented nature of the sherds limits its potential for recognizing pottery types or varieties. Indeed, only one vessel fragment and a few other rim sherds from DB contain sufficient attribute information for further identification of regional Late Prehistoric pottery types. The following attributes, 15 discrete and eight continuous, were recorded: color of slip, exterior and interior surfaces (Munsell 1975 ed.), exterior and interior surface treatment, presence of residue, rim decoration and direction, rim thickness and height, mouth diameter, presence of a handle (as well as its form, width, and thickness), lip form and decoration, shoulder thickness, shoulder decoration and motif, body thickness, temper, and mass.

The most common attribute of the sherds in the assemblage is plain interior and exterior surfaces. Only one sherd exhibits partial and eroded cordmarks. Plain surfaces are considered to be one of the significant attributes of both Steed-Kisker and Hopewell wares. Cordmarked exteriors are indicative of Late (Plains) Woodland pottery, such as that of the Grasshopper Falls phase (Reynolds 1979), and is the predominant (though not exclusive) surface treatment in Central Plains tradition ceramics. With respect to this attribute, then, neither Steed-Kisker nor Kansas City Hopewell can be ruled out as affiliates of the DB ceramic assemblage. By the same token, it is more difficult to entertain the possibility that Late Woodland and, to a lesser extent, CPt cultures are represented.

The next most frequently shared attribute of the sample that is traditionally believed to reflect cultural or temporal differences is shell temper. Sixteen rim sherds and 110 body sherds, 76.9% of the sample, contain evidence of shell temper in the form of thin, flat voids that remained after this aplastic material was leached by soil-chemical processes. Most of the other sherds (n=36, 21.8%) contain sand or grit, either alone or in combination with grog (crushed sherd). One sherd has only grog, another reveals no temper, and a third is indeterminate. Rounded particles of sand were found in five rims (22.7%) and 20 body sherds (15.2%); angular pieces of grit were identified in four body sherds (2.4%), and a combination of either of those materials with grog was recognized in one rim (4.5%) and seven body sherds (4.8%).

Shell temper is considered one of the significata of Steed-Kisker phase ceramics, defined as Platte Valley ware (Calabrese 1969; cf. Chapman 1985:292-293) and described by several authors as occurring in assemblages in frequencies as high as 88-99% (Wedel 1943; Shippee 1972; O'Brien 1993). At Steed-Kisker sites, O'Brien (1993:64) suggests, "the occasional grit or limestone tempered sherd was always an intrusive vessel from a Central Plains tradition complex, usually from the Nebraska phase just up the Missouri River". Stone temper, such as sand or grit, is often attributed, as the foregoing statement exemplifies, to other Late Prehistoric cultures or to earlier, local Woodland complexes, including Kansas City Hopewell (Wedel 1943; Shippee 1967; Johnson 1974) and Grasshopper Falls phase (Reynolds 1979, 1981). While evidence of shell temper in a sherd may contribute to its eventual classification as an example of Platte Valley ware, it does not follow that the presence of stone temper in one that otherwise shares all other attributes of that pottery precludes such classification. Temper type per se is not a sufficient attribute for distinguishing Steed-Kisker pottery from that of other archaeological cultures.

If shell temper was sufficient to recognize Platte Valley ware, then the stone-tempered sherds in the assemblage could be assigned to pottery of another archaeological culture. However, that such discrimination may overlook temper variability in Steed-Kisker ceramics is suggested by one sand-tempered rim (A7039-0296; Fig. 8.1a) that exhibits other attributes of pottery diagnostic of this culture. This piece has a relatively low (18.2mm), everted rim with rounded lip, smoothed interior and exterior surfaces that are both very dark gray in color, and is decorated somewhat haphazardly on the flared shoulder with incised, nested triangular lines that form a chevron. With the exception of temper, this sherd is an example of the Steed-Kisker Incised pottery defined by Chapman (1980:297) and is so designated here. It is also worth noting that the Steed-Kisker pottery from the upland house at the Cloverdale site was tempered with both "sand and shell" (Shippee 1972:15, emphasis Shippee's).

By the same token, if evidence of shell temper sufficed to recognize Steed-Kisker pottery, then rim A5872-0296 (Fig. 8.1b) should be considered a denotatum (Dunnell 1971:46) of that class. However, in addition to shell tempering, this sherd exhibits a pinched collar or fillet, an attribute generally considered diagnostic of Central Plains tradition wares. This sherd is otherwise an excellent example of the Beckman Pinched Rim type of the Nebraska phase (Gunnerson 1952). More is said of the significance of this sherd in the following section.

Ceramic evidence in support of a Middle Woodland component is sparse. Indeed, when sand temper per se is revealed as inadequate for recognizing Woodland wares, the grounds for entertaining this hypothesis nearly vanish. All that remains is the single rim, composed of two sherds (A6368-0296, A7038-0296) from the same vessel, that is shown in Figure 8.1c-d.[1]

The attributes of this specimen that are compatible with some Woodland period pottery include: 1) the channeled interior of the rim that gives it a somewhat s-shaped profile; 2) a rim

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[1] Additional evidence of a late Hopewell occupation was found during the Kansas Archaeological Field School excavation at DB in 1997. This includes a small sample of smooth, sand-tempered body sherds and a rim fragment of Edwardsville ware. The latter has the following characteristic attributes: plain exterior surface, sand temper, a relatively high rim with crenated lip, and low-flaring shoulder.

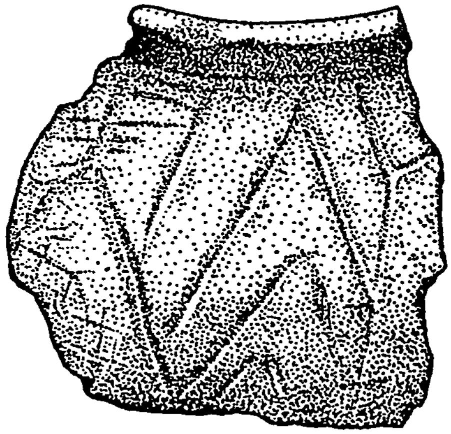


Figure 8.1a. Steed-Kisker Incised rimsherd.

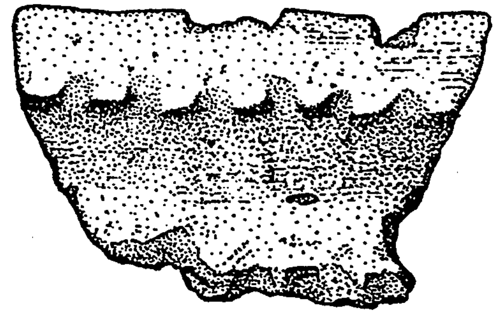


Figure 8.1b. Beckman Pinched rimsherd.

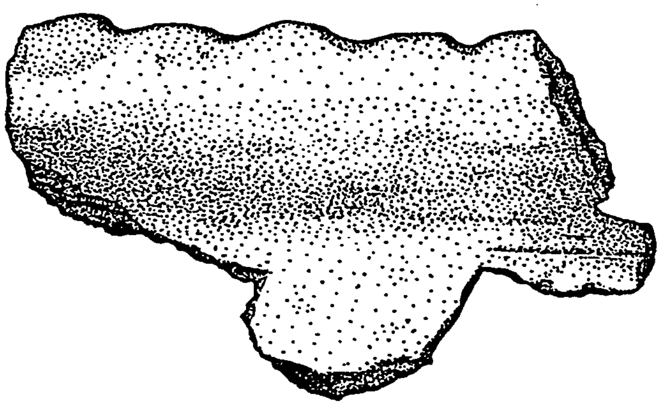


Figure 8.1c. Edwardsville Phase rimsherd.

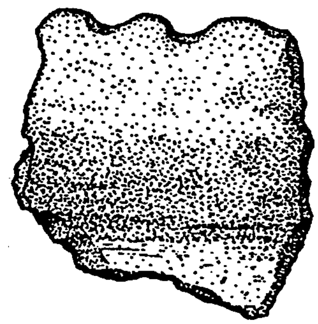


Figure 8.1d. Edwardsville Phase rimsherd.

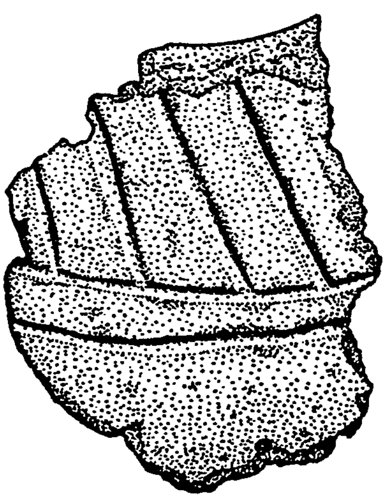


Figure 8.1e. Steed-Kisker Incised bodysherd.

height (30.3-31.5mm) greater than that of typical Steed-Kisker pottery; 3) the low angle of the shoulder (insofar as it is preserved), which is characteristic of elongate Middle Woodland vessels; 4) sand temper; 5) a mouth diameter of 26-28cm, reflecting a vessel with a large capacity; and 6) the notched lip and plain rim. All of these attributes are characteristic of late Kansas City Hopewell pottery, which is comparable to Weaver Plain ware of the late Middle and Late Woodland periods in the Illinois River Valley (Johnson and Johnson 1975). Such pottery in the Lower Missouri Valley is considered diagnostic of the Edwardsville phase (Johnson 1983, in press). Fifteen notched or crenated rims of plain ware such as this specimen were found at Quarry Creek, where Edwardsville phase pottery accounted for 46% of the assemblage (Cook 1993).

The larger of the sherds was found during mechanical stripping ca. 20.5m southeast of the smaller, which was recovered in the block excavation. The depth provenience of the latter may have some bearing on its cultural affiliation, though this line of evidence is not sufficient to confirm it. If this sherd was from an older occupation and if sedimentation of Bignell loess occurred from the latest Archaic to the Steed-Kisker phase occupations (see chapters 3 and 14), then we would expect to find Woodland artifacts stratigraphically lower than Late Prehistoric materials. This is the case for the smaller sherd, found ca. 37cm bs, generally the depth of Archaic-age artifacts. However, some obvious Steed-Kisker sherds were found at this depth, or lower. For example, rim A7039-0296 (Fig. 8.1a) was found in a krotovina 62cm bs (see Fig. 7.2). The depth provenience of this single sherd cannot be granted much weight when considering its age.

While attributes of body sherds in the assemblage do not preclude a Woodland affiliation, they are more compatible with the Steed-Kisker phase. Exterior surfaces of the pottery are predominantely shades of pale brown or yellowish brown. Slip color (n=19; 14 of shell temper, 3 of sand, and 1 each of grit/grog and sand/grog) is shifted to lower chromas and values, ranging from dark gray or gray to dark grayish brown, dark brown or brown. Interior surfaces are more frequently darker brown or gray. In these respects, the pottery is like Platte Valley ware (cf. Chapman 1985:292). The exteriors of Hopewell pottery from the Quarry Creek site are more frequently darker brown hues, like that of the "Edwardsville" sherd described above. However, it is not clear whether surface color should be considered a significata of Middle Woodland and Late Prehistoric wares in this region. That color is a risky attribute for distinguishing classes of prehistoric pottery is apparent when the range of colors on the largest vessel fragment (A3156-0296; Fig. 8.2b), a Steed-Kisker specimen, is considered. It has an exterior surface dominated by a dark gray (10YR4/1) firing cloud. Where this cloud is not present, the surface ranges from gray (10YR5/1) to light yellowish brown (10YR6/4). That such a range of hues can be found on one vessel suggests that the colors of smaller sherds in the assemblage from DB are not a reliable guide to cultural affiliation.

Given an adequate sample, vessel thickness may indicate cultural affiliation with respect to Woodland and Late Prehistoric pottery (Logan 1981a). The generally larger volume of Woodland vessels requires thicker walls for support. The body thickness statistics of the sample from DB are shown in Table 8.1. The thickness of stone tempered sherds, both in range and

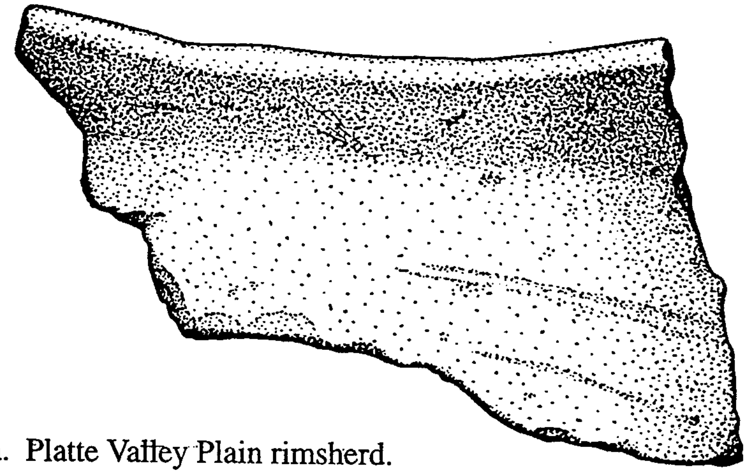


Figure 8.2a. Platte Valley Plain rimsherd.

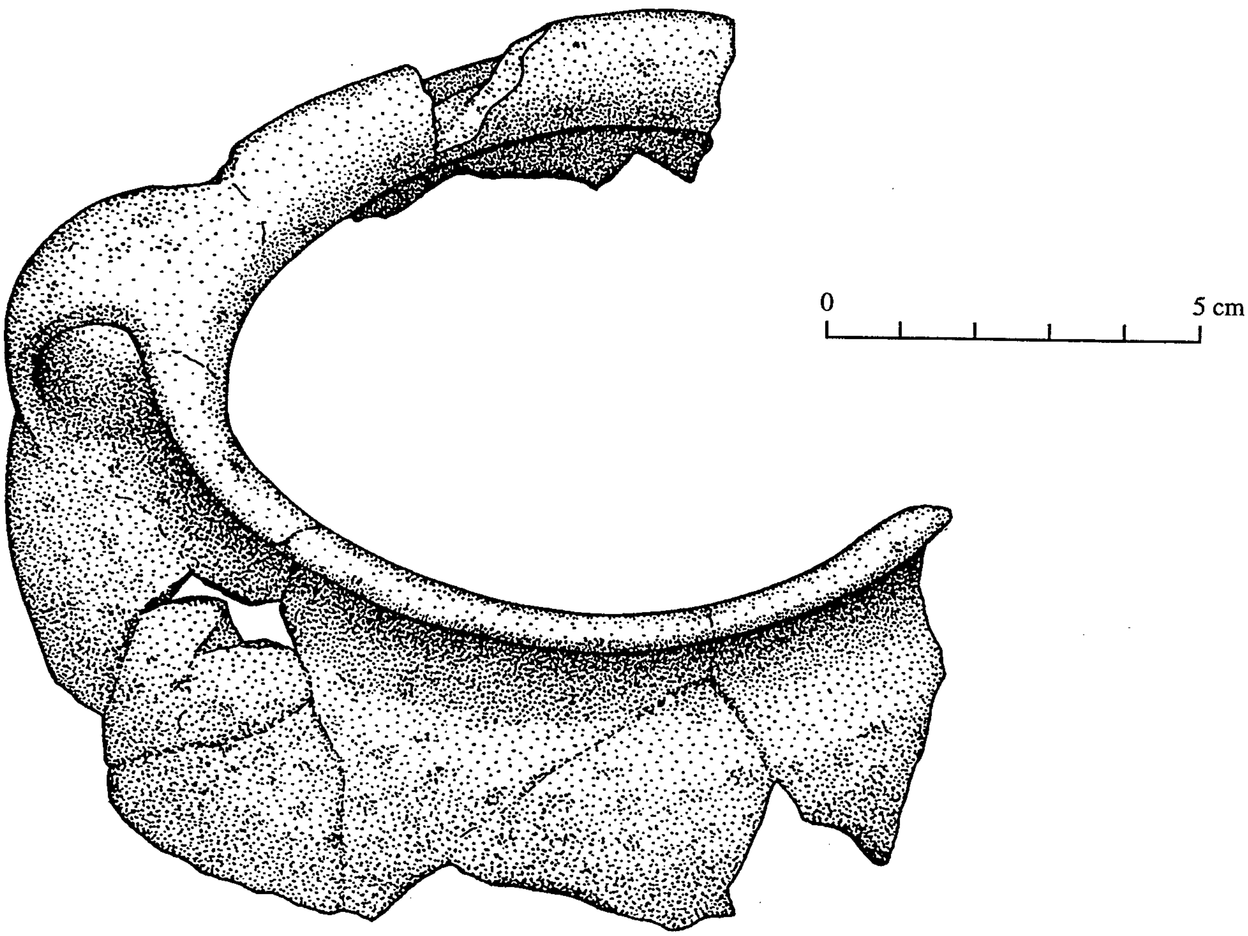


Figure 8.2b. Platte Valley Plain vessel fragment.

mean, is greater. A t-test indicates the difference between the mean values is significant at the .05 level ($t=4$; $df=130$; $p=<0.001$). This supports the hypothesis that there is a difference between the two sets of thickness measures and that they could represent different wares with regard to this one attribute. It does not follow, however, that the two wares reflect different archaeological cultures. The addition of crushed mussel shell pieces, which tend to parallel vessel walls, also facilitates production of thinner pots. Thus, the contrast in thickness values may only reflect the type of temper added to the paste. As sherd A7039-0296 indicates, Steed-Kisker ceramists also made use of sand temper.

Table 8.1. Body Thickness Statistics of DB Site Pottery (Phase IV).

Temper	Number	Range(mm)	Mean	S.D.	Std. Error
Shell	103	3.4-11.5	6.2	1.57	.155
Stone	29	4.9-12.7	7.7	2.04	.38

Two other attributes of Platte Valley ware, handles and incised shoulder decoration, occur with contrasting frequencies. The number of handles (n=10) in the assemblage is relatively large, given that the total mass of the recovered ceramic assemblage is less than that of a single large jar of Steed-Kisker pottery. Two handle fragments cross-mend, which leaves a total of nine. If we assume that paired handles of a vessel were symmetrical (or nearly so), then nine is also the minimum number of handled vessels represented, since they are diverse with respect to form and measure (loop handles have a width/thickness ratio less than 2.0, straps have a higher ratio; width and thickness was taken, when possible, at the middle of the handle arch). All handles are shell tempered and undecorated. Those with bases intact indicate they were riveted to the vessel wall and molded to the upper rim/lip. The relative delicacy and robustness of handles may be indicative of the size of the vessel to which they were attached. In this regard, a reconstructed vessel of Platte Valley ware in the KUMA Archaeological Collection (from 23PL60; R.B. Aker Collection) that has an estimated capacity of 7.5lt (2gls) and mouth diameter of 19cm, has paired handles (which are rather assymetrical) with widths and thicknesses at the low range of those in the DB assemblage. This suggests that nearly all of the handles could have belonged to similar sized vessels. On the other hand, sherd A7041-0296, which preserves only the base of a small handle, must have been part of a small vessel. The few Late Prehistoric rims that provided mouth diameter measures (n=6) reflect a wide range of sizes that include small pots (8, 11, and 12cm) and medium to large jars (18, 20, and 28cm).

In contrast to the number of handles is the low frequency of incised or trailed body sherds. Only eight sherds have traces of such decorative treatment (e.g., Fig. 8.1e); six are shell tempered and the balance tempered with sand (one of the latter was described above; Fig. 8.1a). On three sherds the lines form a chevron (nested, inverted V's), a Steed-Kisker Incised motif. Close inspection of one rim (Fig. 8.2a), found <u>in situ</u> during mechanical stripping of the site, reveals two parallel, curvilinear lines. Unfortunately, the motif of these poorly preserved elements cannot be determined. If several of the nine handled vessels represented above (as well as others that may have lacked such appendages) had decorated shoulders, then we would expect a higher occurrence of incised sherds. That they were not suggests Platte Valley Plain vessels were more numerous than Steed-Kisker Incised. It is worth noting that the nearby Zacharias site yielded a comparable low frequency of incised sherds (e.g., 2 of 47 rims; data on file, OAR, KUMA). The relative frequencies of plain and incised wares may yield insight to questions about site function or chronological seriation (see following section).

Only one fragment in the assemblage is complete enough to infer overall vessel shape, size and possible function. This specimen (A3156-0296; Fig. 8.2b), from unit 149N/59E level 1, is composed of six piece plotted sherds and two body sherds that were recovered from waterscreened fill. Several body sherds from this unit/level that do not cross-mend are probably part of the same vessel. The fragment was two meters south of the larger daub concentration and correlates with an area of charcoal and burned bone that is inferred to have been a hearth (see chapter 12). The parent vessel was a small, globular jar. Though most of the pot below the shoulder is missing, enough remains to indicate its capacity was about 2.5lt. The everted rim is relatively low (RH=19.9) and 8.8mm thick. The lip is rounded and a strap handle 22.7mm wide and 7.7mm thick is molded to it. The mouth is twisted from a perfect plane when viewed in profile. Neither is it perfectly circular when viewed from above, forming a torqued ellipse ca. 12mm along the major axis and 10.5mm along the minor axis. The vessel thins from 6.6mm at its undecorated shoulder to 4.4mm at the upper body. Overall, the fragment is characteristic of Platte Valley Plain (Chapman 1985:292). That it may have been used as a cooking vessel is suggested by the presence of charred organic residue on both surfaces of the fragment and its proximity to a hearth.

Interpretations

Cultural Affiliation: As the above discussion indicates, the assignment of the Late Prehistoric component at DB to the Steed-Kisker phase is supported by the dominance of Platte Valley ware. The presence of a Woodland period occupation is based on a smaller number of sherds. While the assemblage includes plain sherds with stone temper, attributes of Middle Woodland (Kansas City Hopewell) pottery, their low frequency and the presence of at least one rim sherd of Steed-Kisker Incised with sand temper suggests these sherds might also reflect variability in Platte Valley ware. If these ceramics are evidence of Edwardsville phase activity, the interpretation favored here, then we can be confident that it was quite brief and probably did not result in the deposition of much other cultural material. Indeed, the scarcity of Hopewell ware at DB is peculiar when compared to the abundance of pottery at Quarry Creek or, for that matter, to any other excavated Kansas City Hopewell site (see chapter 15 for further discussion of the Woodland component problem). The Late Prehistoric assemblage provides a firmer base for addressing site function, chronology and regional interaction, topics that are discussed below.

Site Function: Again, the small mass of sherds from DB, given the area investigated and when compared to assemblages from other nearby excavated sites, suggests a brief Late Prehistoric occupation. The low number of vessels represented (n=9, based on handles) supports this inference. The presence of one or two lodges, however, suggests it was not an "over-nighter". No more than a single-season stay by one or two nuclear or extended families is indicated, probably one timed for late summer-autumn harvest of woodland plant resources. The relative brevity of the occupation might have precluded the use of ceramic vessels as long-term storage containers, an inference compatible with the absence of the cache pits generally associated with Steed-Kisker sites. The relatively high number of handled pots, which could have been suspended over a fire, suggests they were used for cooking. This inference is supported by seven sherds from at least three vessels (based on temper and decorative treatment) that exhibit encrusted organic residue. Analysis of this residue may reveal what foods were prepared in them. Most piece-plotted sherds from the block (excepting those restored as fragment A3156-0296) were near the daub concentrations, which suggests the pots from which they derived were part of house-related activities, presumably including food preparation.

Seriation: Some aspects of the DB ceramics may be useful for chronological and/or geographical seriation, though we sorely need more assemblages from Steed-Kisker sites in Kansas. The low frequency of incised sherds, even given the small sample available, is remarkable when compared to assemblages from Steed-Kisker sites east of the Missouri River trench. Those in Platte, Clay and Buchanan Counties, Missouri yield higher frequencies of Steed-Kisker Incised pottery. For example, 15.2% of the total ceramic assemblage (n=2,325) from the Steed-Kisker type site was incised (Wedel 1943:75). When only rims are considered, the frequency is significantly higher (48.6%; n=278). O'Brien (1993:65) noted that 61% of shouldered jars from the Young site (23PL4) are incised, while 39% are plain; 67% of those from the Coons site (23PL16) were plain, while 28% were incised and 5% were cordroughened. It would be interesting to see if variation in the frequencies of incised and plain wares is indicative of differences through space and/or time. With regard to geographical variation, it is interesting that Zacharias, the only other excavated Steed-Kisker habitation site in northeastern Kansas, also yielded few incised sherds. Could the low frequency of incised pottery west of the Missouri River reflect differences in the geographical distribution of Steed-Kisker groups or in the nature of activities conducted there? This question can be addressed following the accumulation of more ceramic assemblages from other sites in Kansas.

Could the contrast in the relative frequency of incised and plain pottery reflect change through time? Just as the acquisition of more data from Kansas sites might make it possible to test the geographical question, seriation of frequencies for several sites with temporal control of radiocarbon dates might answer this question. The tighter dates provided by AMS dating of annual plant remains, such as maize, could prove valuable in this regard. At present, limited data from Zacharias and DB do not support such a hypothesis. Averaged and calibrated dates on wood charcoal from the former are ca. A.D. 1050-1200; those on maize from the latter are ca. A.D. 1300-1400 (rounded from one sigma ranges; see chapter 7). Since the DB dates are later that those from Zacharias, they suggest the low frequency of incised pottery may have more to do with space (location west of the Missouri River) than time.

Regional Interaction: The single sherd of Beckman Pinched Rim pottery may indicate interaction between groups of the Steed-Kisker and Nebraska phases, archaeological taxa that could reflect at least two contemporary populations of the Lower Missouri Valley. Such evidence is not unusual. Indeed, Cloverdale, the only other excavated upland Steed-Kisker component, is associated with a lowland settlement that has yielded extensive ceramic assemblages of both cultures, with Nebraska wares predominant (Shippee 1972:14-15; Feagins 1988; Linda Greatorex, personal communication). Logan (1981b, 1985, 1988a) has documented the association of Steed-Kisker and Nebraska ceramics at several sites in northeastern Kansas. Billeck (1993) describes comparable mixtures of wares at sites in the Glenwood locality of western Iowa. The DB sherd was found near the larger daub concentration (100-200gm contour, see Chapter 12) at a depth of 43cm. Thus, it might have been associated with the lodge (and its depth in the lower, "Archaic", levels attributed to bioturbation). However, this context is not sufficient to determine how any Nebraska vessel came to DB. That is, we cannot know if it reflects the trade of a vessel or the post-marital residence of a Nebraska ceramist with a Steed-Kisker family. Indeed, the assumption that the different wares reflect different populations may be wrong. Greatorex (1998) has reviewed the Cloverdale assemblage and shown how it might reflect a dual ceramic tradition among one group.

Nebraska ware was not found at Zacharias, where Platte Valley ware is associated with pottery of the Pomona variant and Grasshopper Falls phase. No comparable association is evident at DB. This contrast, together with the difference in radiocarbon dates, suggests that the Steed-Kisker occupants of the DB ridge were not those who lived at Zacharias nor, apparently, were they contemporaries. The contrast in ceramic associations at the sites may point to changing patterns of regional interaction with respect to the Salt Creek area. It is difficult to attribute this to Pomona abandonment of northeastern Kansas by the late 14th-early 15th centuries. A date of ca. A.D. 1430-1460 from the Pomona occupation at the Shadow Glen site (14JO21), about 50km south, attests their presence in the Kansas City locality (Logan and Hedden 1993). While the small ceramic assemblage from Shadow Glen contained no Platte Valley ware, this absence of evidence does not mean Pomona and Steed-Kisker groups in the region did not interact. Indeed, the 14th century date of the DB component now requires revision of the interpretation that Shadow Glen was occupied "more than 100 years after the end of the Steed-Kisker phase and at least half that number of years following the Central Plains tradition in the lower Kansas and Missouri rivers" (Logan and Hedden 1993:27). While the dates from Shadow Glen are still more recent than those from DB, the disparity in ages between Pomona and Steed-Kisker is not as great as it previously appeared, and contact throughout the 14th century may have been maintained.

The different ceramic associations of DB and Zacharias may point to a pattern of cultural interaction that involved several Late Prehistoric populations for three to four centuries. It may be additional evidence that northeastern Kansas was a shared frontier of Pomona, CPt and Steed-Kisker populations (Logan 1988a, 1990a). Contextual evidence is needed not only to delineate the nature of any such relations, but to determine whether or not this ceramic variability is attributable to more than one population (cf. Logan and Ritterbush 1994).

Chapter 9

Chipped Stone Tools

Virginia Hatfield

Introduction

The lithic assemblage from the DB site includes 384 chipped stone tools. These have been classified into bifaces, flaketools, and modified cores. A biface is an artifact with flaking modification on both sides, a flaketool is an artifact that retains a recognizable platform and/or bulb of percussion on one side, and a modified core is the remaining portion of the chipped stone material from which flakes are removed (by use or retouch) on one or more edges. Stemmed bifaces and stemmed flaketools are recognized within these morphological divisions. Functional categories of drills, scrapers, projectile points/knives, performs/knives, gravers, modified flakes, and early stage bifaces are also identified. Artifacts with more than one function are classified as composite tools and those with unknown functions are classified as indeterminate. The category of projectile points/knives is recognized so as to not inaccurately label these artifacts as functioning exclusively as projectile points or knives. The early stage bifaces have been divided into thick and thin bifaces. Unstemmed thin bifaces that show evidence of use or retouch are classified as knives. The flaketools were sorted into formal and informal tools. The formal tools are flakes that exhibit modification towards an intended design such as a scraper or graver. The informal flaketools are flakes that exhibit usewear, but no formal modification. In this discussion of the chipped stone tool assemblage, I am using the functional classification of the artifacts. The breakdown of tool morphology and tool function by percentage is shown in Tables 9.1 and 9.2. McLean (chapter 10) discusses the material for all the chipped stone tools and Hill (chapter 14) discusses the spatial distribution of the tools.

Chipped Stone Tools

Table 9.1 Tool Morphology	N	%
Bifaces (B)	199	51.8
Stemmed Bifaces (SB)	135	35.2
FlakeTools (FT)	44	11.5
Stemmed FlakeTools (SFT)	2	0.5
Cores (CO)	4	1.0
Total	384	

Table 9.2 Tool Function	N	%
Composite Tools (C)	17	4.4
Choppers (CH)	2	0.5
Drills (D)	17	5.5
Gravers , Mod flakes(GR, MF)	6	1.6
Indeterminate (Ind)	12	3.1
Knives (K)	26	6.8
Projectile Point/ Knives (ppk)	232	60.4
Scrapers (SCR)	26	6.8
Early Stage Bifaces (ESB)	42	10.9
TOTAL	384	

Appendix 1 shows all the metric and nonmetric attributes taken for all chipped stone tools. The vertical provenience of artifacts from the block excavation given in the appendix refers to their depth below the graded surface (bg). In the discussion here, their depth is given in cm below the original surface of the site (bs; see chapter 6 for definition of bs and bg). "Below surface" context is preferred here because it is more realistic than "below grade" provenience.

Projectile Points\Knives

There are 232 projectile points/knives, 60% of all chipped stone tools, made on both bifaces and flaketools. Of these, 135 are recognizably stemmed tools, 98 of which are sorted into morphological varieties based principally on stem attributes. The remaining are untypable fragments. The stemmed and unstemmed untypable portions were sorted into distal, medial, or proximal portions. Of the 232 projectile points/knives, 41 (18%) are complete, 43 (19%) are distal, 77 (33%) are medial, and 71 (31%) are proximal. Of the 41 complete stemmed bifaces, 88% exhibit reworking, 31% of these to the point of exhaustion. Given the percentage of proximal fragments and reworked complete points, tool refitting and discard activity is evident, which supports camp site interpretations (Hofman 1992a). Figure 9.1 shows the distribution by level of the projectile points/knives that are classified into varieties. This graph shows the typed points from known elevations, which includes 55 of the 98 so identified. The distribution of the typed points indicates that there has been some mixing. This is more true of Archaic and Archaic/Woodland points, the more numerous types. The fact that the majority of the Late Prehistoric points is found in the upper levels and the Paleoindian in the lower suggests that overall, this mixing was minimal.

In the classification of projectile points/knives, the stemmed forms were sorted into 11 varieties. Phase IIIa points are included as part of the DB assemblage as they are relevant to a discussion of the site's assemblage. Figure 9.2 illustrates attributes of stemmed bifaces and where measurements were taken. Appendix 1 presents metric and nonmetric information taken for the projectile points/knives, as well as some definitions and descriptions of attributes measured.

VARIETY I: Lanceolate Paleoindian (Fig. 9.3, a-e): The points in this variety are lanceolate and have been basally thinned or fluted. While these are primarily Paleoindian, they include one that is more likely a preform/knife of indeterminate temporal affiliation.

I a A6691-0296 is a partial base of a Folsom point (Hofman 1997, personal communication). One side exhibits a flute, the other does not, and the base edges are not ground. It has a snap fracture at its distal end. This fragment was found in the block excavation at a depth of 50-60cm. The material is probably Mississippian chert.

I b A3095-0296 is another partial base of a Folsom point. This fragment is severely fire fractured with one lateral edge and partial base edge remaining. Base and stem edges are heavily ground and a flute is evident on one side. The other side has been removed by heat spalling. The flute scar on the one visible surface indicates preparation for similar

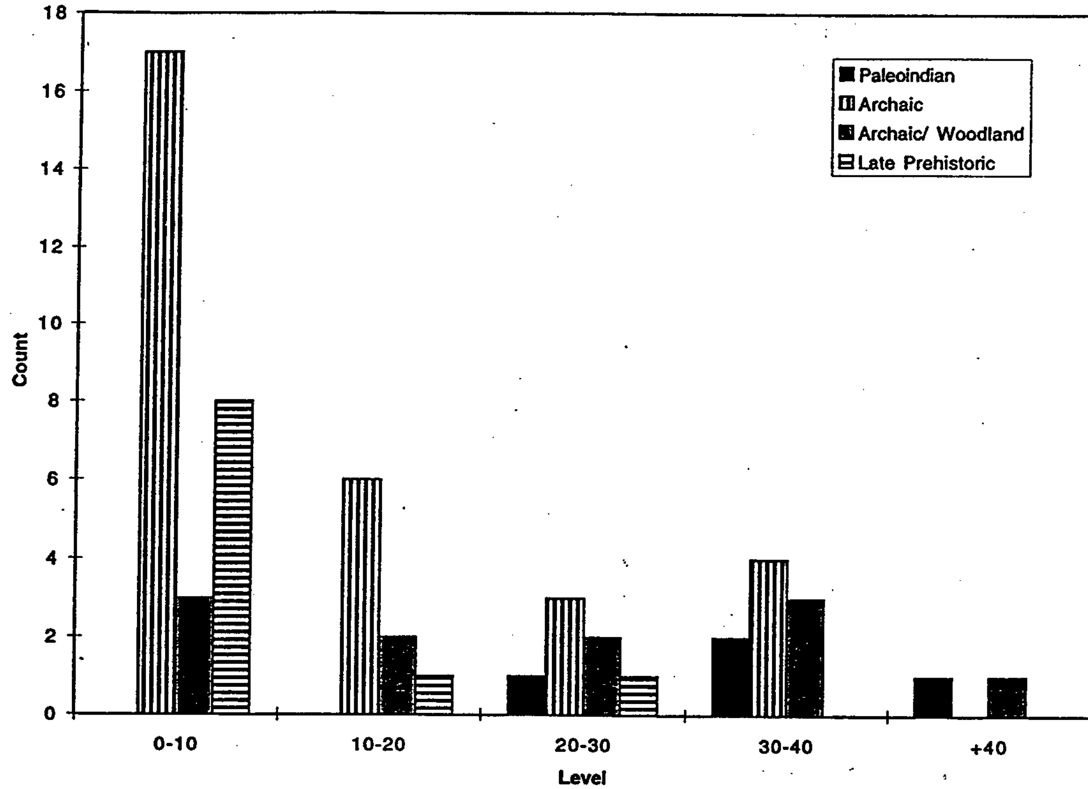


Figure 9.1. Distribution of points by level (below graded surface).

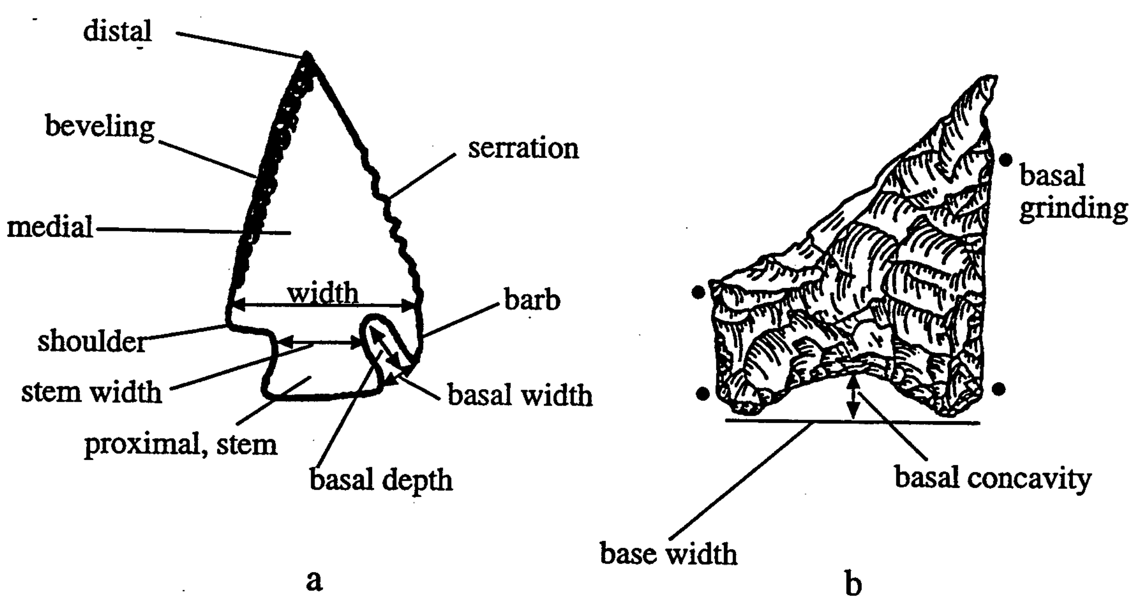


Figure 9.2. Definition of attributes of stemmed bifaces (9.2a from Turner and Hester 1992).

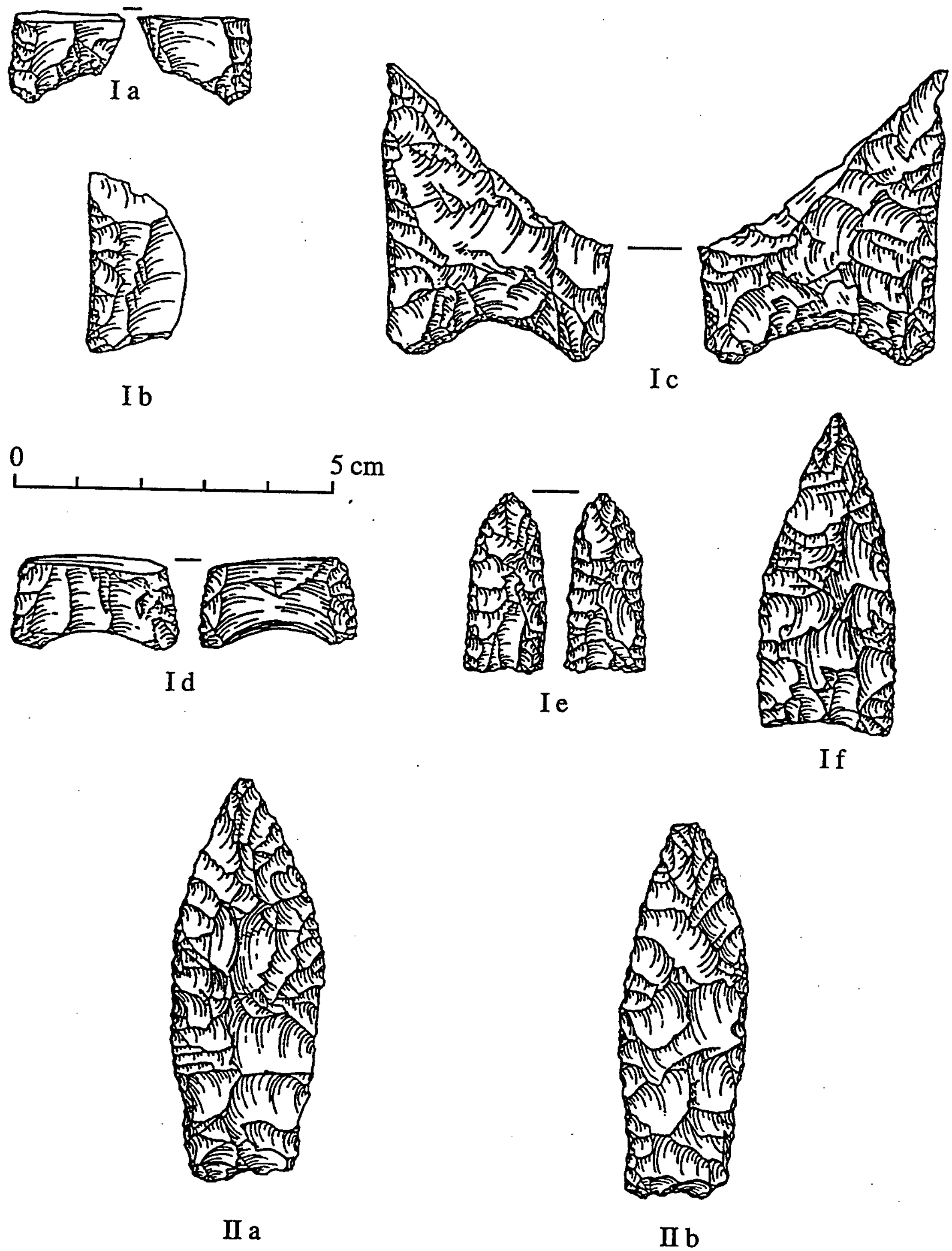


Figure 9.3: Variety I: I a, I b, Folsom; Ic, Id, Dalton; I e misc. Paleoindian, If Plainview
Variety II: II a and II b, Nebo Hill

treatment of the other face, suggesting it had been fluted before spalling occurred (Hofman 1997, personal communication). This point was also found in the block excavation at a depth of 50-60cm bs. It is made from Wreford chert.

I c A7427-0296 is the broad base of a Dalton point (Hofman 1997, personal communication). It is ground on both the base and stem edges and is basally thinned. The small remaining portion of the blade edge tapers. This specimen is made from Plattsmouth chert and was found during grading of the site at an estimated depth of 60-70cm bs.

I d A5744-0296-2 is also the base of a Dalton point (Hofman 1997, personal communication). It has been thinned on both sides. It is not ground on the stem or base edges. The distal end of the fragment tapers symmetrically, supporting its identification as a Dalton point. It is made from Permian chert and was found in the block excavation, 40-50cm bs.

I e A1176-0495 was found during the Phase IIIa excavation in unit 161N/73E at a depth of 59-60cm (Logan 1996a). This complete lanceolate point is basally thinned and ground on stem edges. It is very small, but probably Paleoindian (Hofman 1997, personal communication). It is made from an unidentified chert.

I f A7199-0296 is a complete, lanceolate point, nicely thinned basally. Though the base appears finished, the blade edges appear unfinished. With respect to its general morphology, basal concavity and basal thinning, it it similar to a Plainview point (Hofman 1997, personal communication). Slight beveling to the edge and hinge fractures on the blade suggest it had been used and resharpened while hafted. It is made from Plattsmouth chert and was found during grading activity.

I g A7231-0296 is a complete lanceolate biface of the same material and treated to the same heat treatment as If. However, it has none of the characteristics of a Paleoindian point. It has some use wear and retouch suggesting it was used, probably unhafted, as a knife. It is included here because of its resemblance to If in material type and heat treatment. It is made from Plattsmouth Chert and was found during grading.

VARIETY II: Lanceolate Archaic (Fig. 9.3; IIa, IIb): Two Late Archaic lanceolate style points were recovered from the graded area. These conform to the Nebo Hill point, which Reid (1984a) describes as lanceolate. The base varies from concave to convex. Reid (1984a:17) notes that the lateral edges of Nebo Hill points are frequently resharpened by beveling "indicating that they functioned as cutting and scraping rather than penetrating tools prior to final discard or loss". Both specimens exhibit extensive resharpening.

II a A7180-0296 is a complete lanceolate point. The basal edges are not ground, the blade is beveled from reworking, and one edge shows multiple hinge fractures. This latter attribute may be due to the difficulty of knapping Winterset chert because of its calcite veins (Logan 1997, personal communication). The point appears to have been resharpened extensively, to the point of exhaustion.

II b A7163-0296 is also a complete lanceolate point. The stem edges are not ground, it is fairly thick, and was made from Plattsmouth A chert. Similar to IIa, it is extensively reworked.

VARIETY III: Expanding stem, long barbs (Fig. 9.4, IIIa, IIId): These stemmed bifaces are basally notched and have expanding stems and long barbs. Three specimens resemble the Calf Creek point, which has a deep narrow basal notch and barbs that extend the length of the stem. The base is straight, usually basally thinned. The barbs are frequently broken from these points and the base edges are usually ground (Perino 1968). Perino (1968) estimates the age of this style as ca. 5000-3000 BC. Justice (1987) estimates the age somewhat earlier, ca. 8000-6000 BC. These points are found in Oklahoma, Arkansas, Kansas, Missouri, and Texas. The fourth specimen of this variety (A5719-0296) is less certainly a Calf Creek. It also resembles Cook's (1976) Helton points. The barbs on this fourth specimen are shorter than those on the Calf Creek type.

III a A0193-0495 was recovered during Phase IIIa excavations in 161N/73E at a depth of 42cm bs (Logan 1996a). It is a basally notched, expanding stemmed, barbed point. The base edge is ground and it is basally thinned. The one remaining barb extends the length of the stem. The blade has been reworked extensively- to the point of exhaustion. It is made from Winterset chert.

III b A7195-0296 is the barb portion of a stemmed biface. The length of the barb suggests it came from a Calf Creek point. It is a very long barb with a very small portion of the blade remaining. It is made from Mississippian chert and was found during the surface grid-collection in that portion of the site from which the plowzone had been stripped (e.g., ca. 20cm bs).

III c A7248-0296 is another medial barb fragment, reminiscent of Calf Creek points. It is made from Mississippian chert and found during final grading operations.

III d A5719-0296 is a basally notched dart point with long barbs and an expanding stem. It resembles a Calf Creek point with a narrower base and shorter barbs. It is also similar to Cook's (1976) Helton point. This specimen has been extensively reworked into a hafted scraper. The specimen is made from Winterset chert and it was found at a depth of 20-30cm bs in the excavation block.

VARIETY IV: Straight stemmed (Fig. 9.4, IVa): There are two points in this variety. One is a complete, nicely worked, Late Archaic-Early Woodland style point. The other is a fragment that resembles the base on the complete point. The complete point resembles Dickson cluster style points (Justice 1987). These are long slender points with straight to convex lateral edges, square shoulders and a rectangular stem and dates to the Late Archaic and Early Woodland periods, ca. 1500-500 BC (Justice 1987).

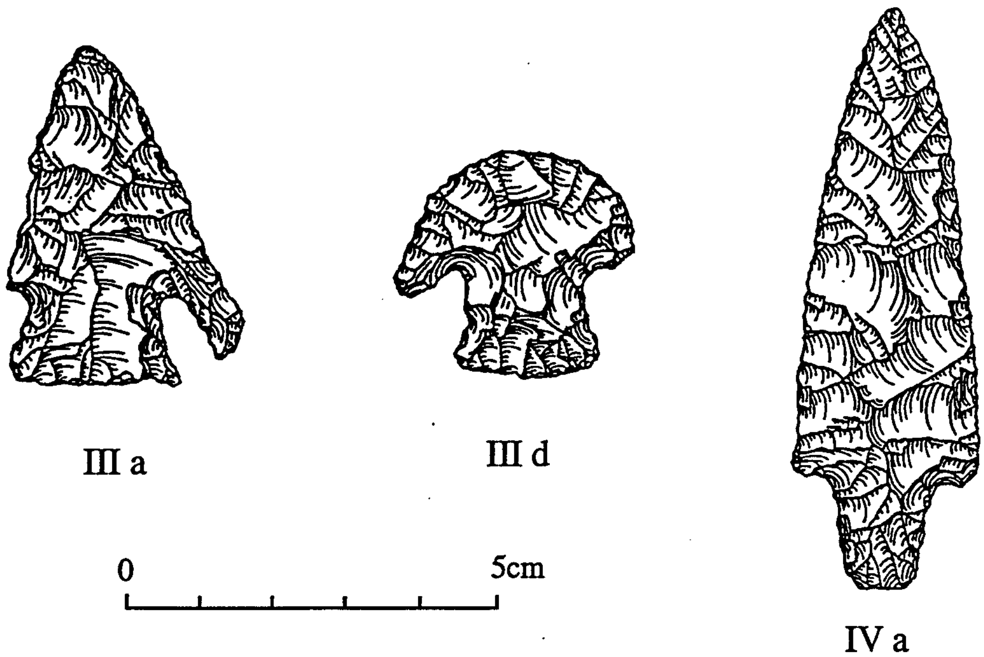


Figure 9.4. Variety IIIa, Calf Creek and IIId, Helton Hafted Scraper; Variety IVa, Early Woodland.

IV a A7188-0296 is a long, complete, straight-stemmed point that may date to the Early Woodland period (A.E. Johnson 1997, personal communication). It has square shoulders, a straight to contracting stem, and a slightly convex to straight base. Its edges are slightly retouched. It is made of Toronto chert and was found in the excavation block, 30-40cm bs.

IV b 7177-0296 is a base fragment from a straight-stemmed point, probably basally notched. It is difficult to identify, given its fragmentary nature. Made from Florence chert, this specimen was found during mechanical stripping of the site.

VARIETY V: Side-Notched (Fig. 9.5; Va, Vc, Vd, Vf, Vj, Vk, Vn, Vp Vq, Vr). This variety incorporates all side-notched points. Some of these resemble Godar and Logan Creek points. There are several other similar side-notched types, including Osceola, Hemphill, Graham Cave Notched, and Rice Lobed, that encompass a good deal of variability. Cook (1976) notes a high number of side-notched types that extend over a large territory and "an impossible time span of five millennia" (Cook 1976:87). Justice (1987) classifies side-notched points within the Large Side Notched Cluster which includes Godar. Several specimens from the DB site are small to medium points that are comparable to Godar and Logan Creek. The Logan Creek points, according to Theis and Witty (1992:145), are small to medium sized, triangular,

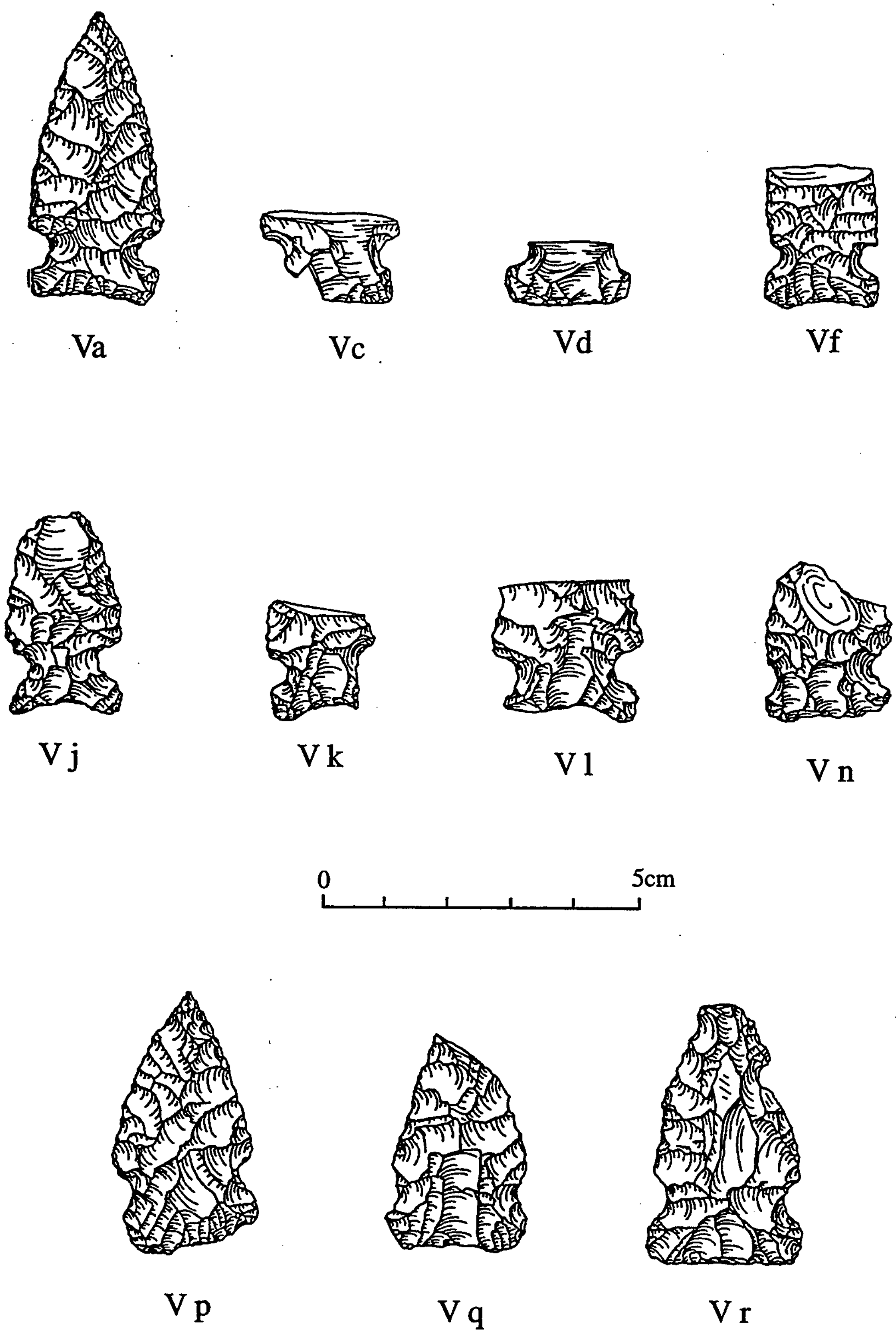


Figure 9.5; Variety V, side notched points.

side-notched points with concave bases that are usually ground. These points are found on the Central Plains. The Godar point, according to Perino (1971:38), is a medium side-notched point with straight to slightly convex base edges. They are basally thinned and base edges are ground or smoothed. Godar is subsumed under the Raddatz type, which is "diagnostic of the Middle Archaic period", from 6000-3000 BC, and found throughout the Midwest (Justice 1987:68). At the Koster site, side-notched points are associated with the Helton phase. Cook (1976:87) notes that these have been "chopped up into many local types". At the Pigeon Roost Creek site, O'Brien and Warren (1976) note similar side-notched points. The DB assemblage more closely resembles Godar or Logan Creek. The great similarity between these types makes it difficult to distinguish them. Several of the specimens in this variety have concave bases with ground edges.

V a (A4019-0296) This nicely worked point has a concave base and a rectangular stem. The stem and base edges are ground and the base is thinned. The blade has a slight alternate edge bevel from reworking and use. Shoulders are rounded to square. The material is unidentified. The point was found in the block excavation, 20-30cm bs.

V b A3803-0296 is a small portion of a base. The base and stem edges are not ground. It has a straight base and the stem is rectangular, similar to IIIa. It is made from Toronto chert and was found in the block excavation, 20-30cm bs.

V c A1882-0296 is a base fragment with a straight, ground base and a square stem. It has square shoulders. Whether the stem was ground is unknown as the edges have been broken. It is made of Toronto chert and was found in the block excavation, 20-30cm bs.

V d A2271-0296-3 is a base fragment with a straight base and square to round stem edges. Both stem and base edges are ground and the base is thinned. The material is Plattsmouth chert and the artifact was found at a depth of 20-30cm bs in the block excavation.

V e (A2828.5-0296) This partial base fragment has been burned and fire fractured. The edges are ground and it is basally thinned. The material is unidentifiable. This specimen was found in the block excavation, 50-60cm bs.

V f A2380-0296 is a base fragment with a concave base and expanding stem. It is basally thinned and ground. The stem of this point is more fishtail-like. It is made from Plattsmouth B chert and was found in the block excavation, 20-30cm bs.

V g A3617-0296-3 is a base fragment that also has a fishtail-like basal concavity. The base and stem edges are ground and it has been basally thinned. It is made from Plattsmouth chert and was found in the block excavation, 30-40cm bs.

V h A5076-0296-4 is a base fragment with a concave base and square stem tangs. Made from Plattsmouth C chert, it was found in the block, 50-60cm bs.

V i 6852-0296-2 is a base fragment with a concave, fishtail-like, base and expanding stem. The base and stem edges are ground. The material is Plattsmouth A chert and it was found in the block at a depth of 30-40cm bs.

V j A7229-0296 is mostly complete with impact damage on the distal end. It has a concave base. The stem tangs are not symmetrical, one is rounded and the other is more pointed. The shoulders are rounded. The stem and base edges are ground. It is made from Winterset chert and was found during site grading.

V k A4262-0296 is a base fragment that retains a small portion of the blade and is missing one tang of the stem. It has been basally thinned. The residual blade edges taper asymmetrically from resharpening and use, probably as a knife. The stem tang is square and the base is concave. It was found in the block excavation, 20-30cm bs, and is made from Toronto chert.

V l A7232-0296 is a concave base fragment with squared stem tangs, one of which is damaged. Its shoulders are rounded to squared. Blade edges taper due to reworking. It is basally thinned and ground. The material is Plattsmouth A chert and it was found during site grading.

V m A4892-0296 is a base fragment with a concave, fishtail base and ground stem edges. It is basally thinned. It was found during final grading and the material is Plattsmouth C chert.

V n A2163-0296-3 is a fire-fractured base fragment with a straight base and rounded shoulders. Neither stem nor base edges have been ground. The material is Wreford chert. It was found in the block excavation, 20-30cm bs.

V o A5076-0296 is a weakly side-notched, concave base fragment. The edges are not ground. The portion of blade remaining is alternately beveled. It is made from Toronto chert and was found in the block, 50-60cm bs.

V p A5295-0296 is a weakly side-notched point with rounded shoulders. The stem is asymmetrically reworked. The blade is bibeveled, favoring one side. It was probably used as a hafted knife. It is made from Mississippian chert and was found in the block at a depth of 30-40cm bs.

V q A7237-0296 is weakly side-notched, with a concave base. It is similar to Cook's (1976) Matanzas style point. The base tangs or ears are rounded, the blade is extensively, exhaustively, reworked, and the tip is broken. The point was found during site grading and is made from Plattsmouth C chert.

V r (A7165-0296) This weakly side-notched point has a straight base. The stem is more fan-like than Vg, but like that specimen, it has rounded base tangs. The thick blade end is hinge fractured. It is from the graded area and is made from Plattsmouth C chert.

VARIETY VI: Pronounced convex base, barbed shoulders (Fig. 9.6, VI a-c): These have strongly convex bases with long barbs. They resemble St. Charles Notched style, which Bell (1960) associates with the Late Archaic, Early Woodland, and Hopewellian periods. However, Justice (1987) dates St. Charles to the Early Archaic, 8000-6000 BC. These points are generally large, well worked, and characterized by an expanding stem made by corner notching (Bell 1960). Two hafted scrapers assigned to this variety were found in the upper level of the block (20-30cm bs). Similar styles are noted at the Koster site (Cook 1976) and the Coffey site (Schmits 1978), both of which contain late Middle Archaic components. In the American Bottom locality near St. Louis area, comparable forms have been found at the McLean site, which was assigned to the Late Archaic, Falling Springs phase (McElrath et al. 1984).

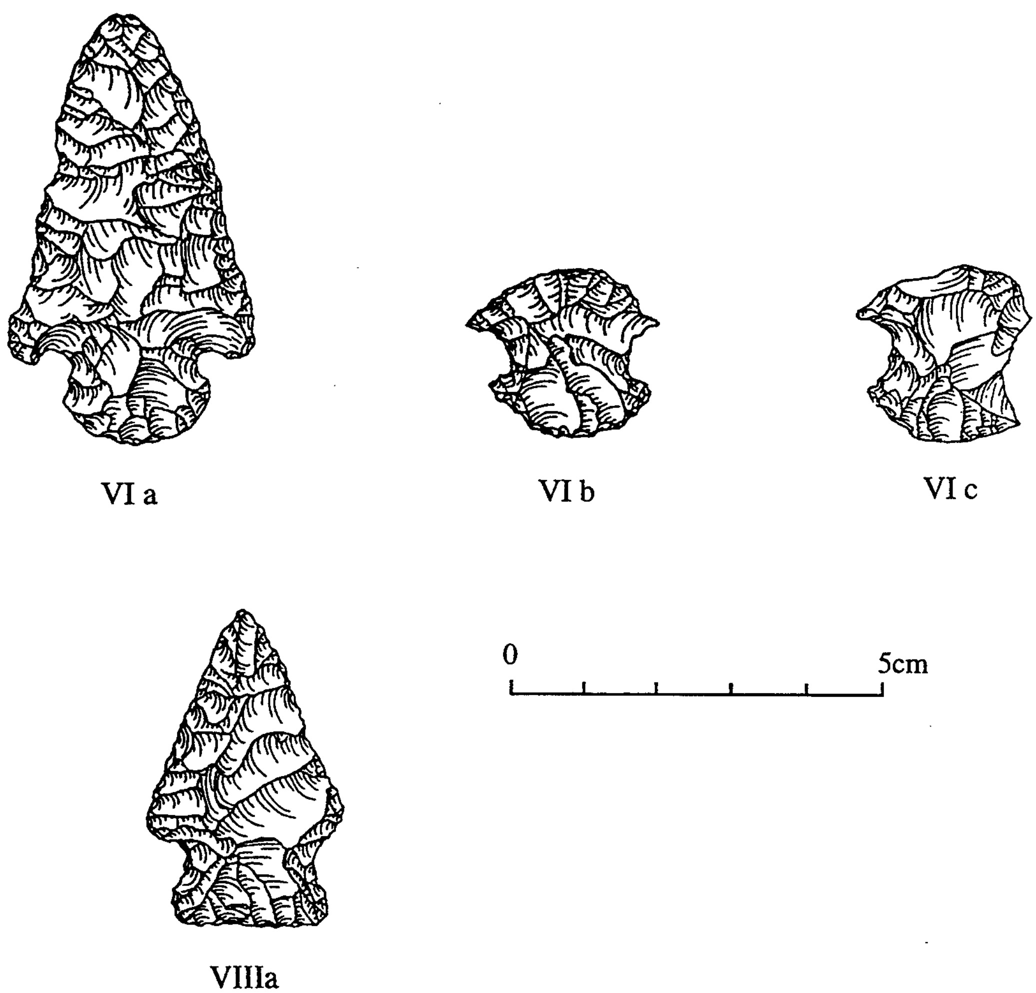


Figure 9.6. Variety VIa, b, and c: St. Charles points; and Variety VIIIa.

VI a (A5646-0296) This specimen has a pronounced convex base, is deeply notched and has long barbs. The blade has been retouched and used as a hafted knife. It is made of an unidentified chert and was recovered from the block, 30-40cm bs.

VI b (A1811-0296) This hafted scraper has a pronounced convex base, very similar to VIa. Its barbs are missing and the blade has been reworked extensively with only a small portion of the blade remaining. Based on the shape of the convex base, it strongly resembles a St. Charles Notched point. It was found in the block excavation, 20-30cm bs, and is made of Winterset chert.

VI c A5273-0296 is another hafted scraper with a convex base. It is complete, and similar to VIb with a similarly exhaustively reworked blade. This specimen was found in the block excavation, 20-30cm bs, and is made from Toronto chert.

VII: Convex base, expanding stem, unknown shoulders:

VII a A7221-0296 is a convex base fragment with an expanding stem and unknown shoulders. It is made of Toronto chert and was found during site grading.

VII b A7171-0296 is a convex base portion, has an expanding stem, and was found during site grading. It is made from Toronto chert.

VII c A2307-0296-2 is a base fragment with a straight to convex base and slightly expanding stem. This point was found in the block, 20-30cm bs. It is made from Toronto chert.

VARIETY VIII: Expanding stem, straight base (Fig. 9.6, VIII a):

VIII a A7190-0296 has a straight base, expanding stem, and rounded to square shoulders. The distal end is reworked to a taper and is very nicely worked. It was made from Mississippian chert and found in during mechanical stripping of the site.

VIII b (A1747-0495) This stemmed biface was recovered during the Phase IIIa excavations in 180N/42E at a depth of 23cm (Logan 1996a). It has a slightly expanding stem and a straight base. The shoulders are barbed and it has been extensively and symmetrically reworked. The barbs are missing. It is made from Mississippian chert.

VARIETY IX: Expanding stem, straight to slightly convex base (Fig. 9.7, a-i): Some of these strongly resemble the Steuben type, which appears throughout the Midwest from the Late Archaic to Late Woodland periods. The range of variation includes many expanding stem points, from convex to concave bases and from rounded shoulders to short barbed. Whether or not this variety actually represents a single population is not certain. Only a few of the DB points fit well within the Steuben type. Many of the other specimens in this variety are expanding-stemmed, weakly shouldered or shoulder unknown. The Steuben style point is "one

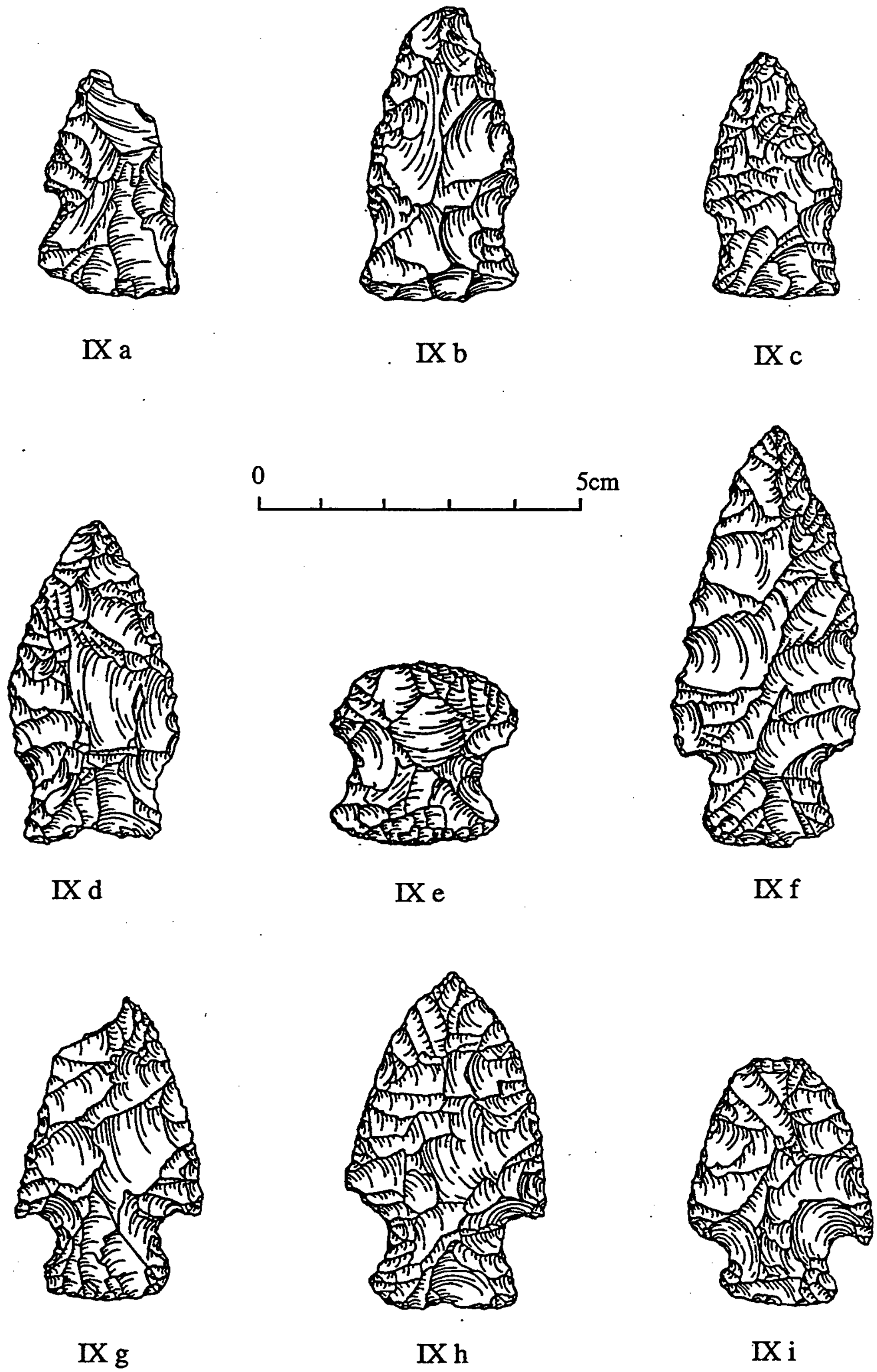


Figure 9.7. Variety IX, a-i.

of a family of expanding base point types representing the later Middle Woodland - early Late Woodland groups in the mid-eastern United States" (Perino 1968:94). Expanding stem points are common and Justice (1987) groups other similar styles within the Lowe Cluster, which subsumes the Steuben Expanding Stem with Bakers Creek and Lowe Flared Base. All three of these points within this cluster are associated with the Middle or Late Woodland periods. Schmits (1989a) recognizes Steuben within his Woods Chapel phase of the Late Woodland period. Other expanding stem points are recognized in the Late Archaic phases (Falling Springs, Labras Lake, Prairie Lake) of the American Bottom (McElrath et al. 1984), as well as at the Koster site (Cook 1976) and the Quarry Creek site (Logan 1993a).

IX a A7167-0296 is mostly complete, has an expanding stem, and heavy impact damage on the distal end, possibly burinated. It has a very thin, fan shaped base that is basally thinned. The one shoulder remaining is square to almost barbed. It is made from Westerville chert and was found in during site grading.

IX b A7196-0296 has rounded shoulders and a fan-shaped base. The blade is beveled with a portion of the tip missing. The point, of an unidentified chert, was found during mechanical stripping.

IX c A7191-0296 has rounded shoulders and a fan shaped base. The distal end is reworked extensively. The reworking has maintained the artifact's symmetry, indicating it was probably maintained and used as a projectile point. It is hinge fractured at the distal end. It has basal thinning with one hinge fracture at the base from thinning. This specimen was found in the block excavation, 50-60cm bs, and is made from Wreford chert.

IX d A2616-0296 is a very poorly worked stemmed biface with rounded shoulders and a slightly expanding stem. The blade edges are serrated. That it was reworked while hafted is indicated by a flake island (hinge fractures at the shoulder area in the middle of the point). It is also beveled from reworking, and the base is crudely thinned. Found at a depth of 20-30cm bs in the block excavation, it is made from Plattsmouth A chert.

IX e (A7183-0296) This hafted scraper has an expanding stem and a fan-shaped base. It is made from Westerville chert and was found in the block, 40-50cm bs.

IX f (A7206-0296) This specimen has short barbs and a slightly convex base. It is a complete point made from Florence chert and was found in the graded area.

IX g A7174-0296 is another complete stemmed biface with a slightly convex base and short barbs. The tip was previously broken and reworked into a diagonal, slightly curved, scraping edge with a very slight bevel. Other edges were also retouched. Made from Toronto chert, this specimen was found in the graded area.

IX h A7178-0296 is a complete point with a slightly concave base, expanding stem, and square shoulders. The blade is beveled from retouch and use and the base is thinned. There is no basal grinding. Made from Mississippian chert, it was found during site grading. This expanding stem biface has a slight concavity that appears to be unintentional. The blade is reworked and there is a hinge fracture on one side of the blade.

IX i (A2229-0296) This complete point has a slightly convex base and short barbs. This point has a transverse flake removed along the base edge. Similar in this respect to specimen X3a, the flake scar is possibly intentional. However, it may be due to a break and subsequent thinning. The tip is reworked and a barb is missing. It is made from Mississippian chert and was found in the block excavation, 40-50cm bs.

IX j A7193-0296 is a convex based, corner notched, barbed biface with distal impact damage. It is made from Mississippian chert and found on the surface of a block unit.

IX k A7219-0296 is a base fragment with a concave base which tapers at the notches. The blade is snapped off. It is made from Plattsmouth A chert and was found during site grading.

IX l A3944-0296 is a base fragment with a concave base. It is a very small fragment made from Plattsmouth C chert. It was found in the block at a depth of 40-50cm bs).

IX m A7173-0296 is a convex base fragment made from Plattsmouth C and was found in the graded area.

IX n (A7228-0296) The stem and basal edges on this base fragment are ground. It is better worked and thinned more than other fragments. It is made from Toronto chert and was found in the graded area.

IX o A4586-0296 is a base fragment with an expanding stem and straight base. It is basally thinned and made from Toronto chert. It was found in the block, 60-70cm bs.

IX p A7166-0296 is a base fragment with a convex base. From the portion present, the shoulders appear rounded. The base may be ground. It is made from Winterset chert and was found in the graded area.

IX q A7331-0296 is a base fragment with a straight base, is made from Florence chert, and was found during site grading.

IX r (A4698-0296) This base fragment is difficult to identify. Made from Florence chert, it was found in the block, 20-30cm bs.

IX s A4793-0296 is a base fragment with an expanding stem and is made from Toronto chert. It was found in the block at a depth of 50-60cm bs.

VARIETY X: Miscellaneous fragments, (Fig. 9.8, 1a- c, 1g-1j, 3a, 3c, 3d):

X 1: Miscellaneous expanding stem

X 1 a A2624-0296-1 is an expanding stem base fragment with a straight to convex base. Made from Plattsmouth C chert, it was found in the block, 30-40cm bs.

X 1 b A2615-0296 is an expanding stem base fragment with a straight base. Made from Plattsmouth C chert, this specimen was found in the block, 20-30cm bs.

X 1 c A7161-0296 is a fragment with an expanding stem and a straight to convex base. This point is made from Winterset chert, and was found during site grading.

X 1 d A7233-0296-2 is a base fragment with rounded base tangs and a "penny shaped" convex base. This specimen was found in the plowed area and the material is an unidentified chert.

X 1 e A6321-0296-3 is a base fragment with an expanding stem, a straight to concave base, and a long, beveled stem. The point fragment is made from Toronto chert and was found 20-30cm bs in the block.

X 1 f A6215-0296 is a base fragment with a convex base and a straight to slightly expanding stem. The small portion of shoulders remaining indicates this point was barbed. It is made from Westerville chert and found in the block at a depth of 20-30cm bs.

X 1 g A7181-0296 is a corner notched, expanding stem point with round shoulders. Some of the Logan Creek points illustrated by Theis and Witty (1992) are similar to this specimen. Another point type similar to it is Matanzas (Cook 1976), which occurs in Middle Archaic contexts at sites such as Koster. This specimen is made from Toronto chert and was found during site grading.

X 1 h A7164-0296 is an expanding stem point with a long straight stem that expands sharply at the base. The base is straight and the shoulders are barbed. It resembles Apple Blossom points, a Middle Archaic, Helton phase type (Cook 1976). It is made from Toronto chert and was found during the grading operation.

X 1 i A7197-0296 is a thin, corner-notched point with long barbs and a concave base. It is basally thinned and made from Florence chert. It was found during site grading.

X 1 j A4141-0296 is a corner notched point, has an expanding stem, and a convex base. The shoulders are barbed. It is made from Plattsmouth C chert and was found in the block, 20-30cm bs.

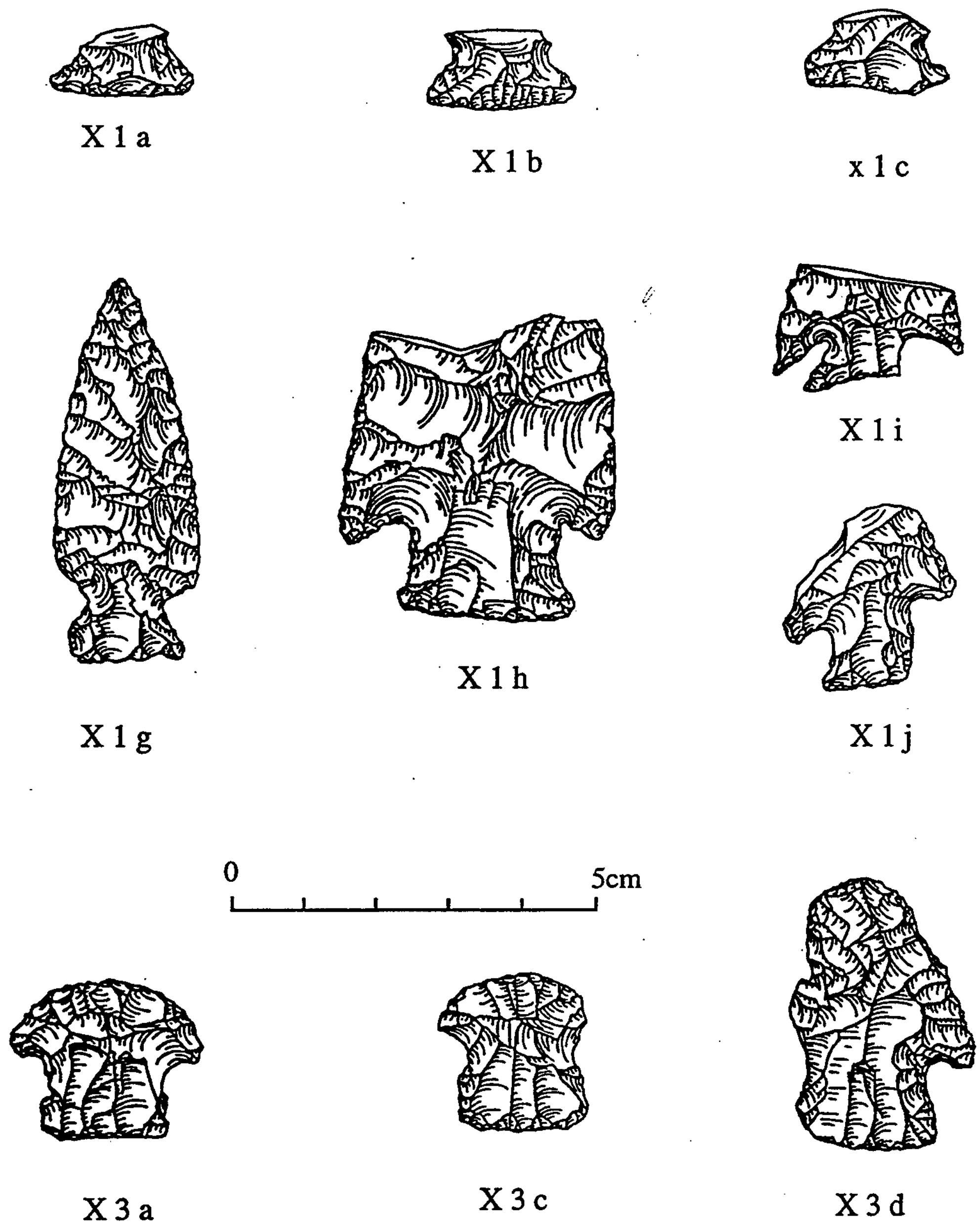


Figure 9.8. Variety X-miscellaneous points: 1a-c, 1g-j; and hafted scrapers: 3a, c-d.

X 1 k A7187-0296 has a pronounced convex base and is corner-notched. The blade is very large and the edges used. It is a thin, stemmed biface, possibly a preform or a hafted knife.

X 1 l A5550-0296 has a convex base and square shoulders. Made of Plattsmouth A chert, it may be a preform. The blade edges are retouched. The blade tapers on one side from reworking and use as a knife. It was found in the block, 50-60cm bs.

X 2: Miscellaneous, straight stemmed

X 2 a A7186-0296-2 has a square stem and square shoulders. One shoulder is missing and the distal end is snap fractured. It was possibly a preform. It has hinge fractures on the blade and used as a hafted knife. The material is Plattsmouth chert and it was found during site grading.

X 2 b A0599-0495 was found during Phase IIIa testing in unit 148N/56E, 20-30cm bs (Logan 1996a). It has a straight thin base and a straight stem and is made from Florence chert.

X 3: Miscellaneous stem, hafted scrapers

X 3 a A7218-0296 This hafted scraper was made from a flake with the platform at the base. The shoulders are barbed and the base is thinned. The blade has been extensively reworked. This specimen is made from Florence chert and was found during site grading.

X 3 b A7201-0296 is a medial portion of a hafted scraper with barbed shoulders. The base is indeterminable. It is made from Toronto chert and was found during site grading.

X 3 c A4263-0296 is a hafted scraper. On one side, a transverse flake extends across the edge of the base. This may be from a break, but it could be intentional. The stem is basally thinned and the shoulders are barbed. The material is unidentified chert. This specimen was found in the block, 20-30cm bs.

X 3 d A7234-0296, a nearly complete point, is missing part of one edge, including one barb. This point has a slightly expanding stem, straight to convex base, and barbed shoulders. It is very nicely, basally thinned and extensively reworked. The area around the top of the stem has multiple hinge fractures indicating this specimen was reworked and used as a hafted scraper and/or knife. This specimen was found in the block, 30-40cm bs, and is made of an unidentified chert.

X 4: Miscellaneous unknown stem, unidentified fragments

X 4 a (A1356-0495) This specimen was found during the Phase IIIa testing in unit 164N/57E, 38cm bs (Logan 1996a). A long stem fragment, too fragmentary for identification, it might be a Calf Creek base. It was made from Mississippian chert.

X 4 b A1864-0296-2 is a midsection fragment of a projectile point/knife and was extensively reworked. The base and tip are missing. The shoulders are barbed. It is made from Toronto chert and was found in the block, 50-60cm bs.

X 4 c (A4487-0296) This point is also missing its base. It has barbed shoulders and the tip is reworked. It is made from Toronto chert and was found in the block excavation.

X 4 d A7189-0296 is a fire fractured, medial fragment that retains a large, broad blade and a portion of the stem. It is corner-notched and has an expanding stem. It is made from Florence chert and was found during site grading.

X 4 e A7192-0296 is a medial fragment that lacks the base and tip. The shoulders are barbed and it is very thick. It was retouched and used. It is made from Winterset chert and was found during site grading.

VARIETY XI This variety consists of arrow points. These are smaller, stemmed and/or hafted bifaces. Most of these specimens were found just below the plowzone (20-30cm bs), reflecting good stratigraphic provenience for these Late Prehistoric artifacts (Fig. 9.9, 1a, 1c, 1d, 2b, 2e, 3a, 4a). There are four groups within this variety.

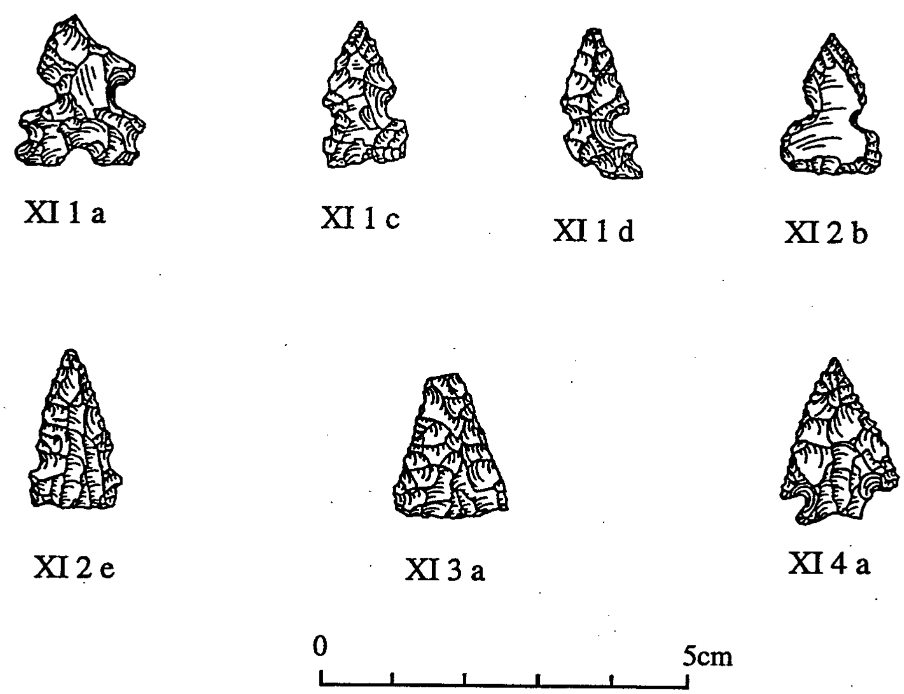


Figure 9.9. Variety XI, arrow points: 1a, c, d; 2b, e; 3a; and 4a.

XI 1: These are double side-notched and basally-notched arrow points.

XI 1 a A2590-0296 is a straight stem, concave base point with square shoulders. It is made on a flake and is double side-notched and basally-notched. The distal end has been broken and reworked into a scraping edge. This point was found in the block, 20-30cm bs and is made from Toronto chert.

XI 1 b A3584-0296-2 has a straight stem and concave base. The shoulders are square. It is bifacially worked and double side-notched. There are multiple hinge fractures at the top of the stem, a flakescar island, indicating reworking while the point was still in the haft. The base is concave and notched. The distal end is reworked. This Toronto chert specimen was found in the block, 20-30cm bs.

XI 1 c A7230-0296 is a side-notched arrow point with a straight stem, a concave to notched based, and square shoulders. The distal end is reworked. It is made from Winterset chert and was found during site grading.

XI 1 d A7217-0296 is a straight stem arrow point with a basal notch and square shoulders. It has a double side notch and the distal end is reworked. Found on the grading surface, this point is made from Toronto chert.

XI 2: This group is side-notched and has a straight base.

XI 2 a A7242-0296 is an arrow point with a straight stem and a straight base. The shoulders are rounded and it has a rectangular shaped base with straight stem edges that are side-notched. It is made from Toronto chert and was found in the block, 20-30cm bs.

XI 2 b A3130-0296-4 has a rectangular shaped base, straight to convex base edge and rounded stem edges. It is side-notched and the tip is heavily reworked. It is made from Mississippian chert and was found in block, 20-30cm bs.

XI 2 c A7227-0296 is an arrow point with a rectangular shaped base, a slightly concave base, and rounded stem shoulders. The distal end is extensively reworked. It is made from Mississippian chert and was found in the graded area.

XI 2 d (A3032-0296) This specimen has a convex base. The stem is fairly rectangular but the edges taper towards the side notches. The distal end is snap fractured. It is made from an unidentified chert and was found in the block, 30-40cm bs.

XI 2 e A4261-0296 is a convex to straight based arrow point which is weakly side notched. The distal tip is beveled from reworking and it is basally thinned. It is made from Toronto chert and was found in the block excavation, 20-30cm bs.

XI 3: Triangular arrow points

XI 3 a A7203-0296 is a triangular arrow point with a convex base and no stem. It was found in the block, 20-30cm bs, and is made from Toronto chert.

XI 3 b A7205-0296 is made from a flake. It has a serrated blade and a straight stem. It is essentially a retouched flake made out of Toronto chert. It was found on the surface of the graded area.

XI 3 c A7215-0296 is a base fragment of an arrow point with a straight to convex stem. It is made from Mississippian chert. It was found during site grading.

XI 4: Miscellaneous arrow points

XI 4 a A2614-0296 is a complete bifacial, Scallorn-like arrow point. It is corner-notched and has a concave base. The blade is serrated. It is made from Florence chert and was found in the block, 20-30cm bs.

XI 4 b (A2739-0296) This medial fragment of an arrow point in not identifiable. The material is an unidentified chert. It was found in block at a depth of 20-30cm bs.

XI 4 c A1723-0296-1 is the shoulder of an arrow point made from an unidentified chert. Its has the lowest provenience of any arrow point at DB, 40-50cm bs in the block excavation.

Bifaces

Early Reduction Stage and Knives: Of the 199 unstemmed bifaces, 42 are early reduction stage bifaces. These are divided into thick and thin bifaces based on an arbitrary thickness of 15mm. The majority are distal, proximal and medial fragments (Appendix 1). Of the 42 early stage bifaces, 33 are thin bifaces and eight are thick bifaces. Figure 9.10 is a scatter plot of width versus thickness of complete preforms and bifacial knives showing few very early reduction stage bifaces in comparison to later reduction stages, evidence that DB was a camp site. This comparison includes the thin bifaces that have been utilized or retouched. Early stage reduction of tools at the site is limited. The lack of early stage bifaces at the site indicates that these early reduction stages were occurring elsewhere. However, without further debitage analysis, biface reduction at DB is tentative.

Twenty-six knives, 7.6% of the chipped stone assemblage, are thin bifaces (Figs. 9.11-12). Several of these appear to be preforms that have been retouched. There are eight complete bifaces and nine distal, five medial, and six proximal fragments. The eight complete tools (Fig. 9.11a-e) show retouch and use (polish on some). One diagnostic biface (Fig. 9.11a) is identified as a Munkers Creek knife (A7223-0296). This specimen of Wreford chert was found in the graded area. It is similar to Witty's Type 1, Munkers Creek

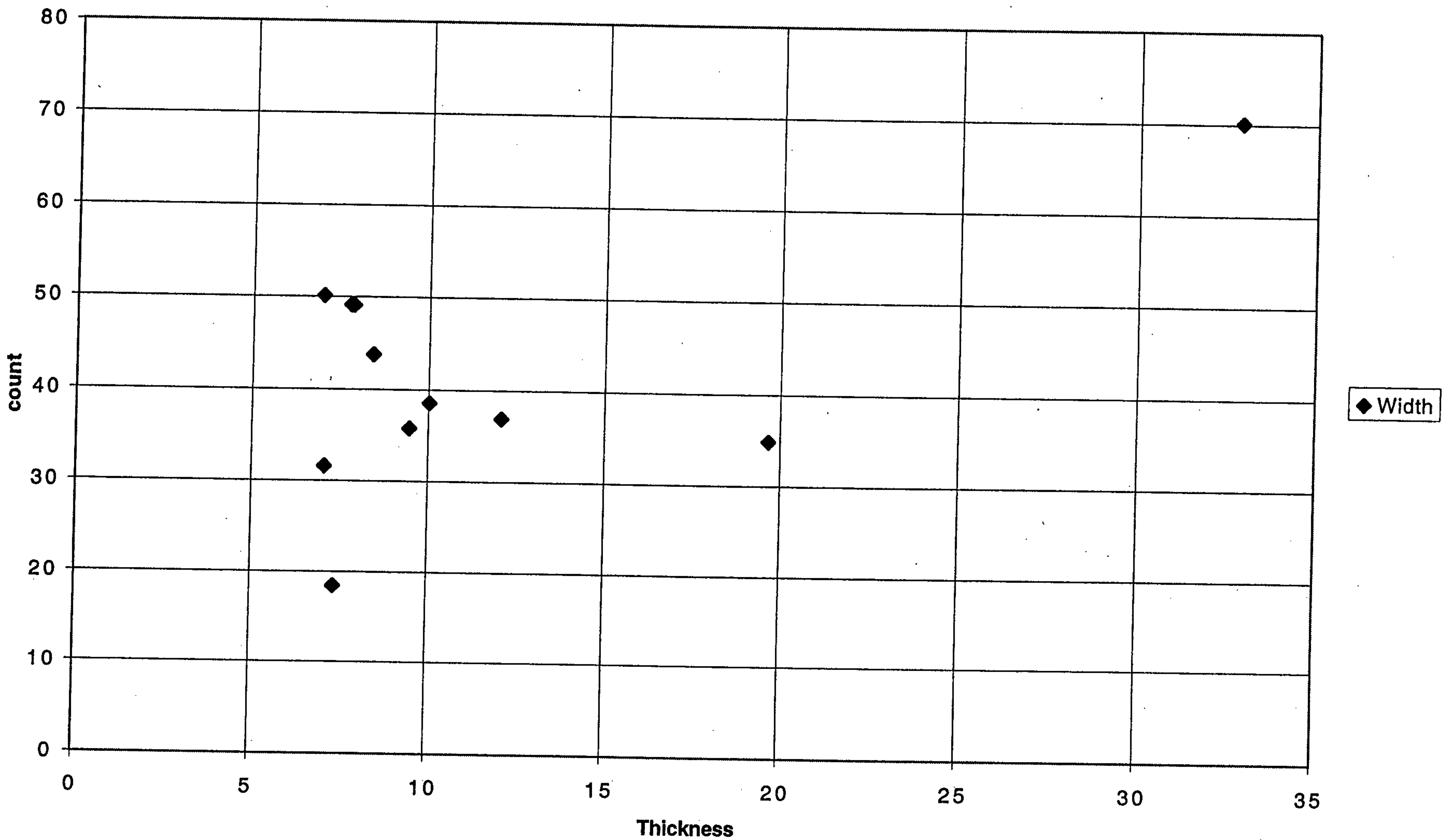


Figure 9.10. Width/Thickness ratios for complete bifaces.

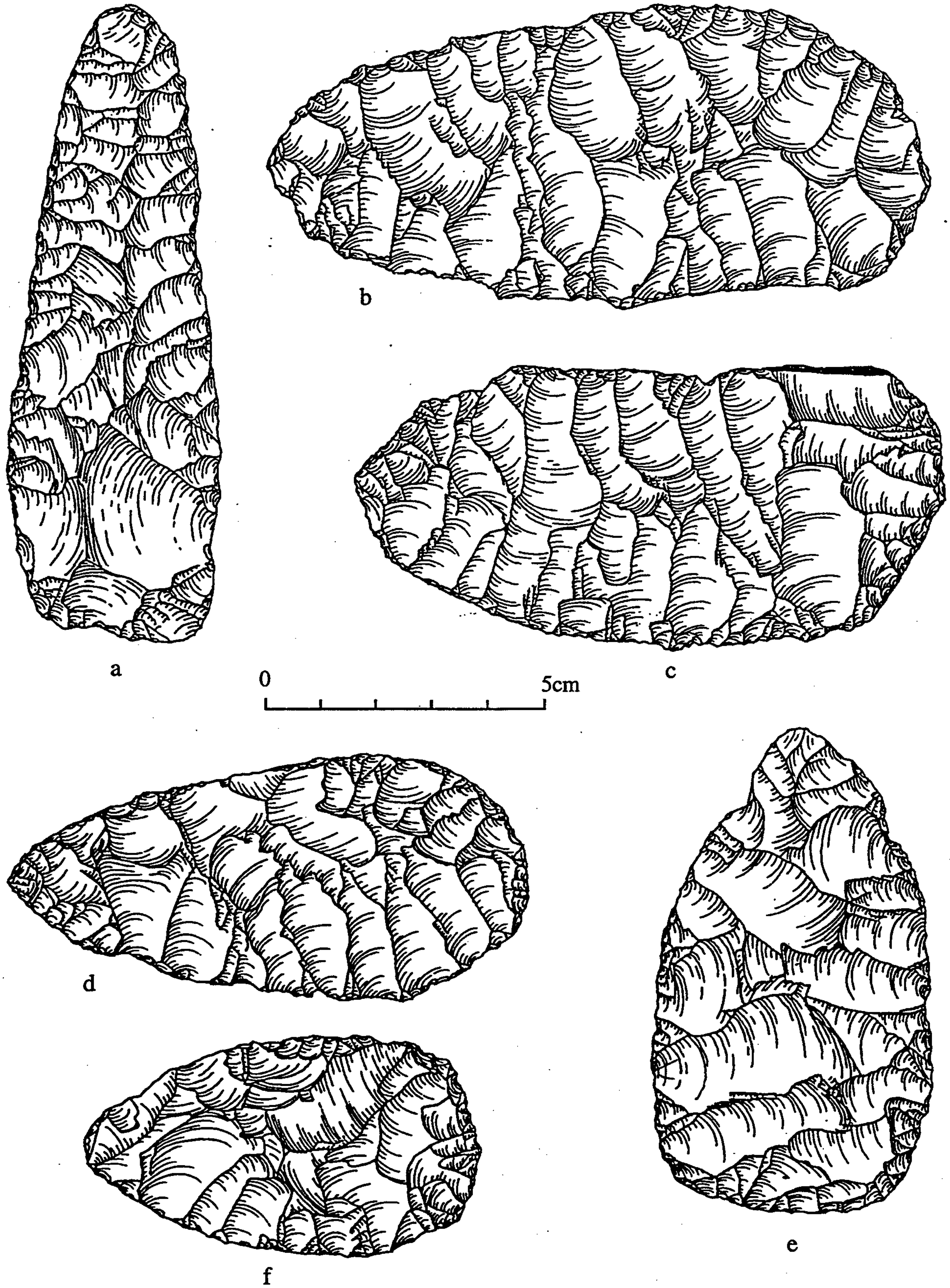


Figure 9.11. Bifacial knives; a-Munkers Creek knife.

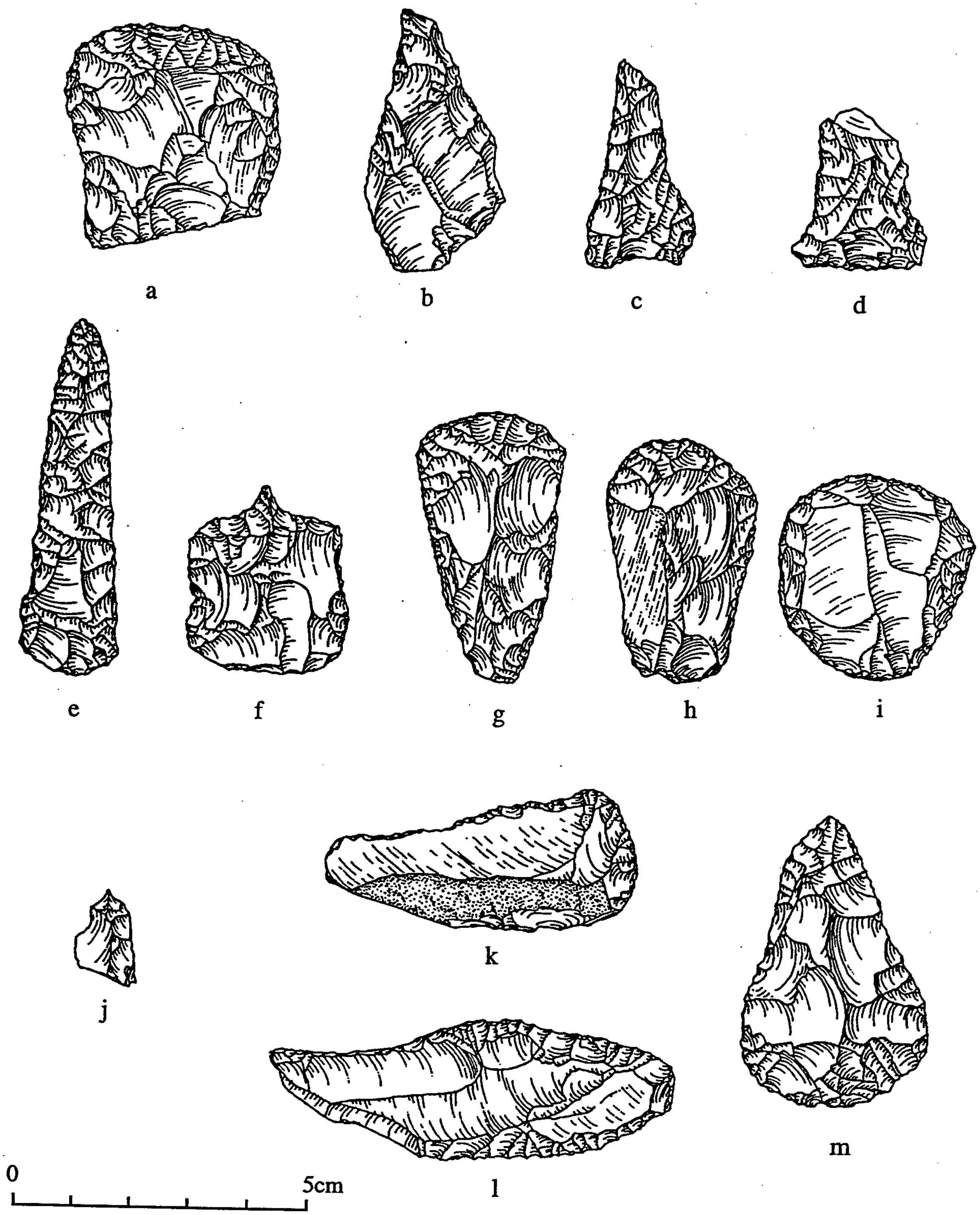


Figure 9.12; a, bifacial scraper (A2885-0296); b-f, drills (b-A6692-0296, c-A2847-0296, d-A7153-0296, e-A7224-0296, f-A6953-0296); g-i, end scrapers (g-A7179-0296, h-A5033-0296, i-A7204-0296); j, graver (A2799-0296); k-m, composite tools (k-AA7200-0296, l-A7182-0296, m-A4379-0296).

knives (Witty 1982). This biface is long and narrow, but it does not exhibit the pronounced curvature typical of Munker's Creek knives (Witty 1982). Both sides have polish, which is visible under the microscope. Witty (1982:152) notes that "this type of wear is generally understood to result from cutting of grasses and other monocots". These knives are diagnostic of the late Middle Archaic, 5500-5000 years BP (Witty 1982).

The remaining seven complete bifaces are oval to oblong shaped bifaces that have been retouched and utilized. A7156-0296 (Fig. 9.11b) is a large, oblong, complete biface that exhibits use wear and retouch. It is very thin and the blade edges are irregular from use and retouch. It is made from Permian chert and was found in the graded area. A7243-0296 (Fig. 9.11c) is another large, oblong biface with retouched blade edges and one tapering, retouched end. This specimen was found on the surface, outside the block excavation.

A7225-0296 is a tear dropped to oval shaped biface with retouched and crushed blade edges and use-polish on the surface (Fig. 9.11d). It was found during grading excavations and depth provenience is unknown. A7236-0296 (Fig. 9.11e) is a medium oval/tear dropped shaped biface that has been heat treated. The blade edges have been retouched- one end tapers to a point from retouch. Made from Toronto chert, this piece was found during site grading. A7162-0296 (Fig. 9.11f) is a small, oval biface with retouched edges. This piece was found in the block excavation, 40-50cm bs, and is made of Florence chert. A3770-0296 is a small irregular to oval shaped biface with retouch on the blade edges. It was found in the block, 40-50cm bs, and is made from Plattsmouth A chert. A2885-0296 (Fig. 9.12a) is a proximal biface fragment, though its steep angle of retouch and use reflects its use as a scraper.

Drills: There are 21 drills, 5.5% of the chipped stone tool assemblage (Fig. 9.12, b-f). These are characterized by a long, slender, beveled, distal end and are assumed to have been used in hide working as perforators or drills. They are predominantly bifacial with the exception of one flaketool drill (Fig. 9.12b). There are four complete, ten distal, two medial and five proximal fragments. Of the complete and proximal drills, four (Fig. 9.12c, e) have narrow bases and broad bits. Two (e.g., Fig. 9.12d), were probably hafted as they have a wider base and broad bit. A6953-0296 (Fig. 9.12f) is unique in that it is a thin, wide biface with a small protrusion on its distal end, probably a very small drill bit.

Scrapers

Twenty-six stone tools are categorized as scrapers (Fig. 9.12a, g-i). These scrapers have a steep edge angle of 45 degrees or greater. Four of these are modified cores, one is bifacially worked, and the remaining are flaketools. This category does not include the hafted scrapers that were described above in the classification of stemmed points. Appendix 1 shows the metric and nonmetric data collected on these artifacts including edge angle and edges worked. A large majority (18) was recovered from the block excavation. There are 18 complete, four distal, two medial, and two proximal fragments. The scrapers were sorted into side scrapers, end scrapers and side-and-end scrapers and utilized (informal) flaketools or cores. In these categories, there are two side scrapers, seven end scrapers and ten end-and-side scrapers, four utilized cores and three informal utilized flaketools. These varied in shape from oval to round to irregular shaped.

Other Chipped Stone Tools

Modified Flakes and Gravers: Gravers are small flakes with a prominence probably used for graving or incising (Fig. 9.12j). The assemblage contains three such gravers. There are also three formal flake tool knives.

Choppers: Also in the chipped stone assemblage are two thick bifaces, one made of ferrous oxide the other of Tongue River Silicified Sediment. These are characteristic of choppers in that one edge of the large cobbles has been bifacially worked and possibly used as a chopping tool. Both specimens are from the block, one at a depth of 50-60cm bs and the other from an unknown level.

Composite Tools: There are 16 composite tools, including six flake tools, ten bifaces, and one distal fragment of a stemmed biface (Fig. 9.12k-l). These served predominantly as scrapers and knives. Three tools were probably used as gouges. The composite tool assemblage includes nine complete, three distal, three medial, and one proximal specimens.

Indeterminate Tools: Thirteen of the chipped stone tools were indeterminate as to function, seven of these are bifaces, five are flaketools.

Conclusion

The evidence from the chipped stone tools indicates the DB site was visited periodically by groups from early Paleoindian to Late Prehistoric times. The assemblage of diagnostic projectile points/knives is similar to the assemblages of late Middle Archaic components, such as Koster (Cook 1976) and Coffey (Schmits 1978), Late Archaic components, such as McLean (McElrath 1984), and the Middle Woodland occupation at the nearby Quarry Creek site (Logan 1993a). The higher proportion of later stage bifaces (thin and utilized bifaces compared to thick, unused bifaces) and the evidence of tool refitting and discard (based on the high percentage of extensively resharpened, complete, stemmed bifaces as well as proximal fragments) suggests DB was utilized as a camp site and/or an overlook, allowing for variation, from Paleoindian to Late Prehistoric times (Hofman 1992a).

Chapter 10

Lithic Raw Material Use at the DB Site

Janice A. McLean

Introduction

Accurate identification of the lithic raw materials used to produce chipped-stone artifacts enables archaeologists to begin reconstructing lithic procurement strategies, understanding the movement of prehistoric peoples across the landscape, interpreting settlement systems, and documenting patterns of trade/exchange. The goal of this chapter is to provide a preliminary description and analysis of the lithic materials used to manufacture the chipped stone tools described in chapter 9 (Hatfield, this volume). Broad research questions concerning temporal changes in raw material use patterns and technological aspects related to lithic resource use can begin to be addressed in this analysis, but questions concerning procurement and mobility cannot be fully resolved without additional information from the rest of the lithic assemblage. For instance, raw material economics cannot be completely understood without first understanding the site entry pose, or form in which a specific material type entered the site. This is accomplished by examining the production debris to determine if a material is entering the site in finished (tool) or unfinished (cores) form and then comparing it to the chipped-stone tool data. With only tool data, our understanding of how specific materials function in a prehistoric economy is limited to knowing which materials are discarded and in what form; data that explain nothing about how a material arrived or was reduced once present at a site. This initial documentation of the lithic resources from DB provides a backdrop for future studies in raw material use at the site and for regional comparisons, but further research is needed before we can fully reconstruct lithic resource use at the site.

Methodology

A sample of 380 chipped stone artifacts from the site was examined to identify the raw material type for each specimen: a synopsis of the identification procedure is provided in the following section. Additional data on thermal alteration, cortex, and degree of patination were collected to complement the raw material analysis. The presence/absence coding of thermal alteration was based on recognition of at least one of the following criteria: crazing (minute surface fractures), reddening, and/or potlids (shallow pits). The criteria used to make the determination was also recorded so pieces falsely identified as thermally altered can be located and recoded if necessary. The presence/absence of cortex, or in some cases, a mechanically induced abrasion rind, was noted for each specimen. The degree of patination observed for each artifact was coded using the following scale: 0 = no patination observed, 1 = one patinated surface, 2 = patination present on opposing surfaces, 3 = complete patination. Four specimens (A3664-0296-1, A6706-0296-2, A7187-0296, A7233-0296-1) which were incorporated into the chipped stone analysis (Hatfield, this volume), were inadvertently not coded for raw material type and therefore excluded from this analysis.

Lithic Raw Material Identification Procedure: Low-resolution microscopic examination was chosen for this analysis because it makes it possible to emphasize macroscopic characteristics visible with the naked eye, as well as to identify subtle microfabric differences between otherwise similar cherts. This approach was chosen over other analytical techniques, such as trace-element sourcing, ultra-violet light fluorescence (UVLF), or petrographic thin-section examination, because of its comparatively low cost, relative effectiveness, and ease of replication, the key requirement of any sourcing study (Tankersley 1989:261). Trace-element sourcing was a poor choice for this analysis because of its prohibitive cost, the potential for sample destruction, the lack of a chert characterization database that incorporates materials identified for DB using visual means, and poor replicability. At present, Plattsmouth chert is the only positively identified lithic material present at the DB Site that has even been partially chemically characterized (Hill 1964), although Burlington chert, which has been the focus of several characterization studies, is also potentially present (Luedtke and Meyers 1984; Ives 1984). A trace element sourcing approach would be difficult to justify given the limited time available for the analysis, the logistical requirements of a rigorous geological sampling project, and overall cost of developing an adequate characterization database for the region. In addition, the costs associated with submitting 384 archaeological samples for potentially destructive characterization made this approach ill-suited for the DB project. UVLF was not used in the DB analysis, despite its success in other studies (Hofman et al. 1991), because the Pennsylvanian and Permian cherts that dominate the DB assemblage tend not to respond under UVLF. Petrographic thin-section analysis, a cheaper and more widely available technique compared to trace-element analysis, is potentially more useful for differentiating fossiliferous cherts than low-resolution microscopic examination (Eley and von Bitter 1989), but otherwise provides few advantages over the low-resolution technique (Luedtke 1992:73). Petrographic analysis requires destructive thin-sections of both geologic and artifact samples for comparative purposes, as well as access to a petrographic microscope; both requirements made this approach unsuitable for the DB analysis.

Each artifact was examined under low (10x-70x) magnification using a Bausch and Lomb Microscope with one attached tungsten and one detached high-intensity halogen lamp and directly compared with samples of known geological origin. Lithic raw material samples from the University of Kansas Museum of Anthropology Lithic Comparative Collection (KUMA-LCC) were used for comparisons with the archaeological specimens. Table 10.1 provides a list of these specimens for future reference. The following macroscopic and microscopic attributes were used to support the lithic identifications made during this analysis: presence, type, patterning and abundance of fossil and other inclusions; range of known color variation; color patterning (the type of mottling or banding displayed by a piece); luster (the degree to which a flakes surface reflects light); texture (general grain size); microfabric (the spatial distribution of

Table 10.1: KUMA-LCC Comparative Samples Used in this Analysis

Sample #	Lithic Type	Geologic Identification / Comments	Collector	Sample Size
96-8	Laberdie Chert	Laberdie Limestone Member; Pawnee Limestone Formation; Marmaton Group; Pennsylvanian System	Bert Wetherill	n=3 pieces
96-9	Argentine Chert	Argentine Limestone Member; Wyandotte Limestone Formation; Kansas City Group; Pennsylvanian System	Bert Wetherill	n=3 pieces
96-10	Plattsmouth Chert	Plattsmouth Limestone Member; Oread Formation; Shawnee Group; Virgilian Series; Pennsylvanian System	Bert Wetherill	n=4 pieces
96-13	Toronto Chert	Toronto Limestone Member; Oread Formation; Shawnee Group; Virgilian Series; Pennsylvanian System	Bert Wetherill	n=2 pieces
96-14	Stoner Chert	Stoner Limestone Member; Stanton Limestone Formation; Lansing Group; Pennsylvanian System	Bert Wetherill	n=6 pieces
96-29	Winterset Chert	Winterset Limestone Member; Dennis Limestone Formation; Kansas City Group; Pennsylvanian System	Bert Wetherill	n=2 pieces
96-30	Argentine Chert	Argentine Limestone Member; Wyandotte Limestone Formation; Kansas City Group; Pennsylvanian System	Bert Wetherill	n=4 pieces
96-31	Westerville Chert	Westerville Limestone Member; Cherryvale Shale Formation Kansas City Group; Pennsylvanian System	Bert Wetherill	n=13 pieces
96-32A	Winterset Chert	Winterset Limestone Member; Dennis Limestone Formation; Kansas City Group; Pennsylvanian System	Bert Wetherill	n=6 pieces
96-32B	Winterset Chert	Winterset Limestone Member; Dennis Limestone Formation; Kansas City Group; Pennsylvanian System	Bert Wetherill	n=6 pieces
96-34	Spring Hill Chert	Spring Hill Limestone Member; Plattsburg Limestone Formation; Lansing Group; Pennsylvanian Sytem	Bert Wetherill	n=3 pieces
96-46	Bethany Falls Chert	Bethany Falls Limestone Member; Swope Limestone Formation; Kansas City Group; Pennsylvanian System	Bert Wetherill	n=3 pieces
96-50	Florence B Chert	Florence Limestone Member; Barneston Formation; Chase Group; Big Blue Series; Permian System	Toby & Julie Morrow	n=~12 pieces
96-51	Keokuk Chert	Keokuk Formation; Valmayeran Series; Mississippian System	Toby & Julie Morrow	n=5 pieces
96-52	Curzon A Chert	Curzon Member; Topeka Formation; Shawnee Group; Virgilian Series; Pennsylvanian System	Toby & Julie Morrow	n=5 pieces
96-53	Burlington Chert	Burlington-Keokuk Formation; Osagean Series; Upper Mississippian System	Toby & Julie Morrow	n=5 pieces
96-54	Winterset A Chert	Winterset Limestone Member; Dennis Limestone Formation; Kansas City Group; Pennsylvanian System	Toby & Julie Morrow	n=8 pieces
96-55	Ervine Creek A Chert	Ervine Creek Member; Deer Creek Formation; Shawnee Group; Virgilian Series; Pennsylvanian System	Toby & Julie Morrow	n=5 pieces
96-56	Warsaw Chalcedonic Chert	Warsaw Formation; Osagean Series; Mississippian System	Toby & Julie Morrow	n=9 pieces
96-57	Burlington Chert	Burlington-Keokuk Formation; Osagean Series; Upper Mississippian System	Toby & Julie Morrow	n=9 pieces
96-58	Stoner A Chert	Stoner Limestone Member; Stanton Limestone Formation; Lansing Group; Pennsylvanian System	Toby & Julie Morrow	n=~13 pieces
96-59	Osagean Chert	Osagean Series Formations (Pierson, Reeds Springs, Elsey, Burlington); Mississippian System	Toby & Julie Morrow	n=3 pieces
96-60	Reeds Springs Chert (Lower, Middle, & Green Varieties)	Reeds Springs Formation; Osagean Series; Mississippian System	Jack Ray	n=>15 pieces
96-61	Choteau Chert	Choteau Group; Lower Mississippian System	Jack Ray	n=~15 pieces
96-62	Burlington Chert	Burlington-Keokuk Formation; Osagean Series; Upper Mississippian System	Jack Ray	n=4 pieces
96-63	Warsaw Chert	Warsaw Formation; Osagean Series; Mississippian System	Jack Ray	n=10 pieces
96-64	Burlington Chert (Marshall Variety)	Burlington-Keokuk Formation; Osagean Series; Upper Mississippian System	John Reynolds	n=2 pieces 1 is thermally altered
96-65	Florence C/D Chert	Florence Limestone Member; Barneston Formation; Chase Group; Permian System	John Reynolds	n=3 pieces
96-66	Nehawka Chert (Pennsylvanian Rice-grain Chert)	Probably the Ervine Creek Limestone Member of the Deer Creek Formation; Shawnee Group;Pennsylvanian System	Joe Herman	n=5 pieces
97-3	Plattsmouth Chert	Plattsmouth Limestone Member; Oread Formation; Shawnee Group; Virgilian Series; Pennsylvanian System	J.McLean & M.Beck	n=>30
97-4A	Plattsmouth Chert	Plattsmouth Limestone Member; Oread Formation; Shawnee Group; Virgilian Series; Pennsylvanian System	J.McLean & M.Beck	n=>30
no #s	Permian Cherts: heated and unheated Wreford varieties, Florence A/B/C varieties, Foraker, Herington, Cresswell varieties	Comparative samples decribed in Haury (1984) and curated at KUMA	Cherie Haury	4 shelves
no #s	Pennsylvanian Cherts: Reid's type samples for Winterset, Westerville, Argentine	Comparative samples decribed by Reid (1980) and curated at KUMA	Ken Reid	3 shelves

the different minerals, types of silica and inclusions present in the material which are only visible under magnification); and translucency, or degree to which light passes through a material (Morrow 1994:110-114; Luedtke 1992:73). Source designations, based on visual similarities to LCC samples, were entered into an EXCEL 5.0 database along with all other coded attributes and provenience data. These data are available in Appendix 2.

In addition to assigning lithic raw material identifications to artifacts, the identifications themselves were qualified using the following "level of confidence" terminology and (usually) supplemented with interpretive comments. A **positive** identification signifies the piece exhibits features that are exclusive to a single chert type. A **probable** identification indicates that the piece falls within the range of variation of a particular type, but lacks some of the necessary criteria for a positive identification (Haury 1984:83). An **indeterminate** identification means that the piece exhibits characteristics suggestive of two or more known material types (noted in the comments section), while an **exotic** designation is reserved for materials outside the range of known variation for the material types described in this report or comparative specimens used in the analysis. These data were collected for several reasons: 1) to document the rationale for making a particular source designation in case the designation is controversial, 2) to establish a reference set of site materials which could then be used in other analyses of DB lithic artifacts, 3) to establish a data set of potential look-alikes in the collection for future reference, and 4) provide a baseline for comparison to blind identification tests and other identification methods. Further discussion of these data appears later in the chapter.

Lithic Raw Material Descriptions

The descriptions provided here are derived from published and unpublished sources, and are included to document references used to supplement and interpret the comparative samples used during this analysis (Table 10.1). A tripartite division of local, near-local, and exotic materials was developed to emphasize the relative abundance of chert resources within the vicinity of the DB site. A single division of local vs. exotic masks resources that would have been accessible to the prehistoric inhabitants, but not necessarily immediately so. This division will make it possible to emphasize utilization of the immediately local Pennsylvanian cherts (Shawnee Group cherts, glacial till) relative to the near-local Pennsylvanian Kansas City Group and Lansing Group materials available south and east from the site as close as 15km. Exotic materials include Permian cherts from the Flint Hills, Smoky Hill silicified chalk from north-central Kansas, and Mississippian cherts from west-central Missouri. Materials considered local to DB are defined as those that occur within a 10-15km(6.2- 9.3mi) radius of the site since a "20- to 30-kilometer round trip appears to be the maximum distance hunter-gatherers will walk comfortably in a day in a variety of habitats" (Kelly 1995:133). Near-local raw materials (15-45km) are those available within an arbitrary distance of up to three days, or 30-45km of the site. Exotics are defined as raw materials located more than 45km from the site. Figure 10.1 shows the general distribution of these chert resources relative to the DB site.

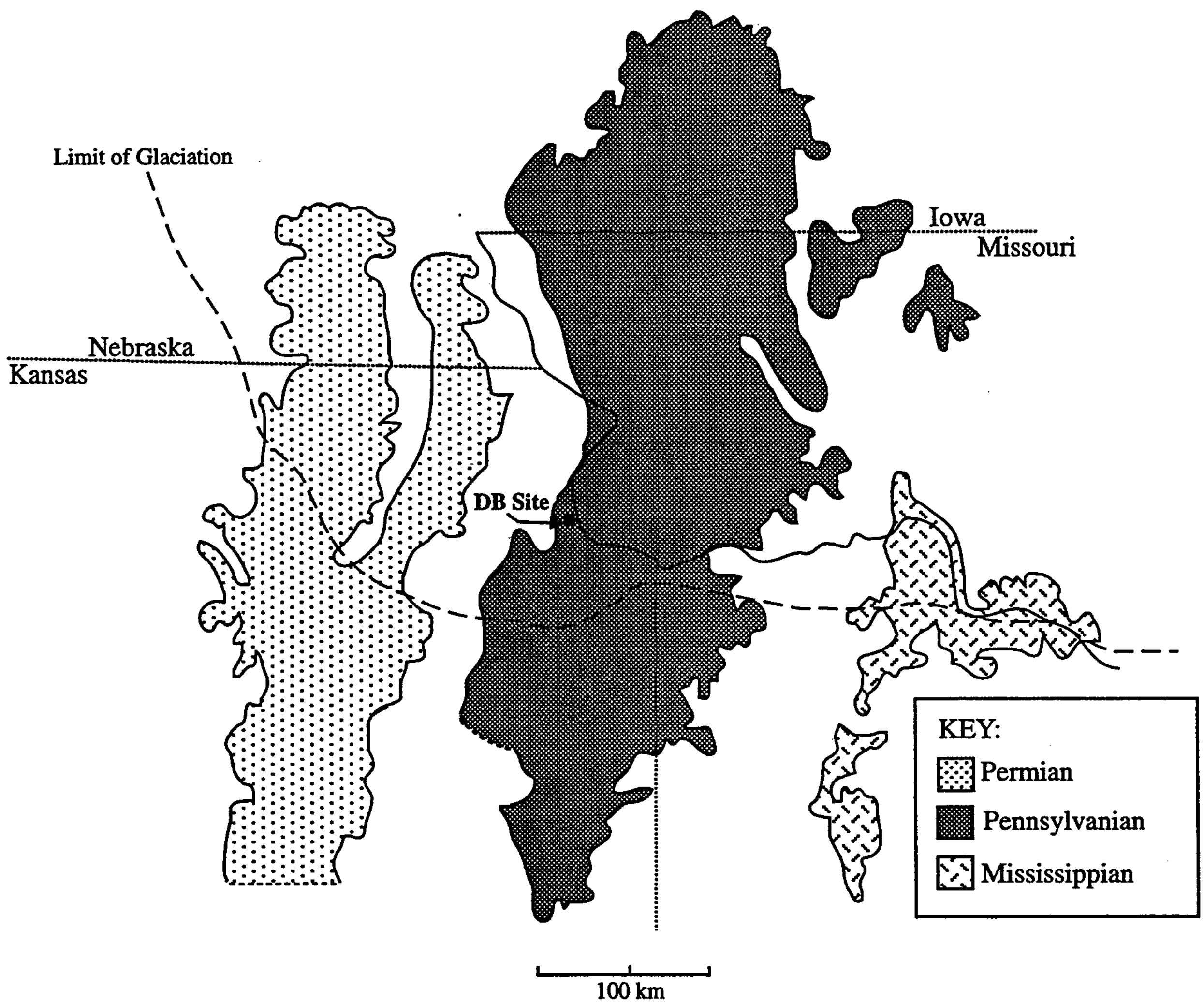


Figure 10.1. Distribution of Permian, Pennsylvanian and Mississippian Cherts Relative to the DB Site.

Local Lithic Resources

Two known chert-bearing members, the Plattsmouth Limestone Member and the Toronto Limestone Member, are present in the Oread Limestone of the Shawnee Group (Virgilian Stage Pennsylvanian System) in Leavenworth County, Kansas (McLaren 1952). In addition to the bedrock outcrops and secondary gravels derived from these two limestones, chert and other lithic resources (particularly ferrous oxide, Sioux Quartzite and Tongue River Silicified Sediment) are present in the Kansan glacial till mantle covering the uplands of northeastern Leavenworth County. McLaren (1957:Plate 1) shows the distribution of the Oread Limestone and Kansan till in Northeastern Leavenworth County in the vicinity of the DB Site.

Shawnee Group Cherts

Plattsmouth Chert: The Plattsmouth Limestone Member of the Oread Formation ranges in thickness from 2.89m (9.5ft) to 6.25m (20.5ft) and consists of an upper and lower unit divided by a persistent 0.06-0.27m (0.2-0.9ft) shale parting. Both the upper and lower units are light to medium gray on fresh surfaces and weather gray to dark yellowish brown (Hill 1964:11). Chert is present in both the upper and lower units of the limestone. Nodules of chert

> occur in the upper three feet of the lower unit and are locally most abundant in the uppermost foot, just below the major shale parting. However, at some locations only a few scattered nodules can be found in the lower part of the Plattsmouth Limestone. In the upper unit of the limestone, a persistent zone of nodular, and locally tabular, chert is found 1.0 to 3.8 feet [0.3-1.16m] above the main shale parting. This zone of chert ranges from 0.9 to 2.0 feet [0.27-0.61m] in thickness and persists from location to location at the same approximate stratigraphic position (Hill 1964:13-14).

Scattered chert nodules are found locally within the limestone above the persistent chert zone, but nodules are found below the upper unit chert zone in only a few locations (Hill 1964:13-14). The contacts of the chert within the host rock are usually sharp with a 1-3mm thick siliceous limestone layer surrounding each nodule (Hill 1964:15). The outer edges of the nodules are irregular, but rounded, having no sharp edges except when the nodules are broken (Hill 1964:41). In the southern Plattsmouth outcrops (Douglas County, Kansas) "the nodules are smaller, and the siliceous limestone layer surrounding the nodules is thicker and almost indistinguishable from the host rock unless weathered" (Hill 1964:15-16). Small vugs can be seen on the weathered surfaces of the chert nodules; some are filled with calcite, and others have a thin, irregular lining of white SiO_2.

The published descriptions of Plattsmouth chert vary, but are, overall, consistent. Hill describes the chert matrix as dark gray (1964:15), while Morrow describes it as "medium to dark gray or brownish gray in color (N5, N4, 5YR5/1)" with broad and faint mottling (1994:127). Samples collected from Ft. Leavenworth (KUMA-LCC Localities #97-3 and #97-4) range from very light gray on weathered surfaces to very dark gray/black on fresh surfaces (see Figure 10.2 for the sample locations). The chert is lighter gray in the southern Plattsmouth outcrops (Hill 1964:15-16). Dark, almost black, undulating bands horizontally cross the nodules, and dark, irregular masses occur within some nodules (Hill 1964). Manganese oxide dendrites have also been observed on the joint surfaces in the chert as a surficial film (Hill 1964:15-16). Translucency is notable to a thickness of only about 0.5mm. Texture is medium-fine and luster is dull to satiny (Morrow 1994:127). Morrow, describing Plattsmouth chert from southwestern Iowa, notes that heating appears to have little affect on this material (1994:127). In contrast, Logan (1985:245) describes a pinkish tinge on Plattsmouth artifacts from Stranger Creek Basin sites (in Leavenworth County, approximately 15km west of DB) which he attributes to thermal alteration. Medium-sized (ca. 2-3mm in diameter, 4-7mm in length) fusilinids are consistently noted as the predominant macrofossil inclusions, although lesser quantities of crinoids, horn corals and bryozoans are also recorded (Hill 1964:15; Morrow 1994:127). Twenty fusulinids per cm^2 may be present but the density is normally lower, ca. 5-10 per cm^2 (Morrow 1994:127). The fossil distribution is random; fossils protrude from nodules when the limestone cortex is dissolved with acid (Hill 1964:40). The fossils are frequently well-preserved, were silicified prior to formation of the chert, and appear as off-white to light grayish brown inclusions (Morrow 1994:127; Hill 1964:40). Crinoid columns are often incompletely silicified, and calcareous fossils are occasionally found encapsulated by the chert (Hill 1964:41).

A KUMA-LCC Plattsmouth chert sample (#97-4) recently collected from Ft. Leavenworth (Fig. 10.2) differs from the published descriptions, which implicitly describe two basic varieties: a generic gray fossiliferous chert (Plattsmouth A) and a predominately fusilinacean chert (Plattsmouth B). Plattsmouth C, the proposed unreported variety, is a very light gray tabular chert with a distinctive banding pattern consisting of alternating dark gray and white wavy bands interspersed with zones of band-free light gray fossiliferous chert. The geologic context of collection #97-4 is somewhat ambiguous because construction activities at the collection locality mixed Kansan glacial till and the underlying *in situ* chert. Heavy patina and a small amount of limestone cortex (but no cobble cortex) on the proposed Plattsmouth C materials suggest that this chert may actually be part of the till, instead of from the underlying Plattsmouth outcrop. No clear example of this variety was observed at collection locality #97-3, which is in the same stratigraphic relationship and elevation as #97-4, although hints of the banding were observed in a few fragments. Unfortunately, the chert collected from #97-3 is also heavily stained by iron oxides, which make it difficult to observe the visual attributes of the material. Both Plattsmouth A and B varieties were collected from #97-3 and #97-4, although no pieces were as heavily patinated as the "C" samples. Until the Plattsmouth C variety can be found and confirmed in another outcrop, its status as a legitimate Plattsmouth variety remains questionable. On the other hand, its status as a local lithic resource remains intact and the probability that it will be found *in situ* remains likely [but see the Argentine chert description for an alternative hypothesis].

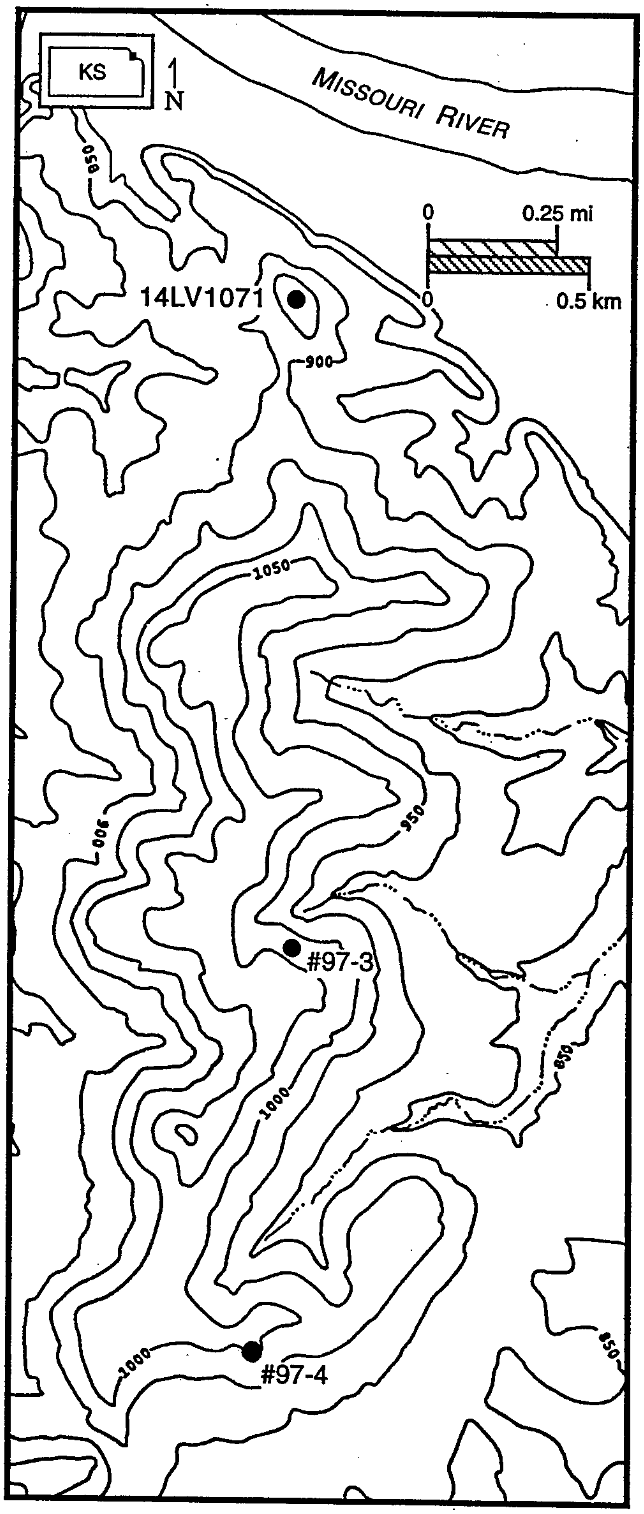


Figure 10.2. Location of Plattsmouth samples from Leavenworth County, Kansas.

Plattsmouth A chert collected from the #97-3 locality is the same as the Area 7 material described in Wagner et al. (1989:180) as potentially derived from either the Plattsmouth or Spring Hill Limestones. McLaren's thesis (1958) on the geology of northeastern Leavenworth County indicates that the material is Plattsmouth, since Spring Hill only outcrops along the extreme southeastern section of his study area directly north of Wyandotte County, Kansas along the Missouri River. Even then it contains no chert (McLaren 1958:17), although it does farther south in Wyandotte and Johnson Counties, Kansas.

Plattsmouth B, the highly fusulinacean variety of Plattsmouth, is fairly distinctive, but could potentially be confused with other fusulinacean cherts from the Pennsylvanian Spring Branch and Ervine Creek Limestones in southwest Iowa (Morrow 1994:127), or the Permian Foraker Limestone in the southern Flint Hills (Haury 1984:80-81). Fusulinid species, overall size, color, and texture can all be used to differentiate these materials. Some of the lithic materials referred to in the literature as "Nehawka" chert are probably from the Plattsmouth limestone (Morrow 1994: 127), although the variation of these materials has not been fully described.

Toronto Chert: The Toronto limestone is the lowermost member of the Oread formation and is characterized by massive, fine-grained limestone which usually contains abundant fossils (Reynolds 1957:29; McLaren 1958:43). Weathered surfaces are generally a rich brownish-yellow, while fresh surfaces range from tan to gray to dark blue (McLaren 1958:43). Chert occurs in the upper few feet of the limestone, and is a total of 5 to 8 ft (1.5-2.4m) thick in northern Leavenworth County (McLaren 1958:44). The distribution of Toronto Chert, according to the two presently available geological reports for Leavenworth County, appears to be concentrated west of R20E and/or south of T10S, although this assessment needs to be ground-truthed since chert is not always consistently recorded in geological profiles (Reynolds 1957; McLaren 1958).

Generally a buff tan, Toronto chert varies in color from white to yellowish brown (range: 10YR 6-8/2-6). The texture is fine-to-medium grained, homogeneous, and virtually inclusion-free (Allen 1982:20; Logan 1988b:324). Toronto chert is opaque and exhibits a dull to slight luster which is typically enhanced by thermal alteration. A pinkish or red-violet tinge (5R 5-7/4-6, or 5RP 4/2) is the most typical sign of thermal alteration in artifacts of this material (Logan 1985:245).

Toronto has been described as closely resembling Westerville chert, a near-local Kansas City Group chert (Logan 1988b:324-325). Brockington's Westerville A variety, which he described as tan-buff in color with relatively few fossil inclusions, does closely resemble the Toronto description (1978:33). However, when several KUMA-LCC samples of Westerville chert collected from the type locality (Reid 1980b:123) were compared under microscopic examination (10x) to Toronto chert cobbles and artifacts collected during the Nine Mile and Stranger Creek Survey Projects, several differences between the materials were noted. Westerville A exhibits a finer-grained texture and typically contains scattered bluish-white calcite streaks and inclusions; these characteristics make it possible to distinguish it from the macroscopically similar, but coarser-grained and virtually inclusion-free Toronto. The reliability of these criteria should be tested further using geological samples of the high quality Toronto varieties presumably mistaken for Westerville. Only poor quality geologic samples of Toronto were available for this analysis.

An additional identification problem regarding Toronto chert arose during this study; small, thermally altered flakes of white or light colored Toronto can closely resemble fossil-free samples of thermally altered white Mississippian cherts (particularly Burlington samples). The full color range of thermally altered samples of both materials has not been documented and should receive further attention, but Mississippian cherts generally become more colorful and lustrous than Toronto chert with heat-treatment. There are slight microfabric differences between non-thermally altered Toronto and Mississippian chert comparative samples, but heat-altered archaeological specimens are extremely difficult to differentiate, particularly if use has produced an artificial "gloss" on the artifacts. The impact of these identification problems on this analysis is mixed, and will be discussed further in the "Identification Evaluation" section of this chapter.

<u>Secondary Sources</u>: The presence of a water-worn rind, abraded surface, or otherwise smooth polished surface indicative of geologic transport is the most common indication that a lithic material was procured from a secondary context. Minimum and maximum sizes of reconstructed chert nodules may also help identify bedrock-procured from secondary materials (Francis 1991:313). Minimal evidence for the utilization of gravel deposits is present in the DB chipped-stone tool assemblage, although this is a fairly common pattern for chipped-stone tool reduction. Only 9.1% of the specimens identified as having cortex (4/44) exhibited any mechanical signs of geological transport; of these, two were local (Plattsmouth and Tongue River Silica), and two were exotic (Wreford and Permian).

Logan discusses the presence of secondary chert deposits (Plattsmouth and Toronto) in the Stranger Creek Basin (~15km distant) (1985). Similar, more easily accessed deposits are likely to be present in the Plum and Salt Creek drainages north and west of DB (<1km distant).

Kansan Till

Unsorted boulders and cobbles of chert and pink (Sioux) quartzite are recorded as present in northeastern Kansas till deposits and were likely utilized prehistorically for chipped-stone tool technology (Reynolds 1957; McLaren 1958). Beck (chapter 11) discusses the utilization of till resources for ground stone raw materials such as quartzites, other metamorphic and igneous rocks. Two lithic resources present in Kansan Till have been identified in the DB chipped stone assemblage: ferrous oxide and Tongue River Silica.

<u>Ferrous Oxide</u>: Abundant ferrous oxide was observed <u>in situ</u> in Kansas glacial till deposits present at KUMA-LCC Locality #97-4 (Fig. 10.2). Three early stage bifaces, one chopper and one flake tool made of ferrous oxide, as well as other pieces of modified ferrous oxide discussed in Chapter 12, were recovered from DB.

Tongue River Silica: This material originates from the Paleocene Fort Union Formation in the northwestern Great Plains. It is abundant in cobble form in glacial gravels throughout western Iowa, Missouri and northeastern Kansas. Cobbles of Tongue River silica up to 40cm in diameter have been recovered from these secondary sources. Tongue River silica is:

> typically olive-brown to yellowish brown in color (2.5YR 5/4, 2.5 YR 6/4) and is composed of a heterogeneous mass of fine, angular quartz grains. This material has a blocky, irregular, and finely crystalline appearance. Fossil stem and root impressions are frequently seen in complete cobbles. These may or may not be visible on artifacts made of this same material. Texture ranges from coarse to medium-grained. Luster is dull with scattered vitreous quartz grains of microscopic size giving the material a distinctly "silty" appearance. Translucency is minimal, notable at a thickness of about .25-.5mm (Morrow 1994:128).

This material is typically quite tough in its natural state, and was commonly thermally altered by prehistoric groups to improve its workability. Heating produces a red to deep maroon color (10R 4/4, 2.5 YR 3/4, 2.5 YR3/4, 5R5/3) and is often accompanied by a satiny luster (Morrow 1994:128).

The irregular, fine texture and "silty" appearance of Tongue River silica makes it fairly easy to identify. While some coarser cherts/quartzites may be confused with this material, they are seldom yellowish tan, olive, or maroon in color and they do not exhibit the microscopic sand particles typical of Tongue River (Morrow 1994:128).

Near-Local Lithic Resources

Only two near-local lithic raw materials have been positively identified at the DB site: Winterset and Westerville cherts of the Pennsylvanian Kansas City Group. Other near-local cherts from the Kansas City or Lansing Groups are potentially present in the unidentified material class. Reid (1980b:Figure 8) shows the distribution of Lansing, Shawnee and Kansas City Group formations east of the Missouri River.

Kansas City Group Cherts

Chert is present in nine members of the Upper Pennsylvanian (Missourian Stage) Kansas City Group (Wetherill 1997:1). Only the three limestone members described in this report contain chert is well-documented in prehistoric contexts (Reid 1980b). The distance to Kansas City Group outcrops from the DB Site is approximately 15km (based on Reid 1980b:Fig. 131). These cherts are arguably local, but definitely near-local (<20 km) (Reid 1980b:Fig. 131).

Argentine Chert: The Argentine Limestone Member of the Wyandotte Limestone Formation contains nodular pebbles and cobbles of chert. The published description of this material is rather vague. Texture is described as smooth to granular, and internal structure as mottled. Colors range from light brown (7.5YR6/4), to dark reddish gray (5YR4/2), light gray (10YR7/1), or very pale brown (10YR7/2). Silicified crinoids are common in the chert and in the cortex, which ranges in color from light yellowish brown (10YR6/4), to light gray (10YR7/1), to very pale brown (10YR7/2). White gypsum filled vugs are present in some nodules (Reid 1984a:100). Thermal alteration experiments caused two samples to change color "from a homogeneous light brown (7.5YR6/4) to a strongly mottled pale red (7.5R6/4) and reddish gray (5R6/1)" (Reid 1980b:130). KUMA-LCC comparative samples of Argentine chert exhibit more variation, such as light and dark gray wavy banding, but their geologic provenance is somewhat questionable since they were collected from unconfirmed regolith deposits (Wetherill 1997). Material from Reid's type locality is stained reddish-orange from weathering.

Argentine chert is described in the literature as more abundant south of the Missouri River in the Little Blue River Valley in southern Jackson and northern Cass counties, Missouri. Reid suggests its limited presence in archaeological sites located north of the Missouri River may be due to its restricted geologic distribution (1980b:126). In support of this assertion, no artifacts from the DB site were identified as Argentine. However, the hypothesized Plattsmouth C (alternating light and dark gray, wavy banding) variety collected from KUMA-LCC locality #97-4 closely resembles a small sample of Argentine chert collected from regolith in northern Cass County, Missouri by Bert Wetherill (KUMA-LCC #96-30). Artifacts were identified as Plattsmouth "C" instead of Argentine because the Argentine sample is coarser in texture, has a slightly different banding pattern, and Plattsmouth "C" is available within 1km of DB. Further investigation into the distribution of Argentine chert in both geologic and archaeological contexts, as well as an evaluation of the possibility that Argentine chert (or other Kansas City Group cherts) is present in Kansan glacial till, is needed to confirm or reject Reid's suggestion.

Westerville Chert: The Westerville Limestone Member of the Cherryvale Shale Formation yields both tabular and nodular chert. The texture of Westerville chert is highly variable, ranging from smooth to fine granular to coarse and chalky. The internal structure can be layered, mottled, or homogeneous. Colors commonly include: light gray (10YR7/1), very pale brown (10YR7/3, 4), pale brown(10YR6/3), light yellowish brown (10YR6/4), brownish yellow (10YR6/6,8), or yellowish brown (10YR5/4). Thin bands of white, porcelaneous chert infrequently co-occur within all of these color masses. Fossils are present, but rarely abundant. Calcite inclusions and veins are also present, and large, calcareous solution cavities occasionally flaw the interior of a slab or blank. The limestone cortex varies in color from a light yellowish brown (10YR6/4) to reddish yellow (7.5 YR7/6,8) (Reid 1984a:100). Thermal alteration experiments conducted on this material produced color changes "from light gray (10YR7/1) to a combination of pink (5YR7/3) and reddish gray (5YR6/1)" (Reid 1980b:130).

Brockington describes two varieties of Westerville chert. Westerville A is "tan-buff in color and contains relatively few fossil inclusions," while Westerville B is "grayer in color, with some tan mottling and more numerous fossils inclusions" (1978:33). Additional sampling of

Westerville outcrops is needed to determine if Brockington's varieties are legitimate distinctions (Wetherill 1997). Comparative samples corresponding to Brockington's descriptions were not available for this analysis. Samples from Reid's type locality were used and appear to mainly coincide with Brockington's Westerville A description, although there is certainly some overlap with the Westerville B description. All artifacts identified as Westerville in this analysis match comparative samples from Reid's type locality (Reid 1984a:100).

Winterset Chert: The Winterset Limestone Member of the Dennis Limestone Formation is 10 to 13 meters thick in the Kansas City area (Platte, Clay, and Ray counties in Missouri), and can generally be divided in to an upper and lower part. A total of eight potential varieties of chert occur in the Winterset Limestone: one in the upper part, four in the lower part, and three regolithic varieties which have been tentatively identified as Westerville due to their stratigraphic position (Wetherill 1997:1). Wetherill and Morrow are currently working independently on descriptions of the Winterset cherts, and revisions to the variety nomenclature will likely occur in the near future as they begin to compare their findings.

Variety 1 corresponds to Reid's type description of material collected from Clay County, Missouri. It occurs only in the upper part of the limestone in multiple continuous beds up to 40 cm thick, or as nodules arranged in discontinuous beds up to 30 cm thick (Wetherill 1997:1). Tabular chunks, slabs, and blocks are the most common form. Texture is very fine, and luster is waxy to dull. Internal structure is generally homogeneous, although layering and mottling are also present. Colors include: light gray (7.5YR7), gray (2.5YR5,6), dark gray (2.5YR4), very dark gray (2.5YR3), and very pale brown (10YR7/4). The very pale brown color appears on heavily weathered surface pieces, and as occasional thin bands within darker gray colored pieces. Dark blue-gray is the most common informal color name used to describe Variety 1. The nickname "Zebra chert" reflects the abundant bands, vugs, and thin stripes of white calcite which are commonly present in this variety. Silicified fossils are generally present, although the overall quantity of inclusions varies. Limestone cortex is yellow (10YR8/6) or white (10YR8/1), and contains abundant fossil inclusions (Reid 1984a:100). Initial experimentation with thermal alteration of this variety produced a color change in calcitic Winterset to very dark gray (2.5YR3) to weak red (10R4/3) and resulted in disintegration of the sample into angular rubble. A piece of weathered, non-calcitic Winterset "turned from very pale brown (10YR7/4) to pale red (10R6/2) and disintegrated into a pile of extremely small chips and cubical shatter" (Reid 1980b:130). The control temperature and time (700° C for four hours in an electric kiln), appear to have been too high for too long. Heating Winterset at lower temperatures and/or for shorter durations may produce better results.

The following four varieties (2-5) are found only in the lower part of the Winterset member as isolated nodules 10 x 30cm, or as nodules in a discontinuous bed up to 10cm thick.

Variety 2 has been found in southern Jackson County, Missouri. It ranges in color from tan to light gray, and is mottled or very faintly banded. This material is a silicifed algal deposit, and it contains scarce fossils and oolites. It was collected from the bottom of an 80cm limestone bed, and appears to correspond with the Winterset A variety found in Iowa (Wetherill 1997:1).

Variety 3 varies in color from tan to light gray to yellow. Internal structure is mottled (tan and gray), homogeneous (tan), distinctly banded (tan), faintly banded (light gray and yellow) or variegated (mixed colors with rare fossils and oolites. Variety 3 was collected from the top of the same 80 cm bed containing variety 2. Wetherill notes that "several bedrock locations in Jackson and Clay Counties, Missouri and a single small nodule from a residual deposit in southern Miami County, Kansas have been identified for this material to date, indicating that it may be a widespread variety" (1997:1).

Variety 4 has been identified based on a single locality in Ray County, Missouri. It is "medium to dark gray, mottled, and densely fossiliferous" (Wetherill 1997:1).

Variety 5 has been identified based on a single locality in central Jackson County, Missouri. It is medium to dark gray, mottled, and contains very small light colored fossil fragments which produce a fine speckled appearance. Larger fossils are also occasionally present. Under magnification, the structure of Variety 5 is somewhat similar to Variety 2 and may prove to be within the extreme color range of that variety (Wetherill 1997:1).

Three additional varieties have been collected in Linn County, Kansas from residual material in a stratigraphic position that is probably Winterset. However, these varieties are provisional since they have not yet been confirmed in a bedrock context.

Variety 6 is coarse to medium textured, and almost white to tan to pale yellow in color with occasional gray areas. This variety is densely fossiliferous; small crinoid stem molds, fusilinids, and small brachiopods are the most common inclusions in order of abundance (Wetherill 1997:1).

Variety 7 closely resembles Variety 4; it is “light to medium gray or dark tan, mottled, and densely fossiliferous” (Wetherill 1997:2).

Variety 8 is "light grayish tan, homogeneous to banded, and medium textured". Dense quantities of tiny fossil fragments are visible under magnification (Wetherill 1997:2)

All materials currently identified as Winterset in the DB assemblage match Variety 1 (originally described by Reid). However, comparative samples were only available for varieties 1 and 2 when this analysis was being conducted. A reexamination of the unidentified artifacts may produce some evidence for utilization of the other six varieties, although there are relatively few unidentified specimens which potentially match their descriptions. This suggests that prehistoric utilization of the minor Winterset varieties (2-8) may have been limited. Additional research is needed to determine the geographic distribution, degree of prehistoric utilization and descriptive attributes of the eight proposed Winterset varieties.

Lansing Group Cherts

Two members of the Lansing Group are known to be chert-bearing: the Spring Hill and Stoner limestones. No artifacts from the DB site were identified as either of the materials, although they are potentially present as unidentified materials, misidentified Plattsmouth in the case of Spring Hill chert, or misidentified Winterset or Westerville in the case of Stoner chert.

Spring Hill Chert: The Spring Hill Limestone is the uppermost member of the Plattsburg Limestone Formation. It is a fine-grained, thick or thin wavy-bedded, light olive-gray limestone, which weathers to a dusky yellow color and has sandy upper beds (Reynolds 1957:13; McLaren 1958:17-18). Scattered crystalline calcite occurs in the middle section of the member at most localities (McLaren 1958:17). Dominate fossils include the brachiopods *Composita*, *Enteletes*, *Marginifera*, and *Dictyoclostus*; crinoid columnals, echinoid spines, ramose and fenestrate bryozoans, fusulinids, and planispirally coiled gastropods (Reynolds 1957:13-14; McLaren 1958:18). The member ranges from 8 to 15ft, but it is generally about 12ft thick. Algal beds ranging from featheredge to 0.8ft are common; one or more thin shale breaks (featheredge to 0.5ft) may also be present (McLaren 1958:18).

Spring Hill chert has been described as tabular in form, smooth textured, and strongly mottled or layered in internal structure. Colors consist of various shades of light to dark gray (7.5YR7, 7.5YR6, and 2.5YR4). Fossil inclusions, both silicified and recrystallized, are common, producing a speckled appearance in the material (Reid 1980b:123). Fusulinids are noted as particularly abundant in the chert (Logan 1988b:324). Plattsmouth chert is frequently cited as a Spring Hill look-alike (Logan 1988b:325). Only one Spring Hill comparative sample was available for use in this analysis (KUMA-LCC #96-34 from southeastern Johnson County, Kansas). It is visually most like Plattsmouth A, although the Spring Hill sample is much lighter and has a coarser texture than the Plattsmouth samples (KUMA-LCC #97-3, #97-4).

Chert is not noted in the Spring Hill limestone in Leavenworth County, Kansas, but is present across the river in Platte County, Missouri and south of Leavenworth in Wyandotte and Johnson Counties, Kansas (Reynolds 1957:13). Reid (1980b:Fig. 8) shows the distribution of Lansing Group and Kansas City Group cherts relative to Shawnee Group cherts. Logan argues that the proposed similarities between Plattsmouth and Spring Hill cherts are due to the similarity of environments under which they were deposited (1988b:324-325). In support of this observation, 52% (44/85) of the gray fossiliferous artifacts from DB were not positively assignable to one of the generic Plattsmouth, A or B varieties (38% [32/85] were probable identifications, 14% [12/85] were indeterminate). However, the obvious spatial differences in the distribution of these materials suggests that Spring Hill may have had relatively little use in areas where Plattsmouth, a material similar both visually and in terms of flakability, was available. Additional work is needed to: 1) establish reliable criteria for differentiating these two materials, and 2) document their respective distributions in the archaeological record.

Stoner Chert: The Stoner Limestone member of the Stanton Limestone Formation does not contain chert in Leavenworth County, Kansas, but chert has been noted in Clinton County, Missouri outcrops (McLaren 1958:20-21; Reynolds 1957:16; Wetherill 1996:2). The distribution of chert in this member is currently unknown. Chert samples collected from a creekbed adjacent to 23CI78, an Early to Middle Archaic site, resemble both Kansas City Group Winterset and Westerville cherts. Nodules collected from the soil located immediately above bedrock range in color from tan to light gray. Several zones of chert in both tabular and nodular form are present in a 2-3ft thick layer of bedded chert and limestone. The bedded chert is tan to gray at the top of the bed and grades downward to a medium to dark gray chert with some white veins; the lighter tan to gray form resembles Westerville, and the darker gray form resembles Winterset (Wetherill 1996:2).

One artifact (A7182-0296) from the DB site indeterminately identified as Westerville mentions Stoner chert in the analysis coding comments as a potential alternative. The absence of fossils (keeping in mind that only one comparative sample was available for this analysis) was the criteria used in this analysis to differentiate Stoner Chert from Winterset, but the overlap with Westerville was not so easily resolved. Additional research is needed to determine the variability in this material, and to establish reliable criteria which can be used to differentiate it from both Winterset and Westerville.

Tertiary Gravel Deposits

Tertiary gravel deposits composed of sub-angular chert embedded in a matrix of red, sandy clay are present in southern Leavenworth County, Kansas on high terrace deposits (elevation 940-950ft) overlooking the Kansas River (Reynolds 1957:42). The gravels are "highly oxidized, uncemented, and [vary] in color from tan to dark brown . . . subangular, tan to medium gray in internal color and dominantly tabular in shape; most specimens had developed a moderate to well developed brown alteration rind with a glossy appearance" (Honderich 1970:27-29, qtd. in Logan 1985:45). Additional "high level chert deposits occur south and north of Atchison at a height of 24m above the Missouri River floodplain. Cherts of this nature occur as artifacts in low frequency at prehistoric sites in Stranger Creek Basin" (Logan 1985:45), and are potentially present at DB as well. Several specimens exhibiting brown alteration rinds were indeterminately identified as Permian in origin, but may in fact be from these gravel deposits. It was impossible to assign artifacts to a Tertiary gravel origin due to a lack of comparative samples from these deposits. Specimens identified as having notable brown alteration rinds should be reexamined once comparative samples are available.

Exotic Lithic Resources

Four basic categories of exotic lithic resources have been identified at the DB site: Permian cherts from the Flint Hills, Mississippian cherts from west-central Missouri, Smoky Hill Silicified Chalk from the Cretaceous Niobrara Formation from western Kansas, and unidentified, exotic cherts which have no presently known local or near-local analogs. The secondary (easternmost) distribution of these materials in gravel form is currently unknown.

Permian Cherts

The Wreford Limestone Formation (Schroyer and Threemile Limestone Members) and the Barneston Formation (Florence Limestone Member) are the most prolific chert producing formations in the Flint Hills (Blasing 1984:2). These formations belong to the Chase Group, Gearyan Stage, Lower Permian Series of the Permian System. There are other Flint Hills geologic units which contain chert, but only cherts present or potentially present in the DB chipped-stone assemblage are described here (see Haury 1984 for descriptions of other Flint Hills lithic resources). Artifacts present at DB were coded as Wreford, Florence, or simply Permian if it was not possible to confidently assign the artifact to either one of these source groups. No attempt was made in this analysis to identify the varieties described here, with the exception of Florence A, which is very different from the other Permian cherts. In contrast, the degree of overlap within the Florence B-D varieties makes it impossible to consistently differentiate them, despite obvious differences between their purest forms. The descriptions are included to describe the range of variation present in the selected Permian cherts, not to document criteria used to differentiate them. The easternmost extent of any of these materials in secondary contexts is currently unknown. The distance from DB to primary bedrock sources of Permian chert is approximately 75km (47mi) to the west.

<u>Wreford Chert</u> (adapted from Blasing 1984:6-7, 9-10): The Schroyer and Threemile Limestone Members of the Wreford Limestone Formation produce cherts which typically occur as horizontal beds of coalescing rounded masses or nodules ranging from a few inches to a few feet across. Occasionally, isolated, spherical nodules are also present (Blasing 1984:9). Wreford chert matrix is either a yellowish brown and fairly limey weathered limestone, or a translucent to nearly opaque, whitish rind. Both types of cortex occur together in the same nodules (Blasing 1984:10-11).

Fossil inclusions and chert content differ only slightly between the Threemile and Schroyer Members. The four chert beds of the basal Threemile Member contain *Composita*, *Derbyia*, *Dictyoclostus*, *Enteletes*, *Aviculopinna*, and *Welleria*, as well as Echinoderms and Bryozoans. The thinly bedded chert of the middle unit contains *Fenstrellina*, *Composita*, *Dictyoclostus*, *Derbyia*, and *Chonetes*, echinoderms, bryozoans, and cup coral. The chert-rich uppermost unit of the Threemile Member commonly includes *Aviculopinna*, *Allorisma*, *Schizodus*, *Astartella*, plus assorted brachiopods, echinoderms and bryozoans. In the southern Flint Hills, clam borings and *Osagia* occur in this member. The basal unit of the Schroyer Member has three to six beds of light to dark gray chert. Common fossils include: *Derbyia*, *Compositas*, *Dictyoclostus*, bryozoans, crinoids, echinoids, and more rarely *Aviculopinna*, trilobites, and corals. The middle shaley unit of the Schroyer commonly contains a cherty limestone section; fossils include brachiopods, bryozoans, and fragmentary echinoderms in the limestone and *Derbyia*, *Dictyoclostus*, *Composita*, *Chonetes*, bryozoans, echinoderms, corals, trilobites, and ostracods in the shaley parts. The uppermost unit is a hard, algal, chert-free limestone. Fossils include: Osagia-like algae, tiny gastropods, ostracods, and fragments of crinoids, bryozoans and brachiopods (Blasing 1984:6-7). Further work is needed to determine if fossil inclusion differences can be used to distinguish cherts from these two members.

Two general types of Wreford chert, present in both the Threemile and Schroyer Limestone Members, have been identified. The varieties most often occur together in the same deposit, but are also found individually in bedded and nodular forms. One variety is a "highly siliceous, compact to slightly porous chert, which is found in almost all localities and ranges from light to dark gray, pale blue to blue/gray, grayish yellow or mottled in coloring. It often forms a light colored patina and normally contains highly fragmented fossils" (Blasing 1984:10). This variety is divided into subtypes: Wreford A and Wreford B. Wreford A is limited in distribution to the southern Flint Hills, from Cowley County southward. It is a uniform buff to tan or gray/buff chert of medium fine grain with Munsell values ranging from 10YR7/4, 5Y6/1 to N70. Wreford B is a blue/gray to gray chert with common Munsell values of 5B4/1 to 5B7/1 and N30 to N90. Values of 5B6/2 to 5B4/2 and 5Y5/1 also occur occasionally. Mottling consisting of darker splotches on a lighter background matrix of a similar color is frequently present. Mottles typically have a Munsell value of around N40. A subtype of Wreford B is a uniform dull, dark blue/gray or gray chert (Munsell=N40) containing many small, white fossil fragments and a texture ranging from fine to medium grain. Wreford B is the most common of these varieties and can be found throughout the Flint Hills (Blasing 1984:10). The second variety is sparsely fossiliferous, brownish gray, bluish gray or dark gray, prominently banded, porous calcareous chert with a medium grained texture. Munsell values vary from 5Y4/1 to 5Y5/1 or 5Y6/1 and 5Y5/2. Gray varieties are N40 to N50. Blasing calls this material Wreford C and notes that a similar material occurs in the Florence outcrops of central Kansas (1984:10).

Florence Chert: Chert from the Florence Limestone Member of the Barnestone Formation typically occurs as layers of irregular nodules in beds one to six inches thick. Four varieties of Florence chert have been described in the literature (Blasing 1984:11, 13).

Florence A (Kay County Chert, Maple City Chert) is fine-grained chert, often banded in a pattern commonly described as "wood-grained" (with darker bands towards the exterior and very fine bands near the interior of nodules). Large fusulinids are the most common fossil inclusion noted in this material. Frequently found thermally altered in the archaeological record, Florence A turns from buff to yellow/gray (Munsell values: 5Y4/1, 5Y5/1, 5Y5/2, 5Y7/2, 5GY7/1, N60, N70) to a pink or bright red (Munsell values: 5YR7/1 to 5YR7/2). Florence A has not been identified at the DB site. The geological distribution of Florence A is restricted to the southern Flint Hills, from southern Butler County, Kansas into Kay County, Oklahoma. The archaeological distribution of Florence A is much larger than its geological distribution, but primarily oriented toward the southern Plains.

Florence B is a steel gray to blue/gray material mottled with dark splotches on a lighter background of a similar color. Munsell values range from N30 to N80 and 5B6/1 or 5B7/1, with darker mottles usually near N30. Fine to medium-grained, Florence B weathers to a tan or rusty brown. Thermal alteration has little effect on this material, although "light blue/gray varieties sometimes turn very pink with the darker mottles turning darker gray" (Blasing 1984:13). Florence B is difficult to differentiate from Wreford B, although Haury claims they can be distinguished on the basis of fossil content; Florence B apparently contains more fusulinids relative to Wreford B, which generally contains more echinoid spines (Haury 1984:196). Fossils in both materials are abundant and fragmented. Florence B is common throughout the Flint Hills.

Florence C is a uniform gray chert, which often exhibits a brown patina if the material is in cobble form. It has a localized distribution throughout the Flint Hills (Blasing 1984:11). Haury notes that the relationship of this material to Florence B is unclear, noting that its distribution and color variation closely matches Florence B. Haury never found the material in a bedrock outcrop, only as large cobbles in creek beds. She classified it as a separate type because of its "homogeneity of texture and color and because none of the identifiable fossils found in B can be found in Florence C specimens" (Haury 1984:76).

Florence D is a highly lustrous, gray to buff, fine-grained chert containing many thin bands of a darker, more translucent material. Background Munsell values include: 5Y4/2, 5Y6/1, 5Y6/2, 10Y4/2, 10Y6/2, and N40 to N70; while band colors are generally 5Y2/1, 5G2/1, 5Y3/2 and N20. Florence D changes to "very red or pink when heated, with the bands remaining darker" (Blasing 1984:13). It occurs as small nodules or as thin beds and is not very abundant in situ, although erosion has concentrated it in some places as residuum. This type has only been found "in the northern Flint Hills, from about Interstate 70 north, but similarly colored, unbanded or marginally banded material is found in many areas of the Flint Hills" (Blasing 1984:11). This latter material has Munsell values of 5Y3/1, 5Y5/1, 5Y6/1, 5GY6/1, 5Y7/1, 5Y7/4, 5Y8/1, 10YR5/2, 10YR6/2, 10YR7/2 and N40 to N80 and is usually fine to medium-fine grained. Florence D is "probably the type described by Carlson and Peacock [1975] as Flint Hills chert" (Blasing 1984:11).

Mississippian Cherts

Various Mississippian-age cherts from west-central Missouri are present at DB. These materials begin to outcrop approximately 130-140km from the site along the Missouri River trench (distance based on Reid 1980b:Fig. 8). Chert from several geologic formations in Missouri is commonly called "Burlington", or Osagean; these terms include highly variable cherts from the Pierson Formation, and Burlington or Keokuk Limestones (Ray 1984:119). In west-central Missouri, Burlington chert commonly occurs as continuous layers or as large, irregular nodules (Ray 1983:119). Collectively, these materials range from densely fossiliferous to virtually fossil-free and are generally opaque. Colors are generally white, very light gray, tan or buff in unheated specimens; thermal alteration produces shades of weak red, pink or orange. Texture can range from fine grained and highly lustrous to coarse, dull, and chalky (Luedtke and Meyers 1984:293). Fractures in Burlington chert often extend around incompletely silicified fossils rather than through them (Ray 1983:121).

In addition to these criteria, there are several fossil indicators which make it possible to identify a chert as Mississippian in origin. Large crinoid columns "are characteristic of several

Mississippian cherts. For example, specimens contained in Burlington chert are frequently 5-10mm in diameter" (Morrow 1994:113). Solitary corals (up to 40mm diameter) "with pronounced septa [partitions between cavities] are typical of Burlington and Keokuk chert" (Morrow 1994:113). Bryozoa, microscopic colonial organisms that form in a variety of shapes, are common in certain midwestern cherts. Fenestrate bryozoa (web-like colonies of fan shapes that appear as a curved linear arrangement of dots in transverse section) are also particularly common in Burlington and Keokuk chert, as are large brachiopods (Morrow 1994:111). The almost total absence of fusulinids in Mississippian cherts and their relative abundance in Pennsylvanian/Permian cherts is the key difference used to differentiate these materials (Reid 1984c:256).

Morrow (1994:123-124) provides detailed descriptions of various Mississippian cherts that occur in Iowa archaeological contexts. Materials that match Morrow's varieties 17 (Burlington White Mottled Chert), 19 (Burlington Fossiliferous Chert), and 20 (Keokuk Chert) descriptions are present at the site, but a lack of adequate comparative samples precludes the assignment of DB artifacts to these specific varieties.

<u>Burlington White Mottled Chert</u>: This material, originating in the Burlington Formation of the Osagean Series, is common in southeast Iowa, northeast Missouri and west-central Illinois. Burlington chert occurs in nodules and nodular beds up to 50cm thick, is typically white to very light gray (N9, N8) and may or may not contain mottled bands of light gray or light grayish brown (N7, 5YR 8/1, 5YR 7/1, 5YR 6/1). This variety

> frequently contains scattered crinoid columns up to 10 mm in diameter as well as fenestrate bryozoa. Small branching bryozoa are sometimes present but are much rarer than fenestrate forms. Sometimes brachiopods and solitary corals with pronounced radial septa occur as well. These fossils usually appear as white "ghosts" in an off-white matrix or as clear or tan crystalline inclusions. Texture is medium to medium-fine and luster is dull to satiny. Translucency is typically observed at a thickness of 1-2mm (Morrow 1994:123).

Thermal alteration produces a satiny to glossy luster and may cause very light gray specimens to turn pure white (N9 or, more commonly, very pale pink [10R 8/2]); "slightly darker mottled areas are frequently left more orange or red-tinted (5YR 8/4, 10YR 8/2, 10R 6/2)" (Morrow 1994:123).

<u>Burlington Fossiliferous Chert</u>: This material is found throughout much of Des Moines county in southeast Iowa and ranges in color from light gray to cream and tan (N8, 5YR 8/1, 5YR8/2, 5YR 7/1, 10YR 8/4, 10YR 7/2, 10YR 7/4). This material is packed with indistinct fossil inclusions about 1-2mm in diameter that are somewhat spicular in appearance and usually darker than their encasing matrix. Most Burlington fossiliferous chert exhibits a medium-coarse or medium texture and dull luster, and is opaque to translucent at 1 mm thickness. Thermal alteration commonly produces a pink or red color (5 YR 7/2, 10 YR 7/2, 10R 8/2, 10R7/4, 10R5/4); "texture and luster may remain unaltered, but a satiny luster is sometimes produced"

(Morrow 1994:124). Off-white to tan pieces of this material are "virtually indistinguishable from unmottled pieces of Keokuk chert", which is usually slightly finer grained and occasionally contains larger, more complete bryozoa (commonly branching in form) and brachiopod fossils (Morrow 1994:124).

Keokuk Chert: Keokuk chert is derived from the Keokuk Formation of the Osagean series and is common in extreme southeast Iowa (Morrow 1994:124). The Keokuk is lumped with the Burlington Limestone on most geologic maps in Missouri, so the distribution of this variety in Missouri is currently unknown (Ray 1983:119). In Iowa, "Keokuk chert occurs in nodules and nodular beds up to 10-20 cm thick" and "ranges from off-white or buff to gray, bluish gray, or brownish gray (N8.5-N6, 5PB 8/2, 5PB 7/2, 5YR 8/1, 5YR 7/1, 5YR 6/1, 5YR 6/4, 10YR 8/6, 10YR 6/2)" (Morrow 1994:124). Gray and "bluish gray pieces are usually fairly homogeneous in color", but "buff, tan and brownish gray specimens may be heavily mottled or streaked" (Morrow 1994:124). Crinoid columnals and small brachiopods may occur as whitish inclusions against the darker areas of the chert. Tiny, dark fossil inclusions, especially sponge spicules, are often present in dense concentrations and bryozoa, particularly branching forms, are common. Texture is typically medium to medium-fine, luster is dull to satiny, and the material is rarely translucent at a thickness of 1mm. Thermal alteration enhances luster but tends not to change the color of gray and bluish gray pieces; buff or brown pieces typically become pink or red (5YR 8/1, 5YR 7/2, 5YR 6/1, 5R6/2, 10R8/2, 10R7/2, 10R7/4, 10R6/2, 10R6/6). Usually streaked or mottled, Keokuk chert is one of the few fossiliferous cherts that exhibits this color pattern. However, "unmottled pieces are difficult to distinguish from Burlington fossiliferous chert" (Morrow 1994:124).

The generic term "Mississippian chert", as used in this analysis, encompasses all light-colored, fossiliferous to non-fossiliferous cherts which lack fusulinids and compare favorably in color, texture, luster, translucency, and inclusion content to the Mississippian comparative specimens present in the KUMA-LCC. Further research into the distribution and development of key identification criteria for Mississippian chert varieties found in Missouri will hopefully produce more specific source assignments for DB artifacts in the future.

Smoky Hill Silicified Chalk

Smoky Hill silicified chalk (also known as Smoky Hill silcrete, Niobrara Jasper, Republican River Jasper, Graham Jasper, or Niobrarite) forms in the Smoky Hill Member of the Cretaceous-age Niobrara Formation when a geologic unconformity due to the erosion of the Pierre Shale allows the Ogallala Formation to rest directly on the chalk. SiO_2 supplied by the Ogallala silicifes the chalk into varying degrees of hardness. Tabular form is most common, although nodules also occur. Colors vary dramatically within a given outcrop; shades of yellow, brown, red, green, and white are the most common. Material texture and luster is also extremely variable, ranging from fine-grained and lustrous to dull and chalky in a single piece. Fossil inclusions are not usually present, but abundant, small yellow chalk inclusions and specks are considered fairly diagnostic of this material. Microscopically, this material consists of distinct chalk particles coated with silica. Fractures pass through the grains or around the grains depending on the amount of silica present. The microfabric characteristics of this material make it fairly distinctive, although less silica-rich pieces may potentially be confused with porous cherts of a similar color and luster. Only one artifact from DB, a scraper/flake tool, has been identified as Smoky Hill silicified chalk, a determination that was coded as a probable identification.

Unidentified Lithic Resources

Unidentified lithic artifacts are not necessarily from exotic sources. Reasons for assigning specific artifacts to the unidentified category were noted in the comment column of the raw material database. A total of 51 artifacts (13.4%; total n=380) was coded as unidentified; only six of these were positively identified as exotics having no local, near-local, or known exotic analogs. One artifact was described as being too small to identify; ten more that lack level of certainty data or adequate descriptions have been assigned to an indeterminate category. The remaining 66.7% of the unidentified artifacts (n=34) are described in the comments as overlapping with the known lithic resources described in this chapter. A total of 70.5% (36/51) of the unidentified artifacts was smaller than 2.5 cm, suggesting artifact size may influence the ability to confidently assign source designations.

Identification Evaluation

One application of level of confidence data is to provide a means to investigate raw material identification problems. Two problems encountered during this analysis require investigation: the Toronto/Westerville debate, and the newly formulated Toronto/Mississippian controversy.

Toronto/Westerville: 10.5% (6/57) of the artifacts probably (3.5%) or indeterminately (7.0%) identified as Toronto were identified in the comments as a potential Westerville look-alike. Overlap with Westerville chert accounts for only 5.7% (2/25) of the probable, 18.2% (4/22) of the indeterminate, and 7.3% (6/82) of the total Toronto designations.

Toronto/Mississippian: A total of 40.4% (19/47) of the artifacts probably or indeterminately identified as Toronto chert was identified in the comments as potentially Mississippian, whitish, or grainy whitish cherts. This accounts for 72.7% (16/22) of the indeterminate, 12% (3/25) of the probable designations, and 23.2% (19/82) of the total Toronto designations. The impact of this identification problem on this analysis is ambiguous because 44.7% (21/47) of the total probable and indeterminate samples had no comments explaining the reasoning behind these source determinations. However, while only one indeterminate (1/22) sample was not assigned a level of certainty, 80% (20/25) of the probable samples were not. This suggests size or thermal alteration, not potential overlap, may be the source of confusion in the probable cases.

A chi-square "goodness-of-fit" test was conducted to evaluate the significance of these two identification problems. The null hypothesis is that all identification problems occur equally. Table 10.2 provides the data. The test statistic is significant at the 98% confidence level. Further investigation reveals that the Westerville-like samples contribute most of the test statistic value (5.99/9.21) by occurring far less frequently than the expected value. I interpret this to mean that the potential for confusing Westerville with Toronto chert is minimal, and that the other identification problems are more significant. Size and thermal alteration should be further investigated to determine how these two factors influence identifications.

Table 10.3 provides the level of confidence determinations for each of the raw materials identified at DB. Consistent collection of these data will make it possible to assess the reliability of microscopic visual identification compared to other techniques. Conducting blind test using geologic samples could help establish the accuracy and precision of this method in the absence of reliable comparative data from other analyses. Verification of this method is desirable in order to increase confidence in an analyst's ability to accurately and consistently identify lithic raw materials found in the archaeological record, in turn increasing confidence in interpretations based on raw material data.

Lithic Resource Use at DB

Figure 10.3 provides the overall breakdown of raw material types present at DB; Figure 10.4 shows the total Permian and Plattsmouth contributions. Figure 10.5 regroups the data into local, near-local, exotic, and unidentified categories. The chipped-stone assemblage is definitely skewed toward local lithic resources. Potential differences in patterns of lithic resource use between the upper and lower components are explored in the following section. Table 10.4 provides the raw data used in that discussion. The composition of the unidentified category is discussed in the preceding section; if the six unidentified exotics were confirmed as legitimate exotic artifacts, the total exotic category increases to 23%, and the unidentified category decreases to 12%.

Documenting changes in lithic resource use through time can help us understand similarities and differences in resource procurement strategies and settlement patterns between diverse groups of prehistoric peoples practicing very different lifeways. One of the primary goals of this analysis was to examine the lithic resource data from a temporal perspective to determine if there are any significant differences between the Late Prehistoric upper component (0-10cm bg; 20-30cm bs) and the lower (>20cm bg; >40cm bs), earlier components (chapter 14). A chi-square 2x2 contingency test was chosen to determine if the proportions of local and near-local cherts vs. exotic cherts from the upper and lower components equal or differ using artifacts with secure level provenience and specific raw material (local, near-local, or exotic) assignments. Unidentified artifacts, as well as artifacts from surface or unprovenienced contexts were excluded. The following hypotheses were evaluated (Logan 1996a:100):

Table 10.2 Chi-square test to evaluate if Toronto identification problems occur equally or unequally

	Mississippian-like	Westerville-like	Unidentified	Total
Observed	19	6	22	47
Expected	15.7	15.7	15.7	47

χ^2=9.2, .01<p<.02, df=2

Table 10.3 Level of Confidence Data

Raw Material	Exotic	Indeterminate	Positive	Probable	blank	Totals
Florence	0	6	14	22	0	42
Permian	0	0	0	5	0	5
Wreford	0	0	3	6	0	9
Mississippian	0	4	1	19	0	24
Niobrara Jasper	0	0	0	1	0	1
Westerville	0	4	0	3	0	7
Winterset	0	2	15	12	0	29
Toronto	0	22	35	25	0	82
Plattsmouth	0	11	7	5	0	23
Plattsmouth A	0	1	23	25	0	49
Plattsmouth B	0	0	11	2	0	13
Plattsmouth C	0	5	18	15	0	38
TRSS	0	0	0	2	0	2
Ferrous Oxide	0	0	5	0	0	5
Unidentified	6	33	0	0	12	51
Totals	6	88	132	142	12	380

Table 10.4 Count of local, near-local, and exotic artifacts by component

Component	Local	Near-Local	Exotic	Unidentified	Totals
Upper (0-10 cm)	48	11	12	13	84
Transition (10-20 cm)	31	7	7	9	54
Lower (>20 cm)	86	10	31	17	144
Totals	165	28	50	39	282

Table 10.5 Chi-square test to evaluate lithic resource use by component

Component	Exotic	Local/Near-Local	Totals
Upper	12 (E=15.42)	59 (E=55.58)	71
Lower	31 (E=27.58)	96 (E=99.42)	127
Totals	43	155	198

χ^2=1.51, p>.20, df=1

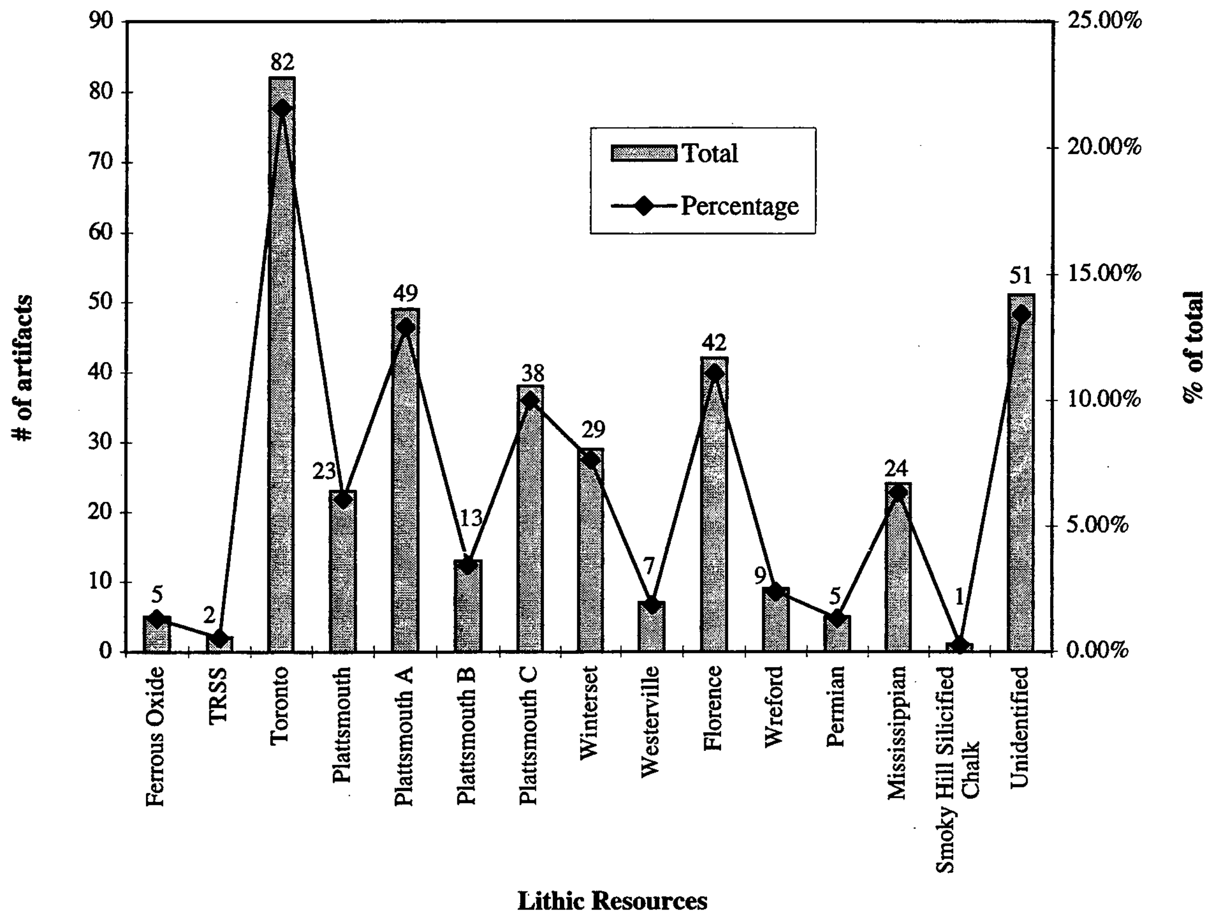


Figure 10.3. Frequency of lithic resources from the DB site (n=380).

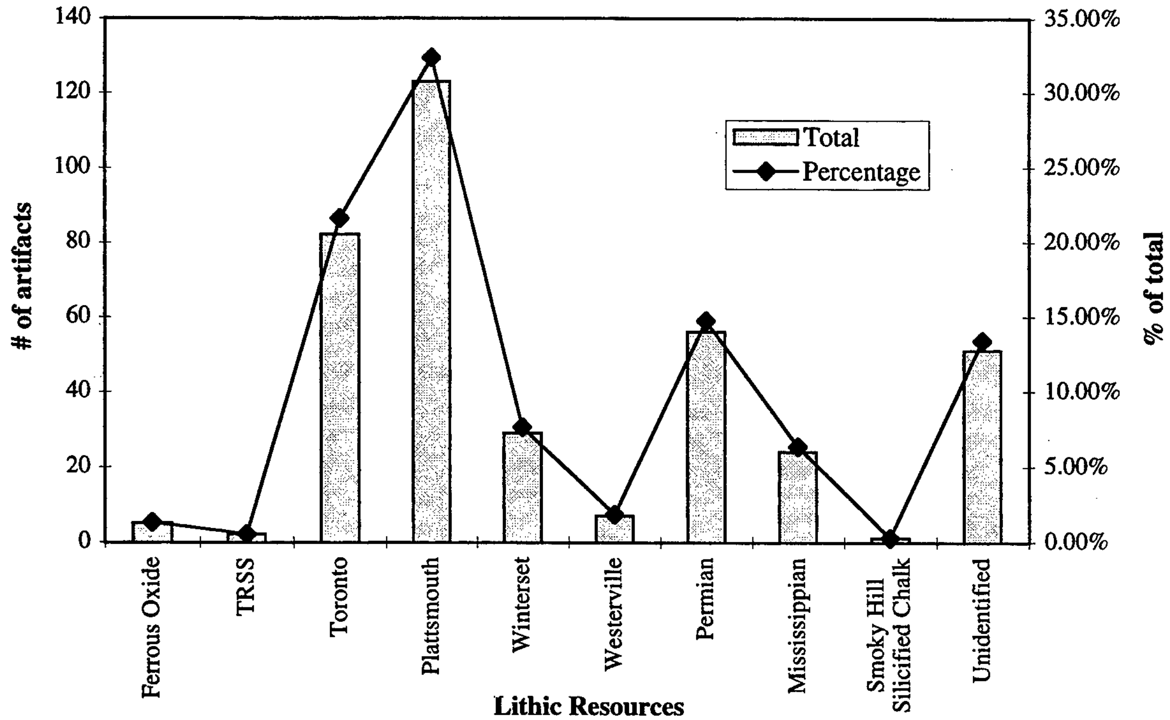


Figure 10.4. Lithic resources at the DB site (n=380).

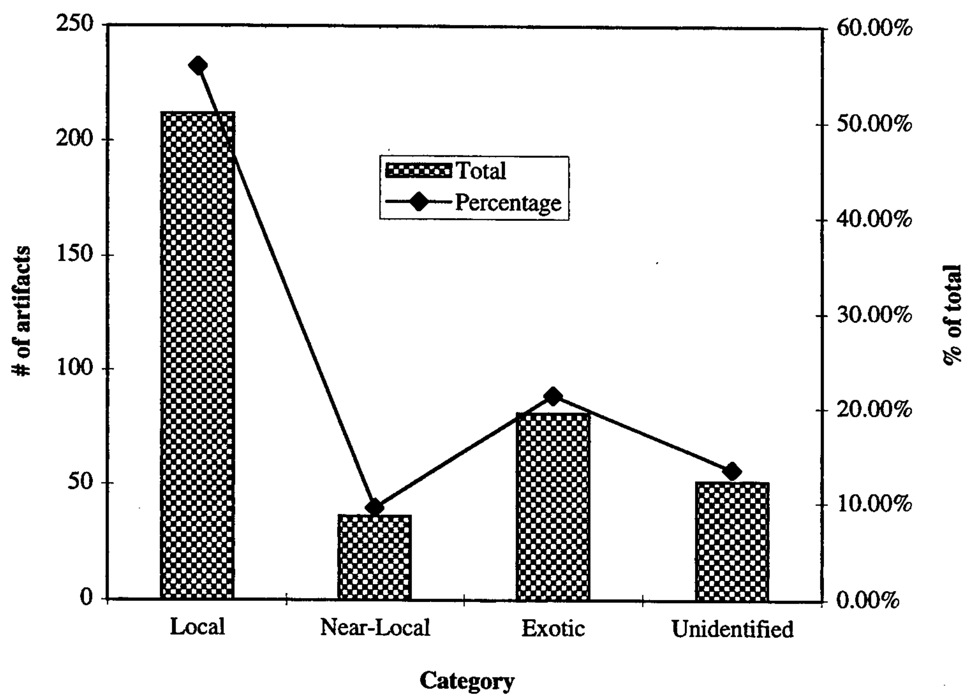


Figure 10.5. Frequency of local, near-local, exotic and unidentified materials at the DB site.

HO: The proportions of local vs. non-local cherts in the lithic assemblages from the upper and lower components do not vary significantly.

H1: The proportions of local vs. non-local cherts in the lithic assemblages from the upper and lower components do vary significantly.

Table 10.5 provides the test data. The calculated chi-square test statistic ($n=198$, $c^2=1.51$, $p>.20$) indicates that the null hypothesis cannot be rejected at any reasonable significance level. The observed differences between the upper and lower components are no more than would be expected due to sampling variation. The absence of significant differences in lithic resource use between the major components could mean that lithic procurement strategies were relatively stable throughout the time periods represented at DB, with local resource use dominating the prehistoric economy during all time periods. However, additional data from the remainder of the chipped-stone assemblage are needed to further evaluate this hypothesis.

Alternatively, mixing may have obscured any distinct temporal resource use patterns that may have existed at the site, or the process of combining data from multiple components into a single lower component has homogenized differences between otherwise discrete temporal occupations. Further investigation indicates that both of these factors are influencing the chi-square result. Diagnostic projectile points with confirmed raw material identifications (n=85) were used to investigate the lack of significant differences between the upper and lower components. Trends in the projectile point data help explain why no differences were found to exist. The Late Prehistoric, or upper component, contains 33% non-local, and 66% local lithic resources. In comparison, the combined data from the lower component (Archaic/ Woodland, Archaic, Paleoindian) likewise contains 32% non-local, and 68% local materials. When the lower components are separated into discrete temporal entities based on projectile points, a very different pattern emerges (Fig. 10.6). Paleoindian points indicate an equal reliance on local and non-local resources (1:1), while the Archaic data suggests a 3:1 ratio of local vs. non-local, and the Archaic/Woodland mirrors the Late Prehistoric data with a 1.5:1 relationship. The presence of Archaic projectile points in the upper component and Late prehistoric projectile points in the lower component confirms that mixing has occurred (Table 10.6). Additional comparisons between single component Forest City Basin sites and DB will help evaluate if the site data are homogeneous due to mixing, or representative of lithic resource use strategies in the region.

The amount of reworking of non-local and local projectile points provides additional support for differences between the Paleoindian/Archaic vs. the transitional Archaic-Woodland/Late Prehistoric evidence (Fig. 10.7). The Late Prehistoric and transitional Archaic/Woodland points share a tendency towards increased reworking of non-local materials relative to local materials. In contrast, Archaic and Paleoindian points show equal reworking of both local and non-local materials. This earlier tendency towards indiscriminate conservation may reflect a fundamentally different approach to technological organization and raw material economics; one based on greater mobility and overall restricted access to raw materials rather than unrestricted access to locally available materials and limited access to non-local materials. Additional analysis of the chipped stone assemblage is required to fully evaluate this hypothesis.

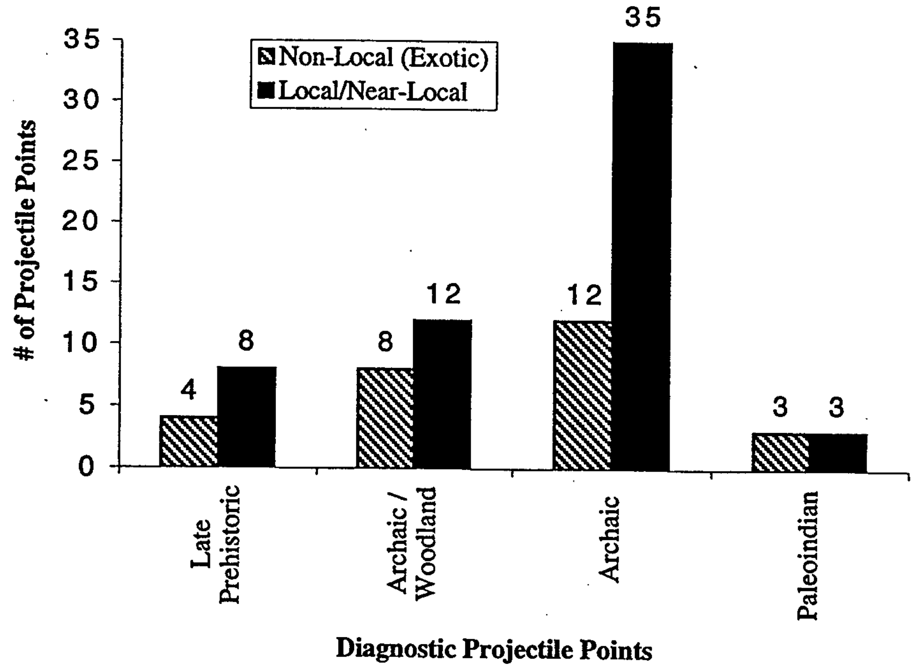


Figure 10.6. Breakdown of diagnostic projectile points (n=85) by local/non-local cherts.

Table 10.6 Diagnostic Projectile Points by Provenience

Component	Late Prehistoric	Woodland/Archaic	Archaic	Paleoindian	Totals
Upper (0-10 cm)	6	2	15	0	23
Transition (10-20 cm)	1	1	5	0	7
Lower (>20 cm)	1	6	11	4	22
Surface	2	4	7	0	13
Plowed Surface	2	1	1	0	4
Graded Surface	3	7	15	3	28
Unknown	0	0	1	0	1
Totals	15	21	55	7	98

Table 10.7 Chi-square test to evaluate western vs. eastern exotic lithic resource use by component

Component	Western	Eastern	Totals
Upper	9 (E=8.65)	3 (E=3.35)	12
Lower	22 (E=22.3)	9 (E=8.65)	31
Totals	31	12	43

Sample size in cell n=3 is insufficient to complete the test.

Table 10.8 Chi-square test to evaluate Plattsmouth vs. Toronto lithic resource use by component

Component	Plattsmouth	Toronto	Totals
Upper	29 (E=31.13)	19 (E=16.88)	48
Lower	54 (E=51.88)	26 (E=28.13)	80
Totals	83	45	128

$\chi^2=0.67$, $p>.20$, df=1

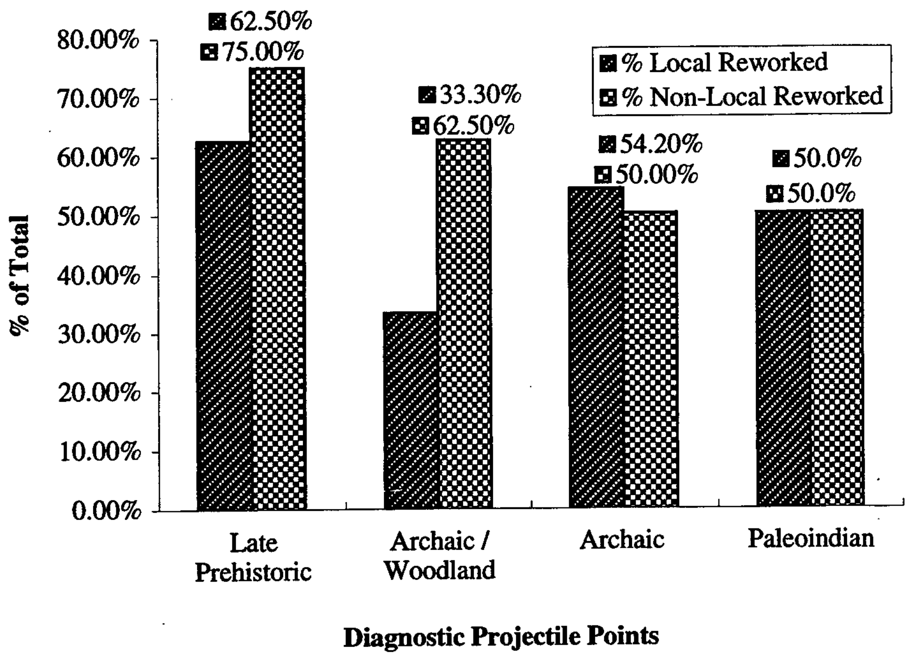


Figure 10.7. Frequency of reworked diagnostic projectile points (n=85) by local/non-local cherts.

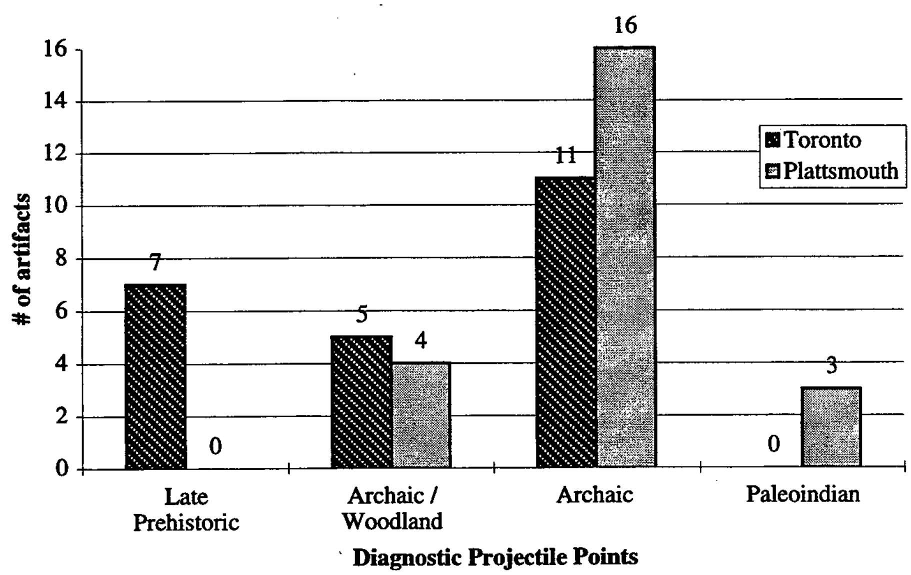


Figure 10.8. Frequency of diagnostic projectile points made of Toronto and Plattsmouth cherts.

Reid's suggestion that Late Archaic peoples in the region were "facing east" with regard to their exotic lithic resource procurement strategies is also testable using data from DB (1984a: 101). A second chi-square test (Table 10.7) was used to determine if the use of western exotic resources (Permian cherts, Smoky Hill silicified chalk) vs. eastern exotic resources (Mississippian cherts) varies between the components. The sample size is insufficient to complete the test, but it appears that eastern and western lithic resource use is very similar between the two components. Claims that Late Archaic groups entered the Forest City Basin from the east via major east-west drainages and remained oriented towards the east are not well-supported by the DB raw material data (Reid 1984a:99). In fact, the diagnostic Late Archaic projectile points from DB include equal proportions of Permian (n=6) and Mississippian (n=6) cherts. Further research documenting the appearance of exotic lithic resources into the region is clearly needed before we can begin to interpret large-scale Late Archaic mobility and procurement patterns based on patterns in the lithic raw material data. Data from temporally distinct or well-stratified sites are needed to adequately investigate these issues.

On a local scale, Logan argues that higher-quality, inclusion-free Toronto chert was preferred over more abundant, but lower quality Plattsmouth chert in his study of the Stranger Creek drainage system in west-central Leavenworth County (1985:241-245). A third chi-square test (Table 10.8) indicates that Plattsmouth and Toronto cherts are similarly distributed in the upper and lower components of the DB site ($n=128$, $c^2=0.67$, $p>.20$). Overall, 32% (123/380) of the chipped-stone tools were made out of Plattsmouth, and 22% (82/380) were made out of Toronto. Easy access to Plattsmouth within 1km of the site could be interpreted as overriding any inherent advantages Toronto offers in terms of raw material quality. Alternatively, data presented in Figure 10.8 clearly suggests temporal patterning with regard to the use of these two raw materials.

All Late Prehistoric arrowpoints are made of Toronto chert, and all Paleoindian points are made of Plattsmouth. Plattsmouth use remains high during the Archaic, but begins to decline during the Archaic/Woodland transition. Again, these divergent data indicate mixing may be responsible for the homogenization present in the upper and lower components. Sample sizes within the projectile point data are too small to statistically address temporal differences in the use of these two material types, but these data suggest strong preferences which should be investigated further. Multiple factors could be influencing these patterns. For instance, preferential Paleoindian lithic resource use has been linked to last direction of movement on the landscape, or, in Late Prehistoric contexts, to socio-economic conditions which dictate which materials are used. In the Paleoindian case, it is tempting to conclude that the patterning represents movement from the east into the Forest City Basin, one explanation of why Toronto was bypassed, but the specific point style evidence indicates this is not the case. The two Folsom point fragments are made of Mississippian and Permian cherts, while the two Dalton points fragments are made out of Permian and Plattsmouth materials. Two additional Paleoindian lanceolate bifaces/points are also made out of Plattsmouth chert. Paleoindian artifacts made of buff chert have been documented in the lower Kansas River basin, but their absence at DB is intriguing (Wetherill 1995). The absence of Toronto Paleoindian artifacts at

DB may be related to retooling events at local Toronto quarries, rather than avoidance of this material type. Additional documentation on the raw material composition, and artifact condition of Paleoindian assemblages from the area is needed to evaluate this hypothesis. Likewise, the Late Prehistoric data may reflect socio-economic factors, such as the distribution of chipped-stone tools made by craft specialists, rather than quality preferences or direction of movement, but again, data from other sites is needed to evaluate these hypotheses. Both cases underscore the need for additional raw material research in the region, and raw material preference research in particular.

Conclusion

This analysis has described and quantified the lithic resources present at DB. A new method of quantifying uncertainty in source designations was also introduced and used to evaluate two common identification problems. Data from this analysis suggest local lithic resources were more important than non-local resources throughout the four general time periods represented at DB, but that non-local resources were used throughout the occupation of the site. Evidence for homogenization of data between the upper and lower components is documented, and the impact of stratigraphic mixing on our understanding of temporal trends in raw material use at DB is discussed. Several lines of evidence related to prehistoric mobility are explored, but additional data from the assemblage are needed to fully investigate this issue. Comparisons to raw material data from well-dated single component, or well-stratified multi-component sites in the region are needed before the full potential of the DB raw material data can be realized.

Chapter 11

Cobble Tools and Other Modified Cobbles

Margaret Beck

Introduction

This chapter and the following chapter describe the groundstone artifacts recovered from the DB site during the Phase IV investigations. Groundstone artifacts are defined here as pieces either formally shaped through grinding (perhaps in conjunction with other methods such as pecking) or modified through use as a grinding implement. Although hammerstones and similar implements do not fall into either category, they are included here with the "groundstone" as it is traditional to do so. The entire range of identified groundstone types at 14LV1071 includes axes, abraders, manos and expedient grinding stones, hammerstones and one ground hematite slab with an incised design.

The glacial till was apparently a rich source of material for the groups who visited the DB site. Almost all of the groundstone artifacts are made of materials from glacial till deposits; the only exceptions are the abraders, which are made from scoria and sandstone. Over a period of about 7,000 years, these tools, raw material, and manufacturing debris accumulated. 80.03 kg were recovered from the 163m^2 of the excavated block; 67.05 kg of this was mapped in, while an additional 12.98 kg was collected during water screening of the fill. About 95 kg more was found and mapped while the site was being graded after excavations were complete. (The total mass of unmapped fragments and smaller pieces recovered from the graded area has not been calculated.) The axes, abraders, formal manos and hematite pieces were easily sorted from the collection, and the investigators were then faced with boxes and boxes of glacial cobbles of varying sizes, shapes, and traces of wear.

This paper represents the author's attempts to determine what purposes some of these cobbles may have served and what they suggest about the nature of the occupations at the DB site. The manos, in this case the simplest of the tools to manufacture and the closest to their original form, are analyzed with the cobbles for comparison with the apparently unshaped expedient grinding tools. Axes, celts, abraders, and hematite artifacts are discussed in the following chapter.

Sample Selection

Artifacts from 14LV1071 can be divided into two categories: those recovered during excavation (163m^2) and those recovered during monitored grading of the remainder of the site (about 3,500m^2). It seemed convenient to limit the sample to excavated pieces for several reasons. First, the smaller assemblage size meant that pieces could be studied more intensively. Secondly, the context and content of the excavated sample is much more secure. It was observed during fieldwork that the grader occasionally moved pieces and carried them for some distance. It is not known if or how many pieces were buried in the backdirt piles around the graded area. Mapping was less systematic in the graded area, and some cobbles were not mapped upon discovery. In contrast, recovery was much better in the excavated block. Between the practices of mapping all pieces over 2.5 cm and water-screening the fill, the analyst can be certain that no cobbles were missed and that the extant assemblage from the block represents the entire groundstone assemblage in this area of the site.

All cobbles from the excavated block that are at least half complete are included in this analysis. Pieces less than half complete were considered to be fragments and were not analyzed. The analyzed 85 cobbles have a combined mass of 46.68 kg, and make up 58% of the mass of all glacial materials from the excavated block. If hematite and limonite, which are inappropriate materials for the cobble tools discussed here, are subtracted, the analyzed cobbles make up 70% of the mass of the remaining glacial materials.

By way of contrast, 104 pieces (which were at least half complete) were mapped in the 3,500m^2 of the graded area. As is noted above, this figure may underestimate the number of cobbles present in this area. However, mapping was biased toward more complete specimens, so this number may be a fair representation of the number of pieces that would have been analyzed from this area. In any case, only mapped pieces would have potentially been added to the analysis. Although this area is 21 times larger than the excavated block, it only contains approximately 1.2 times as many pieces for analysis. This means that, were the cobbles to be evenly distributed across the site, there would be one every 34m^2 in the graded area, as opposed to one every 2m^2 in the excavated block. This disparity continues when one looks at formal manos. One formal mano was found in the 163m^2 of the excavated block. Eight were found in the graded area, which, again assuming equal distribution, would equal one formal mano every 438m^2.

Of course the cobbles and cobble tools are not distributed evenly across the site, as revealed in Figure 11.1. The location of the excavated block was chosen because of the density of artifacts at the summit, and it is likely that the greatest density of artifacts is also in this area. Nevertheless, the point is that the block was expected to fairly represent the variability present within the overall cobble assemblage at the site. A review of the graded area pieces produced only one tool type that was not represented in the block: grinding slabs. Nine slabs, some of which were clearly used during grinding, were recovered during grading of the site and are discussed with the cobbles with evidence of grinding.

Classification of Cultural Wear Patterns

Even within the smaller assemblage from the excavated block, the author was faced with the task of categorizing a bewildering array of sizes, shapes, and wear patterns. Some of these

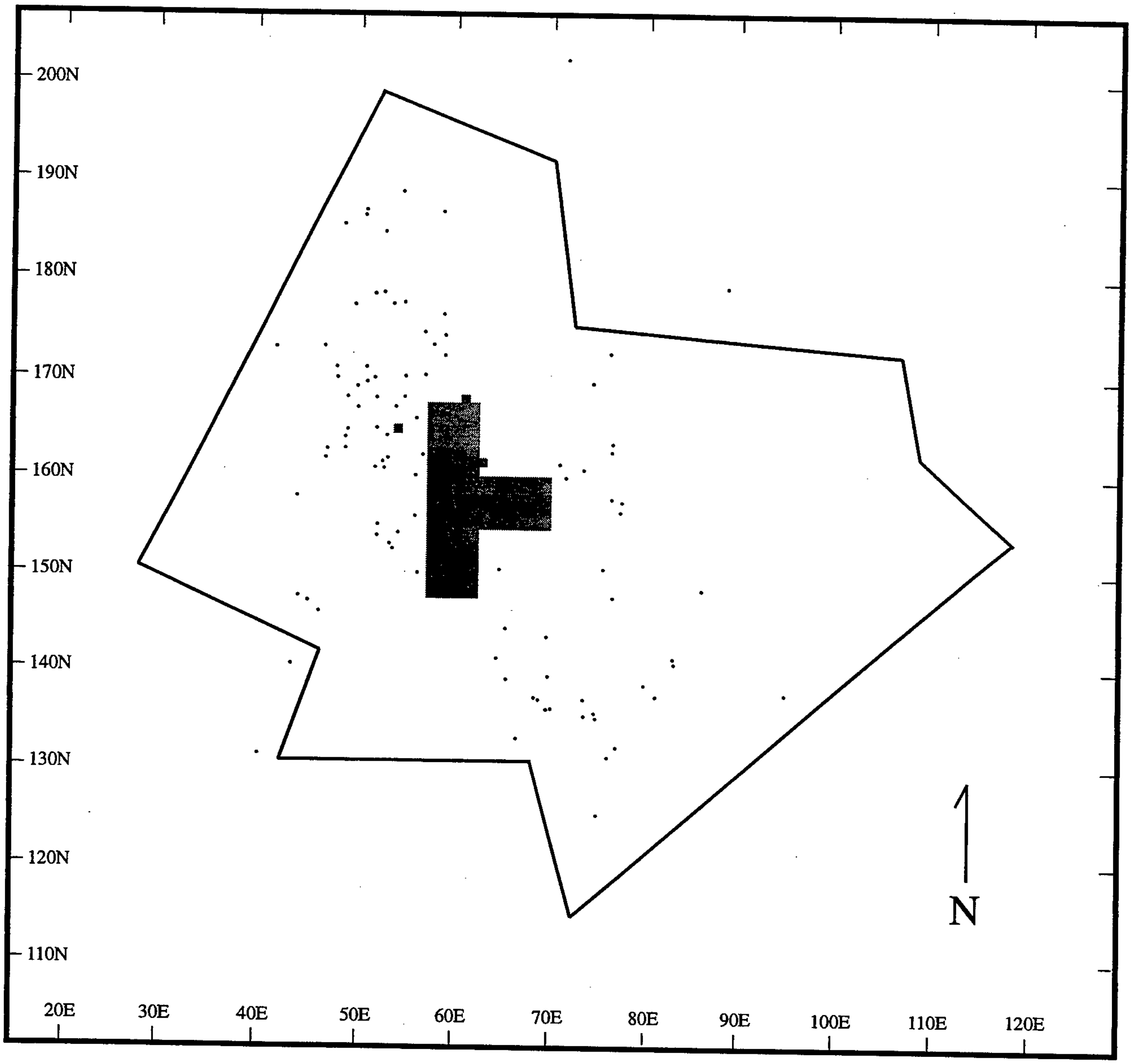


Figure 11.1. Distribution of mapped cobbles outside the excavated block.

pieces seemed to show traces of wear, while other cobbles were irregularly shaped with no apparent indications of use. The first step seemed to be to clarify what wear one should expect through use. This was first approached through a review of the use of similar groundstone objects in the past.

Observations of Groundstone Use: There are a variety of uses of unshaped as well as shaped stone artifacts reported in the ethnohistoric accounts of North American and Plains tribes. The most common function ascribed to groundstone artifacts in archaeological assemblages is the grinding of plant foods, both wild foods and cultigens.

> Grating, grinding, and milling foods mechanically breaks them up into finer particles that can be processed further or can be more easily chewed. . . the protective husk of grains is removed and more surface area is exposed so that digestion, the action of salivary amylase, may begin directly in the mouth (Wing and Brown 1979:169).

The use of a stone mano and/or metate for grinding corn was widespread in the New World and is reported for Native American groups in the Southeast (Swanton 1946:548), Southwest, and Plains, such as the Hidatsa in the Northern Plains (Weitzner 1979:215; Will and Hyde 1917:158-159).

The use of wild plant foods began well before the use of corn and other cultigens, and continued alongside agricultural practices. Seeds of uncultivated and domesticated varieties of amaranths and chenopods have been consumed in Mesoamerica and the Southwestern United States for thousands of years, and their use is both documented ethnographically and deduced from archaeological remains (see Thompson 1988). In the Southwest, amaranth seeds have been found associated with milling stones (Agogino and Feinhandler 1957) and recovered from the surface of such stones through pollen analysis (Bohrer 1972:24). Other wild foods, such as cholla and prickly pear cacti, grasses, and jojoba have been recovered through pollen analysis on Hohokam grinding tools (Greenwald 1990:73).

In the Plains, dried prairie turnips were pounded to be cooked later by the Mandan (Catlin 1973:122) and Blackfeet (Wissler 1910:22). A stone pestle and mortar were used by the Hidatsa to crush chokecherries for chokecherry balls (Weitzner 1979:215-216). The Blackfeet pounded wild cherries with their pits "on a stone" (Wissler 1910:21). In the Southeastern United States, stone mortars were used for cracking nuts (Swanton 1946:548).

Hayden (1987a) observed that modern Maya-speaking groups in Mexico and Guatemala used both shaped and unshaped groundstone tools in a variety of ways:

> Broken metates and manos [used for maize-grinding] often continue to be used as temper grinders, or as pestles and mortars for breaking up calcite temper; for grinding salt or pigments; for grinding sugar, coffee or cacao; for dehusking wheat, or for crushing medicinal herbs. For each of these uses there also exist

> specialized types of grinding stones of distinctive, preferred materials and morphologies (Hayden 1987a:191).

Specialized grinding stones for coffee, cacao, and spices were made of less porous materials than those used for maize-grinding implements "because of the fine grind desired and because of the desire to minimize loss of grounds in the vesicles of the groundstone." Such materials included quartzites or conglomerates, and the pieces may be minimally shaped (Hayden 1987a:202). Unshaped tools included the unmodified cobbles and large slabs or stones used to mash medicinal herbs and the soap root (*Cyclanthera langaei*) for use. The soap root, which could be used as a paste to bleach and clean fabrics, was not pounded on metates or other food-preparation surfaces due to either a bitter taste or mild toxicity (Hayden 1987a:203). The preparation of medicinal herbs was also isolated from food preparation. "Given the strong effects of many herbs for medicinal purposes, this is understandable" (Hayden 1987a:206).

There is evidence for some of these uses in the North American Plains. The Hidatsa reportedly used a stone hammer to crush "rotten granite taken from the fire pit in [the] sweatlodge" for pottery temper. During a pottery-making demonstration for Gilbert Wilson in 1910, this step took about 20 minutes (Weitzner 1979:261-262). The manufacture of paint from hematite or ocher is documented as well. Three Folsom sites in the Northwestern Plains contained grinding slabs stained with red ochre (Roper 1987, 1989). Medicinal herbs may well have been ground with stone implements. Gilmore (1991) describes a large number of plants used by the Native Americans in the Missouri River region, and some of these were pulverized and used medicinally; a powder from Jack-in-the-pulpit (*Arisaema triphyllum*), for example, was dusted on the head to treat headaches, and the "pulverized bark of the root [of the Kentucky coffee-tree (*Gymnocladus diocia*)]" caused uncontrollable sneezing if inhaled and was used to revive patients (Gilmore 1991:17, 38).

Animal products were processed in some cases with groundstone implements. "Invariably, both on the hunt and in the village," states Weitzner (1979:212), "cooked meat and fats were pounded [by the Hidatsa] with a long stone pestle manipulated with both hands." Meat was pounded either in a skin mortar, which consisted of a four inch deep and one and three-fourths feet diameter fitted with a skin covering, or against a stone (Weitzner 1979:212). Dried meat was pounded by the Mandan (Catlin 1973:116) and Blackfeet (Wissler 1910:22) to make pemmican.

Before the use of Euroamerican hatchets or axes, the Hidatsa split bones "with a stone hammer" and boiled them for bone grease (Weitzner 1979:212). The Blackfeet used hammers for crushing wild cherries, as noted above, but also to break bones to obtain marrow (Wissler 1910:22).

Wissler (1910:21-22) describes and illustrates hammers or mauls used by the Blackfeet. One specimen has a head

> made of stone, egg-shaped, and [with] a transverse groove around the middle. The handle is of wood, apparently double, passing around the head in the groove. Over the whole, is a firm covering of rawhide. The entire head, except for the mere surface of contact, is covered. . . [The maker of the hammer] stated that she found the stone already grooved. She had never heard of anyone shaping or grooving them, always using such as were found around old camp sites.

The three specimens discussed by Wissler have stone heads of slightly different shape, but all were grooved and apparently hafted to their wooden handles with rawhide or calfskin.

Stones, most likely unworked, were used in cooking by the Blackfeet. During war or hunting expeditions, men prepared meat or soup in a fresh hide or paunch, using stones that had been heated in a fire to boil the liquid (Wissler 1910:26-27). "Eggs of water fowl were [also] sometimes cooked in a hole with hot stones" (Wissler 1910:26). The camas root was baked in a hole about "ten feet square and three feet deep," lined with hot stones and wet willow leaves and branches and covered with willow brush and earth (Wissler 1910:25).

It has been observed from a review of ethnographic sources that a number of historic North American tribes, including the Hopi, Ute, Sioux, Crow, and Blackfeet may have used handstones at some point in hide-processing as well (Adams 1986, 1988a, b). There are four major steps in hide-working as outlined for the Blackfeet by Wissler (1910). (A more comprehensive discussion of Plains hide-working and associated tools can be found in Schultz 1992). After the hide is removed from the animal and staked out on the ground, (1) cleaning/fleshing is done in order to remove tissue and fat. (2) Scraping follows to work the skin into an even thickness. In (3) braining, the rawhide is placed on the ground and rubbed with oils, consisting of brains, fat, and perhaps liver. The mixture is put on with the hands and worked into the hide "by rubbing with *a smooth stone*" (Wissler 1910:63, emphasis added). The last step is (4) graining, rubbing, and drying. "The surface is vigorously rubbed with *a rough-edged stone* until it presents a clean grained appearance" (Wissler 1910:64, emphasis added). Laubin and Laubin (1977:90), based on conversations with modern Native Americans, suggest that pumice stone was used when available. Graining may also be done with a globular piece of bone, used like sandpaper (Seton 1962:124-125).

Not all historic Plains groups worked hides in this fashion, but the possibility is raised that, as suggested by Adams (1988a), handstones may have been used during braining and graining. Such stones may also have been used generally to work and soften hides. Expedient moccasin-making was done by Hidatsa men if necessary away from the village. The maker killed an antelope to obtain the neck skin, and roughly dehaired it with a knife. The skin was rubbed while it was drying with "a piece of natural brick (clay which has been fired by the heat generated from underground lignite fires) or a stone which was customarily carried thrust down into the folds of the robe under the belt" (Weitzner 1979:219). This rubbing removed the remainder of the hair and whitened and softened the skin. The skin could then be sewn together for moccasins.

Classification of Groundstone Artifacts from Archaeological Sites: At many sites, including Graham Cave (Logan 1952; Klippel 1971), Arnold Research Cave (Shippee 1966), and Trowbridge (Hirsch 1976), groundstone artifacts are classified as types based on a combination of morphology and inferred function. For example, relevant groundstone types recorded from Graham Cave (Logan 1952:42-50; Klippel 1971:37) include hammerstones ("both pitted and unpitted"), manos or "rubbingstones," roller pestles, mortars, cupstones or "nutting stones," metates, and stone balls.

Cook (1976) recognizes many of the same categories at Koster but fits them into a manufacturing trajectory for various raw materials. For many glacial cobbles, he sees a "continous gradation between unmodified forms and highly polished manos and heavily pecked hammerstones" (Cook 1976:35). Modification of these tool types is primarily through use. Other cobbles were formally modified into such artifacts as pendants, axes, mauls, and bannerstones. "[T]he ultimate fate of any piece of ground stone is to be used as a hearthstone" (Cook 1976:37). Cook's "continuous gradation" between unmodified and heavily worn cobbles would seem to best describe the range of variation in the cobble assemblage at 14LV1071.

Reid (1984a:42) records "102 complete or nearly-complete cobbles that have been modified by use rather than hammer-dressing" at the Nebo Hill site (23CL11), a Late Archaic site in Clay County, northwestern Missouri. He sorts them into categories based on their predominant wear patterns "produced by pecking or battering, by grinding or smoothing, or by abrasion." Reid's approach is the most similar to the one taken here. The cobbles at 14LV1071 are categorized based on use-wear patterns, as formal morphology is almost entirely lacking.

The ethnographically documented uses of groundstone described above suggest that *wear patterns or modification on these cobbles should fall into three archaeologically recognizable categories: grinding/rubbing, hammering/battering, and heating*. Grinding/rubbing can be divided into two types: grinding against a hard surface (such as grinding plant material with a mano and metate) and rubbing against a soft surface (such as processing a hide with a handstone). Hammers may be used in flint knapping or for breaking bones apart, driving in tent stakes, etc. Heat damage could result from use of cobble as hearthstones or for stone boiling. All 85 cobbles from the excavated block at 14LV1071 were examined for any evidence of these wear patterns in order to determine function.

Experimental and natural wear patterns: the comparative collection

To aid in the identification and interpretation of cultural wear patterns, a comparative collection was assembled with examples of modification from several agents: grinding against a hard surface, rubbing against a soft surface, hammering, and natural forces such as those involved in glacial till movement. These pieces were examined and later compared to the artifact assemblage both macroscopically and with the aid of 6-70x magnification.

Material identifications of some of the artifact assemblage and comparative pieces were made by Dr. Wakefield Dort, Department of Geology, University of Kansas. These identifications were intended to establish type specimens which could be compared to additional pieces back in the lab. Full responsibility for accurate comparison and material identification of the bulk of the collection rests upon the author alone.

The various materials available in the glacial till possess different physical properties (size of grains, cementation of grains, hardness, roughness, etc.) which affect both their suitability for certain tasks and the expression of different wear patterns on their surfaces. Although time did not permit experimentation with all materials, an attempt was made to test the most common materials (granite and quartzite) and one of the more difficult to interpret (unidentified fine-grained igneous rock).

Natural Shape and Wear Patterns: To observe natural shapes and wear patterns on glacial cobbles, a sample of till was collected from the Fort Leavenworth Military Reservation, in the SE 1/4 of the SE 1/4 of Section 15, T8S, R22E (Fig. 11.2). The UTM location of this till deposit is 4357150 N, 333050 E, zone 15 (1000 m UTM grid). This sample was not systematically collected and is not argued to be fully representative of the glacial erratics in this area. The collection is biased towards a greater variety of materials and toward smaller, conveniently shaped pieces.

Seventy-two pieces were collected, and a portion of these is now housed in KUMA's raw material collection (sample number 97-4). Materials included igneous rocks such as granite, diobase, and syenite, and a variety of metamorphic rocks including several varieties of fine- and medium-grained quartzite (such as pink, reddish, and purple Sioux quartzite), orthoquartzite, and gneiss. There is also an unusual unidentified metamorphic rock with a dimpled texture. Small blocks and cobbles of quartz appear in the till along with the previous materials. Hematite and limonite nodules also appear in this till deposit and, in size and density of material, resemble many of the archaeologically-recovered fragments, suggesting that much of this material may have come from similar till deposits in the area. The sample also includes a cherty limestone, which is eroding at the same locality.

The size range of the cobbles collected is approximately 43-105mm in length and 35-95mm in width. The shape of these cobbles ranges from quite irregular and lumpy to very regular smooth and oval or egglike shapes.

Eighteen pieces, or about 25%, could be comfortably held in the hand and had, either through breakage or other wear, gained a flat surface that could be used for grinding. Two or three of the quartzite and granite cobbles were also rounded and of sufficient weight to serve as hammerstones for chipped stone tool manufacture. All 72 pieces were collected in less than an hour. Clearly, glacial till deposits could have served as an ideal source of raw material, providing a variety of useful material types in shapes that were fairly close to the desired endproducts.

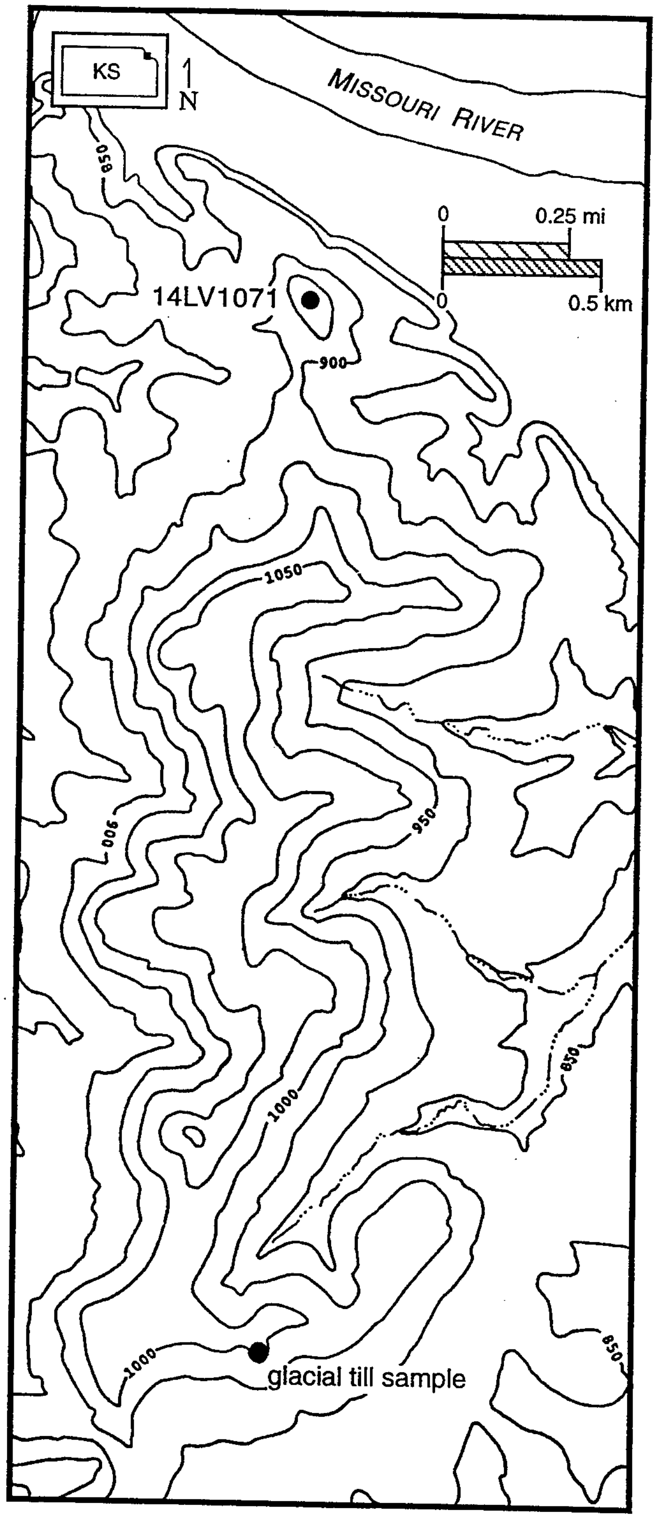


Figure 11.2. Location of glacial till sample collected from Fort Leavenworth Military Reservation (KU sample 97-4).

It is this resemblance to the desired endproduct, however, that complicates the interpretation of archaeological assemblages. Round or oval pieces shaped like hammerstones also tend to have abrasion and pitting on distal and lateral surfaces, much like hammerstones. In fact, all edges and protrusions on all pieces generally show damage. Large, heavy pieces useful for battering do indeed exhibit some evidence of battering, albeit natural. Many cobbles, referred to as "soled" glacial erratics, have surfaces that have been ground flat by glacial movement, and these naturally ground surfaces would have been ideal for human grinding activities. The center of flat surfaces often is marked up with pitting and striations.

In other words, surfaces that best present themselves for cultural wear are apparently those first abraded and worn by natural processes such as those involved in movement of glacial till. Some scratching and polishing of rocks in glacial till deposits has been noted by geologists (Tolsted and Swineford 1984:55; Dr. Wakefield Dort, personal communication, February 1997).

Several examples of the till sample are here illustrated and described to provide a better sense of the natural wear patterns and the special problems they present. Figure 11.3a shows a rounded white quartzite cobble with a yellowish weathered surface. Abrasion and light pitting is located around the lateral and distal edges of the piece as indicated by the hatchured lines. The very smooth surface of this piece, examined at 10-70x magnification, is indistinguishable from experimentally ground quartzite (discussed further below). Two things, however, are worth noting about this surface: (1) it extends over the entire piece, even rounded areas and (2) the yellowish weathered surface also covers the piece and is largely intact.

Figure 11.3b represents a cobble of Sioux quartzite. While its edges have been rounded, the surface does not appear ground or worn in the same way as in Figure 11.3a, and this piece was one of the unground samples used for comparison with artifact surfaces. Light pitting appears on edges and in the center, and the location of several larger pits on the ventral surface is marked.

Figure 11.3c illustrates the ventral face of a cobble of a very fine-grained igneous rock, grey in color with a characteristic tan or brown "sandy" weathering rind that causes the surface to somewhat resemble sandstone. Pitting appears on the ventral and dorsal faces, and there are several striations on the dorsal face.

Striations appear on another cobble of the same material. The ventral surface of this particular piece was used experimentally to work a rabbit hide and is discussed further below. The dorsal surface clearly exhibits natural striations parallel to the width of the piece, and the location of these striations is marked in Figure 11.3d.

In addition to this naturally occurring damage, the weathering pattern of the rock occasionally complicates the identification of cultural modification. One very regular long oval piece found in the till might appear to have been carefully shaped into a pestle. This material, which is an unidentified type of metamorphic rock, has a dimpled surface that closely resembles pecking. One artifact (A7415-0296; Figure 11.6a), which may have evidence of grinding of

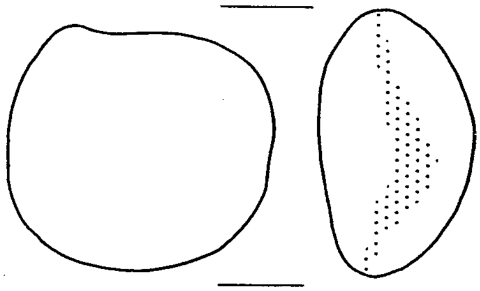


Figure 11.3a: Quartzite cobble from glacial till sample.

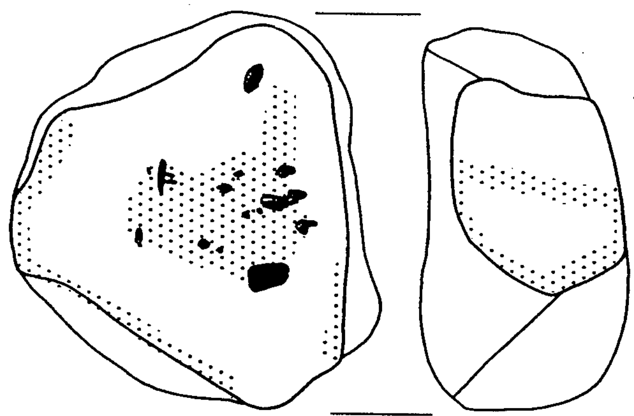


Figure 11.3b: Quartzite cobble from glacial till sample.

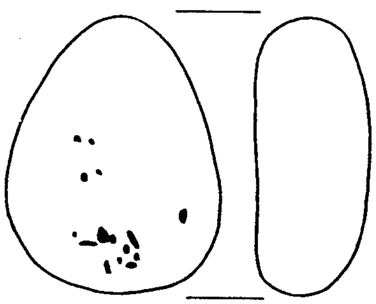


Figure 11.3c: Igneous cobble from glacial till sample.

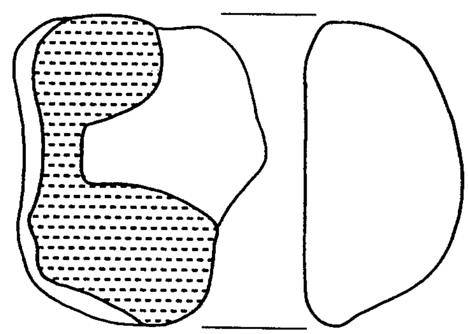


Figure 11.3d: Igneous cobble from glacial till sample.

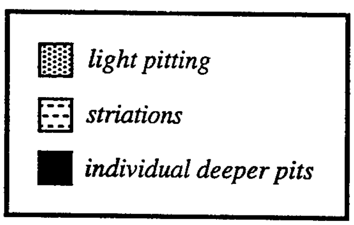


Figure 11.3. Location and types of natural wear on pieces from the glacial till sample (KU 97-4).

Note the presence of pits on the ventral or dorsal sides (Fig. 11.3b, 11.3c), fine pitting around the lateral margins (Fig. 11.3a, 11.3b), and striations from abrasion during movement (Fig. 11.3d). There are also examples of soled glacial erratics--cobbles with a flat surface or "sole" from glacial movement (Fig. 11.3c, 11.3d).

wild grasses on its surface, is made of this material, and the natural surface of the material must be taken into consideration when evaluating cultural wear patterns. This piece will be discussed more later.

This discussion hopefully suggests in a very general way the amount and placement of natural wear on glacial cobbles. These natural patterns may obscure or mimic marks left on cobble artifacts through human use. As a result of this observation, this author tended to be conservative in assessments of use-wear. After reviewing both the artifact assemblage and the till sample, however, there seemed to be clues that would help support an assessment of either "natural" or "cultural." These were (1) an unusual degree of damage, standing out against the expected background noise, (2) the presence, absence, or degree of weathering on a surface, (3) the placement and shape of a potential wear surface, and (4) consistent and unexpected patterning among artifacts. These indicators will be discussed in more detail with reference to specific categories of artifacts at 14LV1071.

Rubbing Against a Soft Surface: The basis for this experiment is the work of Adams (1986, 1988a, b), who compares manos and hide-processing stones from the Walpi Archaeological Project and finds significant differences in the types of wear in both archaeological and experimental specimens. Her work suggests that the use of handstones in hide-processing might be recognizable in other archaeological assemblages.

The pieces used in Adams' experiments were shaped from "a medium-to-coarse grain, well-cemented sandstone from the Shinarump Formation, near Winslow Arizona" (Adams 1988a:310). The material chosen for the handstone in this experiment was a grey, very fine-grained igneous rock. This particular material develops a tan to brown "sandy" weathering rind that initially caused the material to be mistaken for sandstone.

Following the suggestions of a Hopi informant, Adams used a handstone instead of a chipped stone scraper to remove flesh, fat, and tissues clinging to the inside of a deer hide. This was described as a "difficult, time-consuming process" that took perhaps six times as long as processing the hide with a stone scraper. In her review of the ethnographic literature, the Hopi were the only people to use a handstone in hide-working for something other than braining or graining. Given the discovery of chipped stone scrapers at 14LV1071, it seemed more reasonable to emulate the hide-working methods of historic Plains groups such as the Sioux, Crow, and Blackfeet and study any use-wear developed on a handstone during braining.

In preparation for this experiment, a freshly-killed domestic white rabbit was obtained from the University of Kansas Animal Research Unit. The animal was frozen overnight and then skinned with a metal utility knife. The hide was rolled up, sealed in a plastic bag, and put back in the freezer. Several days later, the hide was removed and allowed to thaw at room temperature for five hours. Remaining patches of ice were melted by soaking the hide briefly in a tub of warm water. McPherson and McPherson (1992) have observed that freezing a hide does not affect its workability in any noticable way.

The rabbit hide was then stretched out and nailed to a wooden pallet, and the hide was defleshed and scraped using an unhafted chert scraper. This task could have been performed more efficiently with the aid of a serrated beamer or flesher, a hafting element on the scraper, and the ability to resharpen the scraper as work continued. Nevertheless, the rabbit hide was reasonably clean after a period of about 45 minutes. The hide stretched considerably during fleshing, and was stretched further and nailed down again to dry overnight.

The frozen rabbit head was relieved of its brain the following day. One-half cup of boiling water was added to the brain and the mixture was applied to the clean, dry rabbit hide using the smooth cobble of fine-grained igneous rock. At the start of this phase of work, the rabbit hide was stiff and yellow, and the mixture initially sat on the surface instead of penetrating it. The skin softened and began to absorb the brain and water within five minutes. Thick white rolls of tissue came up from the hide and clung to the working surface of the cobble, and the cobble continually had to be wiped clean. After 15 minutes, the worked portion of the hide had become soft enough to crease and wrinkle while being worked. When an hour had passed, the skin was very soft, pliable, and pink, bearing a resemblance to lunchmeat in texture and appearance. The skin also stretched considerably during this process. The rabbit hide was worked for about one hour and fifteen minutes in the interests of prolonging the experiment. At that point, the hide was flabby in the center, and it seemed possible that further work would damage it, as layers of tissue continued to roll off the hide and cling to the handstone.

Adams (1988a:312) describes the wear on her experimental hide-processing handstone, used for about 6 hours, in this manner:

> The individual grains on the working surface of the experimental hide-processing stone are not as angular as they had been before use. This macroscopic observation is confirmed under 40x magnification. Each grain has been smoothed free of all angular edges, as have the topographic lows and the interstices between grains. The sheen that surrounds the individual grains and extends into the interstices is undoubtedly the result of the build-up of reaction products created by tribochemical interactions.

On the archaeological handstones identified as hide-processing stones, it was observed under 40x magnification that

> [t]he interstices between the grains are free of debris, smooth, and as shiny as the grains. The sheen on both the interstices and the grains gives the macroscopic appearance of uniformity, yet the grains are left in high relief, and the relief on individual grains is not obliterated. Rarely is there microflaking on a grain, and in a few places it appears that a grain has been plucked out of its place and the resulting hole has not yet been worn (Adams 1988a:308).

Initially, there were several reasons to worry that Adams' findings would not be easily applicable to the present study. Adams notes that the grains on her sandstone piece became less angular; none of the grains on the glacial cobble were angular to begin with. No buildup of residues, as noted in her experiment, was expected to survive on the archaeological pieces from 14LV1071. In addition, the wear described by Adams was acquired during six hours of use, while the cobble in this study was only used for approximately one hour.

It was a surprise, therefore, to find that the cobble used in this hide-working experiment did show some traces of wear similar to those described by Adams. The grains of the working surface were polished, and the soft hide, by pushing up between and around the grains, removed the weathering rind and other particles from the interstices. The application of the brain, or other animal fats, may have little or nothing to do with this wear. This pattern might occur instead in any situation where a softer, malleable material can polish between and around grains, such as the Hidatsa moccasin-making example. Unfortuately, this signature is material-specific; none of the other material types in this study have similar weathering rinds.

Grinding Against a Hard Surface: Three experiments were carried out with different materials, grinding for different lengths of time. The purpose was to see how clear these grinding patterns were, both macroscopically and microscopically, and to see if they could be clearly distinguished from natural wear patterns.

In the first two experiments, a cobble of the fine-grained igneous rock was ground against a piece of Sioux quartzite for (a) ten minutes and (b) an hour. Due to the sandy weathering rind, it was initially thought that grinding might be difficult to discern on the cobble surface. Just the opposite proved to be true. The weathering rind wore away in under ten minutes, leaving a smooth, ground patch dark gray in color. Pecking and gouging appear on both cobbles, apparently the result of new surfaces of the "mano" hitting irregular surfaces on the quartzite "metate." After one hour of wear, the maximum thickness of the cobble decreased by approximately 1.5mm. About 1/8 teaspoon (0.2g) of grit was recovered.

The ground areas on the piece of Sioux quartzite were visible macroscopically. At all magnifications (6-50x), shiny rounded individual grains were observed in the unworn area (at 12x, these looked like pink caviar). At 50x, it could be seen on the piece ground for an hour that some grains were worn completely flat. The outlines of the individual grains were visible, producing an effect resembling fish scales. The grains were scratched and frosted.

In the third experiment, a piece of granite was ground against a piece of Sioux quartzite for ten minutes. 0.2g of grit was produced during this ten minutes. The quartzite showed patterning similar to the quartzite that was worked for a hour. At this point, however, the ground patches were not as flat. At 50x, the patches look white and flaky--"white" because of scratches and wear on the individual grains, and "flaky" because the grains were just beginning to wear down and tended to overlap neighboring grains somewhat, giving a "platy" appearance to the surface.

On the granite cobble, a rough side was intentionally chosen for grinding. The worn areas are macroscopically very obvious, appearing as whitish patches in which the grains seem to melt into one another. At 6x magnification, however, these patches are indistinguishable from the smooth, worn side of the granite cobble, which has been worn by water or other agents. Further examination of the smooth natural surface with magnifications up to 50x revealed natural wear, such as small pits and fine lines (appearing as valleys at 50x) running through the smooth area, suggesting that this surface was worn significantly by natural processes after it was smoothed. Another clue that this smooth surface is natural is the shape; it is not flat like the ground surface, but extends over curves and along corners, implying that water may be the agent responsible.

The effects of grinding are compatible with the observations of Adams (1988a:311-312), who notes that after six hours of use, the sandstone mano displays

> [s]everal large areas. . . worn to the point that the grains are level and the interstices obliterated. *At this point it would be necessary to resharpen, or peck the surface to roughen it and increase the grinding efficiency of the mano.* . . Under 40x magnification. . . {i]n the flat shiny areas the grains have lost their distinctiveness. Scratches run across the surfaces of several grains without interstices to break up the path of the scratch. . . Where individual grains are still distinct, with interstices between, minute fractures give the grains a frosted appearance [emphasis added].

Adams' comments also suggest that one might well expect to find pecking on the working surface of a well-ground mano in order to extend its use-life.

These grinding and rubbing experiments with glacial materials substantiate some of the claims made by Adams for wear patterning. They were also carried out in a relatively brief period of time, suggesting that even pieces that were used briefly or expediently may carry traces of use-wear.

<u>Hammering</u>: To observe the wear on hammerstones used during flintknapping, three hammerstones were borrowed from an amateur flintknapper. While three pieces do not comprise a very impressive sample, and certainly do not express the range of sizes, shapes, materials, and weights possible for this tool type, they do provide examples of several types and locations of wear for comparison. Hammering and battering during activities other than flintknapping, while certainly to be expected at the site, was not experimented with.

Three types of modification were recorded from the borrowed hammerstones. The first was pecking, pitting, and spalling along ends and corners of ends, the result of striking blows with these surfaces. The second was the presence of striations from grinding of knapping surfaces. These striations were located along lateral edges, parallel to the length of the piece through the center, and/or around the edges of the ventral or dorsal faces (almost perpendicular to the edge). The third was pitting and gouging in areas with striations. The flintknapper believes he created these during grinding, when sharp edges were caught within natural depressions or pits in the stone and gouged out further (William E. Banks, personal communication, March 1997). Photographs of archaeological and experimental hammerstones with all three types of wear can be seen in Whittaker (1994:86, 88).

Heating: This category includes the effects of stone boiling as well as serving as a hearthstone. Changes in color (a reddish or pinkish color, best identified if only affecting part of the artifact) and shape (spalling, cracking, or fragmentation) are assumed here to be the result of heat. Further work using the criteria described by Shott (1997a) might separate cobbles altered by wet heat (as boiling stones) from those altered by dry heat (as hearthstones).

Classification of the Cobbles from 14LV1071

After review of the visible wear patterns, the 85 cobbles in this assemblage were grouped into the following categories: hammerstones, grinding stones, pitted stones, heat-damaged pieces, and unmodified cobbles. Three pieces apparently had multiple functions, combining evidence of both hammering and grinding. Two of the three also were pitted in the center. Figure 11.4 summarizes the distribution of pieces into these categories.

In the following descriptions, the ventral face of the cobble is arbitrarily defined as the face with the least curvature. The use of "ventral" and "dorsal" is not meant to suggest how the piece was held during use.

Grinding Stones: There are 13 pieces in the assemblage, including the four multi-use cobbles, that exhibit grinding against a hard surface on one or two faces. These artifacts and their working surfaces are described in Tables 11.1 and 11.2.

Simple comparison with the experimental grinding surfaces was not always sufficient to identify cultural grinding surfaces on artifacts. Examination of the natural cobble collection and apparently natural surfaces on the artifacts revealed that worn surfaces identical to ground ones in shape and wear of the grains could be produced by natural processes. Analysis of the entire comparative collection led to the development of several criteria to identify cultural grinding surfaces:

(1) the shape and location of the ground surface. Many naturally ground surfaces are worn along edges and angles that would not have been affected by intentional grinding. The hypothesized working surface should be one that could reasonably have come into contact with another grinding stone or "metate." In this assemblage, those surfaces were expected to be reasonably flat and located on broad ventral and/or dorsal surfaces. Dips and holes in the "grinding" surface were checked to make sure they displayed no sign of similar wear.

(2) the appearance of other surfaces on the artifact. Are ground surfaces easily distinguishable against a rough background, or has the entire cobble been worn naturally to the

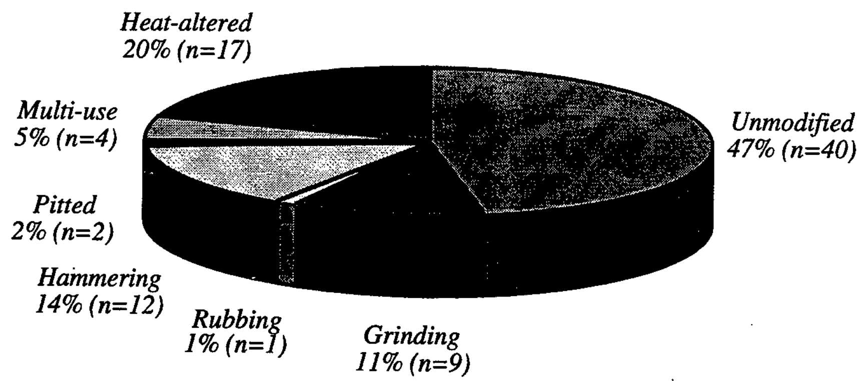


Figure 11.4. Distribution of functional groundstone types at 14LV1071.

point where it is difficult to tell? The presence of naturally worn surfaces on a piece, as described above, suggests that smooth ventral and/or dorsal face(s) may also be the result of natural processes.

(3) the presence of weathering upon the ground surface. A great deal of weathering subsequent to grinding or flattening of the surface implies that the wear is too old to be of cultural origin. Evidence of such weathering includes tiny, shallow pitting and cracking and a weathering rind. Several pieces at 14LV1071 were identified as culturally ground because the weathering rind had been worn away from an appropriately-shaped surface.

The question of the weathering rind was initially a difficult one, as it seemed possible that weathering might occur after use, affecting cultural surfaces that were several thousand years old. Could the regeneration of a weathering rind obliterate any traces of use? Given the variation in local environments, no definitive answer is possible without the study of the weathering of other rocks in the area (Dr. Wakefield Dort, personal communication, February 24, 1997).

One artifact (A6798-0296) from 30-40cm bg (50-60 cm bs) supported the theory that most of the weathering rind will not have regenerated after deposition. This piece is a fine-grained igneous cobble with the distinctive tan "sandy" weathering rind, the same material used in the two grinding experiments. When ground, the weathering rind disappears and the underlying dark grey of the rock shows through. This color difference is not as sharp in the artifact as it is in the experimental pieces, but the ground surface can still be clearly identified. This discovery made it clear that several other cobbles of the same material lacked ground surfaces.

Table 11.1. Metric and wear attributes of identified **grinding stones.**

CATNO	FN	Material	L*	W*	T*	Mass (g)	Working Face	Ground Surface Dimensions	Direction of Striations	Notes
A7418	811	?	84	63	39	310	ventral dorsal	oval, 50 x 40 oval, 33 x 22	---- ----	----
A6697	1321	quartzite	87	65	46	335	ventral dorsal	round, 38 dia. oval, 28 x 25	parallel to wid	----
A7426	662	quartzite	84	72	49	390	ventral	30 x 20, patchy	3 directions	Some striations in all directions
A2995	984	?	73	71	58	474	ventral	round, 39 dia	most NE	----
A6698	1322	quartzite	96	63	32	265	ventral	45 x 26, 21 x 26, patchy	----	----
A6798	1324	igneous	127	111	61	1164	ventral	egg, 88 x 76	parallel to wid	curated phytolith sample (Spring 1997)
A5339	966	quartzite	99	76	59	684	ventral	34 x 29, patchy	----	Very light wear, just frosting grains
A7417	1096	granite	111	78	43	575	ventral dorsal	oval, 100 x 76 oval, 80 x 68	---- ----	PHYTOLITHS; formal mano; deep pits in dorsal; Fig. 11.5a
A7415	1088	meta.	136	90	61	1191	ventral	oval, 102 x 60	----	PHYTOLITHS; weathering mimics pecking; Fig. 11.6a

Table 11.2. Metric and wear attributes of **multi-use cobbles with grinding surfaces.**

CATNO	FN	Material	L*	W*	T*	Mass (g)	Working Face	Ground Surface Dimensions	Direction of Striations	Notes
A2492	609	quartzite	75	72	39	319	ventral dorsal	oval, 54 x 49 49 x 39, patchy	----	Pecking, pitting; see PITTED, HAMMER
A4960	660	quartzite	78	76	51	465	ventral	oval, 46 x 44	----	Pecking, pitting; see PITTED, HAMMER
A6696	1319	quartzite	94	90	51	667	dorsal	oval, 85 x 64	from knapping	Pecking, spalling; see PITTED, HAMMER; Fig. 11.7b
A6438	1379	?	122	71	48	659	ventral	oval, 92 x 65	----	Pitting on ends, dorsal; see HAMMER Pitting on grinding face to roughen surface.

Table 11.3. Metric attributes of potential **rubbing stone** (used against a soft surface).

CATNO	FN	Material	L*	W*	T*	Mass (g)	Working Face	Working Face Dimensions	Notes
A4926	552	igneous	85	68	57	404	ventral	oval, 39 x 35	potential wear not visible macroscopically; "working" surface missing weathering rind at 50x magnification

* Length (L), width (W), and thickness (T) are maximum measurements. All measurements are reported in mm.

Pecking or pitting of the ground surface was, depending upon its location and appearance, attributed to another type of use of the piece or to intentional roughening of the surface once the surface had been worn flat to increase grinding efficiency. Intentional roughening was identified on two pieces: both sides of the well-shaped mano (A7417-0296; Fig. 11.5a) and the ground surface of a multi-use cobble (A6438-0296). This pitting was distributed fairly evenly across the entire ground surfaces, and many of the individual pits were pointed in cross-section.

As stated earlier, there is only one grinding tool that is formally modified. There is another piece of an unidentified metamorphic rock (A7415-0296; Fig. 11.6a) which, at first glance, appeared as though it had been pecked into its overall shape. Comparison with a piece of the same material from the glacial till sample, however, indicated that these tiny pits are part of the natural weathering pattern of the material. Structures around and through the center of the pits were found during microscopic examination, indicating that these holes were created by chemical and not mechanical forces (Dr. Wakefield Dort, personal communication, February 1997).

The largest grinding surfaces appear on the two pieces chosen for phytolith analysis, the formal mano (A7417-0296; Fig. 11.5) and the large soled metamorphic cobble (A7415-0296; Fig. 11.7), with oval working surfaces of 100 x 76mm and 102 x 60mm, respectively. (The formal mano has another large grinding surface on the opposite face, measuring 80 x 68mm.) The next largest appears on an igneous cobble; it is egg-shaped and measures 88 x 76mm. The fourth and fifth largest are found on multi-purpose cobbles (A6438-0296, A6696-0296); both surfaces are oval and measure 92 x 65mm and 85 x 64mm. These grinding surfaces exceed 3,200mm^2 in area.

The grinding surfaces on the other eight cobbles, however, are relatively small, with areas under 2,300mm^2. Four of these have worn surfaces that are patchy, suggesting that use of the cobble for grinding was minimal. The bulk of these grinding implements, therefore, are regarded as expedient tools. Many of these pieces were not very efficient as grinding tools, indicating that a great deal of processing or grinding of anything (plant, animal, or mineral) was probably not carried out with these implements.

Microscopic examination of unmodified utilized cobbles from the Friend and Foe site (23CL113) revealed that the surfaces were "impregnated with particles of ground hematite" (Calabrese 1969:142). No hematite was observed on the cobbles from 14LV1071 during either macroscopic or microscopic analysis--a surprising find given the amount of hematite recovered from the site (see chapter 12). One possibility is that the cleaning of some artifact surfaces with a toothbrush removed all traces of hematite staining. This seems unlikely, as such treatment did not succeed in removing all traces of dirt from the pieces. Another possibility is that sandstone implements were used instead to process hematite. While no obvious staining is noted on sandstone either, that class of artifacts was not microscopically examined (see chapter 12).

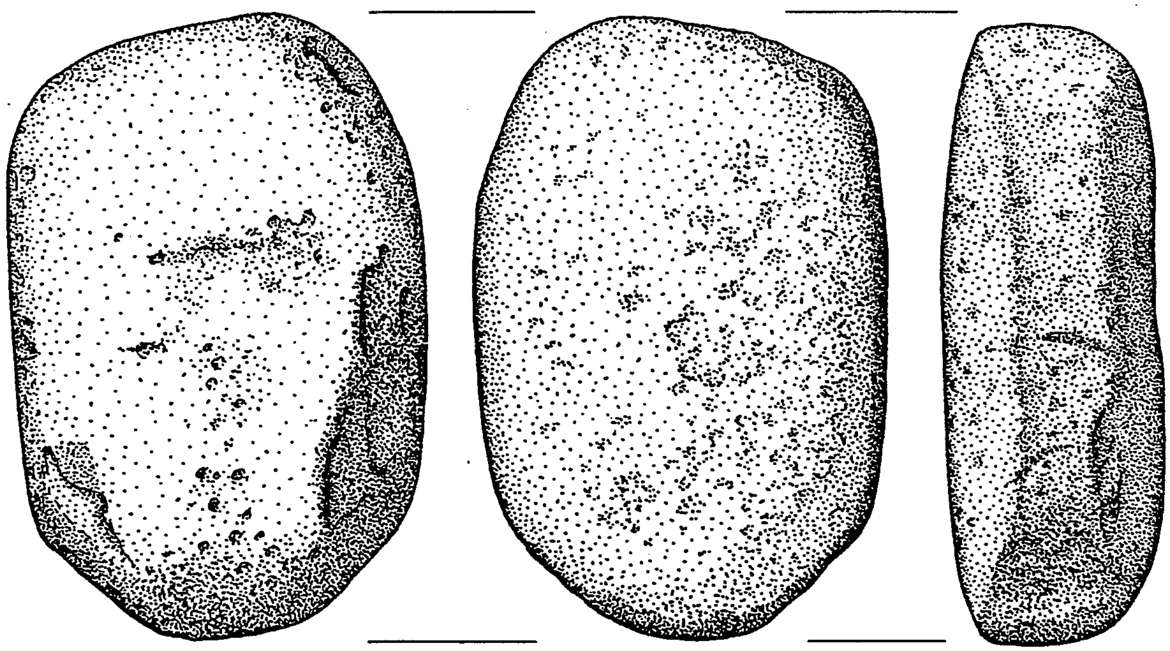


Figure 11.5a. Mano from excavated block (A7417-0296).

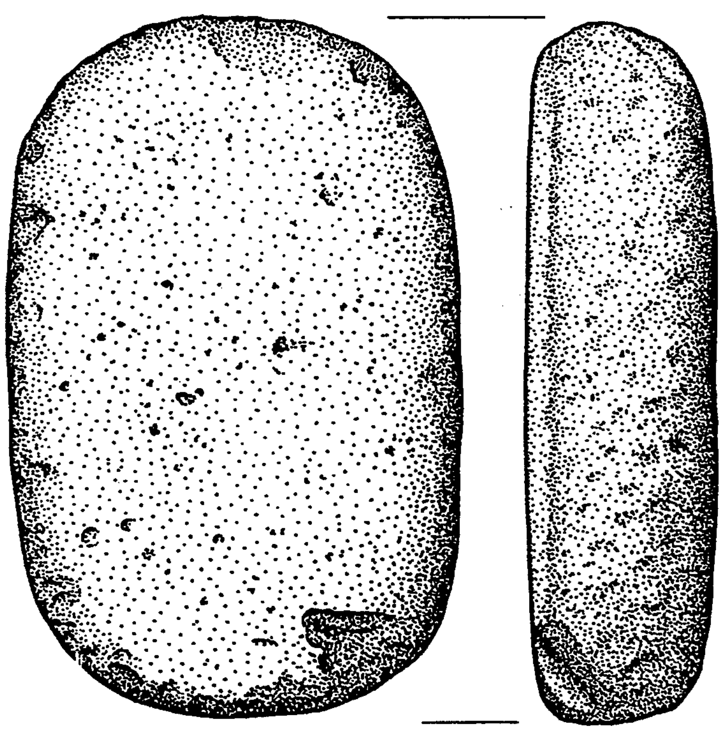
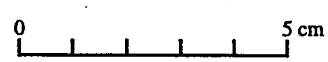


Figure 11.5b. Mano from graded area (A7619-0296).



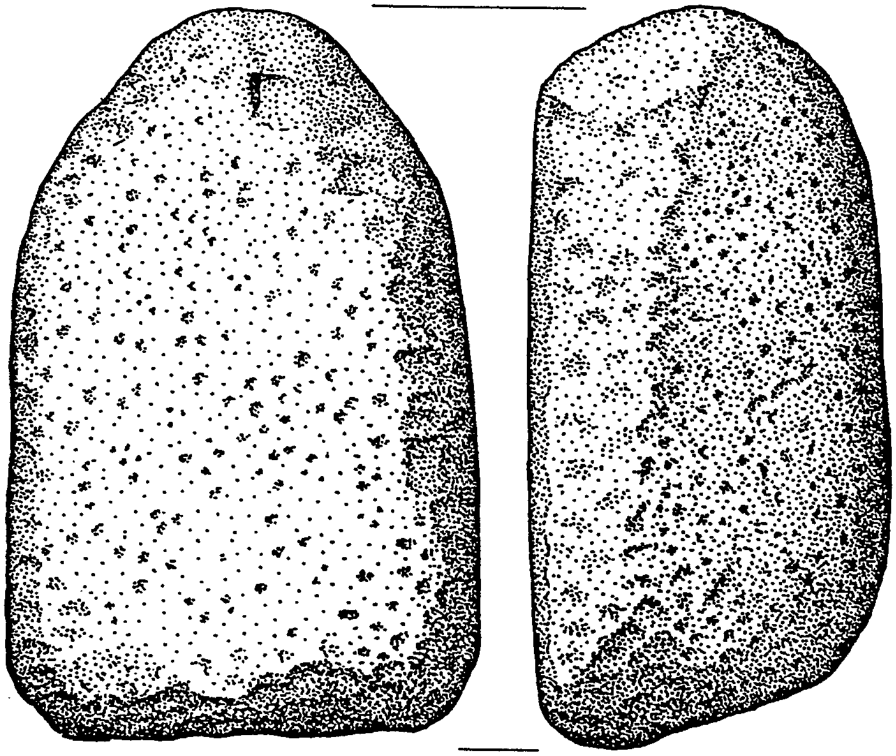


Figure 11.6a. Grinding stone (A7415-0296).

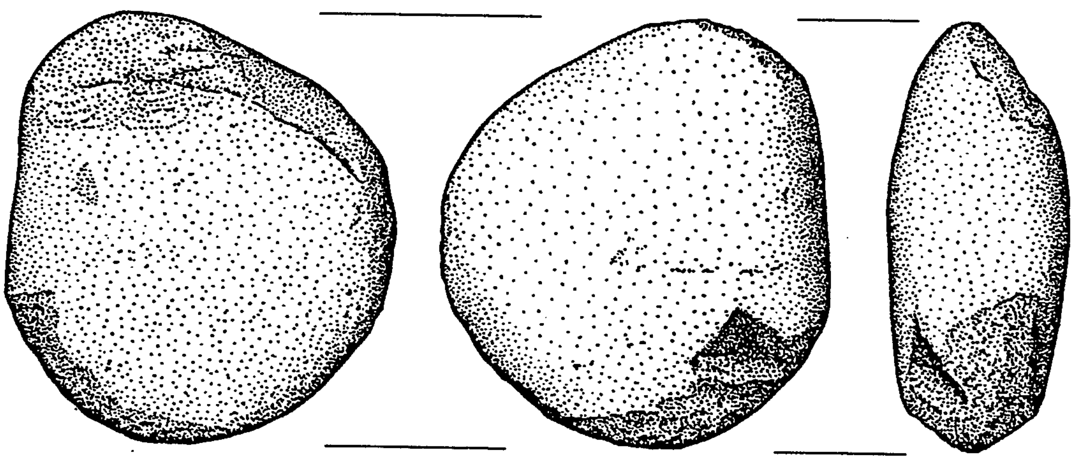


Figure 11.6b. Hammerstone (A6554-0296).

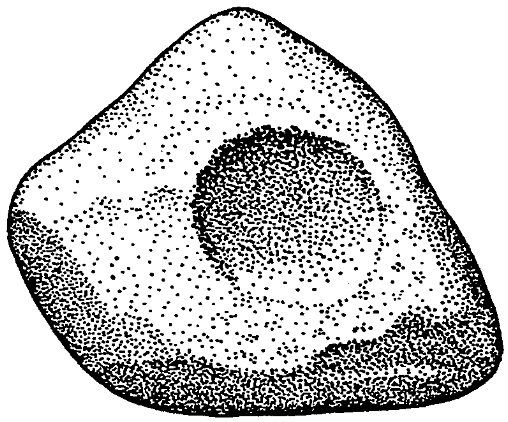


Figure 11.7a. Cobble with natural depression (A1717-0296).

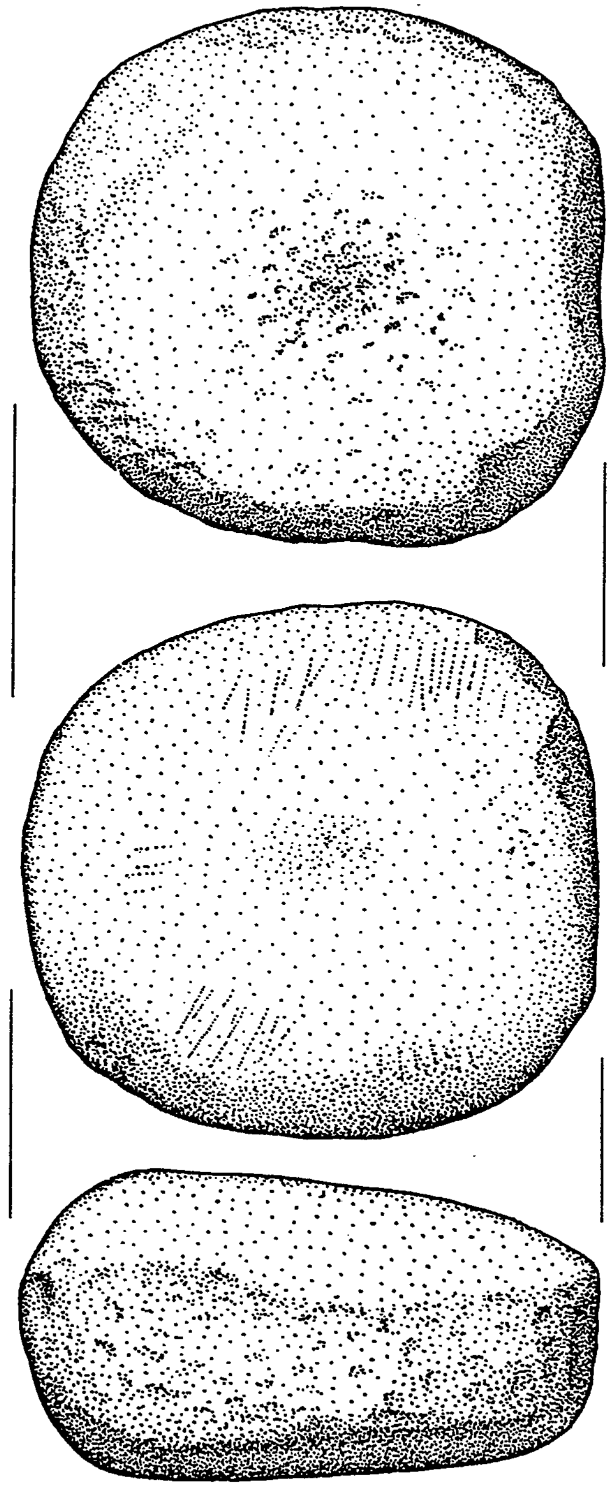


Figure 11.7b. Multi-use cobble (A6696-0296).

Striations on the grinding surface were recorded to provide information about the manner of grinding; it is assumed that they should be parallel to the direction of use. Therefore, a "reciprocal or back-and-forth motion should result in linear striations parallel to either the long or the short axis of the mano. A rotary or round-and-round motion should result in a pattern of random striations" (Lancaster 1983:22-23).

Of the nine pieces with grinding surfaces, only four had visible striations. This does not appear unusual; in Lancaster's (1983:26) sample of small, round "Type I" manos from the Mimbres Valley in New Mexico, 53% had no striations. Three of the four with striations at 14LV1071 had all or almost all of the striations aligned in one direction (two had striations parallel to the width, and one had striations almost parallel to length). The remaining piece, which is a rounded triangular shape, had striations in three directions corresponding to points of the "triangle." The different striations seem to have been acquired while grinding with different points at the top or front.

Lancaster observes that primarily random striations are present on the Type I manos in his sample and concludes that these pieces were used with a circular motion. He suggests that those with no striations may have been used in this way as well, as rotary motion may tend to "obliterate previous striations" (Lancaster 1983:26). This explanation seems inappropriate for the lack of striations on some grinding implements from DB, as the only observed striations on the other four pieces are probably the result of grinding with a back and forth motion.

Lancaster (1983:26) also suggests that the material type of the artifact may affect the production of striations. Although the sample from 14LV1071 is small, no relationship between material and the presence or absence of striations was observed. It is unclear why some pieces have no visible striations, but it may be related to the regularity of the grinding surface of either these pieces or the metates. It was observed during grinding experiments that gouged lines occurred around margins when new surfaces contacted irregular portions of the other grinding stone. The one formal mano (A7417-0296), which is heavily used and well-worn, lacks striations.

The shape of the grinding surface is another clue to the manner of use of these grinding tools. In most cases, the ground surface was small and simply mimicked the natural surface of the cobble. In three cases, however, the surface was well worn along a larger, strongly convex shape. These three pieces consisted of the one formal mano (A7417-0296), one multi-use quartzite cobble (A6696-0296), and one large igneous cobble with only one ground surface (A6798-0296). The only visible striations are on the igneous cobble (A6798-0296) and run parallel to the width of the piece, suggesting that this grinding tool was pushed back and forth in a concave metate or grinding slab, with the length of the piece perpendicular to the forward motion.

Three quartzite slabs with clear evidence of grinding were recovered from the graded area of the site. The first (A7645-0296; Fig. 11.8) is a fragment of a metate with a very concave working surface. The working surface of the second (A7646-0296; Fig. 11.9) is less

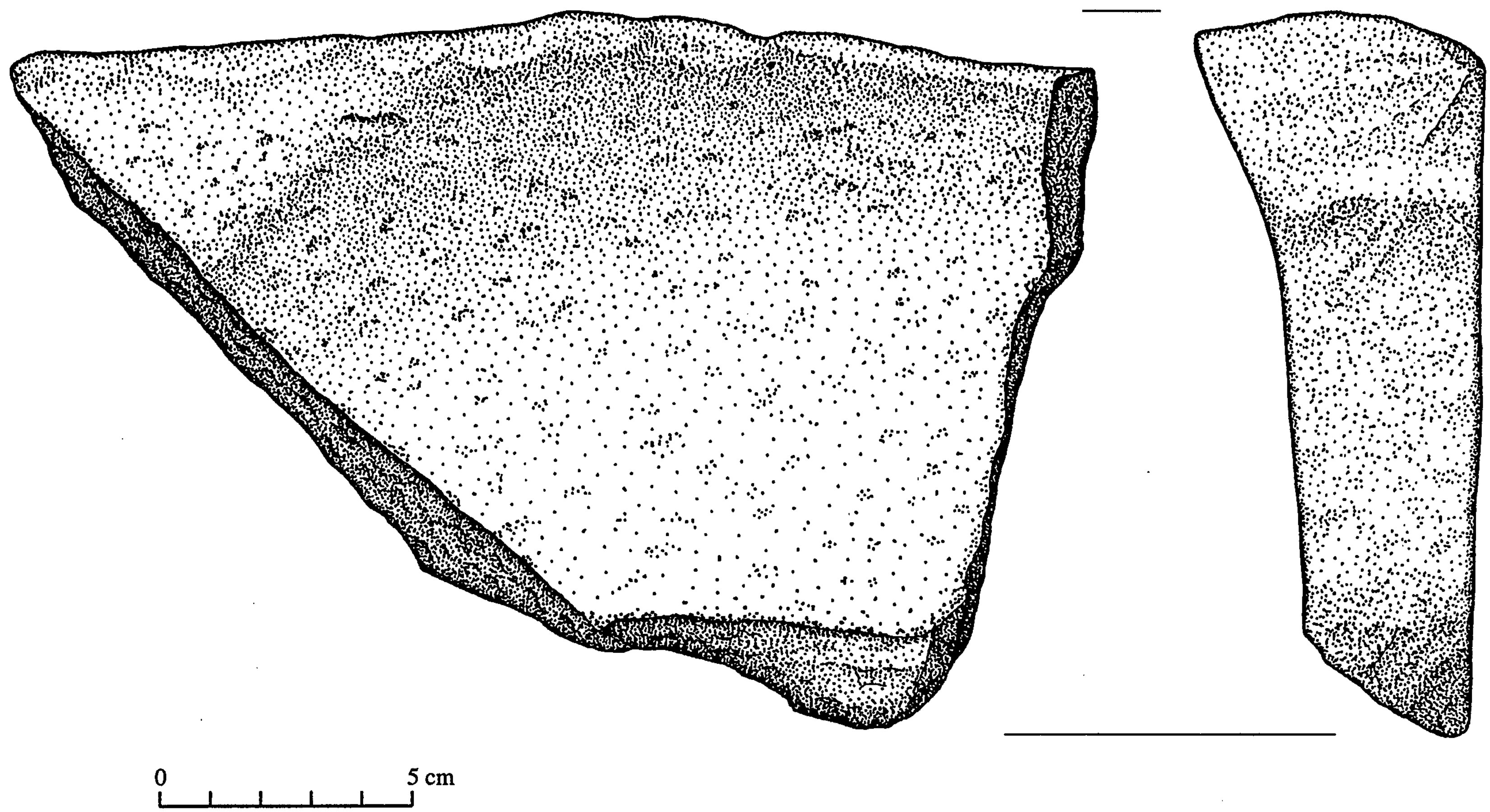


Figure 11.8. Grinding slab (A7645-0296) from the graded area outside the excavated block.

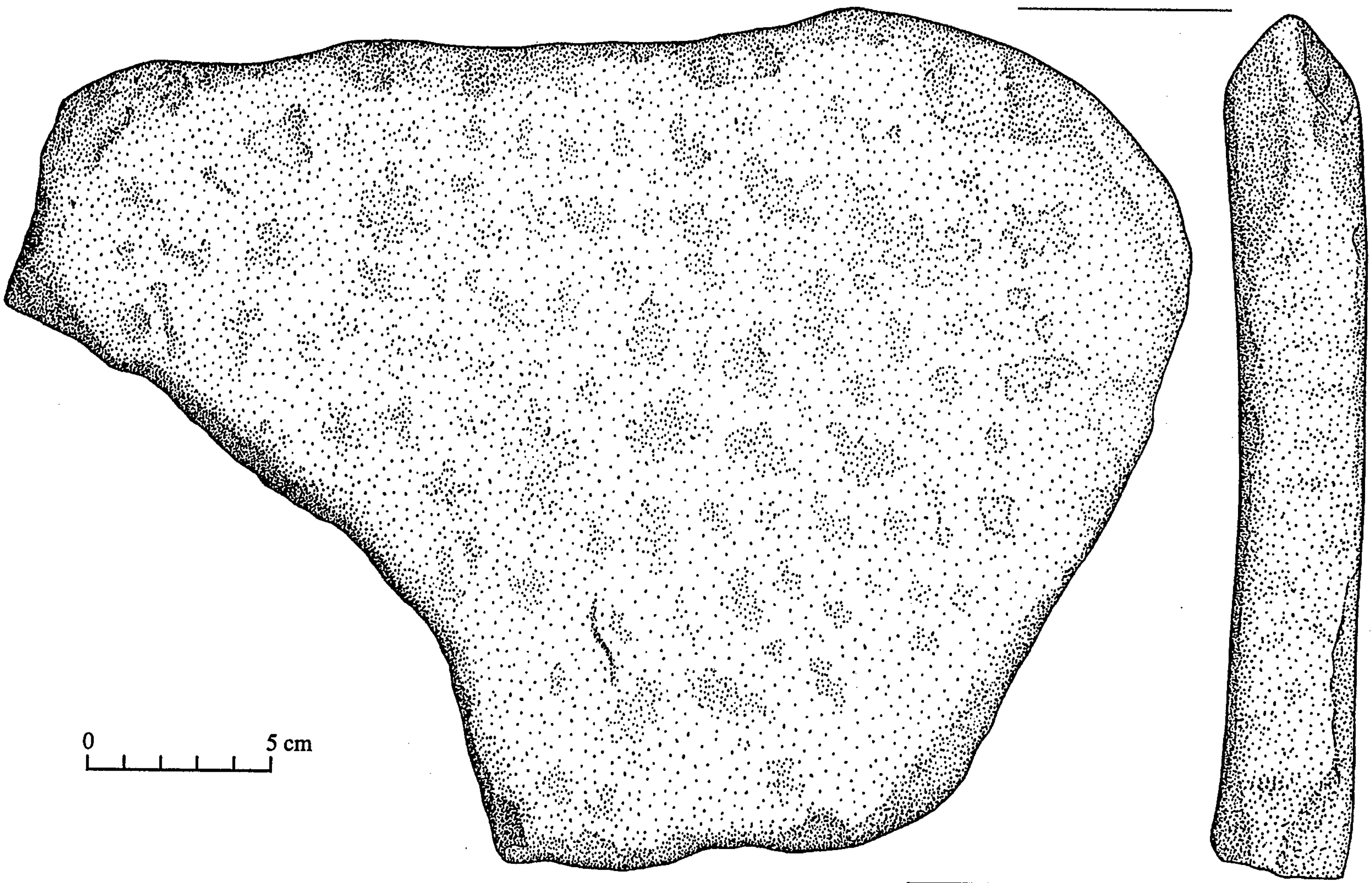


Figure 11.9. Grinding slab (A7646-0296) from the graded area outside the excavated block.

concave but still well-developed. The third slab (A7647-0296) exhibits a moderate amount of grinding on a flat surface. This small sample suggests that heavily-worn grinding slabs will be concave.

Rubbing Stones: As noted above, rubbing brains into a rabbit skin in the hide-working experiment left behind some evidence of use--the removal of the weathering rind from the surface and between individual grains while leaving the rounded shape of the grains intact. One piece in the assemblage (A4926-0296; Table 11.3) has one surface with a similar appearance. This artifact is a cobble of the same igneous rock as the cobbles used in the grinding experiments. This patterning is dependent upon the unusual weathering rind of this material, and it is unknown what patterning should be expected, if any, on other material types.

The apparently used surface is roughly oval with a length of 58mm and width of 35mm. It is not the largest surface available on the piece, but it is the flattest. It seems probable that not only hide-working or braining but rubbing on any soft surface for any purpose might create such a surface. However, it is uncertain whether noncultural processes might as well. Not enough is known about the formation of this particular weathering rind and processes that might subsequently affect or alter it to claim that this faint signature is certainly cultural.

Hammerstones: Table 11.4 provides metric attributes and description of the 12 pieces identified only as hammerstones, and Table 11.5 describes evidence for hammering on the four multi-purpose cobbles. One hammerstone from the site is illustrated in Figure 11.8.

The most common type of wear on these pieces is pecking and pitting, present on all 16 hammerstones. Spalling of at least of one end appears on seven pieces that were only hammerstones and on two of the four multi-use cobbles. Striations attributed to flintknapping are relatively rare, identified only on two artifacts: one piece that was only a hammerstone (A5802-0296) and one multi-purpose cobble (A6696-0296; Figure 11.7b). Striations were best identified macroscopically with a strong focused light, and the coarse or rough surface of some of the cobbles may have obscured evidence of them.

The most unusual wear appears on one multi-use stone (A6438-0296), which--in addition to intentional roughing of its ground surface as noted above--exhibits pitting on both the ventral and dorsal surfaces. Pits are located in the center of each end on the dorsal face. This pattern may be the result of using the piece as a hammer against a wedge. This piece also has thin striations across the flat surface of the dorsal side that are very similar in appearance to natural striations on pieces in the comparative collection. They are assumed to be natural on this artifact as well.

Pitted Cobbles: Cobbles were placed in this category if they had a pitted circle in the middle of either the ventral or dorsal face. Tables 11.6 and 11.7 provide descriptions and metric attributes for these pieces.

Table 11.4. Metric and wear attributes of identified **hammerstones.**

CATNO	FN	Material	L*	W*	T*	Mass (g)	Pecking/pitting	Spalling	Striations	Notes
A1932	101	quartzite	100	83	38	502	both ends	both ends	----	Phytolith sample analyzed.
A3868	1012	quartzite	84	70	42	377	edge of dorsal	1 end	----	----
A2265	698	quartzite	104	75	63	635	both ends	both ends	----	----
A7416	521	quartzite	123	56	50	455	one end	other end	----	----
A5679	1481	quartzite	94	57	40	318	one end	other end (2)	----	----
A2461	589	quartzite	97	70	40	589	3 of 4 corners	----	----	----
A1931	88	quartzite	113	74	56	796	heavy on ends, line in center	----	----	----
A7513	950	quartzite	114	76	54	635	heavy in center, 1 end and sides	one end gone	----	Heat damage?
A2135	593	quartzite	100	79	90	1005	heavy on 1 end	----	----	----
A5802	1487	quartzite	112	70	40	417	----	1 end	dorsal	Natural wear..
A2941	816	quartzite	79	65	44	340	2 ends, 1 side	----	----	Coarse surface; pecking removes rind.
A6554	1173	quartzite	79	74	33	254	both ends, side	1 end	----	Small pitting in dorsal center; curated phytolith sample; Fig. 11.6b

Table 11.5. Metric and wear attributes of **multi-use cobbles with evidence of hammering.**

CATNO	FN	Material	L*	W*	T*	Mass (g)	Pecking/pitting	Spalling	Striations	Notes
A2492	609	quartzite	75	72	39	319	3 sides, 3 ends	2 on end	----	See GRINDING, PITTED.
A4960	660	quartzite	78	76	51	465	3 ends	----	----	See GRINDING, PITTED.
A6696	1319	quartzite	94	90	51	667	3 of 4 sides	3 on sides	dorsal, perpend.. to sides	Small pitting in dorsal, ventral center. See GRINDING, PITTED. Fig. 11.7b
A6438	1379	?	122	71	48	659	in middle of each end of dorsal face	----	----	Dorsal striations natural. See GRINDING. Dorsal pitting from use with wedge? Pecking on ground surface to roughen

* Length, (L), width (W), and thickness (T) are maximum measurements. All measurements are reported in mm.

Table 11.6. Metric and wear attributes of identified **pitted stones.**

CATNO	FN	Material	L*	W*	T*	Mass (g)	Working surface	Pitting in center	Notes
A7423	551	igneous	83	[68]	39	382	dorsal	round, 21 dia; next to oval, 17 x 14	—
A2108	529	quartzite	[81]	77	46	404	ventral	oval, 38 x 21	—

[Brackets] around a number indicate that the measurement is incomplete due to breakage of the piece.

Table 11.7. Metric and wear attributes of **multi-use cobbles with pitted surfaces.**

CATNO	FN	Material	L*	W*	T*	Mass (g)	Working surface	Pitting in center	Notes
A2492	609	quartzite	75	72	39	319	ventral	teardrop, 33 x 21	See GRINDING, HAMMER
A4960	660	quartzite	78	76	51	465	ventral	oval, 31 x 17	See GRINDING, HAMMER
A6696	1319	quartzite	94	90	51	667	ventral	oval, 21 x 16	See GRINDING, HAMMER. Light pitting in dorsal center. Fig. 11.7b

* Length (L), width (W), and thickness (T) are maximum measurements. All measurements are reported in mm.

Several explanations have been advanced for similar artifacts. At Graham Cave they are described as either pitted hammerstones (Logan 1952) or pitted manos (Klippel 1971). Cook (1976:36) states that these pieces are formed when "used as both a mano and a hammerstone and so producing a shallow pecked depression in the center of the grinding surfaces--hence the name *combination stone* or *pitted manos*." Logan (1993b:146) suggests that pitting in the center of two quartzite cobbles at the Quarry Creek site occurred through use of the pieces as nutting stones. These pieces are not always combination tools, as is clear from Tables 11.6 and 11.7. Out of the four pitted stones, two exhibited no other cultural wear than the central pitting. The remaining two were used for both grinding and hammering.

Roper (1984:5) has suggested that pieces identified as "pitted manos" may have served instead as anvils for bipolar lithic reduction (Crabtree 1972:10), as "the anvil used for bipolar flaking need not be large and a rock that is somewhat flattened on both sides provides the most stable surface. . . experiments have shown that repeated use of a single rock as an anvil will produce shallow, circular pits in a relatively short period of time." Future study of the debitage may establish the presence of bipolar reduction at the site.

It is worth describing one additional piece here. This igneous cobble (A1717-0296; Fig. 11.7a) has a large, circular pit about 31mm in diameter and 7mm deep in one face which causes the artifact to resemble a mortar. However, it is apparent, both macroscopically and at 10x magnification, that the grains inside the pit are not worn or ground as one would expect with use of a pestle. In fact, they are remarkably unworn, leaving the agent which created the pit a mystery. It is assumed here to be natural.

Heat-Altered Pieces: Seventeen pieces exhibited signs of heat alteration such as spalling, cracking, or discoloration (Table 11.8). Presumably, smooth cobbles that could withstand heating would be chosen for use in stone boiling, rather than materials that would either trap dirt in cracks (adding it to the food) or disintegrate or crumble upon heating (adding sediment to the food). Quartzite would be an acceptable choice; granite would not. Fifteen pieces fit these criteria and could possibly have been used in stone boiling.

Unmodified Cobbles: Forty pieces in this category exhibited either no wear or wear that was only attributed to natural processes (Table 11.9). It is possible that such pieces could have been used in activities that left no observable traces of wear, or wear that was indistinguishable from natural wear. Any polish from rubbing stones against a soft surface, for example, might not always be detectable. Smooth cobbles used in pottery manufacturing would probably not have traces of use (Hayden 1987a:212). Stones might not always exhibit evidence of heating if used in stone-boiling or around hearths. Cobbles could also have served simply as weights to hold down tents or other materials.

Phytolith Analysis

Four pieces were chosen for phytolith analysis in the fall of 1996. Pieces were selected for analysis while still dirty on the basis of general shape and a smooth, potentially ground surface. After the pieces were washed, two of them were identified as grinding implements (A7417-0296, A7415-0296; Table 11.1), one of them was classified as a hammerstone (A1932-0296; Table 11.4), and one was termed a heat-altered but otherwise unmodified cobble (A7419-0296; Table 11.8). Functional identifications were made prior to the return of the phytolith analysis results.

The two identified grinding tools had evidence for the grinding of native grass seeds (see chapter 4). A7417-0296 (assigned FN 1096 in the field; Fig. 11.5a), is the one formal mano recovered from the excavated block. The other, A7415-0296 (FN 1088; Fig. 11.6a), is the soled glacial erratic of unidentified metamorphic rock. These two pieces have the largest grinding surfaces in the analyzed assemblage.

No elevated levels of phytoliths from grass seeds were found on the two pieces apparently lacking grinding surfaces. While there is a variety of possible explanations for this, these findings do not contradict the wear patterns identified here.

Nine additional phytolith samples were collected in the spring of 1997, dried, and curated for future analysis. Table 11.10 provides a list of pieces with curated phytolith samples and their functional classifications. Future analysis of the curated phytolith samples could tie in function with observed wear patterns, and help support the conclusions about evidence of grinding. To this end, it is important that samples from pieces with a variety of wear types are analyzed, not simply those from more formal pieces with clear evidence of grinding.

Table 11.8. Description of **heat-altered cobbles.**

CATNO	FN	Material	Mass (g)	Evidence of heating
A5422	971	quartzite	950	breakage pattern
A2494	638	quartzite	176	spalling
A4216	842	quartzite	393	black and grey areas, cracking
A7618	653	quartzite	459	darkened areas, breakage
A2203	409	quartzite	403	dark pink area on yellowish cobble
A7419*	576	quartzite	915	end broken, pink area on yellowish cobble
A4217	843	granite	404	dark areas, cracks and breakage.
A7523	665	granite	315	blackened areas, spalling
A4438	284	quartzite	289	darkened areas
A4452	140	quartzite	567	pink and grey areas, sloughing of surface
A7520	602	quartzite	808	grey areas, breakage
A3027	50	meta.	1436	mottling (red w/grey and white), black spots
A5108	463	meta.	1435	mottling (red w/grey and white), black spots
A4585	203	quartzite	392	greyish area, breakage
A3063	183	quartzite	674	cracking, breakage, dark area
A2943	890	quartzite	313	cracking, breakage
A2237	540	quartzite	260	cracking, breakage

*phytolith sample analyzed, Fall 1996

Table 11.9. Description of **unmodified cobbles.**

CATNO	FN	Material	Mass (g)
A1905*	80	igneous	436
A7617	577	quartzite	538
A7422	482	quartzite	727
A7420	578	quartzite	326
A2109	579	quartzite	531
A7424	691	granite	167
A4882	396	quartzite	461
A2824	877	igneous	510
A7425	446	meta.	678
A5565	851	meta.	572
A5110	471	igneous	569
A2826	898	quartzite	1179
A2678	792	quartzite	235
A3893	1038	granite	323
A5318	917	quartzite	632
A2734*	895	quartzite	495
A7295	683	igneous	683
A5767	1433	quartzite	346
A4437	260	igneous	312
A5321*	916	igneous	741

CATNO	FN	Material	Mass (g)
A4821	572	quartzite	384
A3968	879	quartzite	276
A6373	1105	quartzite	76
A2942	897	quartzite	24
A2233*	414	quartzite	803
A2796	813	syenite	270
A7519	574	quartzite	501
A2234*	549	meta.	718
A5109	470	?	2026
A4694	764	hornfels	209
A6700	1318	quartzite	727
A7522	500	quartzite	299
A6557	1176	?	268
A5448*	987	meta.	598
A1717**	154	igneous	517
A6079	1270	meta.	868
A3307	172	quartzite	470
A6558	1251	quartzite	295
A5773	1434	quartzite	650
6080	1271	igneous	1039

* curated phytolith sample, Spring 1997

** illustrated; see Figure 11.7a
(also with curated phytolith sample)

Table 11.10. List of curated phytolith samples (Spring 1997).

CATNO	FN	Assigned functional category
A5321	916	unmodified
A2234	549	unmodified
A1905	80	unmodified
A6798	1324	grinding
A1717	154	unmodified (see Fig. 11.7a)
A5448	987	unmodified
A6554	1173	hammerstone
A2734	895	unmodified
A2233	414	unmodified

Discussion and Conclusions

From the large number of cobbles recovered at 14LV1071, there was initially assumed to be a great deal of evidence of plant processing, particularly nut processing, at the site. A careful study of the wear patterns on these pieces has somewhat tempered these conclusions. Of the 85 glacial cobbles analyzed, 13 of them show signs of grinding against a hard surface, four exhibit pitting in the center of the ventral face, and 16 show crushing or pecking along a distal or lateral edge. Some of this wear could be due to the grinding of nutmeats and cracking of nuts against an anvil, although the phytolith analysis suggests that some of the grinding is from processing wild grasses (see chapter 4). This by no means diminishes the potential economic importance of the nuts available at the site, but it may indicate that many of these nuts were not processed here. (Alternate possibilities are that nuts were not processed with these tools, or that the processing left no discernible evidence on these tools.)

The vast majority of pieces exhibiting use-wear are unshaped, used without modification to the original cobble. This is the case for all but one of the grinding stones. Some authors argue that this reflects upon the nature of the occupation. "Part-time (seasonal?) habitations are identifiable in part by the presence of expediently used grinding tools, those that are unshaped or 'casually shaped' river cobbles (Whittlesey and Reid 1982:206)" (cited in Nelson and Lippmeier 1993:290). Some go farther and argue that it reflects the scheduling of the use of various sites and how commonly a site is visited by a particular group. "As site furniture, grinding tools remain on sites and are reused by site occupants. . . We suggest that items made with the intention of regular reuse should receive greater investment in production toward durability and use efficiency" (Nelson and Lippmeier 1993:301). If Nelson and Lippmeier are correct, then 14LV1071 was not a site that many groups returned to frequently and to which they regularly scheduled stops.

However, there are other explanations for the predominance of inefficient, unshaped tools with relatively little use-wear, involving the factors of curation and scavenging. One or more ground stone implements might well be curated as part of a traveling kit, for example, as in the Hidatsa moccasin-making example (Weitzner 1979:219). While many curated items are cached at frequently-visited locations, the same items may also be carried along "when a stop is anticipated at a place not normally used," as in the Nunamiut example given by Binford (1983:260).

Scavenging of sites for materials and tools is a frequently recognized phenomenon, and the practice is alluded to by the Blackfeet informant describing how stone hammers were made (Wissler 1910:21-22). The impact of prehistoric scavenging on archaeological assemblages is considered by Schlanger (1991:470), who finds that sites with short periods of access to structures after abandonment (where structures burned around the time of abandonment, sealing the contents inside) have more grinding tools and more whole artifacts than other sites. This is true not only for the structure assemblages, but for all contexts at the site. Schlanger (1991:470) suggests that "the act of burning roofs at sites may have served to restrict general postabandonment visitation and scavenging." Judging from the wide range of point styles at 14LV1071, this location was a popular spot with many groups. It is entirely possible that the most efficient and/or well-made grinding implements might have been carried off by subsequent inhabitants of the site.

Conclusions about site activities based on the groundstone assemblage must be tempered with caution. Any discussion of the importance of grinding activities at 14LV1071, for example, must take into account that many implements used for grinding may have been perishable. Implements such as the wooden mortars and/or pestles documented for the Hidatsa (Wilson 1924:270-271), Mandan (Catlin 1973:116), and Pawnee (Weltfish 1965:80) would not survive in this depositional environment. It is also clear that a number of activities potentially involving the groundstone artifacts might not leave traces of wear. The practice of pounding meat or other materials on a skin rather than a hard stone surface would certainly reduce the amount of wear expected on the pestle.

However, the evidence currently available for 14LV1071 indicates that the bulk of the grinding tools were inefficient, expedient tools. There is nothing in the assemblage of cobble manuports, as it was recovered, to suggest that intense processing requiring grinding took place at the site. This assemblage does support the presence of other activities such as flint knapping and general hammering. Stone boiling could be indicated by the appearance of heat-altered cobbles, although these may simply have served as hearthstones.

Suggestions for Future Research

There are a variety of topics here that are worth investigating further. The first is the nature of natural wear on glacial cobbles, and the resulting extent to which pieces have been misidentified as grinding tools. The number of manos and/or grinding tools may be overestimated at sites such as Graham Cave and other sites that have large numbers of glacial cobbles in the artifact assemblage.

For example, Klippel (1971:37), from his excavations in the late 1960s at Graham Cave, reports 44 manos (pitted, bipitted, unpitted, or too fragmentary). He points out earlier in his manuscript that the materials used were apparently obtained from nearby outcrops of glacial till. With such a large number of "manos," some of these pieces may simply be smooth unmodified cobbles, particularly since some of them are fragments.

In her analysis of groundstone from Trowbridge, a Kansas City Hopewell site, Hirsch (1976:59) defines manos "on the basis of surfaces showing evidences of grinding (may be smooth, striated, or finely pitted)." This is uncomfortably vague when dealing with assemblages of glacial till cobbles--which, judging from the raw material list, his almost certainly is. I have demonstrated above that smooth, striated, and finely pitted surfaces all occur naturally in till assemblages. In addition, I would not characterize the gouging and grooving that results from grinding on an uneven surface as "fine pitting." The fine pitting observed by Hirsch may be entirely natural. Bell (1976:47) provides a photograph of a "mano" from the same site that does not appear to be ground, although admittedly it is difficult to tell from the photograph.

Alternately, authors may assume that wear on naturally worn cobbles would not be identifable unless the pieces were formally and/or heavily modified. Calabrese (1969:142) did not find a formal grinding surface on unmodified utilized cobbles "of dense sandstone or granite" at the Friend and Foe site, but does find traces of hematite ground into their surfaces. He attributes the absence of grinding wear on the surface to the hardness of the material, which could be a factor if these pieces were ground against a softer material (if hematite was ground with a cobble against a hide, for example).

He goes on to suggest that many unmodified cobbles without traces of hematite, "occuring frequently in the house fill, were at least occasionally utilized for grinding. Their surfaces, however, bear no indication of such activity--primarily because of their hardness or infrequent use." I have tried to demonstrate here through experiments that cobbles used even for a short time in grinding tasks should bear traces of this use, and that these surfaces will be worn regardless of their hardness if used against another hard surface. In thirteen cases in this study, this wear could be clearly identified.

One way to further address the problem of natural wear would be systematic sampling of glacial till deposits, perhaps using sampling methods outlined by Shelley (1993) for secondary lithic deposits. The appearance and relative frequency of natural wear patterns should be characterized further to help support assessments of natural or cultural wear on artifacts. Grinding and other cultural wear patterns should be superimposed on a variety of naturally worn surfaces during experiments to better understand when cultural wear can be detected and when it cannot.

The interpretation of the grinding technology at 14LV1071 as primarily expedient is worthy of further study. An argument that many grinding tools may have been taken from the site over the millenia could be supported by a look at other tool classes or types of raw material.

Were whole tools in usuable condition found at the site? Are there incompletely used cores which could have been used further?

Ethnohistorically, preventing theft was a concern of groups who curated grinding tools at sites. Underhill (1951:26, 44) reports that in Pueblo groups, grinding stones were buried near the user's home before trips or at plant collecting/harvesting camps. If 14LV1071 is a heavily scavenged site, how is it that the formal mano was recovered? Could it have been part of a cache? The spatial distribution of cobbles across the site can be checked for any evidence of caching behavior or other significant clustering.

The numerous fragments of glacial materials may also contain valuable information about the groundstone assemblage. While many of these pieces are likely to be fire-cracked rock, others could well be manufacturing debris from axes, celts, and manos. Some research has been done on groundstone material procurement and tool manufacture in ethnographic and archaeological contexts (Huckell 1986; Hayden 1987b; Nelson 1987). A study of the debitage from groundstone tool production might suggest the manufacture of more formal tool types which were carried from the site.

This analysis demonstrates the utility of careful macroscopic and microscopic analysis of use-wear patterns on glacial cobbles, and the assessment of tool function based on these patterns. As I have described above, natural wear patterning is a special problem with this material that needs to be taken into consideration. Nevertheless, the effort to evaluate and overcome this factor is necessary if we are to make any sense of this common expedient tool type. Expedient tools in general play a large role in the activities of many prehistoric groups, and the interpretation of activities at any site is incomplete and possibly misleading without a careful examination of the expedient technology.

Acknowledgements

Microscopes were used at the University of Kansas Museum of Natural History with the assistance of Anne Maglia, a Ph.D. student in the Department of Systematics and Ecology, and at KUMA.

Materials for the experiments and comparative collection came from several sources. The University of Kansas Animal Research Unit provided a freshly-killed domestic white rabbit. Will Banks, a Ph.D. student in the Department of Anthropology, University of Kansas, made three unhafted chert scrapers specifically for this project and loaned the author three hammerstones.

Additional help was received from Dr. Wakefield Dort, Department of Geology, University of Kansas, who identified a portion of the glacial materials in the till sample and artifact assemblage. Assistance from all of these people is gratefully acknowledged.

Chapter 12

Abraders, Axes, Celts and Hematite

Margaret Beck and Ann V. Begeman

The previous chapter described expedient or relatively unshaped tools made from cobbles of glacial till. This chapter discusses the remainder of the groundstone assemblage, including highly worked glacial materials and other materials.

The glacial materials here include greenstone and schist (worked into axes and celts) and hematite (ground and polished into one celt and several geometric fragments). The mass of glacial materials recovered within the excavated block and the graded area was noted in the previous chapter, with the exception of hematite. The amount and appearance of the hematite from 14LV1071 will be addressed later in this chapter.

The apparently non-glacial materials used include sandstone and a lightweight, porous stone that resembles pumice. This latter substance may be either "clinker" or "scoria." Clinkers or "floatstone" are products of the burning lignite beds to the north in Montana and North Dakota and float down the Missouri River (Flenniken and Ozbun 1988:39). Scoria are volcanic byproducts similar to pumice, defined as "porous, frothy magma blobs (Schumann 1993:232) or "[p]umice-like crusts full of holes on lava flows. They are more compact than pumice stone, weather-resistant and usually reddish" (Schumann 1993:236). "Pumice [itself] is relatively rare on the Plains but can be found in tills and fluvial deposits," (Flenniken and Ozbun 1988:39), and it is possible that scoria would be available in the same locations. It is uncertain which material--clinker or scoria--is represented in the assemblage from 14LV1071. In the text, it is tentatively labeled "scoria." 1126.8g of scoria was mapped in place, and an additional 317g was collected from the water screen.

Nearly 16kg of sandstone is catalogued at 14LV1071. 10.38kg was mapped, while 5.54kg was recovered through water screening. Sandstone is available in the area from several sources, including the Tonganoxie member of the Stranger Formation, which stretches from near Leavenworth across much of eastern Kansas (Buchanan and McCauley 1993:8), and the Dakota formation to the northwest (Buchanan and McCauley 1988). No attempt has been made here to distinguish between sandstones from different sources.

Abraders

The groundstone assemblage from the excavated block and graded area includes eleven sandstone and three scoria abraders. Tables 12.1 and 12.2 provide some description of the shape and wear patterns of these abraders.

Table 12.1. Summary of grooves on sandstone abraders.

CATNO	Abrader shape	Groove shape	Groove length (cm)	Groove width (cm)	Groove depth (cm)	Possible use creating groove
A7536	trapezopid	U to V	3.5	0.5	0.2	pointed tool abrader
		V	3.7	0.3	0.2	chipped stone abrader
		V	3.5	0.2	0.2	chipped stone abrader
A5041	irregular rectangle	rounded	2.7	0.3	<0.1	unknown
A2205	oval	U	3.7	0.3	0.1	pointed tool abrader
		U	3.5	1.1	0.3	arrow-shaft abrader
A6746	oblong	V	2.6	0.2	<0.1	chipped stone abrader
A2235	irregular rectangle	rounded to angular	3.2	0.7	0.2	pointed tool abrader
A3079	irregular rectangle	wide, rounded	3.7	1.2	0.3	unknown
A5559	irregular rectangle	V	1.2	0.5	0.2	chipped stone abrader
A3523	teardrop	rounded to angular	2.8	0.7	0.4	unknown
A6839	irregular triangle	rounded	3.6	0.3	0.1	unknown
		wide, rounded	3.2	0.6	0.1	unknown
		narrow, rounded	2.9	0.5	<0.1	unknown
		slightly rounded	2.6	0.4	<0.1	unknown
		wide, rounded	2.9	0.5	0.1	unknown
		rounded	0.2	0.2	<0.1	unknown
A7016	triangle	V	1.7	0.6	0.2	chipped stone abrader

Table 12.2. Summary of grooves on scoria abraders.

CATNO	Abrader shape	Groove shape	Groove length (cm)	Groove width (cm)	Groove depth (cm)	Possible use creating groove
A5319	oblong	rounded	5.1	0.8	0.5	pointed tool abrader
		rounded	1.6	0.6	0.3	unknown
		rounded	3.9	1.2	0.4	unknown
		rounded	1.9	0.2	0.3	pointed tool abrader
A7537	irregular	narrow, U	2.8	0.2	0.3	unknown
		narrow, U	1.4	0.2	0.1	unknown
		V	2.4	0.3	0.2	chipped stone abrader
		V	4.0	0.7	0.7	chipped stone abrader
		V	5.4	0.2	0.4	chipped stone abrader
		V	5.1	1.0	0.5	chipped stone abrader
		narrow, U	4.8	0.8	0.4	unknown
		slightly rounded	3.3	0.8	<0.1	unknown
A7000	irregular trapezoid	rounded	2.3	0.2	<0.1	unknown
		rounded	3.6	0.3	<0.1	unknown
		rounded	1.2	0.1	<0.1	unknown
		rounded	3.8	3.1	0.3	unknown

Three of the sandstone abraders have been shaped by grinding. The first (A7536-0296; Fig. 12.1a) is a trapedzoidal block measuring 4.5 by 2.1cm with a thickness of 1.9cm and weight of 22.8g. One distinct groove appears on each of the three sides of the block, and a very slight depression indicating the beginning of a groove appears on the fourth. The largest U-shaped groove on this piece tapers to a V-shaped groove and measures 3.5 by 0.5cm with a depth of 0.2cm. This is similar to grooves resulting from pointed tool abrasion (Flenniken and Ozbun 1988:49-50). One sandstone abrader with similar grooves was found in Feature 7 at the nearby Quarry Creek site (14LV401) along with three turkey bone awls. The honed end of all three awls fit the grooves of this abrader (Logan 1993b:149). The piece from 14LV1071 may have served several functions. The two distinct V-shaped grooves on this piece, measuring 3.7 by 0.3cm and 0.5 by 0.2cm with depths of 0.2cm, probably resulted from use of this piece in the chipped stone tool-making process (Flenniken and Osbun 1988:46).

The second intentionally shaped abrader (A5041-0296) has an irregular rectangular shape, measuring 3.3 by 2.1cm with a thickness of 1.2cm. On one side is an hourglass-shaped, slightly-rounded groove measuring 2.7 by 0.3cm with a depth of less than 0.1cm. The activity that created this groove is unknown.

The third shaped abrader (A2205-0296; Fig. 12.1b) is oval with one blunt end. It measures 4.1 by 2.7cm with a thickness of 2.4cm. It has grooves on opposite sides. One of these grooves is U-shaped and measures 3.7 by 0.3cm with a depth of 0.1cm. This groove may have been created through use of the piece as a pointed tool abrader (Flenniken and Ozbun 1988). The other U-shaped groove measures 3.5 by 1.1 cm with a depth of 0.3cm, and suggests abrading of arrow shafts (Flenniken and Ozbun 1988).

Seven of the eight remaining sandstone abraders vary in shape and include irregularly rectangular, oblong, triangular, or teardrop-shaped pieces (Table 12.1). The length of these abraders varies from 3.6 to 9.7cm, with an average of 6.3 cm. The width ranges from 3.5 to 5.9cm with an average of 4.1cm, while the thickness ranges from 1.6 to 3.9cm, with an average of 2.7cm. The mass of these pieces ranges from 20.5 to 117.9g, with an average of 68.4g. Six of these pieces appear to have been used minimally, with only one groove, while one additional piece (A6839-0296; Fig. 12.1c) has grooves on two sides and one end. The shape and maximum dimensions of these grooves and the activities they may represent are indicated in Table 12.1.

The last sandstone abrader (A4441-0296) is irregular in shape and has a rounded oval abrasion measuring 3.2 by 2.3cm with a depth of approximately 0.5cm. It is unknown how this wear was created.

Three of the sandstone abraders described above (A5319-0296, A2235-0296, and A3523-0296) have small, shallow indentations ranging from 0.6 to 1.0cm in length and 0.2 to 1.0cm in width. These could be due to natural rather than cultural processes.

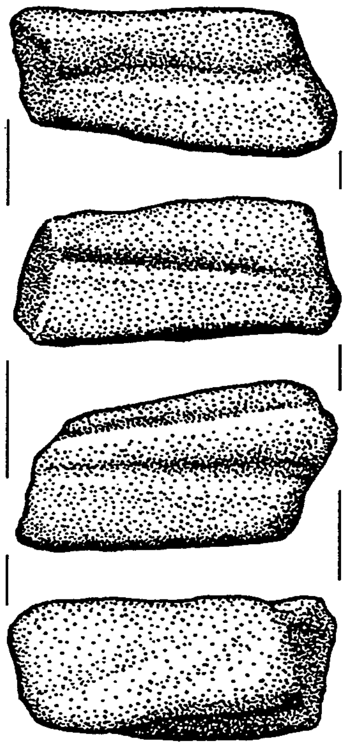


Figure 12.1a. Shaped sandstone abrader (A7536-0296).

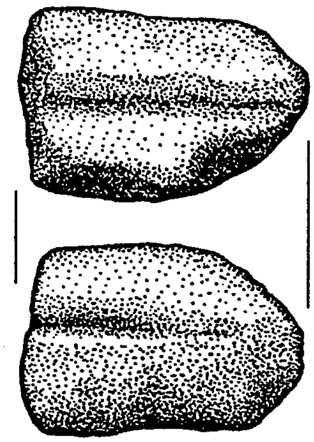


Figure 12.1b. Shaped sandstone abrader (A2205-0296).

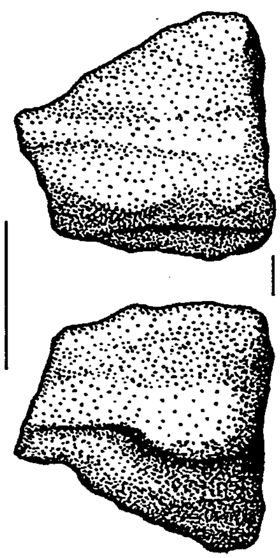


Figure 12.1c. Sandstone abrader with multiple shallow grooves (A6839-0296).

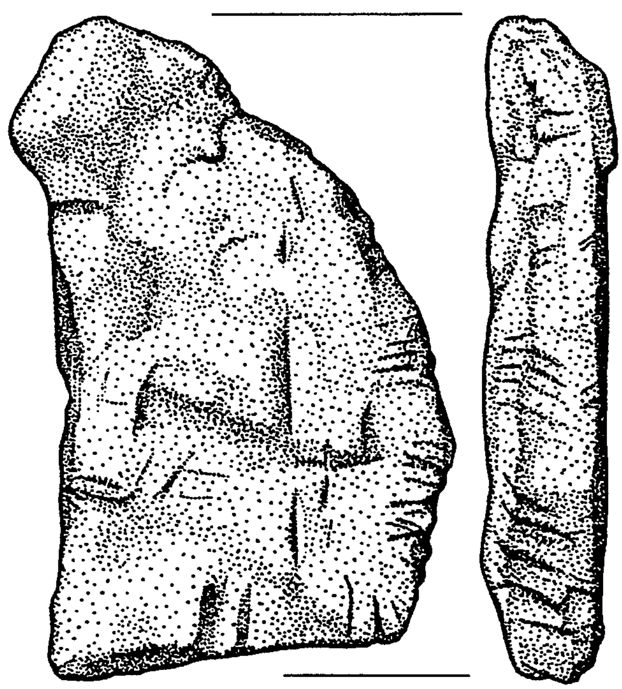


Figure 12.1d. Sandstone abrader with one groove and multiple striations (A7016-0296).

Five of the above abraders (A6746-0296, A4441-0296, A2235-0296, A5559-0296, A7016-0296) show striations on their ventral or dorsal surfaces or on their lateral edges. One of these (A7016-0296; Fig. 12.1c) has 34 striations ranging from 0.3 to 1.1cm in length, with widths and depths of less than 0.1cm. The striations of all of these abraders, if cultural, were probably the result of grinding during the chipped stone tool-making process.

The three scoria abraders were all found in the 20-30 and 30-40cm levels below the graded surface, and are attributed to activities by Archaic groups. One irregular trapezoidal piece (A7000-0296), which measures 4.4 by 3.2cm with a thickness of 1.6cm, exhibits grooving on two sides. One side has three shallow, rounded grooves that blend together, and the other has a distinct groove with a depth of 0.3cm and extended, shallow margins. The grooves' dimensions range from 1.2 to 3.8cm in length and 0.1 to 3.1cm in width with a depth of 0.3cm or less. The function of this piece is unknown.

The second scoria abrader (A5319-0296; Fig. 12.2a) has an irregular oblong shape and measures 9.0 by 6.0cm, with a thickness of 4.1cm. It has two grooves on the dorsal side. One rounded groove measures 5.1 by 0.8cm with a depth of 0.5cm. The second groove is curved and measures 1.6 by 0.6 cm with a depth of 0.3cm. One of the grooves on the ventral side is curved and rounded, and measures 3.9 by 1.2cm with a depth of 0.4cm. The other groove is narrow and rounded, and measures 1.9 by 0.2cm with a depth of 0.3cm. This piece may have been used as a pointed tool abrader (Flenniken and Ozbun 1988:50). Striations are also present on the ventral surface of this abrader.

The last scoria abrader (A7537-0296; Fig. 12.2b) is irregularly shaped with two narrow U-shaped grooves on the ventral surface, both 0.2 cm in width. The first groove is 2.8 cm in length with a depth of 0.3 cm, and the second is 1.4 cm in length with a depth of 0.1 cm. There are also three v-shaped grooves on the dorsal surface. The dorsal surface has three grooves. The first is a V-shaped groove measuring 5.1 by 1.0 cm with a depth of 0.5 cm. The second is a narrow U-shaped groove measuring 4.8 by 0.8 cm with a depth of 0.4 cm. The third groove measures 3.3 by 0.8 cm. The ventral side also exhibits one striation.

There are thirteen sandstone pieces (A5423-0296, A5197-0296, A5560-0296, A5563-0296, A5454-0296, A2974-0296, A4521-0296, A2971-0296, A4932-0296, A3108-0296, A1721-0296, A2585-0296, A3557-0296) that are possible abraders, with wear patterns that could be either natural or cultural. Twelve (all but A3557-0296) have anywhere from two to seventy-two striations on one or more sides and/or ends. Some of the larger striations range from 0.1 to 3.5 cm in length.

Other types of possible cultural wear on these thirteen pieces include shallow linear depressions ranging from 1.0 cm to 3.0 cm in length and 0.1 to 0.5 cm in width that appear on two pieces (A5560-0296, A1721-0296). Five others (A2974-0296, A2971-0296, A1721-0296, A5560-0296, A3557-0296) have abraded areas ranging from 0.7 to 1.9 cm in length and 0.1 to 1.6cm in width.

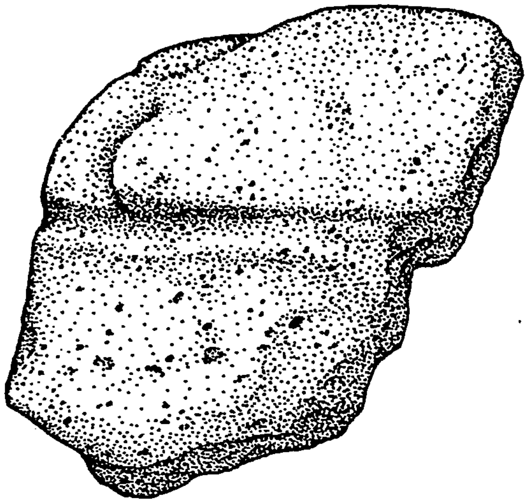


Figure 12.2a. Scoria abrader (A5319-0296).

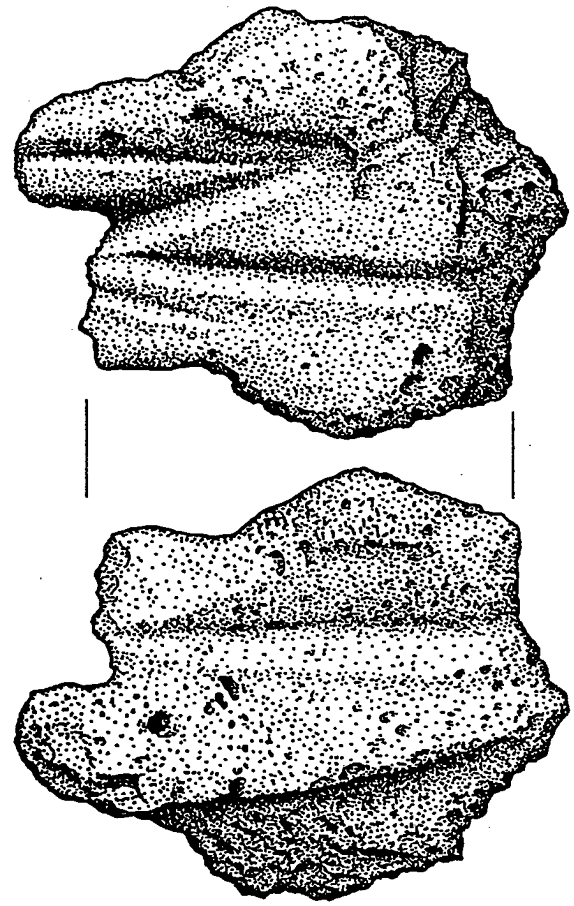


Figure 12.2b. Scoria abrader (A7537-0296).

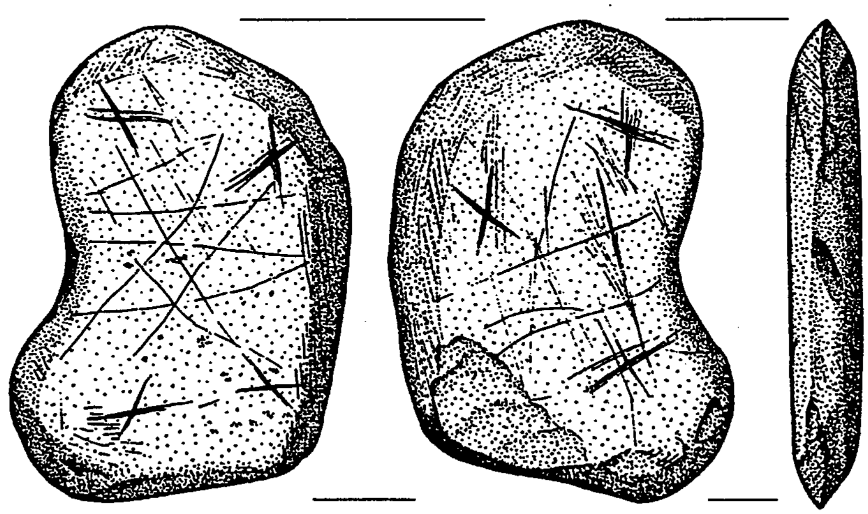


Figure 12.2c. Incised hematite celt (A7648-0296).

The three scoria abraders, as noted above, appear in the 20-30 and 30-40cm b.g levels. Scoria fragments are recovered from all of the levels, although the vast majority of them by mass appear in the 20-30 and 30-40cm bg (40-50 and 50-60cm bs) levels. Sandstone abraders were recovered from all levels.

Differences in function between abraders from different occupations cannot be specified, given the compression and mixing in the profile, but some general differences can be suggested. Arrowshaft abraders are most likely to belong to the Steed-Kisker component of the site, as the bow and arrow was not introduced into eastern Kansas until about A.D. 500 (Johnson 1976b:14; Logan and Beck 1996c:93) and evidence of Woodland occupation at DB is sparse.

Worked and Unworked Hematite

A total of 15.15kg of hematite and limonite is recorded at 14LV1071. 3.77kg was mapped in the block, 9.7kg was found by water-screening, and 16.65kg was mapped in the graded area around the block.

This material ranges from soft and powdery to relatively hard and dense. Some of the denser pieces exfoliate in layers, with a softer yellow rind falling away to reveal progressively darker, redder, denser material underneath. Similar hematite was collected approximately two miles south of the site in a glacial till deposit (Fig. 11.2).

The bulk of the hematite and limonite appears to be debris from the manufacture of finished pieces or raw material for use as pigment. There are several modified pieces which fall into four categories: flaked, ground and/or polished, incised, and abraded.

Four pieces (A6794-0296, A5904-0296, A3379-0296, and A6210-0296) have been bifacially flaked around the edges, taking the form of crude choppers. These bifaces are made from the densest hematite present at the site, but it is not clear if they were actually used for cutting or chopping. All are from an Archaic level, 30-40cm bg (50-60cm bs).

Six pieces have been ground and smoothed, and all have striations on one or more surfaces. Five (A4272-0296, A3896-0296, A4273-0296, A2179-0296, A7252-0296) are abstract, blocky shapes, and one of these (A3896-0296), a small multifaceted fragment, has been polished to a high gloss. All but A3896 appeared in the 0-10 or 10-20 cm bg (20-30 or 30-40 cm bs) levels. The faceted piece was recovered from 40-45cm bg (60-65cm bs). Similar pieces were found at the Friend and Foe site (23CL113), a Late Prehistoric site in Smithville Reservoir, northeastern Missouri, that is related to both the Steed-Kisker and Doniphan phases. Striations on those pieces are described as "similar to striations produced in a bar of soap by the sandstone found within the structures" at 23CL113, implying that sandstone abraders may have been used to shape and polish--or remove pigment from--these pieces.

The sixth ground piece (A2650-0296) is subrectangular with a circular depression about 29mm in diameter and 7mm deep on the ventral face. This "well" is only three-fourths complete, as the piece has been broken or cut and smoothed along one side. Striations cross the ventral surface through this depression. It is unknown what activity created the depression and/or left these striations. It is unclear whether this piece belongs to the Late Prehistoric component, like most of the other ground hematite pieces. It was recovered from 20-30 cm bg (40-50cm bs).

One piece (A7648-0296; Fig.12.2c) has been ground and polished into what may be a celt. The edges have been shaped to points along three of the four sides, and linear striations (perhaps from shaping) run parallel to the edges. Incised designs appear on both the ventral and dorsal faces, including what may be V- or X-shapes in the middle. Deep X-shapes are etched into each of the four corners on the dorsal side; three of four corners have similar marks on the ventral side. There may have been a fourth X on this face but the surface of the fourth corner has been abraded or sloughed off. Because this piece was recovered during the grading of the site following excavation, its stratigraphic position has not yet been related to those of units within the excavated block.

Two pieces (A6925-0296, A5771-0296) are relatively broad and flat and bear vertical grooves along their edges similar to those on one sandstone abrader (A7016-0296; Fig. 12.1d). This material feels smooth and chalky to the touch--characteristics that should make it unsuitable for abrading (Flenniken and Ozbun 1988). The activity that produced these striations is unknown. These pieces were found in 30-40 and 20-30cm bg (50-60 and 40-50cm bs) levels, respectively.

Axes and Celts

No axes were found in the excavated block. Six full-grooved greenstone axes were recovered when the remainder of the site was graded following excavation (Fig.12.3-12.6a; Table 12.3). These pieces are similar in shape and size to a full-grooved axe found during test excavations in 1995 (A0664-0495; Fig. 12.6b). Three of the axes recovered during the 1996 excavations (A7531-0296, A7530-0296, A7529-0296) were found in situ.

Two axes (A7531-0296, A7528-0296) had evidence of recent damage that is probably due to the grader. Use of the axes is indicated by other damage to the pieces, varying from the removal of very small chips to the absence of a large section on all of the pieces. Five of the six axes (A7532-0296, A7531-0296, A7528-0296, A7526-0296, A7529-0296) exhibit polishing on varying areas.

The largest axe (A7530-0296; Fig. 12.5), with a mass of 2005g, measures 22.2 by 11.9cm with a thickness of 5.5cm. The length of the five remaining axes ranges from 10.5cm to 16.5cm, with an average of 13.8cm. The width ranges from 7.0 to 9.2cm, with an average of 7.9cm. The thickness ranges from 3.4 to 4.9cm, with an average of 4.3cm,

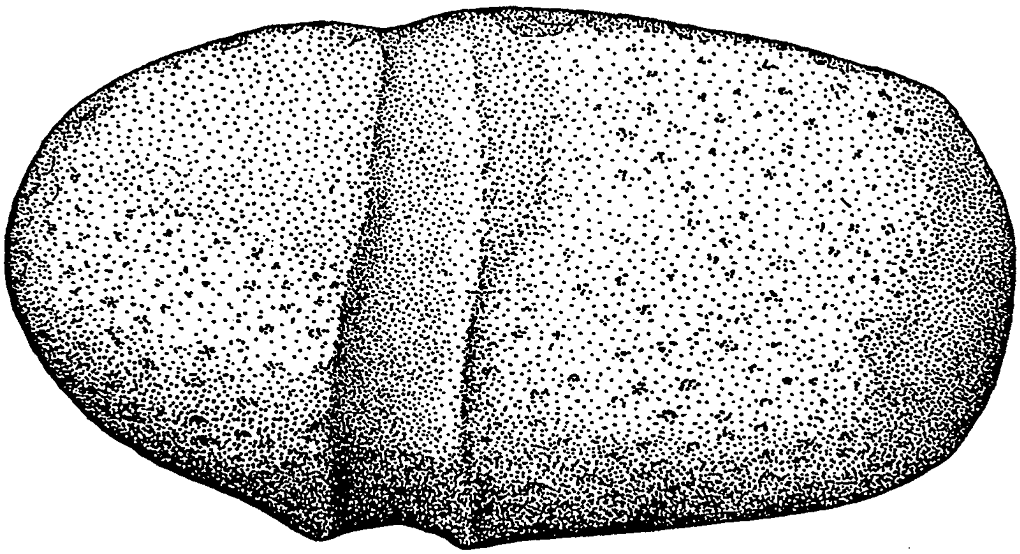


Figure 12.3a. Full-grooved axe (A7529-0296) from the graded area outside the excavated block.

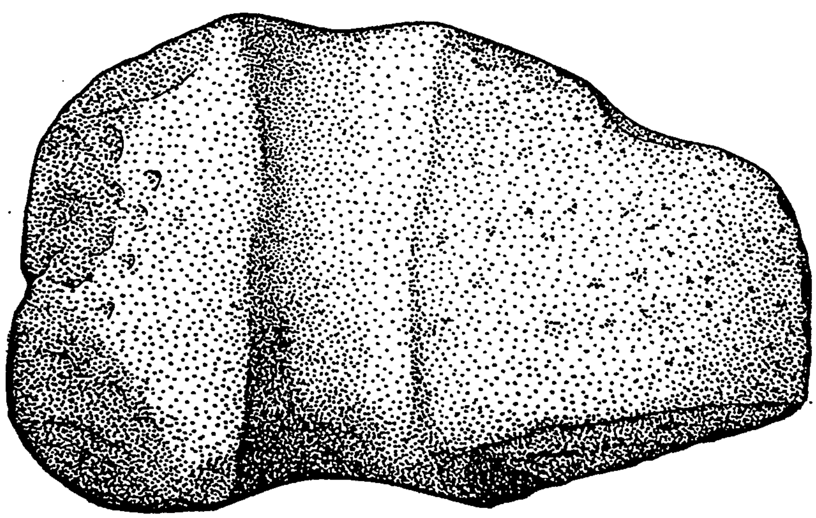


Figure 12.3b. Full-grooved axe (A7532-0296) from the graded area outside the excavated block.

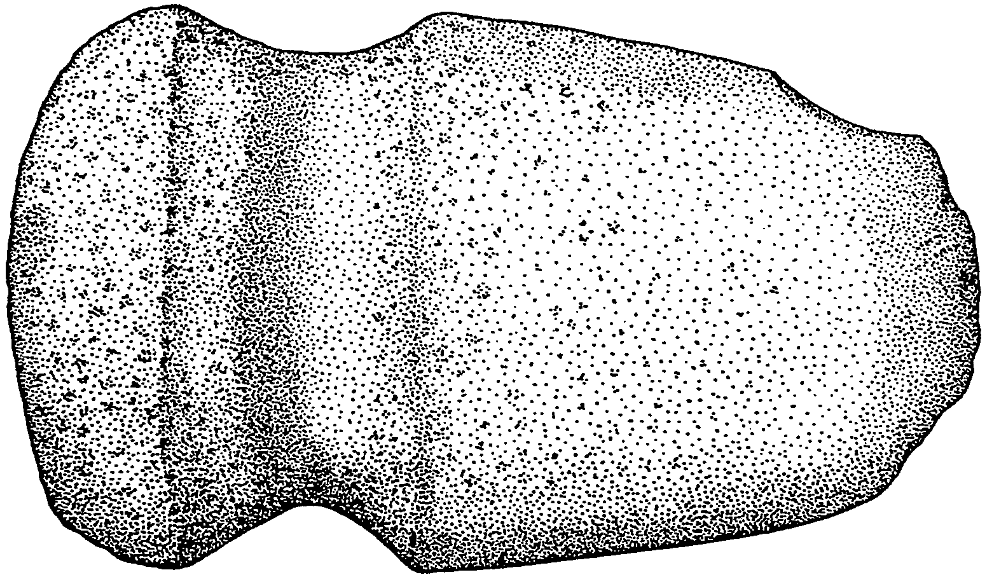


Figure 12.4a. Full-grooved axe (A7528-0296) from the graded area outside the excavated block.

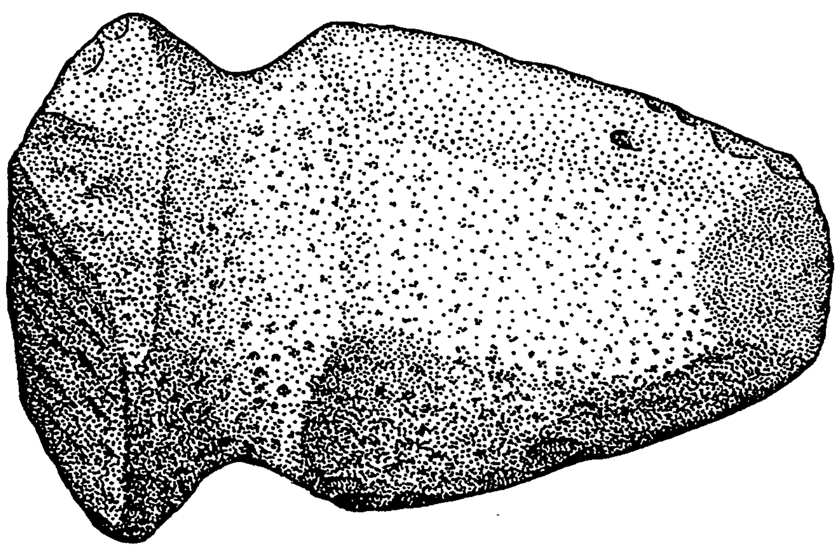
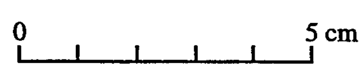


Figure 12.4b. Full-grooved axe (A7531-0296) from the graded area outside the excavated block.



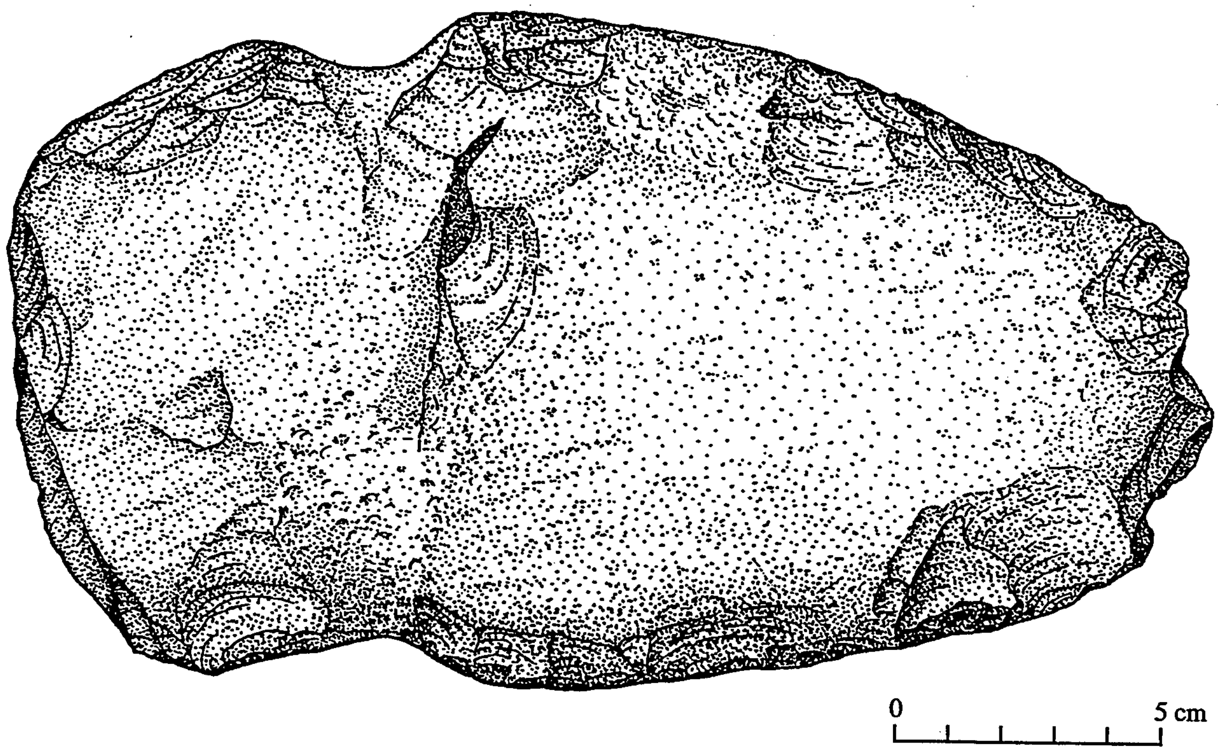


Figure 12.5. Full-grooved axe (A7530-0296) from the graded area outside the excavated block.

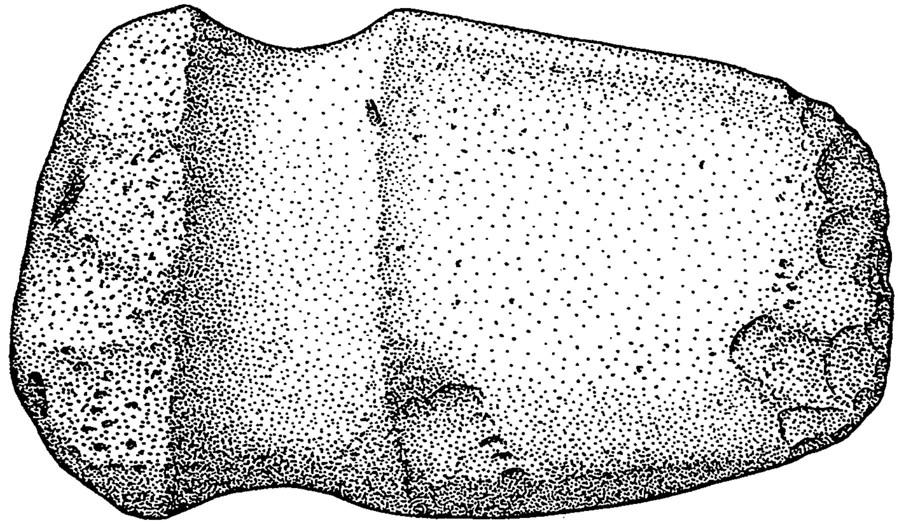


Figure 12.6a. Full-grooved axe (A7526-0296) from the graded area outside the excavated block.

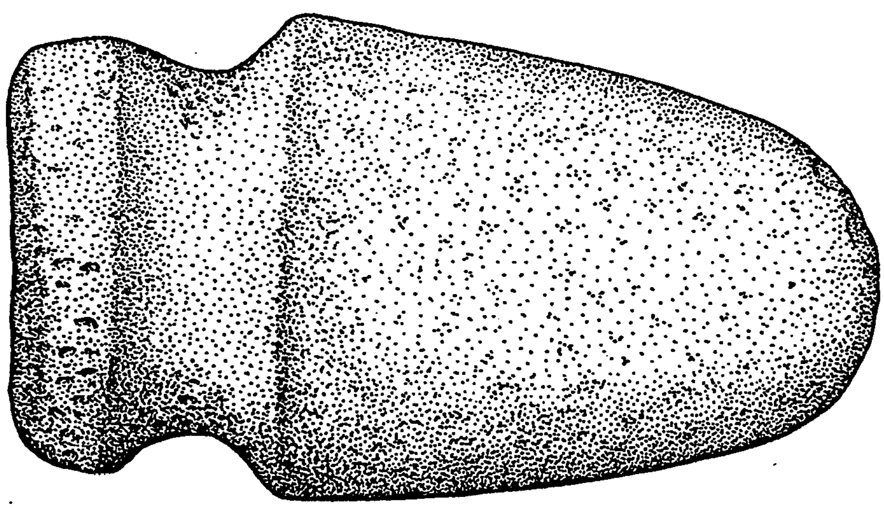


Figure 12.6b. Full-grooved axe (A0664-0495) recovered from 149N 56E during October 1995 excavations.

Table 12.3. Metric attributes of full-grooved axes.

CATNO	FN	Material	Length* (cm)	Width* (cm)	Thickness* (cm)	Mass (g)	Completeness
A7532	—	greenstone	10.5	6.5	4.4	459	complete
A7531	1618	greenstone	14.2	8.5	4.9	629	complete
A7530	1567	greenstone	22.2	11.9	5.5	2005	complete
A7528	1571	greenstone	16.5	9.2	4.1	997.5	complete
A7526	—	greenstone	14.6	8.2	4.9	1042	complete
A7529	1546	greenstone	13.4	7.0	3.4	437	complete

Table 12.4. Metric attributes of celts.

CATNO	FN	Material	Length* (cm)	Width* (cm)	Thickness* (cm)	Mass (g)	Completeness
A7527	6	greenstone	7.4	5.6	2.9	198	bit fragment
A7525	5	schist	6.7	5.3	2.6	149	poll fragment
A7648	1526	hematite	7.2	4.6	1.1	68	complete

*All measurements are maxium measurements.

and the mass ranges from 437 to 1042g, with an average of 713g. Table 12.3 presents the measurements and weights for individual pieces.

Reid (1984a:40) proposes that

> at least two functionally discrete implements are represented by the conventional term 'three-quarter grooved axe': true axes with heads ranging up to at least 1.7 kg in weight, swung with both arms and capable of tree-felling, and general purpose hatchets swung with one arm. The latter are not suited for tree-felling but are appropriate for a wide range of other woodworking tasks.

Reid bases this suggestion on reported modern preferences for axes of different weights for different tasks (Dickson 1981:86-87). If these can be used as a guide for the function of full-grooved axes, then only one axe from 14LV1071 (A7530-0296, which has a mass of 2kg) is heavy enough to have been used for tree-felling. The other five axes range in mass from 0.4 to 1kg, and may have been more general woodworking tools. Both axes and celts have been interpreted as woodworking tools at other sites such as Quarry Creek (Logan 1993b:146).

Full-grooved axes are striking artifacts, but unfortunately they are not diagnostic of any particular prehistoric complex or time period. Reid (1984a:41) reports that they may appear as early as the Early Archaic "in the Prairie Peninsula and riverine midwest." They continue to be used through the Plains Village period and into the early 1800s.

Two celt fragments were found on the surface after the initial grading to remove the plow zone (Fig. 12.7; Table 12.4). One (A7527-0296) is a greenstone bit fragment that

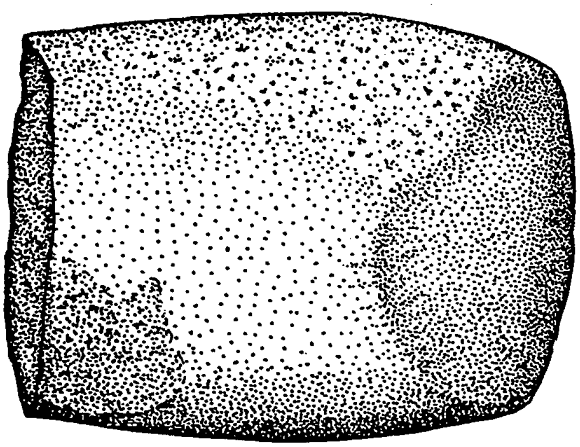


Figure 12.7a. Celt fragment (A7527-0296) found on surface after initial grading (0 cm b.g.).

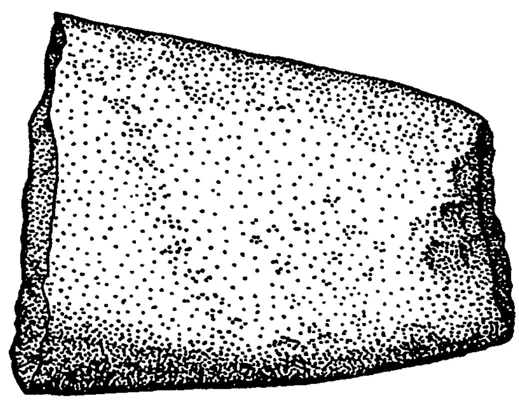


Figure 12.7b. Celt fragment (A7525-0296) found on surface after initial grading (0 cm b.g.).

0 5 cm

measures 7.4 by 5.6cm with a thickness of 2.9cm and a mass of 198g. The poll fragment (A7525-0296) is made of schist. It has a mass of 149.1g and measures 6.7 by 5.3cm with a thickness of 2.6cm. Both celts have polished areas, possibly the result of use. While their provenience (0cm bg, 20-30cm bs) suggests a Late Prehistoric association, these fragments of woodworking tools could have been brought to the site by the Archaic occupants as well. Several Archaic style projectile points/knives have comparable provenience at DB (see chapter 9).

Conclusions

The scoria, sandstone, hematite, and worked glacial materials described in this chapter--together with the cobbles and cobble tools addressed in Chapter 11--make up the non-chert stone tool assemblage from 14LV1071. These pieces suggest that a wide variety of activities took place at the site.

Sandstone and scoria abraders were apparently used in the manufacture of chipped stone tools, projectile point shafts and pointed bone or wooden tools. Sandstone pieces may also have been used to abrade and grind hematite into shaped objects or pigment. Hematite appears at the site as raw material or debris, shaped fragments, and one polished and incised celt. The designs on this celt may be evidence of use during some ceremonial activity.

The DB environs would have been wooded prehistorically (see chapter 2). Only one axe recovered from the site is heavy enough for use in felling trees. The remaining axes and the two celt fragments are evidence that prehistoric inhabitants were working the wood which was so abundantly available at the site.

Chapter 13

Biological Assemblages

Introduction

Brad Logan

Nature has not been kind to the biological assemblage of the DB site. 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 its prehistoric inhabitants. For example, despite extensive and systematic flotation sampling in 1988 and 1989, the Zacharias site in Salt Creek valley yielded very little bone and plant material. The DB site was not only systematically sampled for flotation but all of the excavated fill was waterscreened, a recovery technique more gentle with biological material than the dry-screening method applied at Zacharias. Nonetheless, 70.58m^3 of fill from DB yielded only 205.4g of charred plant remains and 242.2g of animal bone (Note: these figures do not include unsorted flotation samples, but they would not significantly alter them). While this may be due to soil acidity, the loss of organic remains is also likely the result of their exposure to the elements on a surface that experienced periodic erosion. Most of the bone is calcined, and the burning undoubtedly contributed to its preservation.

In contrast to DB and Zacharias, the nearby Quarry Creek site yielded hundreds of well preserved unburned bones and thousands of pieces of burned bone. For example, the fill (ca. 980lt, 204gl) of Feature 7, one of six storage pits dug at that site, contained 210.6g of burned bone and 638.1g of unburned bone. Obviously, soil acidity was not a problem there. It is possible that the anthropogenic contribution of organic matter, particularly phosphates, to the soil may have had a neutralizing affect (cf. Zabel 1976). The major difference in organic preservation there is more likely taphonomic. Rather than lying exposed on the surface, plant and animal remains at Quarry Creek were disposed in pit features and quickly buried in deeper middens, both indications of prolonged settlement, and thus protected from some weathering processes.

We can derive some insight from the lack of organic material beyond the suggestion that soil chemistry contributed to it. Had the occupants of DB accumulated trash mounds like those still visible at Quarry Creek, we may have recovered more material. This would particularly apply to the terminal Archaic occupation, which is suggested to have been sealed by Bignell loess within a relatively short time. The loess mantle over trash mounds would have granted them an additional measure of protection. Instead, it is likely that the extreme paucity of biological remains at DB is due to several factors beginning with relatively brief occupations by small groups that entailed deposition of thinner deposits of organic material. The floral and faunal remains in the sheet middens of the preceramic and ceramic-age occupations at DB were then even more vulnerable to the effects of exposure on an upland surface and any deteriorating affects of soil chemistry. Thus, the small number of biological remains at the site may be to some extent a reflection of short-term encampments.

The following two parts of this chapter, then, are attempts to glean some information about the subsistence practices of the DB inhabitants from the biological assemblage. The first concerns faunal remains in general and the second focuses on macrobotanical remains from selected units of the block excavation.

Part 1

Faunal Remains

Brad Logan

The DB faunal assemblage includes 188.2g of burned bone and 54.0g of unburned bone. All of the pieces are small, less than a quarter (2.5cm) in size and the vast majority smaller than a fingernail. This review focuses on the calcined fragments; unburned bone is probably historic. Surface survey of the site yielded considerable quantities of unburned bone on the eastern lobe of the ridge in association with 20th century artifacts. Much of the bone exhibits machine cutmarks indicating their recent age. While 15.8g (29.3%) of the unburned bone was found below 10cm bg (30cm bs) in the block excavation, this is believed to have been transported by rodent burrowing and other bioturbation processes. The burned bone has the following vertical distributions- 0-10cm bg (20-30cm bs): 40.4g (21.5%); 10-20cm bg (30-40cm bs): 44.9g (23.9%); 20-30cm bg (40-50cm bs)- 59.5g (31.6%); 30-40cm bg (50-60cm bs)- 38.0g (20.2%); 40-50cm bg (60-70cm bs)- 5.4g (2.9%). The slightly greater mass of burned bone from 30-50cm bs may reflect more animal food processing or consumption in the upper part of the preceramic horizon, but this may be stretching a small amount of data to the breaking point. Indeed, the distribution of burned bone in all levels appears to be relatively uniform.

The bones are so fragmented as to be unidentifiable with regard to species. No elements of fish, reptile, amphibian or bird species were noted; all appear to have been from mammals. It is notable that none of the pieces is robust and none of the cemented portions (i.e., shaft) of long-bones is thick, as we would expect of large mammals such as bison or elk. As a whole, we can only infer that the highly comminuted bone is from animals the size of deer or smaller. In chapter 14, Hill uses the horizontal distribution of burned bone and charcoal in first excavation level (0-10cm bg; 20-30cm bs) to identify a Late Prehistoric hearth area. The close correlation between the areas of higher bone and charcoal density in the southwestern portion of the block, their association with certain lithic and ceramic artifacts, and their complementary relationship with daub clusters supports the interpretation of an extramural hearth/activity area. The bone reflects either cooking of animal foods or the exposure of marrow-processed elements to the fire. Beyond these few inferences, the assemblage offers no insight at this time.

Part 2

Macrobotanical Remains

Mary J. Adair

Introduction

The recovery of plant remains from archaeological sites through the use of systematic flotation or water screening techniques has become a standard in archaeological investigations to ensure the representation of an important element in the reconstruction of past lifeways. At the DB site, both systematic flotation and water screening methods were employed, in part, to retrieve plant remains that could address the subsistence practices of the Archaic and Village period occupations. The recovered archaeobotanical data, when combined with the phytolith assemblage and the geomorphological interpretations, were also valuable contributions to an understanding of site formation processes. This section describes the recovered macrobotanical remains, evaluates their context within the site, and discusses the taphonomic variables that played a critical role in the preservation of the remains.

Laboratory Methods

Excavation procedures at the DB site included the selection of two 4.5gl flotation samples from each level of each excavation unit. These samples were processed with a Dausman Flot-Tech machine with a light fraction mesh of 0.325mm and a heavy fraction mesh of 1mm. All additional matrix from the excavation units was water screened through a series of graded mesh sizes. Both techniques, although very different in regards to the type of recovered material, yielded archaeobotanical remains. Water screened remains were typically larger and more capable of withstanding the direct water pressure while the flotation samples retrieved smaller and more delicate plant particles. In general, however, charred plant remains were not well preserved at the DB site. This became apparent as the amount of wood charcoal was calculated for each excavation unit and each level and as the flotation samples were initially examined for sort sampling. To retain a representative sample for the macrobotanical analysis, it was determined best to select both water screened and flotation samples from all of the levels of a few excavation units, rather than randomly select from the entire site. Water screened samples were selected from five excavation units (Table 13.1) while flotation samples were selected from four of the same units (Table 13.2).

Charred remains from the water screened samples were sorted under 10x magnification into wood charcoal and nutshell (or "other") categories and bagged separately. Using standard laboratory procedures, the light fraction flotation samples were size graded, using mesh sizes of 2mm, 1mm, .5mm, and a base pan. As very few of the flotation samples contained large particles of charred remains, the size grading was eliminated after a few samples. Samples were

Table 13.1 Identified Plant Taxa and Weights from Waterscreened Samples

Provenience	156N 68E	158N 68E	149N 59E	163N 59E	156N 59E	Total
Number of Samples	4	5	4	5	3	21
Taxa						
Juglans	128/4.2g	124/3.7g	37/1.2g	70/1.7g	40/.8g	399/11.6g
Carya	790/13.6g	178/6.4g	68/1.8g	40/1.1g	50/.8g	1126/23.7
unknown			13/.2g	10/.2g	18/.6g	41/1.0g
Zea mays						
kernel			15			17
embryo			1			
cupule			1			

Table 13.2 Identified Plant Taxa from Flotation Samples

Provenience	156N 68E	163N 59E	149N 59E	156N 59E	Total
Number of Samples	3	2	4	4	13
Modern					
Amaranthus sp.	X		X		
Chenopodium sp.		X		X	
Polygonum sp.			X		
Unidentified "seeds"	X	X	X	X	
Charred					
Zea mays			3		
Cucurbita sp.			2	2	
Unidentified fragments			14		
Total			19	2	

further examined under 10x magnification with all charred residue removed. Plant remains from both water screened and flotation samples were identified using published guides and comparative modern charred samples. Identifications were made to the genus and species level when possible. The identified remains from each recovery method are listed in Tables 13.1 and 13.2 according to provenience.

Interpretations

The archaeobotanical data from water screened and flotation samples combine to demonstrate the paucity of preserved remains at the DB site. The flotation samples consistently yielded modern weedy annuals, such as pigweed (*Amaranthus* sp.) and smartweed (*Polygonum* sp.), along with numerous small unidentified "seeds". These "seeds" had no outstanding morphological characteristics, such as seed coats or attachment scars, that could be used to further identify them. It is quite possible that they are not seeds at all, but some other organic residue that is deposited in the soil from various burrowing animals.

Flotation samples from only two excavation units, 149N/56E and 156N/59E, yielded charred plant remains that could be associated with the prehistoric occupation. Remains of domesticated corn (*Zea mays*) and very small fragments of what appear to be squash or gourd rind (*Cucurbita* sp.) were recovered from the first unit while only two such rind fragments were recovered from the second unit (Table 13.2). Rinds from the DB site are thin, measuring ca. 0.5mm in thickness. *Cucurbita pepo* was first grown in the Eastern United States during the Archaic period while a greater distribution and utilization of this species is noted throughout most of North America in later time periods. Recovery of both seeds and rind fragments attest to its selection for food (both the flesh and the seeds) and for containers (the hard shelled forms). All of the Middle Holocene *Cucurbita* rind fragments recovered from sites in Illinois, Kentucky, Tennessee, and Missouri (Smith 1992: 41) are thin shelled fragments, averaging below 2.0mm in thickness. Asch and Green (1995) report *Cucurbita* rind from a Glenwood locality site in western Iowa as measuring about 0.4mm in thickness, a size fairly consistent with that recovered from the DB site. A comparison of rind thickness from two wild species, the Texas wild gourd (*C. texana*) and the buffalo gourd (*C. foetidissima*) with the domesticated "squash", *Cucurbita pepo*, lead King (1985) to suggest that rind fragments thinner than 2.0 mm should not be identified as a gourdlike variety of the tropical cultigen *C. pepo*. Instead, they should be reported as belonging to the genus *Cucurbita*, and compared to the wild buffalo gourd, the Texas wild gourd, or the two subspecies groups *C. pepo* var. *ovifera* and *C. pepo* var. *texana*.. Given the rind thickness from the remains recovered from the DB site, it is unlikely they represent the fleshy pumpkin squash or even the C. pepo grouping. Without a more detailed examination of the cross-sections of the rinds and a comparison with noncultivated taxa, the DB rinds are simply reported as belonging to the genus *Cucurbita*. Remains from unit 149N/59E were recovered from the first level (0-10cm bg) while the two rind fragments from unit 156N/59E were recovered from 20-30cm bg. It is therefore difficult to determine if the remains are associated with only the Steed-Kisker occupation or if they also represent the late Archaic occupation.

The corn remains consist of two cupules and one fragment that closely resembles a cupule. Also recovered from excavation unit 149N/59E are 14 unidentified charred fragments, most of which exhibit morphological characteristics similar to corn kernels. All of the corn remains were recovered from the upper 20 cm of fill which is consistent with the use of this domesticate by Late Prehistoric groups. The relative concentration of domesticates in unit 149N/59E may tentatively suggest that this area of the site was a location of food preparation or processing.

The water screened samples were dominated by nutshell remains (Table 13.1) which could be identified as either hickory (*Carya* sp.) or walnut (*Juglans* sp.). Hickory shells are smooth surfaced and average less than 1.0mm in thickness. Walnut shells are typically thicker and display rough or ridged surfaces. In some samples, the remains were too small to accurately determine identification. All remains were counted and weighed to the nearest tenth of a gram. Small fragments of corn were also recovered from the upper level (0-10cm bg) of unit 149N/59E. Included was one embryo, one cupule, and 15 kernel fragments.

Discussion

The macrobotanical remains recovered from the DB site consist of modern weedy annuals (intrusive into the archaeological deposit); small fragments of thin *Cucurbita* rind, possibly representing a wild taxa; domesticated corn (Zea mays); and nutshell remains identified as either hickory (*Carya* sp.) or walnut (*Juglans* sp.). The lack of a more dense concentration of archaeobotanical remains can be partially explained by the erosional forces that must have prevailed both during and after the occupations of the site. These forces were largely responsible for the depletion of small particle remains. Without protection, such as being deposited in a below ground feature, the delicate plant remains could not have withstood the forces of erosion and deflation on the ground surface. Only those remains with a larger mass, such as nutshells or corn fragments, were able to securely lodge into the ground and thus, remain associated with other remnants of the past occupations. Even these larger remains, however, were subject to erosion and displacement and it is therefore impossible to determine the percentage of remains that may have once been associated with the repeated occupations. Given the relative shallow nature of the archaeological deposits, it is also difficult to determine which of the identified taxa were associated with the various occupations. The remains of corn however, may be safely associated with the later Steed-Kisker occupation, since all available data from North America would concur that its association with a mid-continent Archaic component is highly unlikely. Direct AMS dates on corn from the DB site unequivocally confirm its placement with the Steed-Kisker component. The nutshell fragments however, were recovered from all levels of the site, suggesting that this resource may have been used by repeated occupations at this locality. Although nuts are fairly dominant in the archaeobotanical assemblages from Archaic and Middle Woodland sites in the lower Missouri River area (Adair 1977, 1993; Root 1979), they are still represented, although in smaller quantities, in assemblages attributed to the Village period (Adair 1994).

Further investigations at this site may reveal intact features that would provide good contextual control for the preservation and interpretation of archaeobotanical remains. The current data presented should not be taken as an indication of poor preservation of botanical remains in Archaic deposits. Rather, the paucity of remains can be attributed to non-cultural factors, suggesting that further investigations of Archaic deposits in a different ecological setting may provide for excellent preservation and recovery of delicate macrobotanical remains. In ecological settings similar to the DB site, data important to the reconstruction of diet may perhaps be better preserved as pollen or phytoliths.

Chapter 14

Spatial Analysis

Matthew E. Hill Jr.

Introduction

This chapter examines the spatial distribution of artifacts from the block excavation at the DB site. This type of analysis is useful for reconstructing the formational history of the deposits (Schiffer 1987), as well as for identifying on-site activity areas (Ingbar and Larson 1996). The general questions addressed in this chapter include whether the distribution of artifacts results from natural processes or relates to the behavior of humans. Also, if this patterning is the result of human action, is that behavior spatially segregated?

This chapter focuses on the distribution of artifacts from the 163m² block excavation. The block, while large by archaeological standards, is only a small fraction of the actual size of the DB site. Logan (chapter 1) estimates that the DB site covers a total area of approximately 23,000m². The excavation block, then, encompasses approximately 0.7% of that area.

The block is also rather small in relation to many ethnographically known hunter-gatherer sites. Small ethnographic hunter-gatherer sites are reported by O'Connell and others (1991) for the Hadza of East Africa. They state that camps occupied by 35 to 50 people usually cover an area between 550 and 1,250m². In this instance, the DB block would cover between 13% to 30% of such a site, which is actually a very good sample. Other hunter-gatherer sites are much larger. Gargett and Hayden (1991) state that a large encampment of nearly 300 Pintupi in the Western Desert region of Australia covers ca. 115,000m². At such a site, the DB block would only cover 0.1% of the total site area. In this example, the size of the DB block would be woefully too small to adequately sample the full range of activities at a large hunter-gatherer site. Although the size of the DB block is not very large, it may, however, be of the proper scale to sample the actions of a single family. Ethnographic research (Gargett and Hayden 1991; O'Connell et al. 1991; Binford 1991; Gould 1969; Yellen 1977) indicates that the typical area utilized by an individual household (i.e., single family) in its normal daily activities ranges between 80 and 1,900m². The size of the DB excavation block is more in line with the area used by a single family. As a result, it should be remembered that conclusions drawn from this study are based on data drawn from only a small portion of the site, and therefore probably do not represent the full range of activities that actually occurred across it.

This analysis mostly discusses artifacts recovered from the block. The primary reason for excluding artifacts beyond it is that there is too much contrast in collection techniques between the two areas to make statistically meaningful comparisons. The type and size of artifacts recovered and techniques used in their collection from these areas were different. Therefore, it is difficult to use these data in the same analysis.

As Logan and Beck (chapter 6) discussed, three dimensional coordinates, long axis orientation and degrees of inclination were recorded for artifacts over 2.5cm in length irrespective of artifact class. Smaller items were recovered in the water screens. In this way all material greater than 1/8" (4mm) in size was recovered. Material collected during the grading operation or incidentally on the surface generally includes only larger formalized lithic tools (e.g., projectiles, scrapers, drills), ceramics, and groundstone artifacts. Small lithic pieces, plant and animal remains, and fragmented groundstone pieces were collected without point provenience. The soil matrix from this area was not screened, so an unknown number of artifacts was missed. Several analyses in this study utilize the distribution of small artifacts, and therefore, it would be inappropriate to compare material collected from the block with that beyond it.

Also, it is difficult to compare the elevation of piece-plotted artifacts from outside the block with those collected from within it because of the natural slope of the ground. The above is not intended to imply that material collected away from the block is archaeologically useless (this material contributes substantially to other analyses in this volume), only that it lacks the precision required for many aspects of this spatial analysis.

Site Formation

The first part of this spatial analysis examines how the vertical and horizontal distribution of artifacts from the block excavation help us to understand the formation of the archaeological deposit. As is true of all archaeological sites, sedimentary, pedogenic, biological, and physical processes contributed to the formation of DB (Schiffer 1987; Behrensmeyer and Hill 1980; Wood and Johnson 1978). In order to understand the role human behavior played in its formation, it is important to consider the action of noncultural agents. To achieve this goal, this chapter uses spatial analysis to determine whether natural processes redeposited or moved artifacts across the surface of the site or vertically through the soil profile prior to, during, and after deposition (Carr 1984; Gifford-Gonzalez et al. 1985; Hofman and Enloe 1992). By understanding the extent and nature of disturbance processes at DB, we can make the analysis of human actions there more productive and realistic (Binford 1981b; Hofman 1992c:129).

Known Processes

Numerous taphonomic processes could have contributed to formation of the DB site. However, considering its age and location, local vegetation, and regional climate, only a few processes likely had an important impact. These include faunalturbation (fossorial animals), floralturbation (plant growth and death), cryoturbation (frost action), argilliturbation (soil shrink/swell), and sheet wash erosion. After summarizing the key research into these processes, I construct "models" or expectations of how these processes affect the position, orientation and declination of artifacts at an archaeological site. By comparing the data collected from the DB excavation to these "models" we can determine to what extent, if any, the site has been systematically altered by these postdepositional processes.

Faunalturbation: Two types of fossorial (burrowing) animals disturb archaeological deposits: those that forage on the surface and those that forage underground (Schiffer 1987:207-208). Differences between these two behavioral adaptations have important implications on the degree to which these animals caused stratigraphic mixing and size sorting of particles within the soil matrix.

Subsurface foragers, such as gophers, earthworms and voles, spend most of their life in the top 40cm of the soil consuming plant roots, decayed organic material, and other animals (Schiffer 1987). Stein (1983) notes, however, that in times of stress (intense cold or dryness) most of these subsurface foragers seek shelter farther underground. Damage caused by these animals comes from their incessant horizontal and vertical tunneling through the soil in search of food and their dumping of spoil dirt on the surface. This constant tunneling mixes artifacts within and between different stratigraphic units and archaeological horizons (Wood and Johnson 1978; Stein 1983; Erlandson 1984; Bocek 1986). Also, by repeatedly transporting spoil dirt, subsurface foragers systematically move sedimentary particles from deep in the profile to the surface (Bocek 1986; Schiffer 1987). Rolfsen (1980), for example, reported that earthworms can bury items placed on the surface to a depth of 45cm below ground surface in as short as five years.

Surface foragers, such as rabbits, foxes, ants, and some rodents, do not live below ground, but instead build subterranean nests. The depth of these nests varies between 1-2m below surface (Wood and Johnson 1978). After a nest has been abandoned, it usually fills with material blown or washed in from the surface. These filled burrows, or krotovinas, are easy to identify because the fill is usually a different color than the surrounding matrix. Krotovinas produced by subsurface animals are more difficult to identify because subsequent tunneling obliterates earlier ones. Therefore, and some what surprisingly, the more obvious krotovinas produced by surface forages usually cause less disturbance (i.e., less mixing) than those produced by subsurface foragers that are more difficult to identify (Schiffer 1987).

The size of artifacts within a soil influences the rate and direction of displacement. Small objects, <5 cm, usually move upwards through the stratigraphic profile, sometimes being deposited on the surface, by animals cleaning backdirt from their tunnels (Scheffer 1931; Murray 1967; Hansen and Morris 1968). It is more common for large items to move downward, because burrowing animals usually tunnel under large objects. In fact, after intensive reworking of the soil, large items commonly form a "cobble bed" at the base of the tunnels (Bocek 1986). Erlandson (1984:787) identified such a concentration 60cm below the surface at a Late Period site near Santa Barbara, California that was the result of intensive rodent burrowing.

Floralturbation: Vegetation is a common cause of disturbance to archaeological sites (White 1979; Strauss 1978). As plants grow, networks of roots extend in all directions searching for nutrients and water. This movement exerts tremendous pressure on objects in the soil. Today, the most familiar form of floralturbation is the damage to sidewalks or house foundations caused by tree roots (Wood and Johnson 1978). At archaeological sites the damage can be just as severe; buried artifacts or features can be displaced or damaged by plant roots. Schiffer (1987) claims that much of the damage caused by plants occurs soon after site abandonment. Trees, as well as other plants, preferentially grow in areas disturbed by human actions, such as abandoned houses or trash pits.

Even long after burial, plants can cause a tremendous amount of damage to archaeological sites. Trees, for example, are most destructive after they die (Waters 1992; Schaetzl 1986). Strong winds topple trees, ripping their network of roots (and any archaeological material contained within it) from the ground. Overtime, the dirt adhering to the roots falls to the ground forming small mounds. These mounds, together with the depression caused by the uprooting of the tree, produce a characteristic topographical feature of all forested areas called cradle-knoll. These "tree throws" result in the inversion of stratigraphy and in size-sorting of artifacts (Schaetzl 1986; Schaetzl et al. 1990). This size-sorting can sometimes result in the formation of "pavements" made of large artifacts and unmodified stones which have been dislodged by fallen trees (Wood and Johnson 1978).

Cryoturbation: In northern latitudes, seasonal freezing and thawing of the ground causes buried objects to move vertically through a soil profile (Johnson and Hansen 1974; Johnson, Muhs, and Barnhardt 1977; Schiffer 1987) and horizontally across the surface (Bowers et al. 1983). While this "frost-heave" uniformly moves buried items upward, the rate of this movement is controlled by edaphic conditions (soil texture, soil moisture), environmental factors (rate of freeze, amount of snow fall, annual precipitation, seasonality), and morphological characteristics of the artifact (thermal conductivity, shape, effective height, depth of burial, and orientation) (Johnson and Hansen 1974; Johnson, Muhs, and Barnhardt 1977). The upward movement of buried artifacts results from the 9% increase in the volume of soil water when it freezes. The direction of this expansion is in the path of least resistance (i.e., upward). Buried items that are less efficient thermal conductors than the surrounding matrix (e.g., bone and wood) are pulled upwards as the soil expands by friction between the item and the surrounding matrix. Other artifact classes such as stone, obsidian, and metal conduct heat better than the surrounding matrix and are not pulled upward; instead, they are pushed upward by ice forming below the artifacts.

In a series of experiments, Johnson and others (Johnson and Hansen 1974; Johnson et al. 1977) demonstrated that even after one year, freeze/thaw action can vertically displace a buried artifact as much as 10cm. Bowers and others (1983) show that surface material can be horizontally displaced up to 20cm a year. In a few instances objects were even moved upslope by frost action. While these studies may overestimate the normal annual displacement of artifacts (see Johnson et al. 1977), they nonetheless emphasize the effect cryoturbation can have on archaeological deposits.

There are several indications of cryoturbation. In far northern regions, frost action results in characteristic soil profile features, such as sand wedges, soil deformation, and stone polygons (Wood and Johnson 1978). At lower latitudes, frost action results in size-sorting of artifacts within the soil. Over time, larger pieces are pushed farther upward through the soil profile than smaller artifacts. Another indication of freeze-thaw action is that artifacts will generally be oriented at high angles in the soil (Schweger 1985; Bowers et al. 1983). In a report on the Nebo Hill type-site, 15km east of Kansas City, Missouri, Reid (1984b) noted that frost heaving caused numerous artifacts to be oriented on their edge rather than lying flat. It is not surprising that archaeological sites in the Kansas City area undergo intense freeze-thaw modification considering that the average depth of frost penetration is approximately 40cm and can be as deep as 90cm (Johnson and Hansen 1974: 92, Table 5; Washburn 1980; Reid 1984b).

Argilliturbation: The seasonal shrinking and swelling of clay is another process that results in soil mixing (Wood and Johnson 1978; Schiffer 1987). During dry periods, clayey soil shrinks causing large vertical cracks to appear on the surface. These cracks are commonly only a few cm deep, but under very dry conditions they can reach depths of over a meter. Artifacts, wind blown sediments, and other surface material fall into these cracks. As the moisture content in soil increases, clay swells and closes the drying cracks. This results in the burial of anything that fell into them. Argilliturbation also results in large pieces moving upward through the profile. "Swelling" of the clays--like cryoturbation--often pulls large buried artifacts towards the surface.

Sheetwash Erosion: Sheetwash erosion is the mixing and movement of sediment by low energy fluvial activity (Ingbar and Larson 1996; Wood and Johnson 1978). Sheetwash erosion acts to translocate surface and shallowly buried archaeological material down slope, and bury such material at its base. The transport potential of sheetwash is correlated to the intensity of the rain, the amount of vegetative ground cover, and steepness of the slope. While sheetwash can be very intense, it usually only has the ability to move large pieces short distances or reorient their direction. Sheetwash erosion can result in the gradual "deflation" of a site. It removes small items and sedimentary particles from a site (e.g., sand, gravel, and small artifacts), and leaves behind large pieces. If intense enough, this type of erosion has the ability to create a surface "pavement" of gravels and artifacts. Deflation also brings to one surface artifacts that originally come from different stratigraphic levels.

Analysis of Site Formation

Based on the above summaries, there are several key variables that are indicative of post-depositional disturbance. These include vertical size-sorting of artifacts, stratigraphic mixing of chronologically distinct artifacts, artifacts having high dips and preferred long axes of orientation.

Vertical dispersion of artifacts is indicative of the amount of disturbance before and after burial (Hofman 1992b; Ingbar and Larson 1996). Intensive rodent burrowing, tree-throws, frost action, and shrink-swelling of clayey soils segregate artifacts vertically by size. Faunal and floralturbation cause large items to move downward, while frost action and shrink-swelling of clays bring large particles to the surface. To evaluate if this type of disturbance is present, one needs to determine if there are elevation differences among artifacts of different size classes.

Deflation can also size-sort artifacts. Sheetwash erosion removes small items and leaves behind larger ones. One way to examine if a site has been deflated is to determine if chronologically distinctive artifacts are found in the same stratigraphic level. One can assume that if deposition at a site was continuous and not interrupted by deflation that artifacts of different ages would be found in stratigraphically separate levels, with the younger artifacts above older artifacts.

The degree of declination of an artifact reflects the degree of post-depositional disturbance (Fiorillo 1989, Gifford-Gonzalez 1985; Lyman 1994). Artifacts deposited on a fairly level surface, and not later modified by post-depositional taphonomic processes, should be recovered lying more or less horizontal to the ground (Shipman 1981; Voorhies 1969). Only under unusual depositional environments or post-depositional disturbance will large numbers of artifacts be oriented at a steep angle to the surface. Ingbar and Larson (1996) and others (Johnson and Hansen 1974; Johnson et al. 1977; Schiffer 1987) have argued that high dip values suggest that the deposits have undergone intense post-depositional modification by processes such as rodent burrowing, frost action, clay shrink-swell, and floralturbation.

Low-energy fluvial action such as slope wash characteristically moves artifacts on slopes so that their long axes align parallel with the direction of slope (Schiffer 1987; Rick 1976; Ingbar and Larson 1996). By recording the long axis orientation of artifacts, one can examine the impact of sheetwash erosion on a site. A preferred direction in the long axis orientations of artifacts is expected at sites that have undergone intensive sheetwash erosion.

Size Sorting: The vertical size sorting of artifacts is examined by grouping all piece-plotted artifacts into seven size classes based on mass (0-5g, 6-10g, 11-25g, 26-50g, 51-100g, 101-200g, >200g), and then comparing the mean elevation for each class. To account for slope in the ground surface the data were separated into six 2m wide excavation unit transects that ran north-south across the entire block and three 2m east-west excavation unit transects from 154N to 160N. To statistically evaluate differences among the size classes, mean elevation values were plotted along with their 95% confidence limits (Sokal and Rohlf 1995:140). The results are graphically represented in Figures 14.1-14.5. The rule of thumb for interpreting confidence limits is that any two values that do not overlap are statistically different.

Figure 14.1a shows the mean elevation values for the seven size classes for artifacts from units 57-59E. There is a gradual decrease in mean elevation as artifact size increases. Most of these differences are not statistically significant except for the difference between Class 1 (0-5g) and Class 6 (100-200g). Considering, however, that the mean elevation value for the largest size class (Class 7, >200g) is greater than Class 6, and not significantly different from the

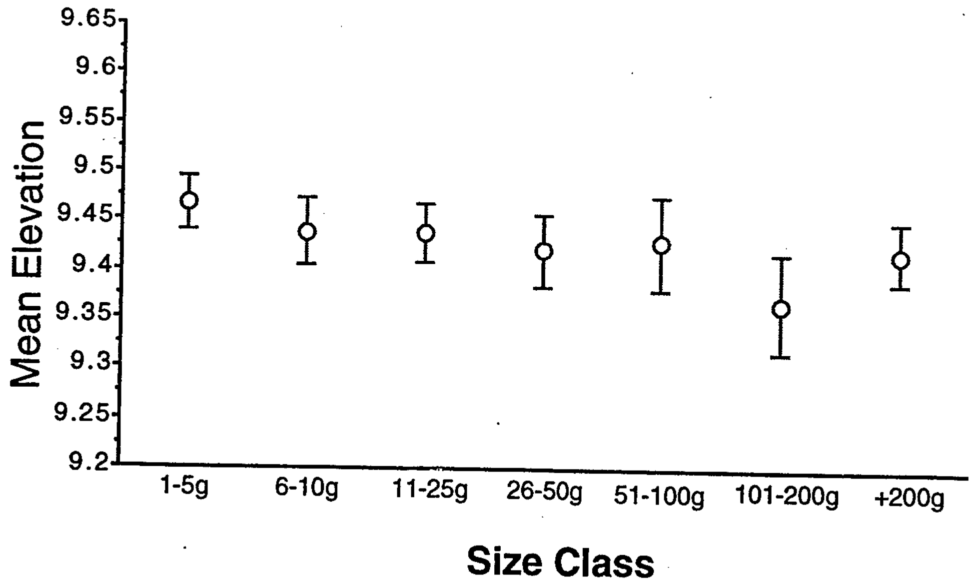


Figure 14.1a. Mean Elevations (± confidence limits) for artifacts from 7 size classes from the 57-59E transect.

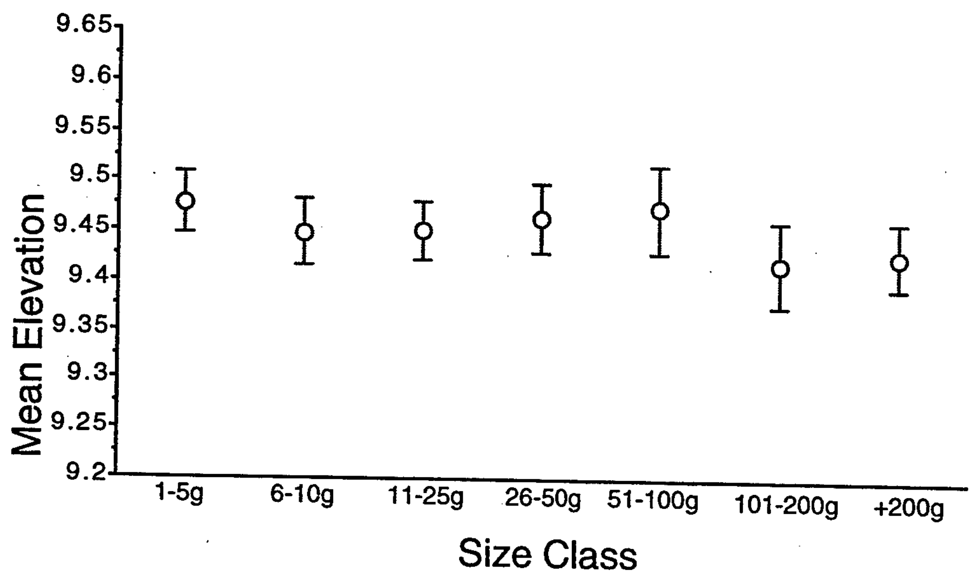


Figure 14.1b. Mean Elevations (± confidence limits) for artifacts from 7 size classes from the 59-61E transect.

smaller size classes, it is unlikely that the elevation differences in artifacts from 57-59E represent postdepositional size sorting.

In the 59-61E and 61-63E transects (Fig. 14.1b and 14.2a), there is no evidence for statistically meaningful elevation differences based on size. The mean elevation values for the largest (Classes 6 and 7) and smallest (Class 1) size categories may be different, but not in a statistical sense.

Large artifacts (>100g) from 64-66E are statistically below the small artifacts (<25 g) (Fig. 14.2a). This pattern is more likely a function of small sample size for the larger pieces (n=14) rather than true size sorting. This interpretation is probably correct considering that there is no evidence for an overall decrease in mean elevations for the different size categories. In fact, Classes 3 (11-25g) and 5 (51-100g) artifacts actually have higher mean elevation values than the smallest size classes.

There is no strong evidence of size sorting in either the 66-68E or 68-70E transects (Figs. 14.3a-3b). There is a small, but meaningful, difference between the elevations of Classes 4 (26-50g) and 6 (100-200g) artifacts in the 66-68E transect. There is, however, no overall trend in size sorting for this transect, and the sample is small for all size categories from it. Thus, the observed difference is probably not significant.

Examining the east-west unit transects for artifacts in 154-156N shows a slight trend of size sorting (Fig. 14.4a). There is a significant difference between the mean elevation of material greater than 100g (Classes 6 and 7) and those less than 25g (Classes 1-3). The larger artifacts are generally lower than the smaller artifacts in this transect. There is no difference in the mean elevations of any of the size classes in the 156-158N transect (Fig. 14.4b). For 158-160N, the largest size class (>200g) is significantly below Classes 1-3 and 5 (Fig. 14.5). With the exception of Class 5 (51-100g) artifacts, there is an inverse relationship between artifact size and mean elevation in this transect. Small sample size is apparently not a problem in this case, so there may be good evidence for size sorting of material in 158-160N.

Overall, the data do not support the theory that post-depositional processes have systematically caused size sorting of artifacts. This is not, however, to imply that a small degree of size sorting has not taken place. Two transects (154-156N and 158-160N) with large samples of artifacts, show good evidence of mean elevation values decreasing as artifact size increases. A third transect (64-66E) with an adequate sample of observations has larger items below smaller material but this is not the case for all size categories. These patterns suggest that it is unlikely that either frost action or the shrink-swelling of clay has intensively modified the DB deposit. These processes would have moved large artifacts upwards. It is more likely that processes such as rodent burrowing, tree throw, and possibly animal/human trampling caused

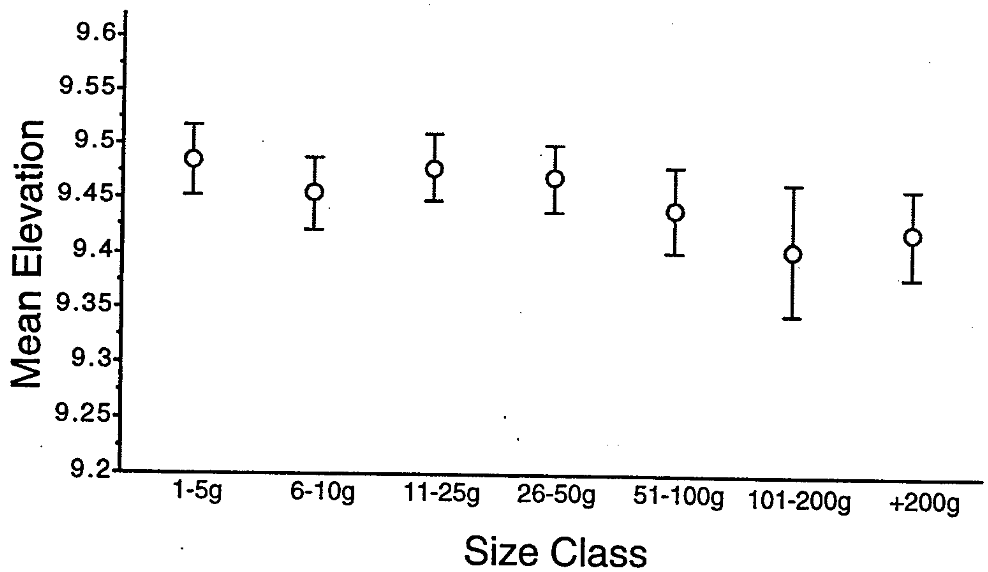


Figure 14.2a. Mean Elevations (± confidence limits) for artifacts from 7 size classes from the 61-63E transect.

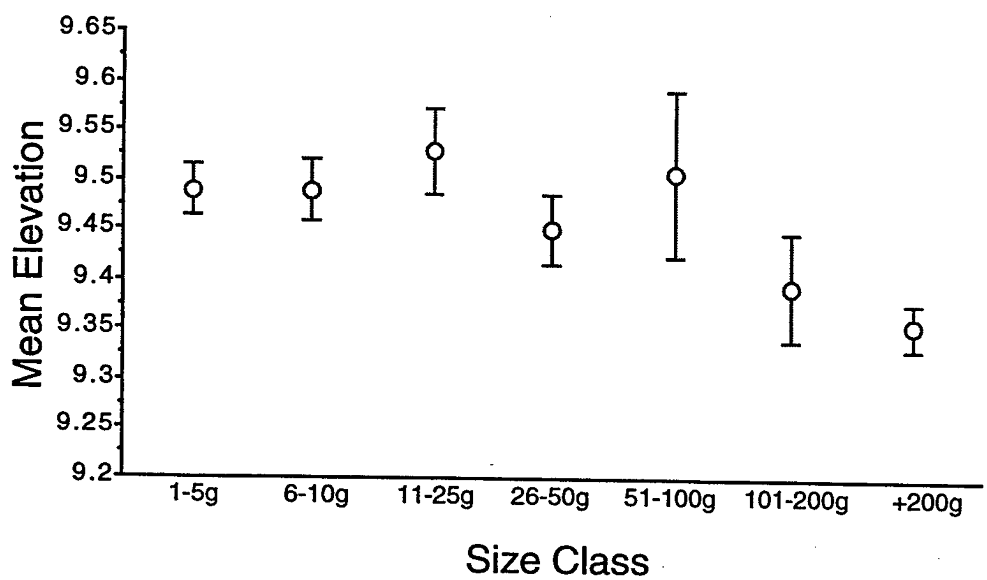


Figure 14.2b. Mean Elevations (± confidence limits) for artifacts from 7 size classes from the 64-66E transect.

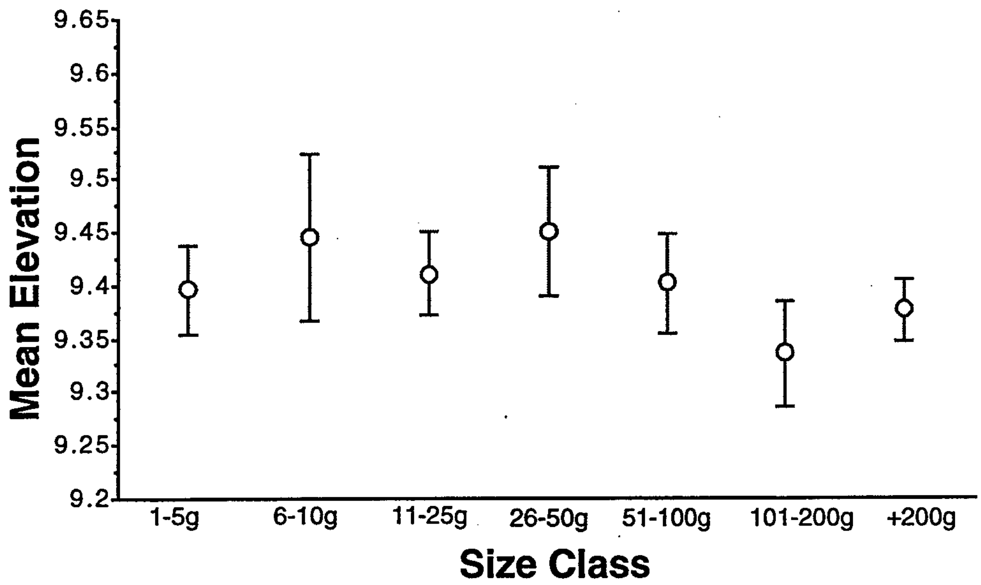


Figure 14.3a. Mean Elevations (± confidence limits) for artifacts from 7 size classes from the 66-68E transect.

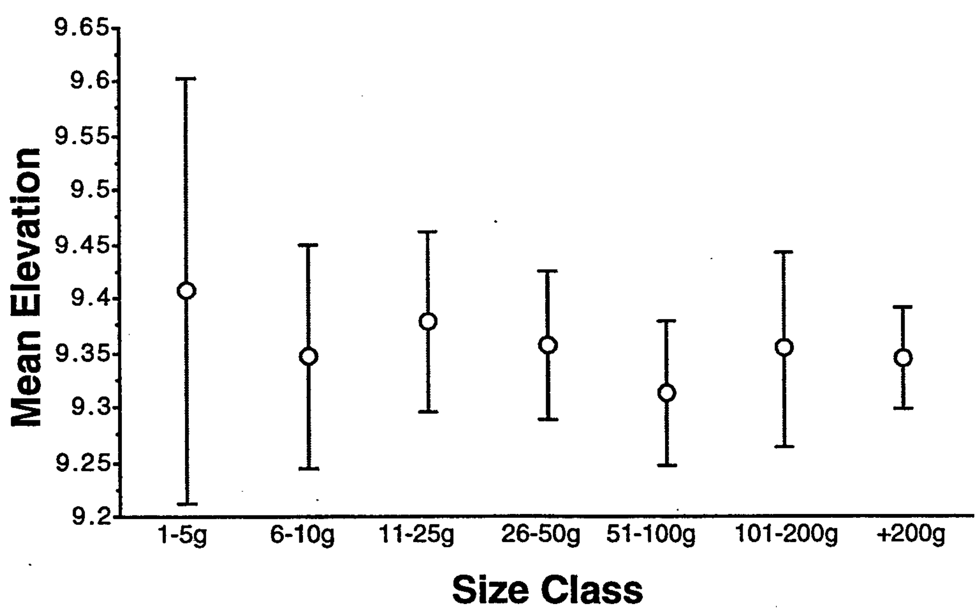


Figure 14.3b. Mean Elevations (± confidence limits) for artifacts from 7 size classes from the 68-70E transect.

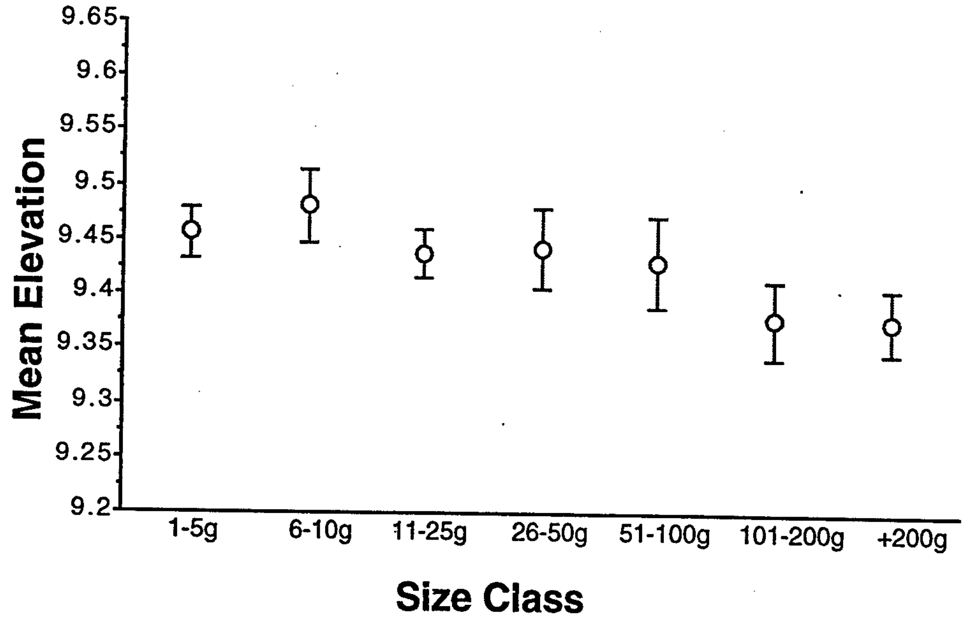


Figure 14.4a. Mean Elevations (± confidence limits) for artifacts from 7 size classes from the 154-156N transect.

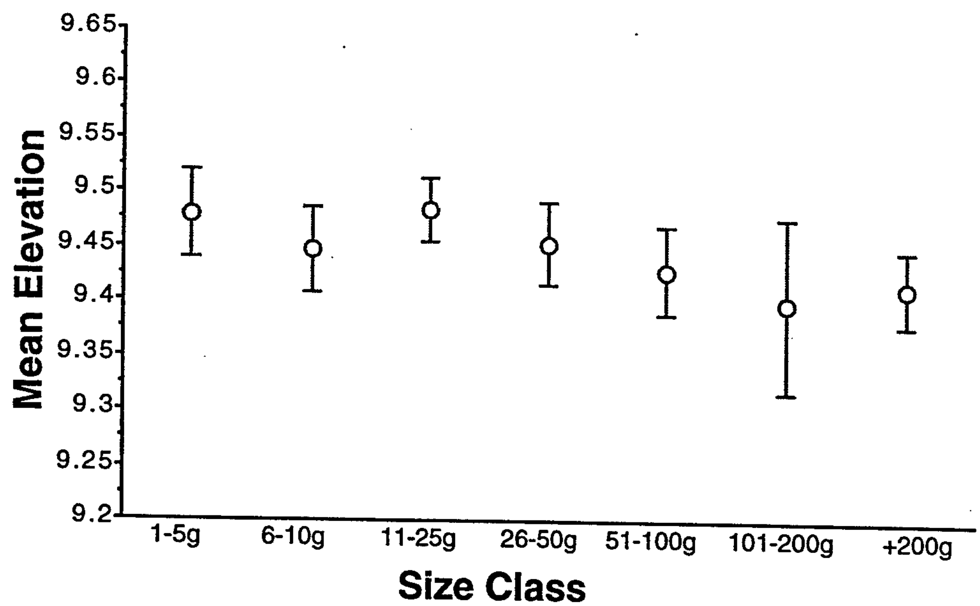


Figure 14.4b. Mean Elevations (± confidence limits) for artifacts from 7 size classes from the 156-158N transect.

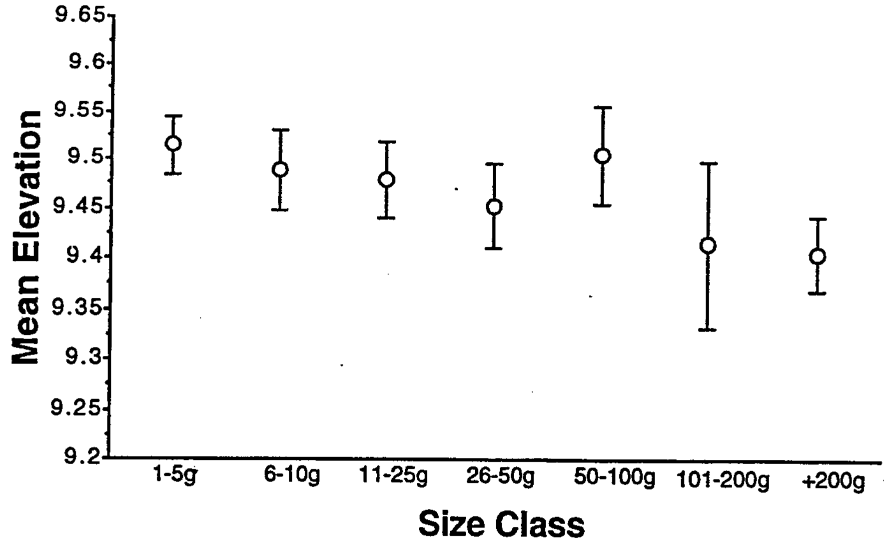


Figure 14.5. Mean Elevations (± confidence limits) for artifacts from 7 size classes from the 158-160N transect.

this pattern as they tend to cause small items to move upwards and large items to settle downward. Human behavior is still a possible explanation for this pattern; however, we need to continue to examine noncultural explanations before we can come to that conclusion.

Vertical Distribution of Diagnostic Artifacts: To test if deflation had significantly affected the DB site, a back-plot of the elevations of all temporally diagnostic artifacts (projectile points, ceramics, and daub) recovered during the block excavation was graphed along a north-south transect (Fig. 14.6). In these graphs, the exact elevations of the diagnostic artifacts were plotted along a vertical plane corresponding to the western wall of the excavation block. For reference, all other non-diagnostic artifacts were plotted in the background.

In the vertical distribution of projectile points, the 16 artifacts used in this analysis were classified into four cultural-temporal designations based on the analysis of Hatfield (chapter 9). These include: Late Prehistoric, Archaic/Woodland, Archaic, and Paleoindian. If the DB site was well stratified, one would expect the Late Prehistoric and Archaic/ Woodland points to cluster near the top of the profile, while the Archaic and Paleoindian points would be located at the bottom.

As can be seen in Figure 14.6a, some of the diagnostic artifacts fit this model. One Late Prehistoric and two Archaic/Woodland artifacts are located near the top of the excavation surface or 10cm bg (30cm bs). The two Paleoindian points are both located near the bottom of the excavation at approximately 40cm bg (60cm bs). The distribution of Archaic points, however, is more problematic. Points assigned to the Archaic period are found in all excavation levels. Several are found below 10cm bg (30cm bs); however the majority are located in the upper 10cm (20-30cm bs) of the profile. Some, in fact, are stratigraphically above the potentially younger Archaic/Woodland points.

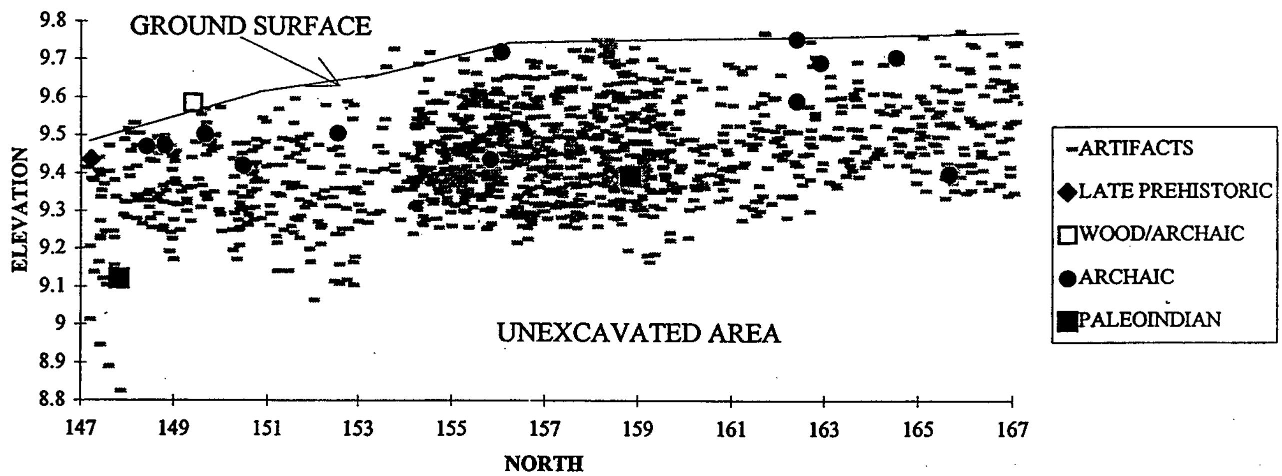


Figure 14.6a. Backplot of the elevation of diagnostic projectile points along the west wall of the excavation block.

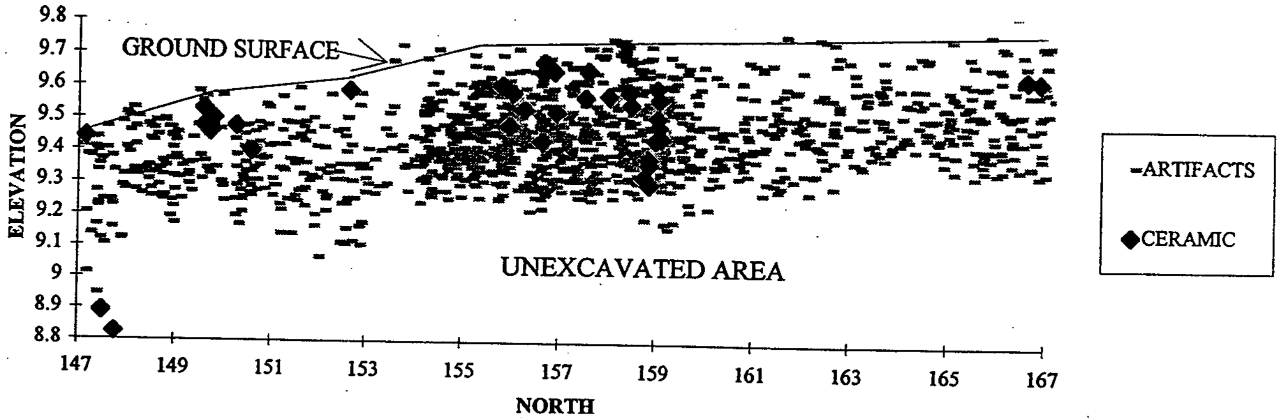


Figure 14.6b. Backplot of the elevation of ceramics along the west wall of the excavation block.

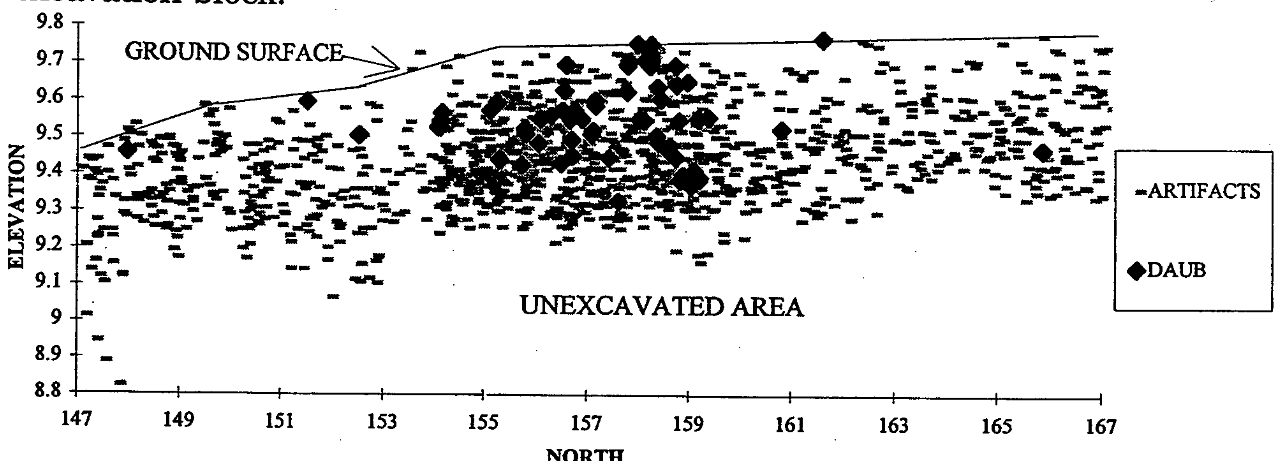


Figure 14.6c. Backplot of the elevation of daub along the west wall of the excavation block.

Hatfield (chapter 9) has shown a similar pattern for the vertical dispersal of all projectile points (n=232) recovered from DB. In Figure 9.1, she shows that nearly all of the Late Prehistoric points come from the upper level, while all Paleoindian points are in the lower levels. Only two Late Prehistoric points were recovered below 10cm bg (30cm bs). No Paleoindian points were recovered above the 20-30cm bg (40-50cm bs) level. Archaic points present another pattern altogether. These points are found in every level, and in fact, predominate in the 0-10cm bg (20-30cm bs) level. There are Archaic age points above the younger Late Prehistoric points and below older Paleoindian points. Clearly, the DB site is not a pristine stratified deposit. Some factors are causing points of different ages to be associated, occasionally in reverse stratigraphic order.

When the chronological age of these artifacts is considered, it is apparent that there has also been some compressing of the stratigraphy. The upper two excavation levels (0-20cm bg; 20-40cm bs) contain mostly Late Prehistoric and Archaic/Woodland points and other artifacts. Radiocarbon dating elsewhere on the Plains places these periods ca. AD 900-1500 and AD 900-3000 B.C. respectively (see chapter 5). AMS assays of maize kernels from the 0-10cm bg (20-30cm bs) level at DB date this horizon ca AD 1300-1400 (chapter 7). Therefore, the top 20cm of the excavation unit contains mostly material deposited in the last 5000 years. In the underlying levels (20-40+ cm bg; 40-60+ cm bs) there is a wide variety of point styles that are characteristic of the Woodland and/or Archaic periods and a few artifacts that date well into the Paleoindian period. Chronologically, these points date anywhere from 1,100 to 10,500 years ago, but probably between 2500-10500 BP, based on geomorphic evidence (see also chapter 3). Such a huge time span represented in a small stratigraphic zone suggests the deflation of this surface (probably sometime during the Archaic period) that resulted in the mixture of a wide variety of artifacts. Following this period of erosion, wind deposited sediment on the DB ridge and the surface began to accrete. As a result, there is little hope for stratified deposits below 20cm bg (40cm bs). Artifacts above this level represent mostly more recent (circa <2000 yrs BP) activities, but there is evidence of mixing of some older artifacts. Upward movement is not the only direction of artifact displacement. If we look at the vertical distribution of ceramics and daub we can see how many specimens moved down the profile (Fig. 14.6b-14.6c).

With the exception of a few Middle Woodland sherds, the majority of the ceramic material from DB dates to the Late Prehistoric period (see chapter 8). One should therefore expect the ceramic material to be recovered mostly from 0-10cm bg (20-30cm bs). For the most part, that is the case; however, several sherds are found well below this level, some as deep as 70cm bg (90cm bs) (Fig. 14.6b). Two sherds near the 147N line were recovered in a rodent burrow at elevations of between 8.8 and 8.9m (ca. 70cm bg). Similarly, excavators collected Late Prehistoric sherds at an elevation of approximately 9.3m (ca. 40cm bg; 60cm bs) along the 159N line that were also within a krotovina. These latter specimens were, in fact, recovered below a Folsom point fragment found in an adjacent unit. Rodent activity appears to be a major cause of the vertical displacement of these Late Prehistoric ceramics.

Figure 14.6c shows a similar pattern for the vertical distribution of daub. While this will be discussed later in this paper, the presence of daub at DB relates to a possible house feature in the the Late Prehistoric component and not to any earlier occupation. As a result, daub should be distributed mostly within the 0-10cm bg (20-30cm bs) level. As the figure shows, daub was recovered from several of the lower levels. Disturbance is most intense between 155N and 160N. As previously stated, rodent activity and, possibly, human actions were probably the chief cause of this displacement.

Declination: As previously discussed, artifacts that have been systematically disturbed should have a high variation in declination measurements (Ingbar and Larson 1996). In stable environments most artifacts should lie relatively flat (low dip). If, however, artifacts were disturbed by rodents cleaning out their burrows, the in-filling of krotovinas, the action of plants, or other taphonomic processes, we should expect to find many artifacts lying on their edge.

Figure 14.7a shows the distribution of dip values for the overall collection (n=1,119) from the block excavation as well as separate distributions for the upper four 10cm excavation levels (Figs. 14.7b-14.8b). For all levels, the majority (74-79%) of artifacts is lying fairly flat (0-10°), with all other intervals represented by only a few artifacts. The small number of pieces (ca. 6%) with high dips (>60°) is probably what should be expected by chance. That the distributions for the individual levels are very similar ($X^2=0.84$, $p=0.99$, $df=6$) probably indicates that the formational processes affecting dip occurred uniformly throughout the history of the site.

By examining the overall patterning for dip, we may obscure localized areas of disturbance, such as rodent tunnels or tree throws, that result in concentrated areas of high dip. To examine such areas, Figures 14.9-14.10 show contour maps of mean dip values for each 10cm level. Mean dip value is the mathematical average of dip readings for all artifacts from a single unit that occur in the same 10cm excavation level. While this will not identify the exact location of a rodent burrow or tree throw, it should identify to within a meter or so the general area of the disturbance. Units that do not have at least two artifacts with dip measurements were not considered in this analysis and are represented in the figures by crossed-out squares. Adequate data can only be obtained for the top four excavation levels (0-40cm bg; 20-60cm bs), so only these levels are considered.

Two dip intervals are used in the graphs: low (0-29°) and high (>30°). Since research has been unable to determine the expected variation in dip measurements when artifacts are lying on a more or less flat, stable surface, I only consider concentrations of very high dip as representing areas of intense disturbance.

There is poor data resolution for the 0-10cm bg level (Fig. 14.9a). Sixteen of the 45 excavation units (35.6%) have sample sizes that are too small to be used in this analysis. There are three areas of high dip. The largest area is centered on the 151N/57E unit. Surrounding units generally have low mean dip values, so it appears that whatever is causing these high dips

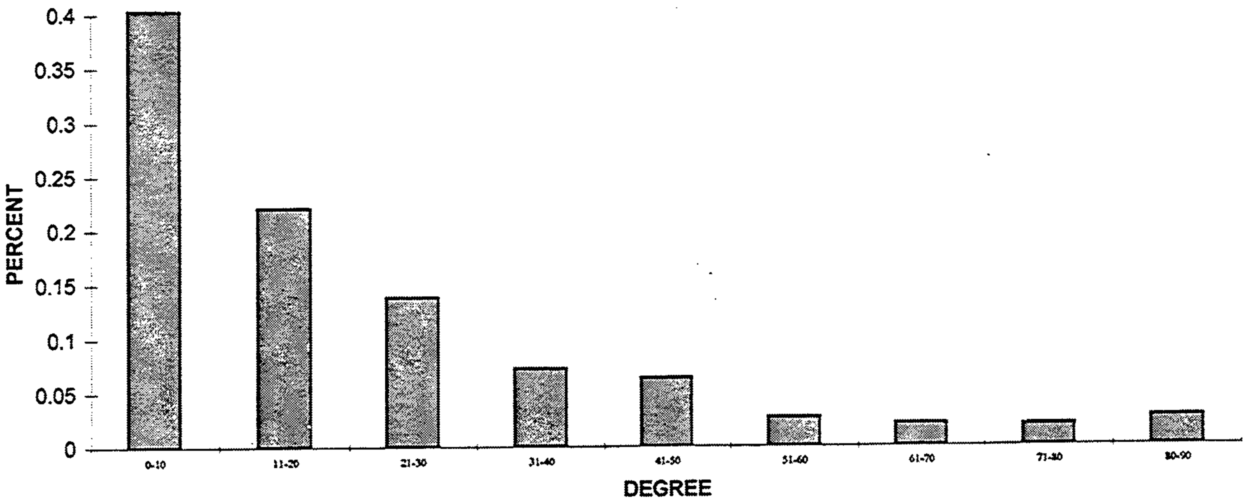


Figure 14.7a. The distribution of dip measurements by 10 degree intervals for artifacts from all levels.

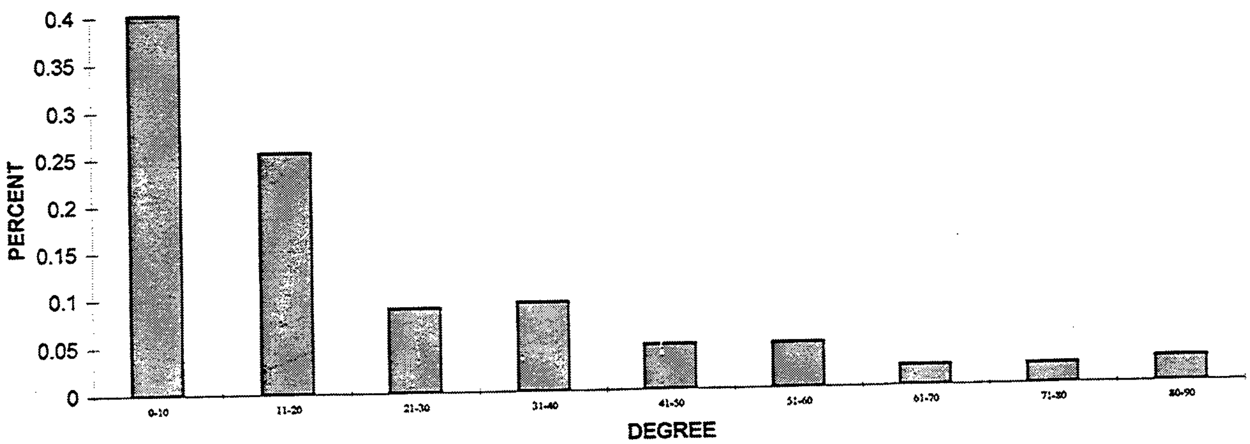


Figure 14.7b. The distribution of dip measurements by 10 degree intervals for artifacts from 0-10cm bg level.

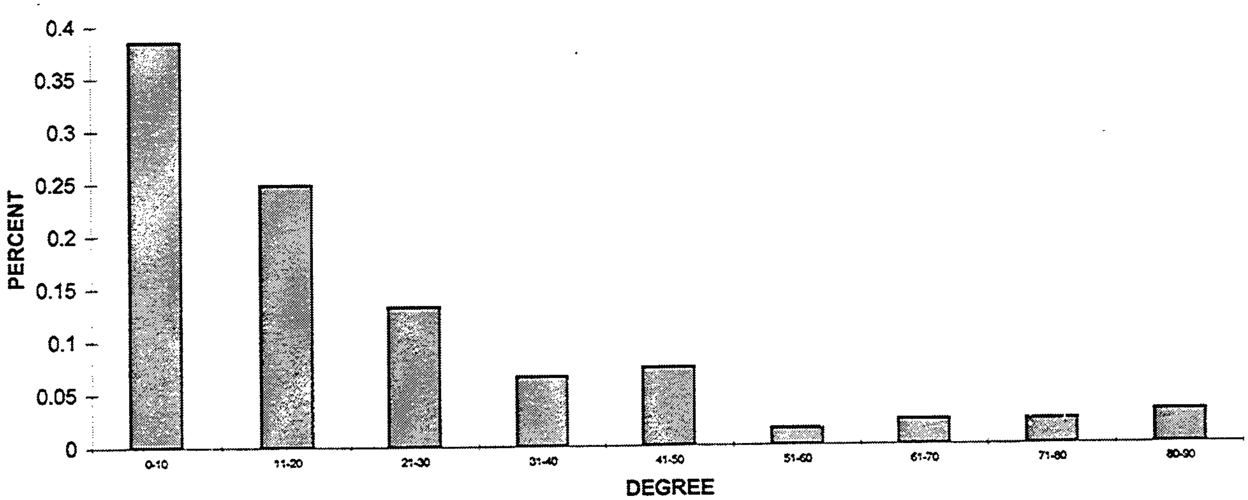


Figure 14.7c. The distribution of dip measurements by 10 degree intervals for artifacts from the 10-20cm bg level.

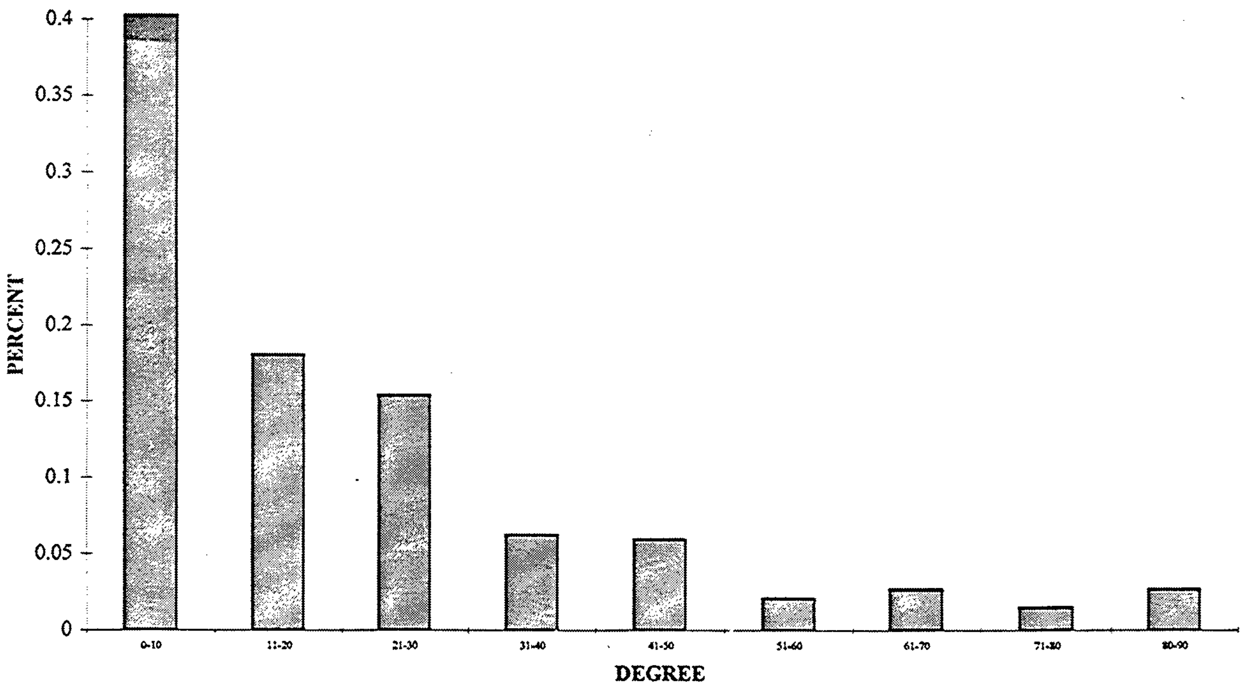


Figure 14.8a. The distribution of dip measurements by 10 degree intervals for artifacts from 20-30cm bg level.

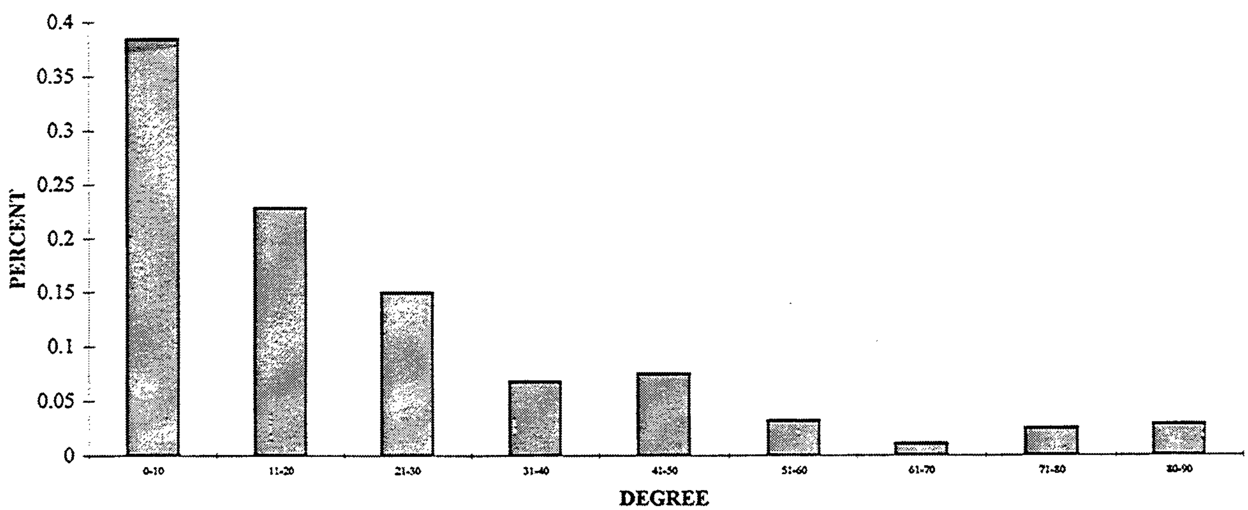


Figure 14.8b. The distribution of dip measurements by 10 degree intervals for artifacts from 30-40cm bg level.

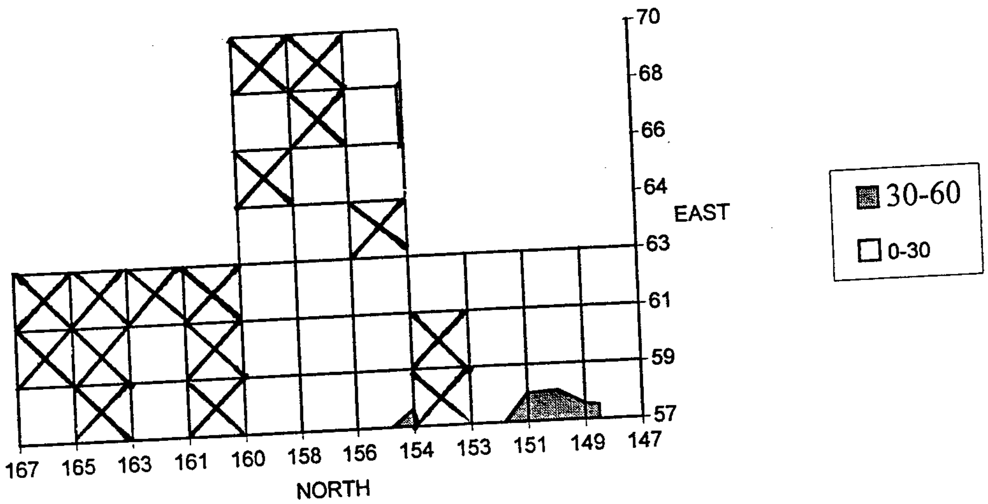


Figure 14.9a. Plan view of areas of high dip measurements for 0-10cm bg level. Units marked with X lack adequate data.

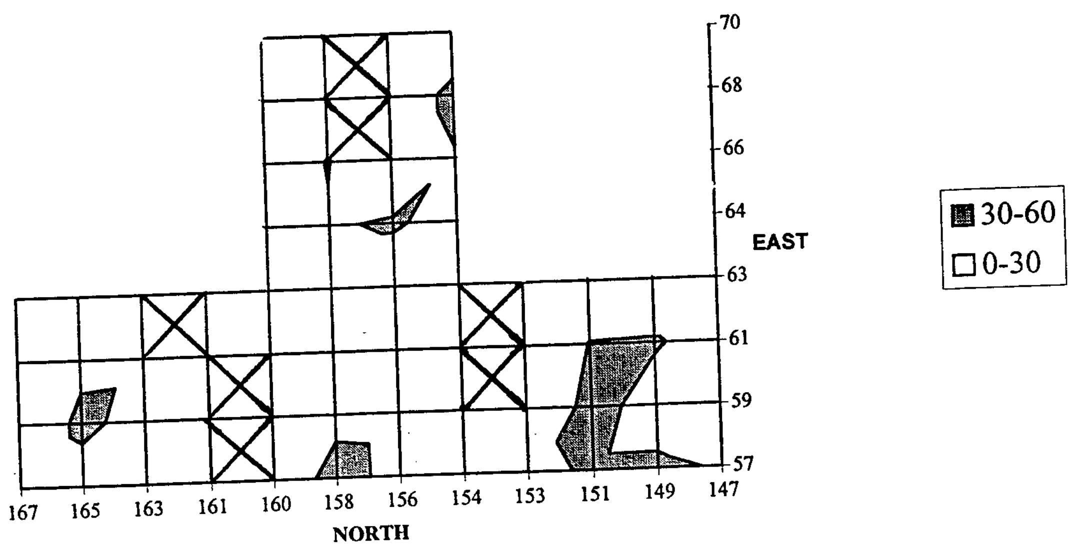


Figure 14.9b. Plan view of areas of high dip measurements for 10-20cm bg level. Units marked with X lack adequate data.

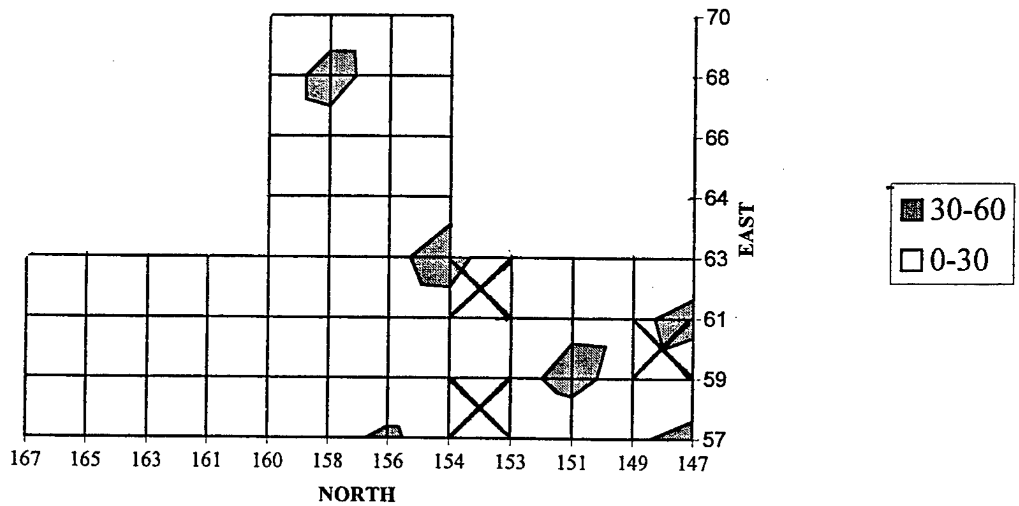


Figure 14.10a. Plan view of areas of high dip measurements for 20-30cm bg level. Units marked with X lack adequate data.

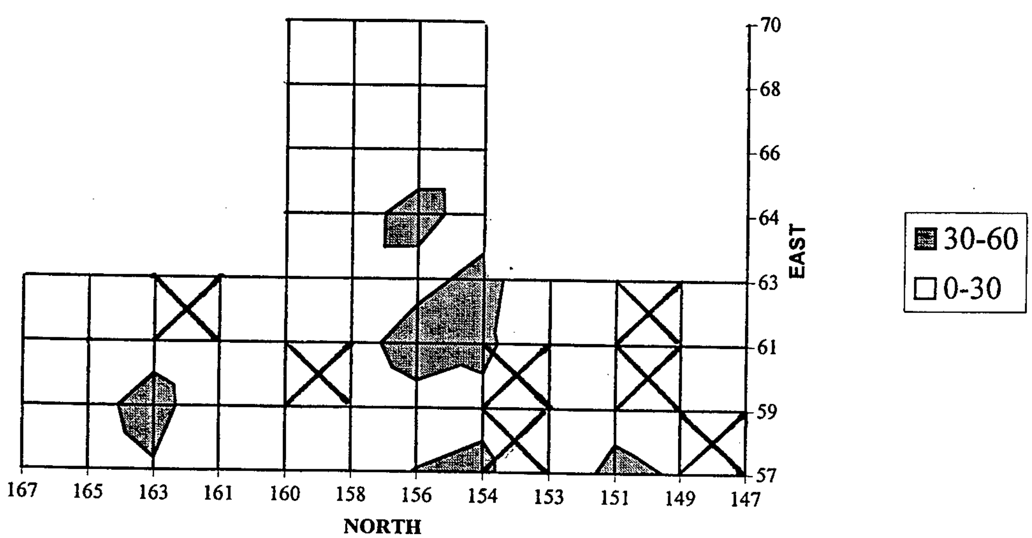


Figure 14.10b. Plan view of areas of high dip measurements for 30-40cm bg level. Units marked with X lack adequate data.

is a small scale phenomenon, such as a rodent burrow. Field excavators did, in fact, identify a rodent burrow in this area. There are two smaller areas of high disturbance in units 154N/66E and 154N/57E. The disturbance in 154N/57E may reflect the bioturbation the excavators noted in the field while digging this unit. There is, however, no explanation for the area in 154N/66E in the field notes.

In the next level (10-20cm bg), data resolution is slightly better. In this case, only seven units (16%) have insufficient data (Fig. 14.9b). Five different areas of high dip are identified. A large area that generally follows the 151N line is observed in the southern portion of the excavation block (cf. 0-10cm bg). The field excavators reported observing disturbance by trees and rodents in this area. Two small areas are seen in the eastern part of the block centered on 156N/64E and 154N/68E. Field notes do not record any unusual disturbance in either of these units. In the northern portion of the block, a small area of disturbance is focused in the area of unit 165N/59E. A few small areas of root and rodent disturbance were noted in this unit.

Only three units (153N/57E, 153N/61E, and 147N/59E) do not have adequate sample size for analysis of the 20-30cm bg level (Fig. 14.10a). Six distinctive areas of high dip are identified here. Three areas are concentrated around the four southwestern units of the block. There is minimal evidence for bioturbation in this area. Excavators recorded evidence of a tree-throw or decay in 147N/59E, and rodent burrowing in 151N/61E. However, other than this there was no reference to evidence of large scale disturbance. The only possible explanation was that there was a change in soil texture at this elevation. Changes in soil compaction may explain this area of high dip readings. A small area is centered on unit 156N/57E. Several rodent krotovinas were recorded in these areas. Two separate areas of high disturbance appear in the eastern portion of the block (154N/63E and 158N/68E). Evidence of bioturbation was noted during field work in both areas.

Data are not available for seven (15.6%) of the excavation units in the lowest excavation level (30-40cm bg) (Fig. 14.10b). There is a very large area of high dips covering most of the 154N/61E unit and including parts of the surrounding units. Field notes indicate that there was a large area of disturbance (especially in 154N/63E) caused by the uprooting or decay of a tree. Another peak is seen in a nearby unit (156N/64E). This area is much smaller and apparently separate from the large area of disturbance. There is no record of any form of disturbance in this unit. Two small areas (151N/57E and 154N/57E) of high dip three meters apart are seen on the western edge of the excavation block. Rodent disturbance was only observed in the excavation of 154N/57E. The last area is in the northern portion of the excavation block, and centered on unit 163N/59E. This is well north of the other areas of disturbance and likely represents an unrelated phenomenon. This probably reflects disturbance by the rodent activities observed in the eastern half of this unit.

There are several locations in the block where concentrated areas of high dip appear repeatedly in different levels. Some form of disturbance has been observed in a $16m^2$ section in the southwestern portion of the block in all four excavation levels. An $8m^2$ area of high dip occurs along the 57E line between 154N and 158N for all levels. Some disturbance processes caused high dips in the eastern portion of the block excavation. This area is defined by at least a $16m^2$ area between 154N-158N and 64E-68E. Between 20-40cm bg an area of high dip repeatedly appears around unit 154N/61E ($4m^2$). Also, the same process may be responsible for the high dip measurements seen between 163N and 165N along the 59E line ($4m^2$) in levels 10-20cm bg and 30-40cm bg.

Disturbance is clearly not uniform across the block, but instead is limited to several areas. In most cases, areas of high dip occur in units that have evidence of either rodent activity or tree-throw/decay. There are, however, areas of high dip that cannot be associated with field observations of disturbance. It may be that the excavators did not record disturbance in their field notes or that other factors, such as change in soil texture, were responsible for these high dips. The total surface area included in these areas of high disturbance is at least $52m^2$. This is nearly a third of the entire surface area of the block. The actual extent of disturbance is probably much greater than this estimate because this analysis has focused only on areas of intense disturbance (as measured by very high dip values), and therefore would not include areas of slight or moderate disturbance. Also, several areas of rodent disturbance were identified in the field that do not correspond to concentrated areas of high dip.

Orientation: To measure if the directions of long axis orientation of artifacts have been affected by sheetwash erosion, this study tested the distribution of orientation values for randomness. Measures of artifact orientation were limited to those items that had a long axis (e.g., rounded cobbles had no orientation). Orientation was measured in the direction of the object's dip; if the object had no dip, its orientation was with reference to the northern half of the compass. To test the distribution of orientation randomness, I followed the proposal of Shipman (1981:71), which was to group all orientation values in eighteen 20° units. A chi-square analysis (Zar 1974) was then used to test if orientation values were randomly distributed--as would be expected if slopewash had not affected artifact position. The distributions of orientations for all levels, except 20-30cm bg, were significantly non-random at the 95% confidence level (Fig. 14.11-14.12)[2]. The preferred direction of artifact orientation was towards the north to northwest for all levels that had a non-random distribution of orientations. This preferred direction is similar to the orientation of the present-day slope at DB. Both Rick (1976) and Schiffer (1987) have suggested that slopewash can cause artifacts to align with the slope on which they are lying. Interestingly, there is not a concurrent preferred orientation to the south-southeast to match the north-northwest preferred orientations. This means that artifacts are dipping upslope, since orientation was recorded in the direction of dip. This situation is similar to imbricated pebbles in a stream, which always dip upstream. I am not suggesting that the artifacts at DB are imbricated, just that some factor caused a preferred dip parallel to the direction of slopewash. Slopewash is usually a low energy process which only reorients artifacts rather than transports them a great distance.

There are several ways to explain the fact that artifacts in the the 20-30cm bg level had no preferred orientation (see Ingbar and Larson 1996:16). First, the artifacts have not been moved by slopewash, and hence lie in their original, presumably random, orientations. Second, following realignment of orientation by slopewash some other processes (e.g., treadage) changed

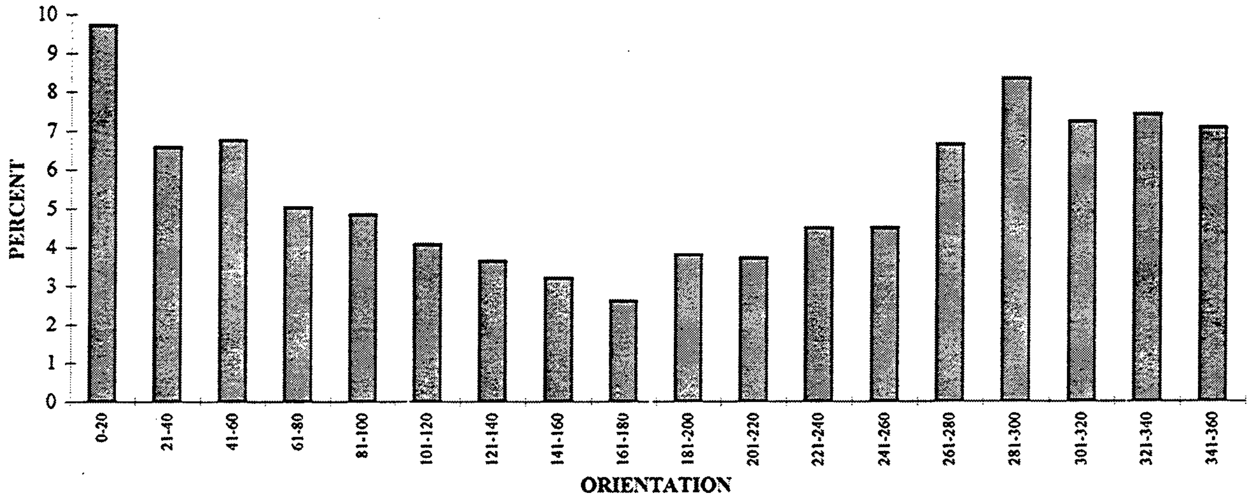


Figure 14.11a. Distribution of orientation data by 20 degree intervals for artifacts from all levels.

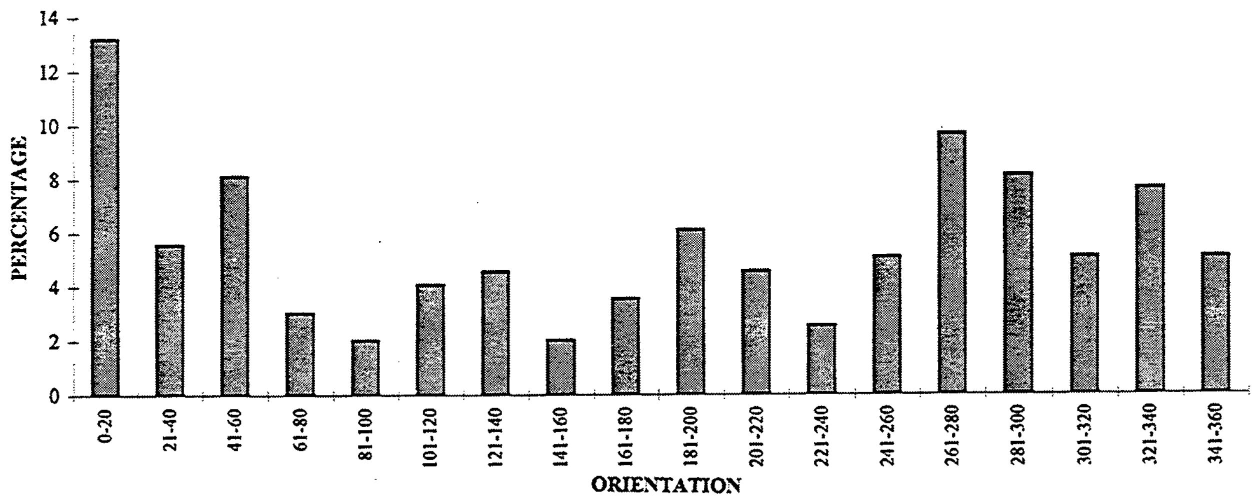


Figure 14.11b. Distribution of orientation data by 20 degree intervals for artifacts from 0-10cm bg level.

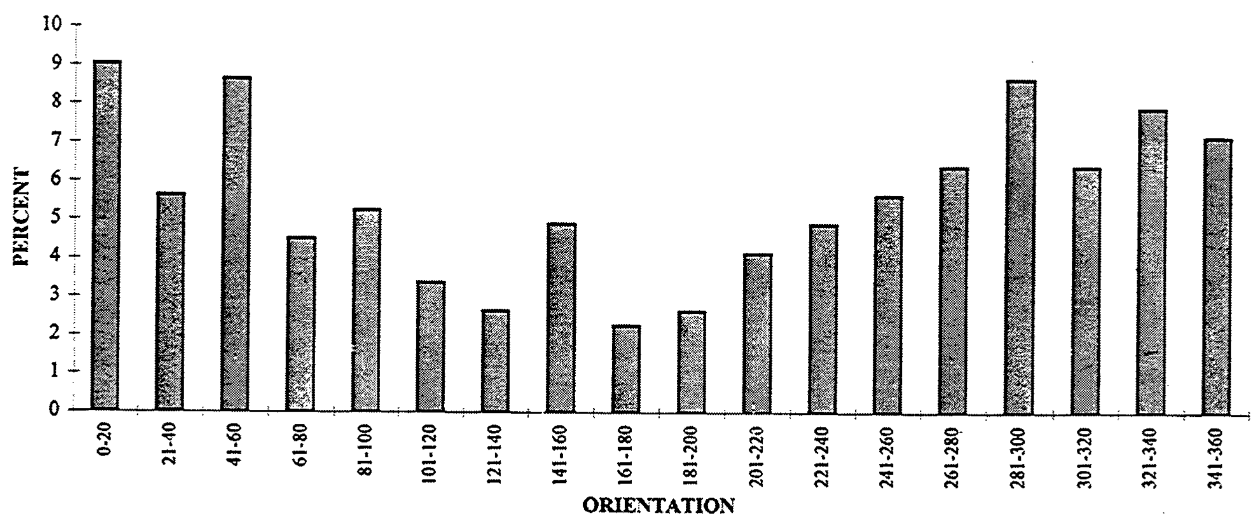


Figure 14.11c. Distribution of orientation data by 20 degree intervals for artifacts from 10-20cm bg. level.

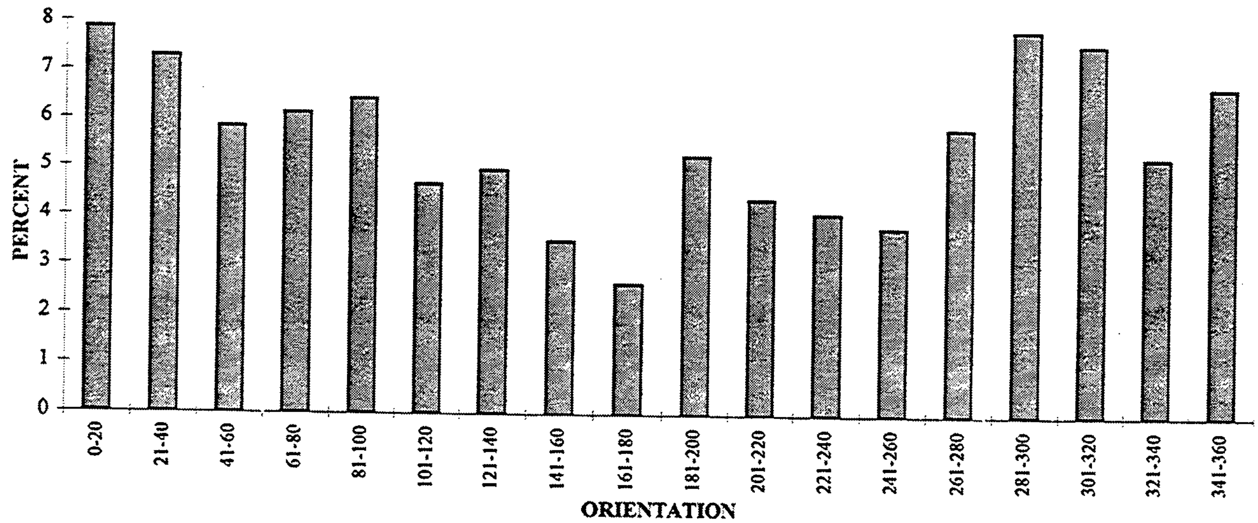


Figure 14.12a. Distribution of orientation data by 20 degree intervals for artifacts from 20-30cm bg level.

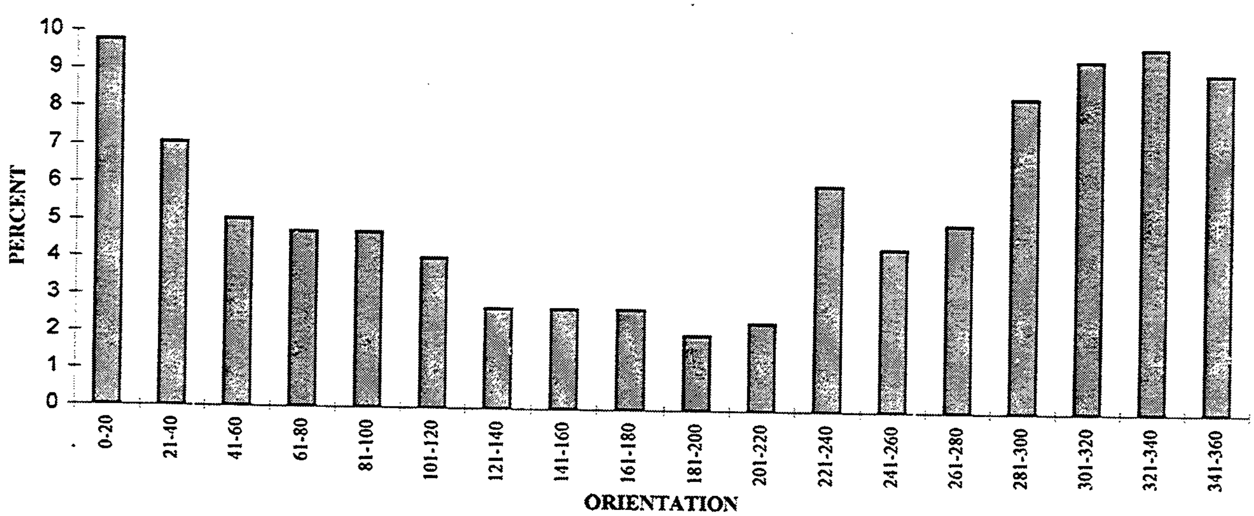


Figure 14.12b. Distribution of orientation data by 20 degree intervals for artifacts from 30-40cm bg level.

the orientation of the artifacts. Finally, slopewash was never sufficiently strong to align artifacts, although other more dominant processes may have affected artifact positioning. Considering that the chi-square value for orientation distribution for artifacts from 20-30cm bg was significant at 0.1 level but not the 0.05 level, probably indicates that the second explanation is correct.

Results of Formational Analysis

The previous section outlined several taphonomic processes that could have impacted the DB site, including faunalturbation, floralturbation, and surface deflation. These processes have severely disturbed the lower levels (20-40cm bg) of the block excavation and have caused material from the upper component to moved down the profile. As a result, artifacts from numerous different occupation episodes spanning thousands of years have been artificially grouped together in the lower levels at DB. Binford (1980, 1981a) used the term palimpsest to describe such as situation. Palimpsest is defined as the accretional accumulation of archaeological material by a variety of events and processes (see Lyman 1994). It would be very difficult, if not impossible, to separate individual occupation episodes from this palimpsest.

The upper levels (0-20 cm bg) have not gone undisturbed. Older artifacts, such as Archaic projectile points, have been mixed into these younger levels. Rodent burrowing has caused artifacts from this upper component to move down the profile. I believe, however, that material filtering from the upper component to the lower levels is a more serious problem then material moving upwards. In the previous section on size sorting, I described a slight pattern in the horizontal distribution of artifacts. Larger items tended to be lower than smaller items, possibly indicating the systematic size sorting of artifacts. This pattern probably reflects the fact that most of the groundstone artifacts (i.e., hammerstones, grinding stone, abraders) were recovered in the lower levels. However, this is probably not the result of size sorting, but rather is evidence that the earlier occupants used this artifact class more intensively than the later occupants (chapter 11).

Figures 14.13-14.15 show the distribution of artifact mass by excavation level. The data are divided into 2m wide north-south transects. In almost every case, there is a greater mass of material in the 0-10cm bg level than in the lower levels. This may indicate that the upper component represents a more intensive occupation than any of the earlier occupations. One of the most obvious patterns seen in these figures is that in units with dense concentrations of material in the 0-10cm bg level there is usually an associated, albeit smaller scale, increase in the mass of material in the lower levels. A likely explanation for this is that material originating in the upper component is filtering down the profile. So even though some material is moving up the profile, the majority of artifacts seem to be moving downward.

To evaluate this possibility, the distribution of mass by level was plotted for daub, groundstone, and lithic artifacts. By mass, these three artifact classes account for the majority of material collected from the block. Furthermore, field observations and this analysis indicate

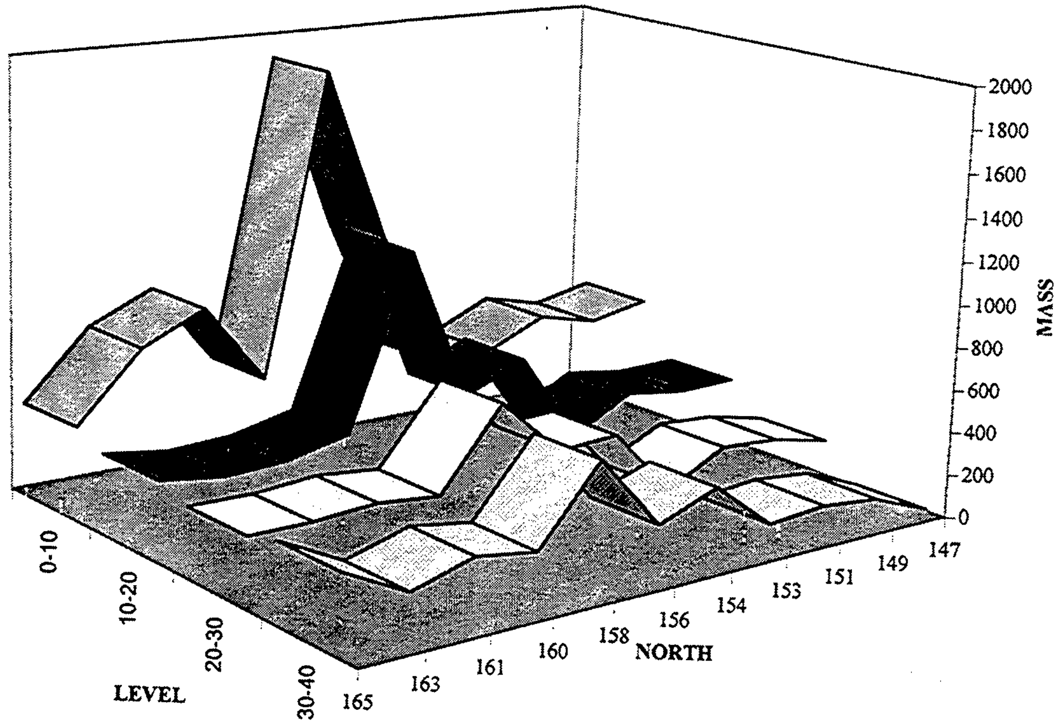


Figure 14.13a. Distribution of artifacts mass by excavation level for 57-59E transect.

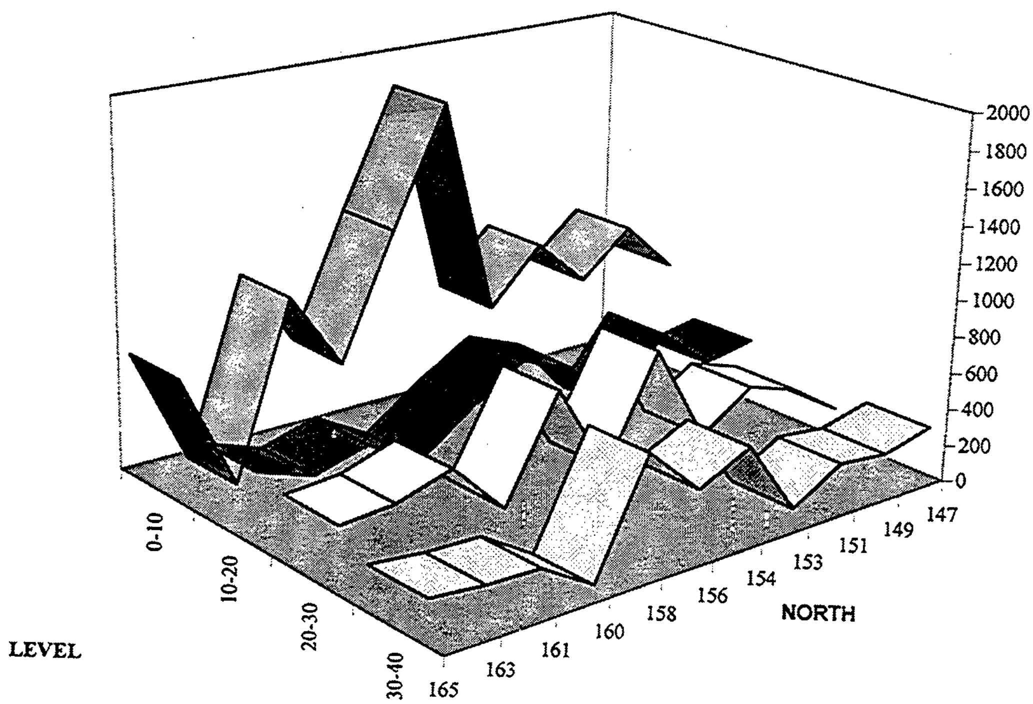


Figure 14.13b, Distribution of artifacts mass by excavation level for 59-61E transect.

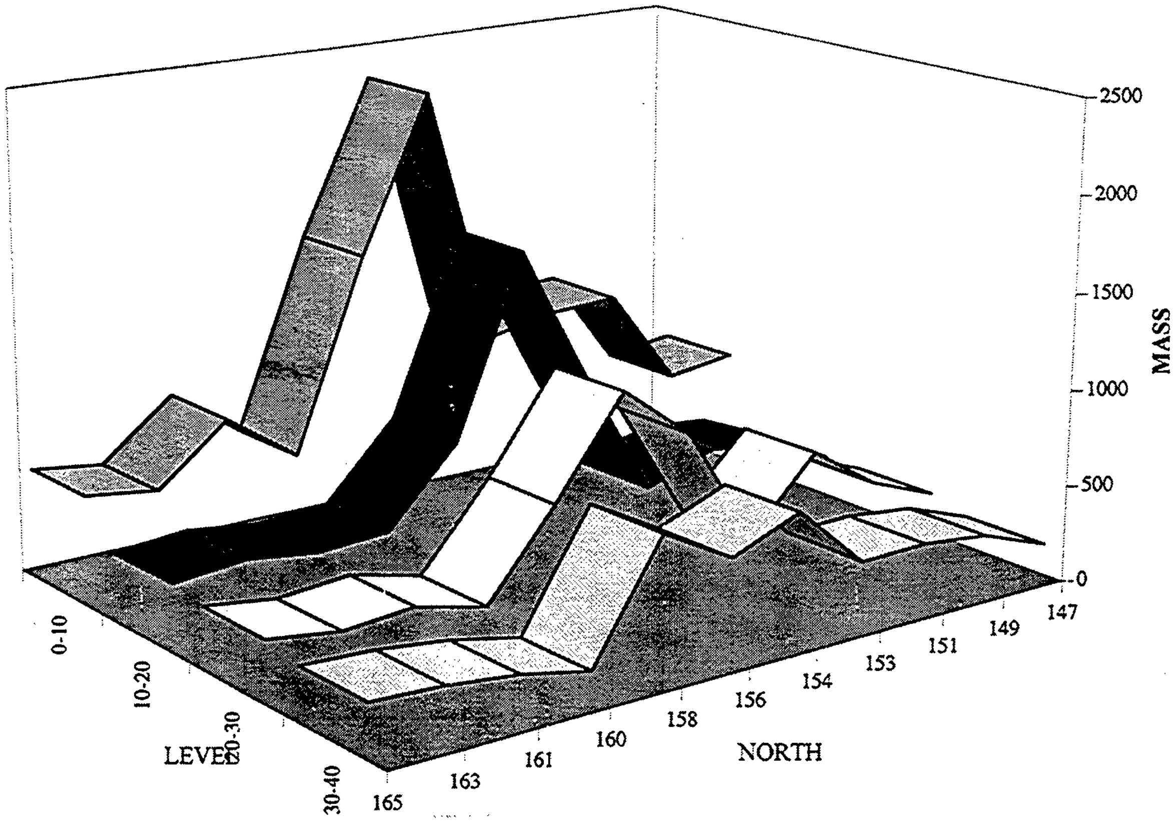


Figure 14.14a. Distribution of artifacts mass by excavation level for 61-63E transect.

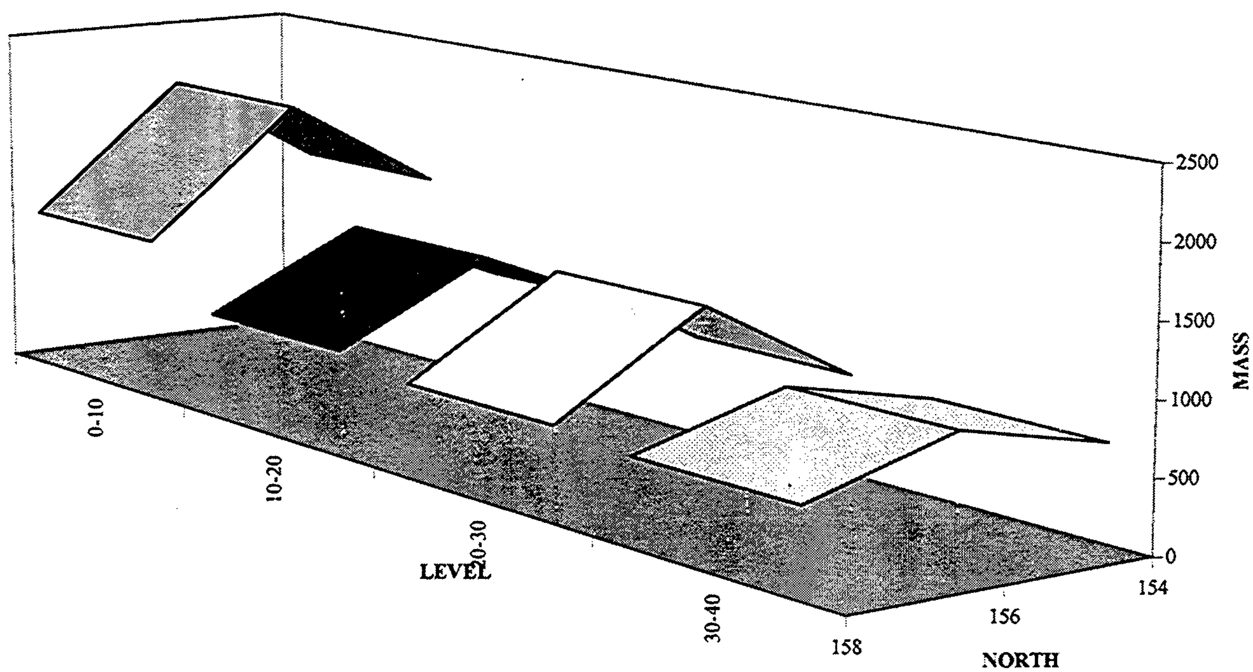


Figure 14.14a. Distribution of artifacts mass by excavation level for 64-66E transect.

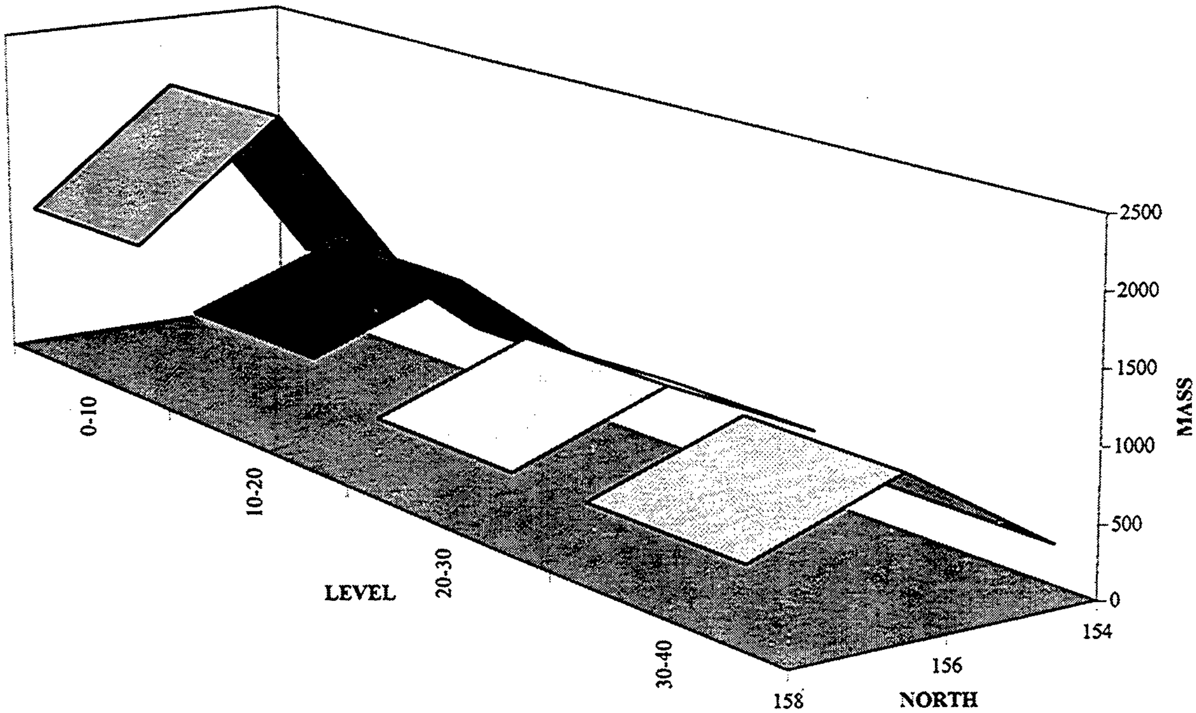


Figure 14.15a. Distribution of artifacts mass by excavation level for 66-68E transect.

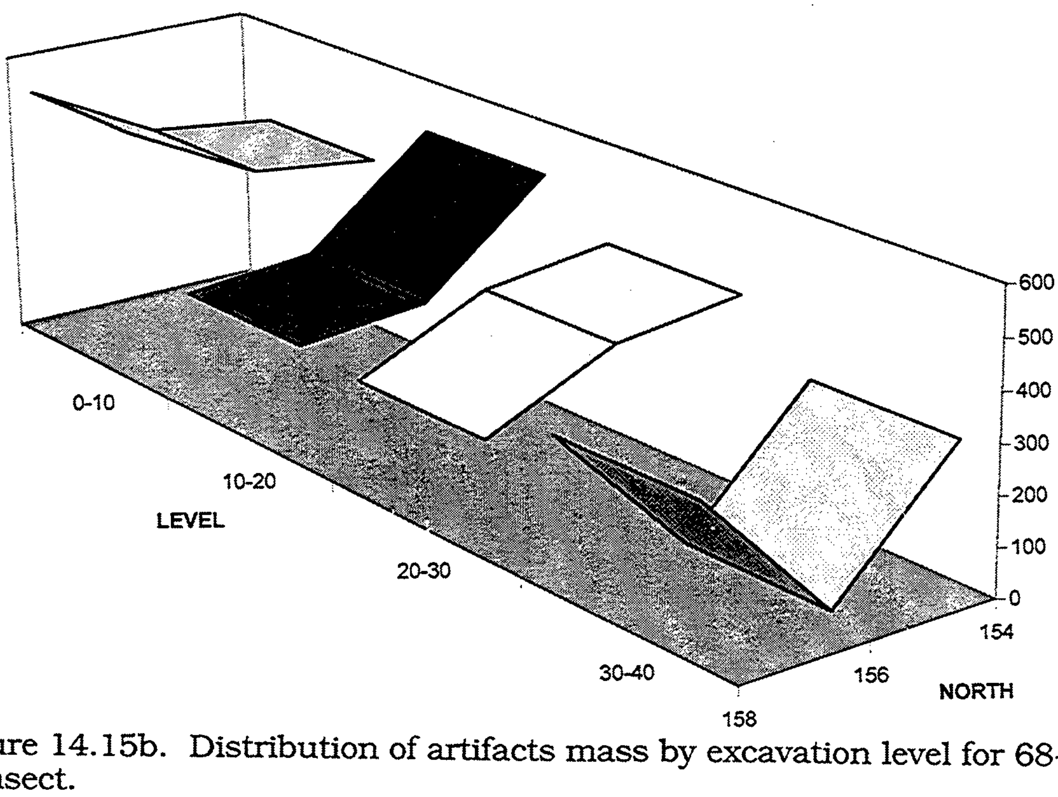


Figure 14.15b. Distribution of artifacts mass by excavation level for 68-70E transect.

that daub was predominantly found in the Late Prehistoric level (0-10cm bg) at DB, while groundstone artifacts came mostly from the lower levels. As a result, a proxy measure for vertical displacement of artifacts downward from the upper component and upward from the lower levels can be examined through the vertical distribution of daub and groundstone artifacts. The quantity of lithic remains in each level should reflect the intensity of lithic reduction and tool maintenance and the amount of vertical displacement.

The distribution of daub (Figs. 14.16-14.18) shows that the majority of it was recovered from 0-10cm bg. Peaks in the distribution of daub in the lower levels invariably occurred in units that have a high quantity of daub in the upper level. This is strongly suggestive, as stated previously, that some taphonomic process(es) moved the daub down the profile.

Groundstone is rarely found in the 0-10cm bg level, and is more common in the lower levels, especially 20-30cm bg and 30-40cm bg (Figs. 14.19-14.21). In the few instances in which groundstone artifacts were recovered in the upper component, they were usually a single artifact per unit. Multiple pieces were common in lower unit-levels.

There are a few instances (e.g., 156N/59E and 165N/61E) where there is a high concentration of groundstone artifacts in multiple levels of the same unit. This may indicate vertical displacement of artifacts through the profile. Considering the small sample size (n=85), and the fact that groundstone artifacts are not temporally or culturally distinctive of prehistoric populations in the DB area, it is difficult to evaluate this interpretation. Logan (chapters 7 and 15) suggests that the groundstone artifacts are a hallmark of the lower, Archaic horizon at DB and that their greater numbers in the lower levels reflect more intensive or frequent occupation during that period vis-a-vis the ceramic components.

The distribution of lithic artifacts is ubiquitous in all levels (Figs. 14.22-14.24). No single level has a higher quantity of lithic debris than any other. Therefore, without refitting of artifacts (which requires a huge time investment) (Hofman 1981; Hofman and Enloe 1992), we cannot determine the degree of their vertical displacement. Considering, however, that the distribution of daub shows evidence of downward movement of artifacts, it is reasonable to assume that other artifact classes are also moving downward. In relation to the few diagnostic points shown to have moved up the profile, downward movement of artifacts appears to have been more extensive.

Site Structure of the Late Prehistoric Occupation

This section examines the internal arrangement, called site structure, of the artifacts and features in the Late Prehistoric occupation (0-10cm bg) at DB. The study of the formational history of the site indicated that while sheetwash erosion has potentially moved artifacts around the surface and rodent burrowing and tree-throw have caused accretional loss of material from the upper levels, there is less evidence of upward transport of material from the lower ones.

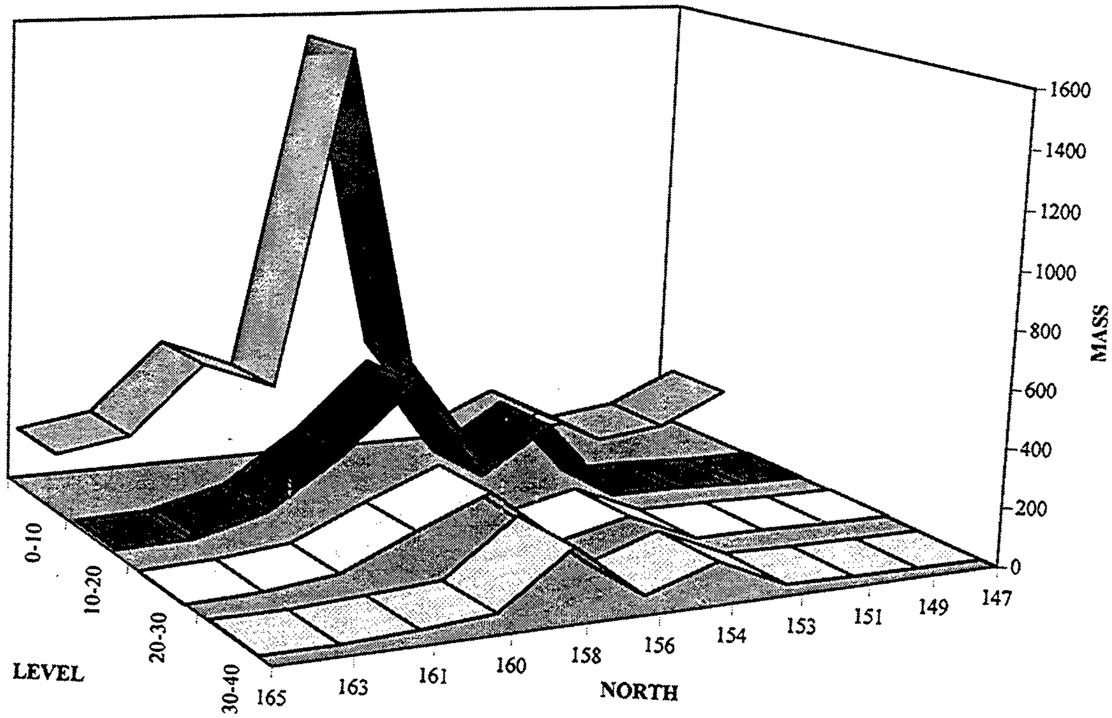


Figure 14.16a. Distribution of the mass of daub by excavation level for 57-59E transect.

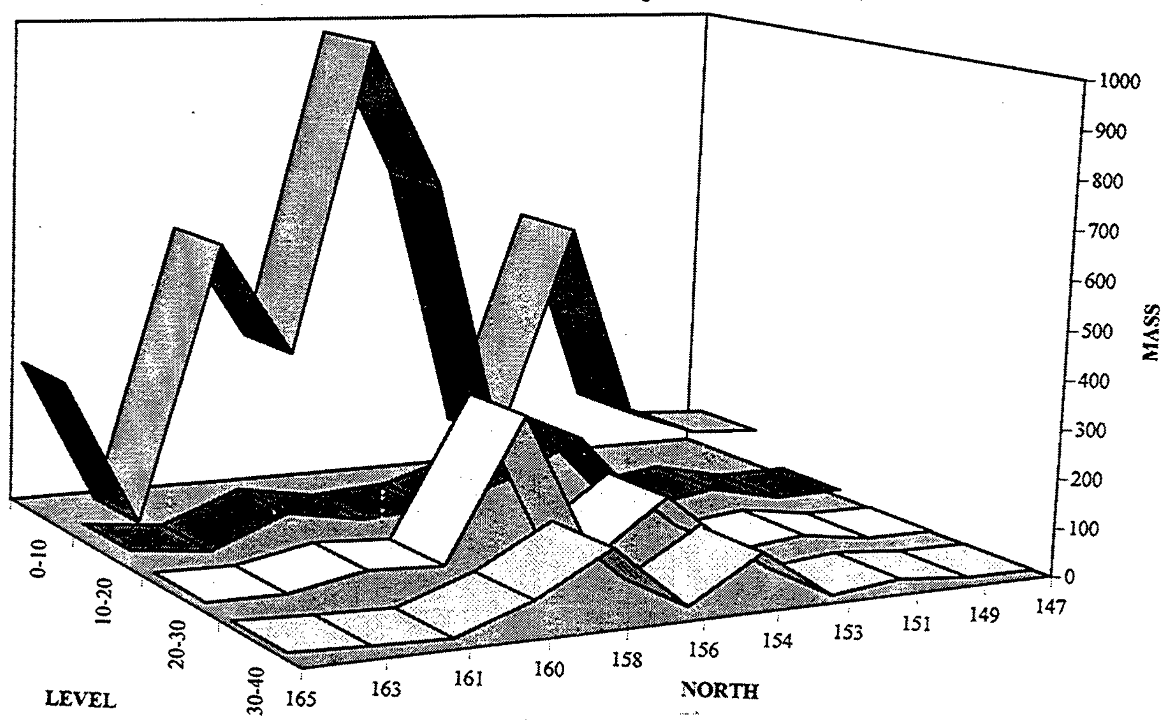


Figure 14.16b. Distribution of the mass of daub by excavation level for 59-61E transect.

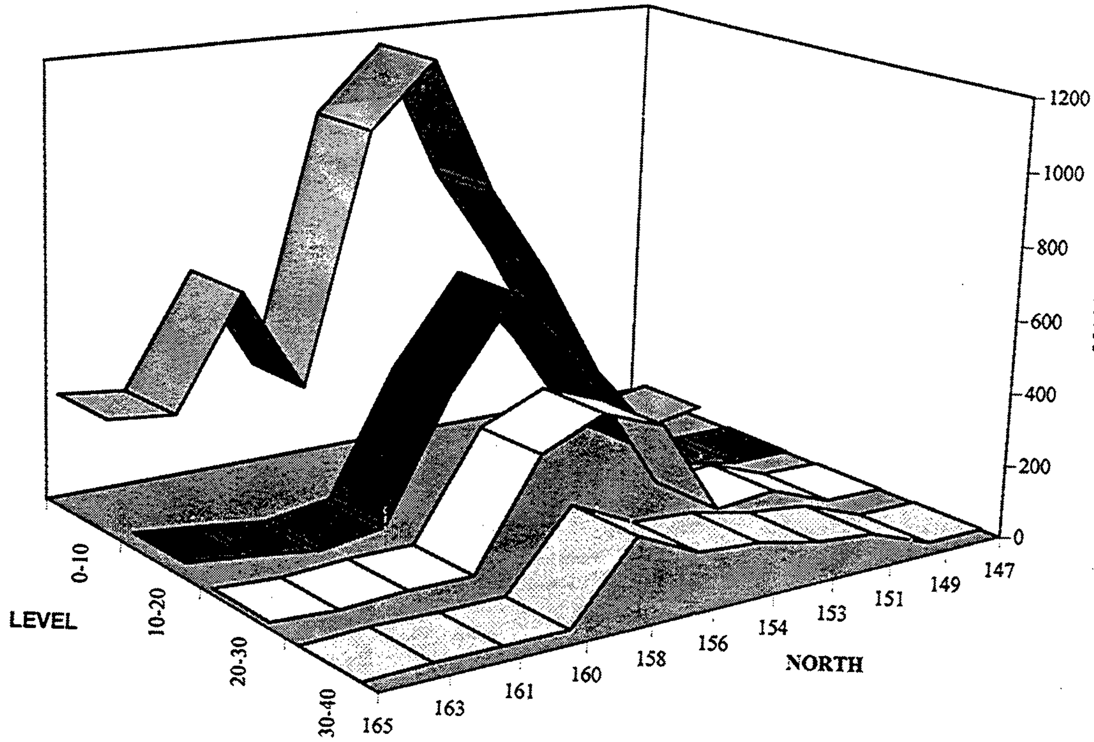


Figure 14.17a. Distribution of the mass of daub by excavation level for 61-63E transect.

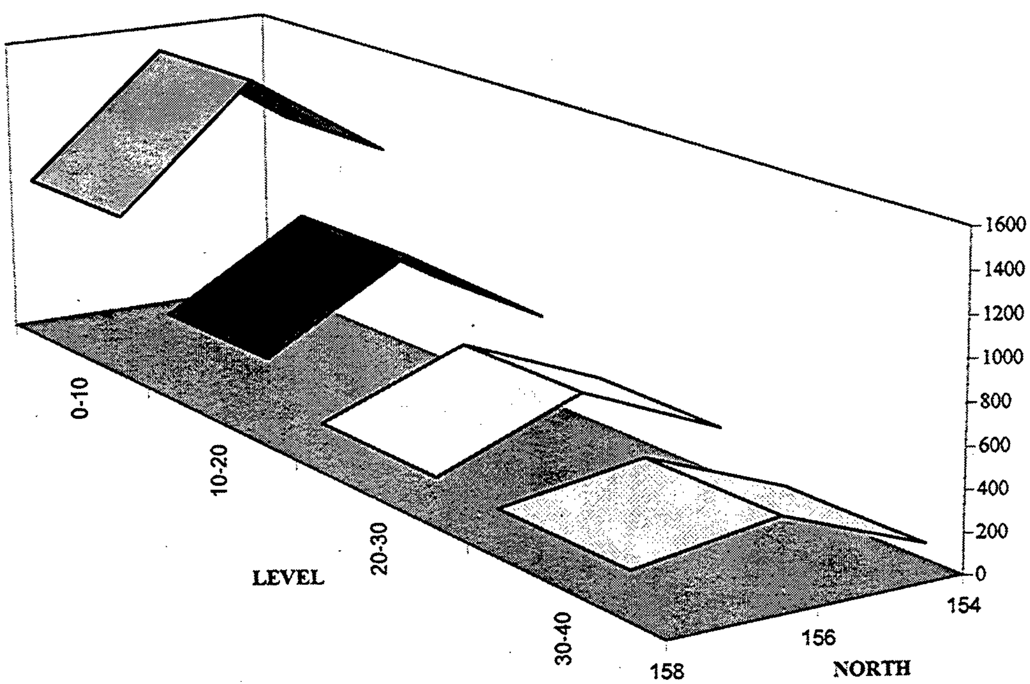


Figure 14.17b. Distribution of the mass of daub by excavation level for 64-66E transect.

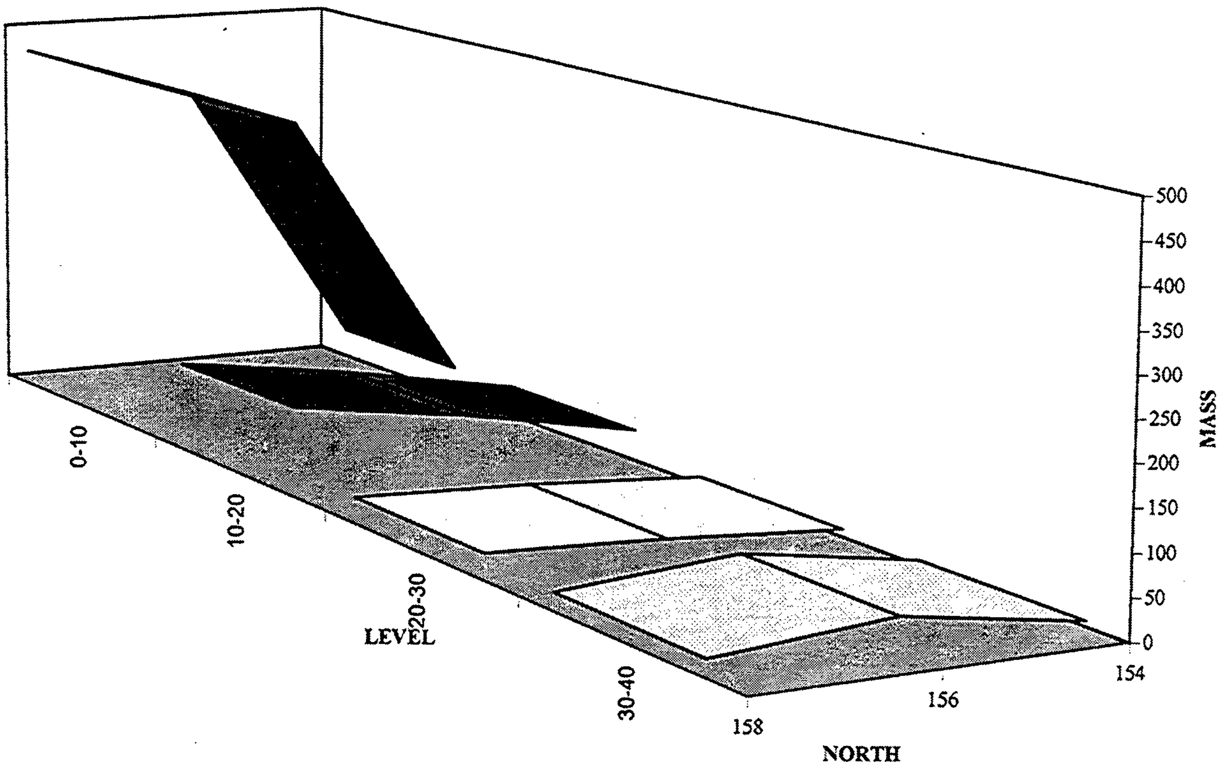


Figure 14.18a. Distribution of the mass of daub by excavation level for 66-68E transect.

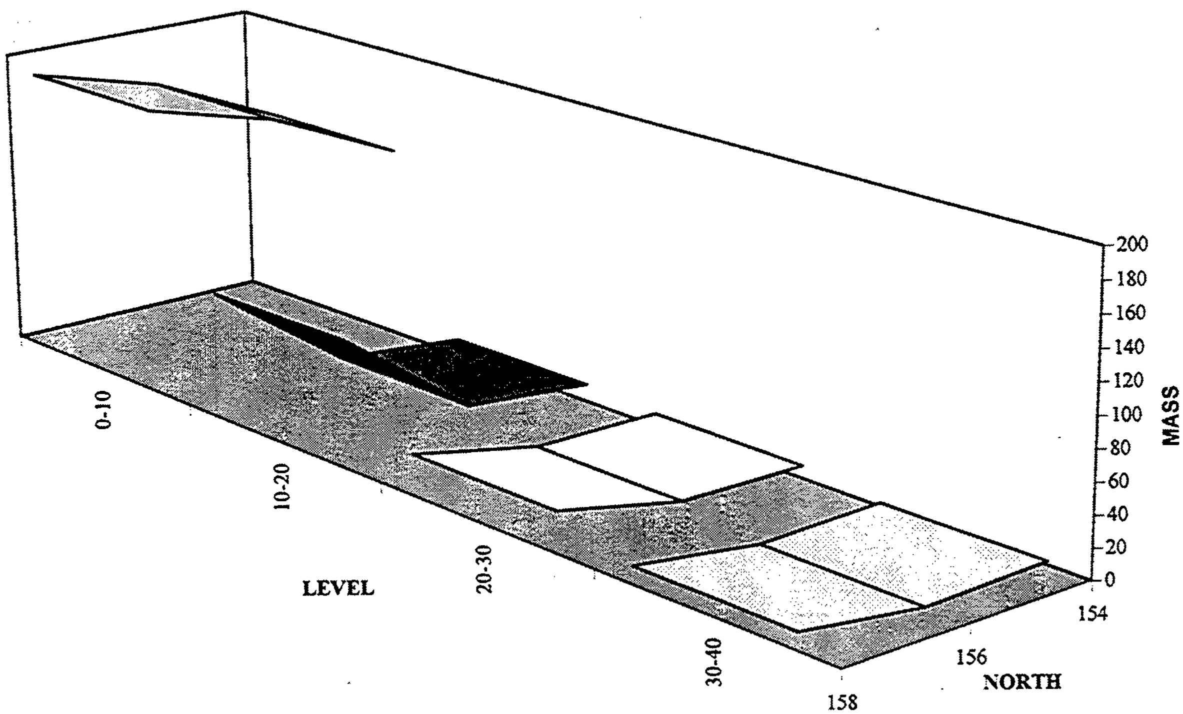


Figure 14.18b. Distribution of the mass of daub by excavation level for 68-70E transect.

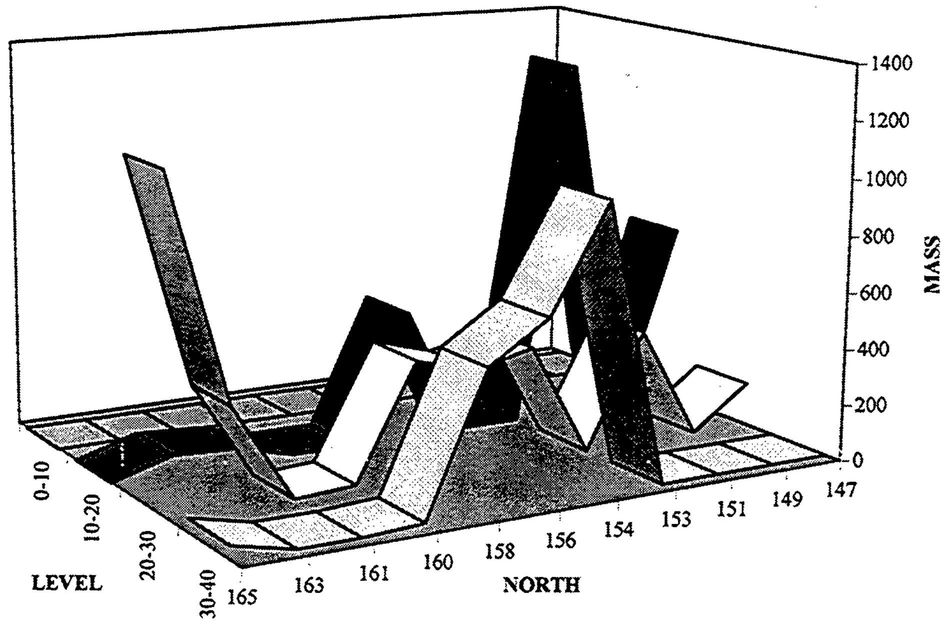


Figure 14.19a. Distribution of the mass of groundstone by excavation level for 57-59E transect.

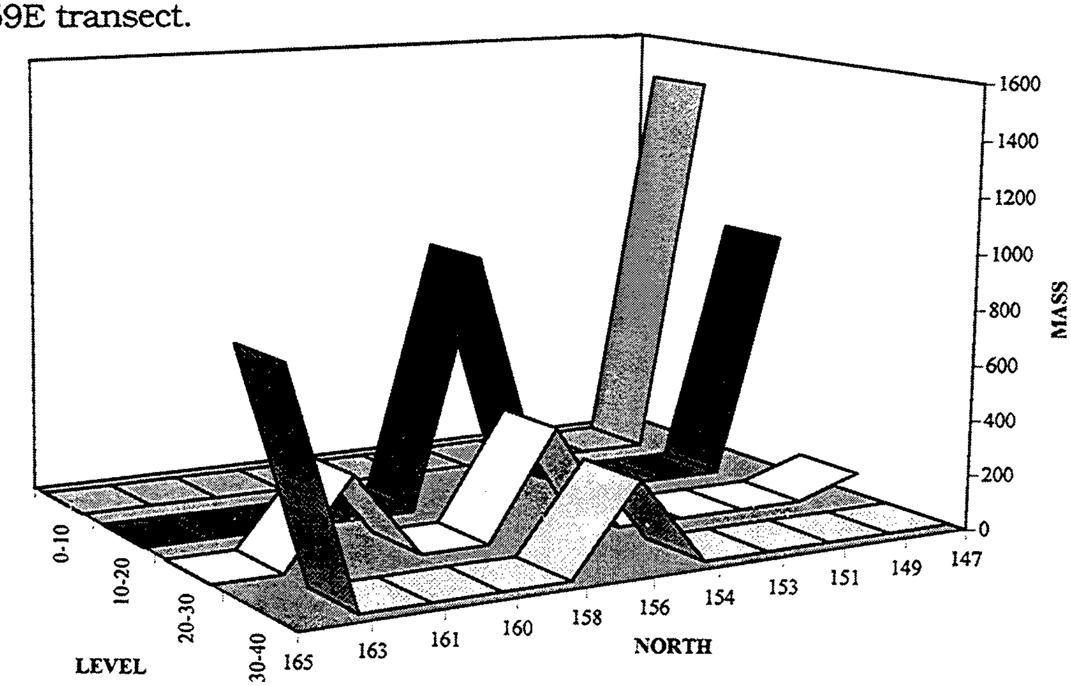


Figure 14.19b. Distribution of the mass of groundstone by excavation level for 59-61E transect.

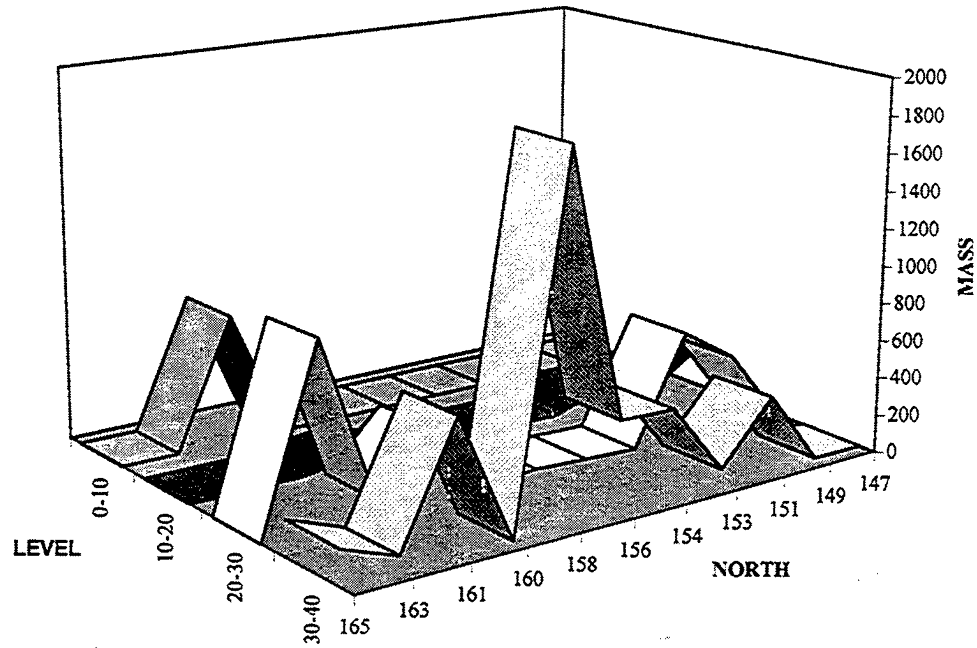


Figure 14.20a. Distribution of the mass of groundstone by excavation level for 61-63E transect.

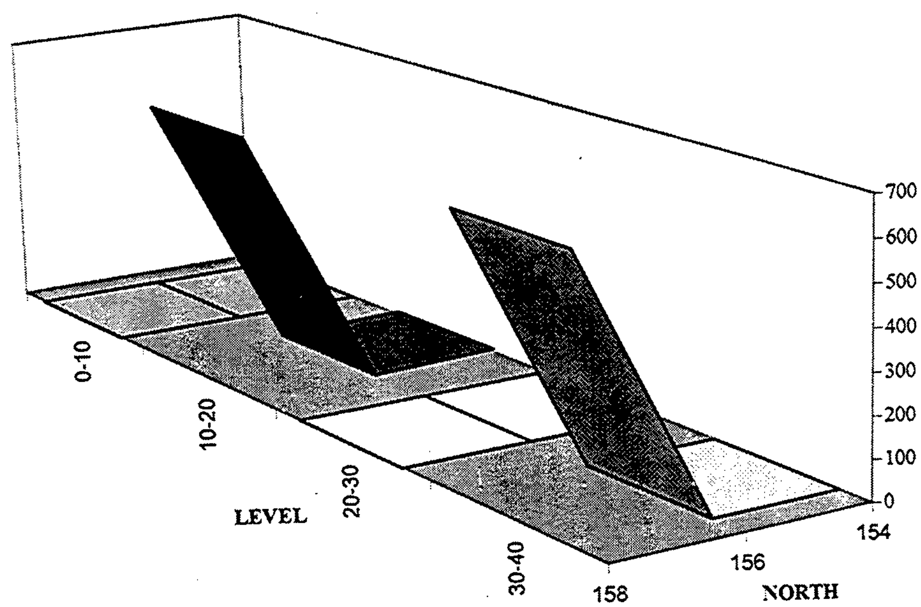


Figure 14.20b. Distribution of the mass of groundstone by excavation level for 64-66E transect.

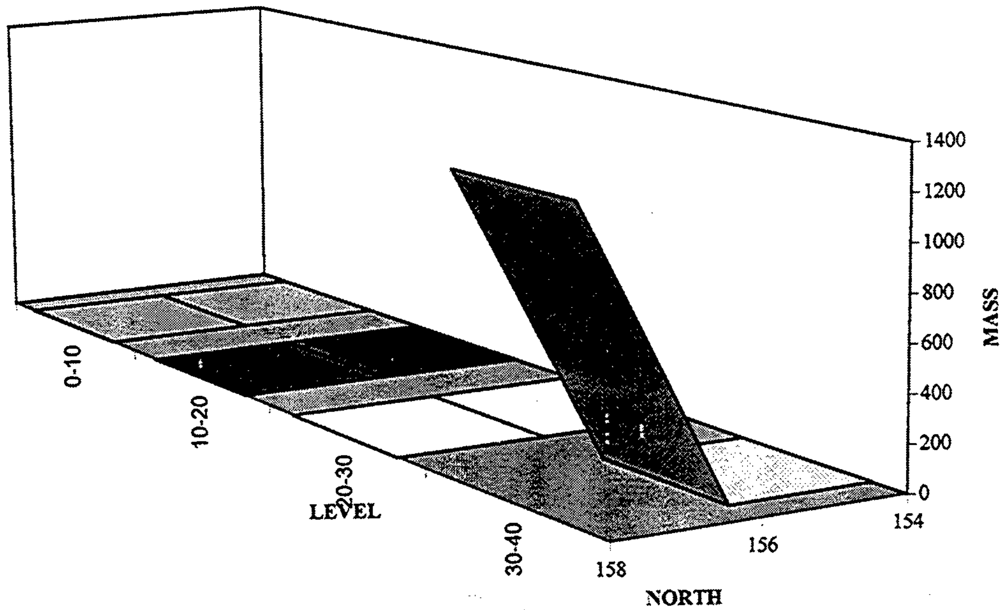


Figure 14.21a. Distribution of the mass of groundstone by excavation level for 66-68E transect.

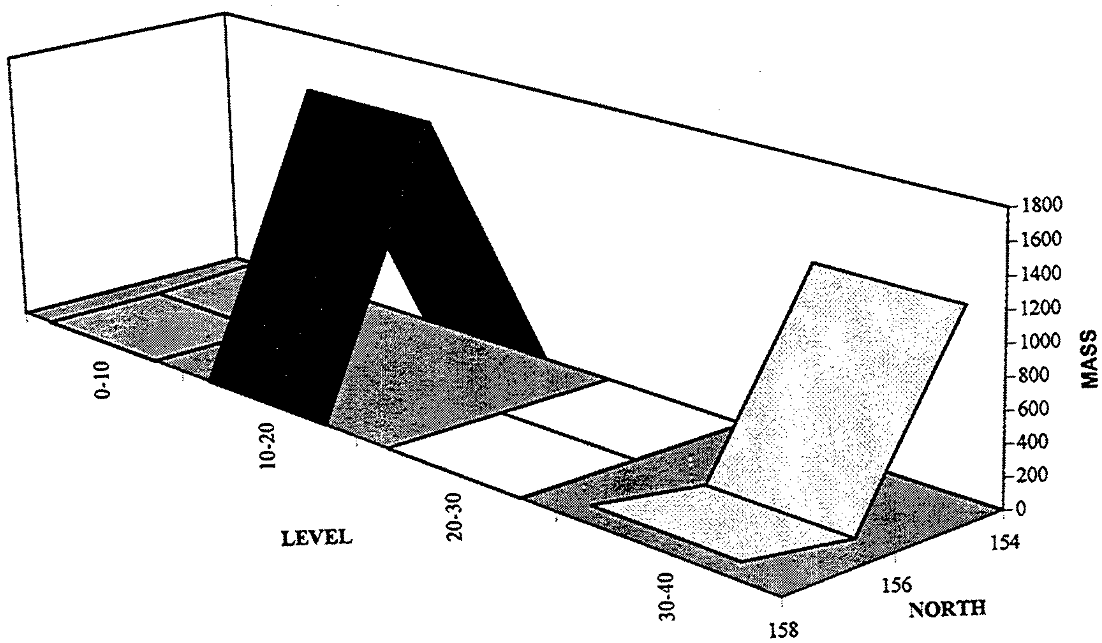


Figure 14.21b. Distribution of the mass of groundstone by excavation level for 68-70E transect.

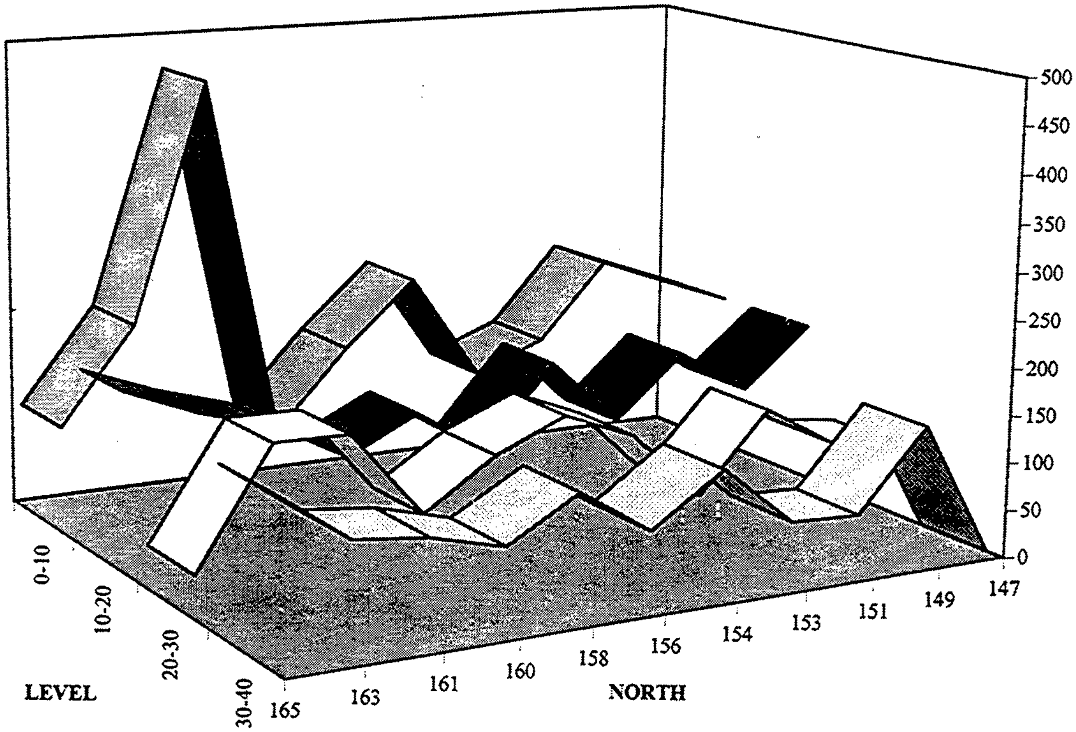


Figure 14.22a. Distribution of the mass of lithic material by excavation level for 57-59E transect.

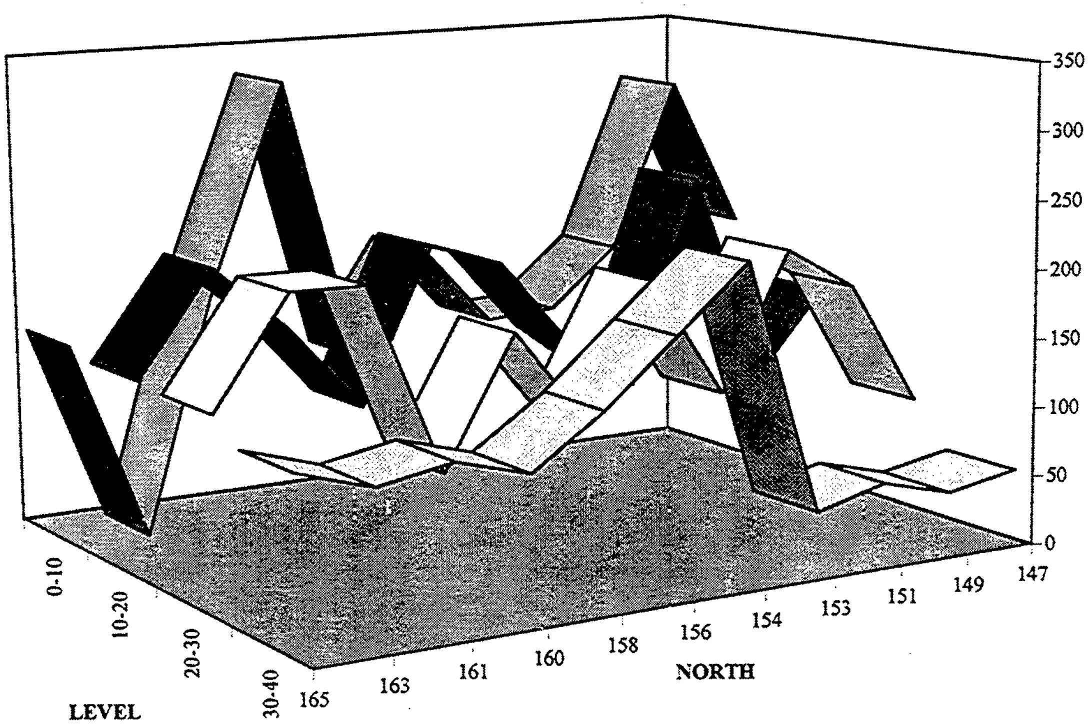


Figure 14.22b. Distribution of the mass of lithic material by excavation level for 59-61E transect.

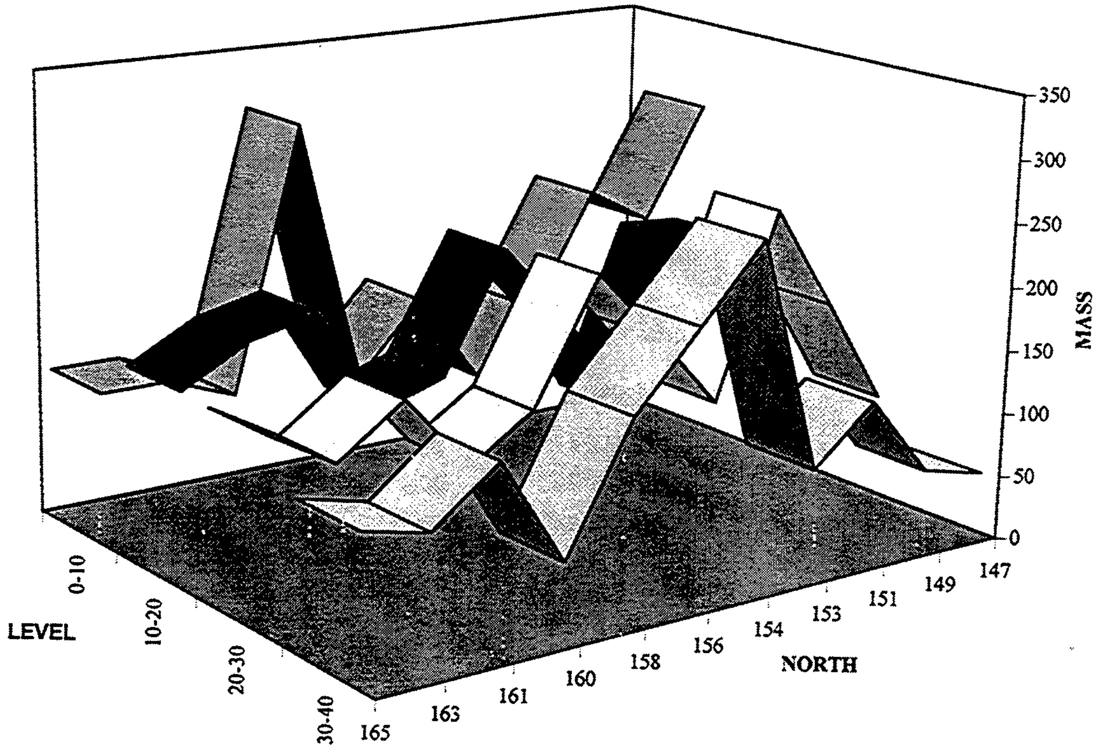


Figure 14.23a. Distribution of the mass of lithic material by excavation level for 61-63E transect.

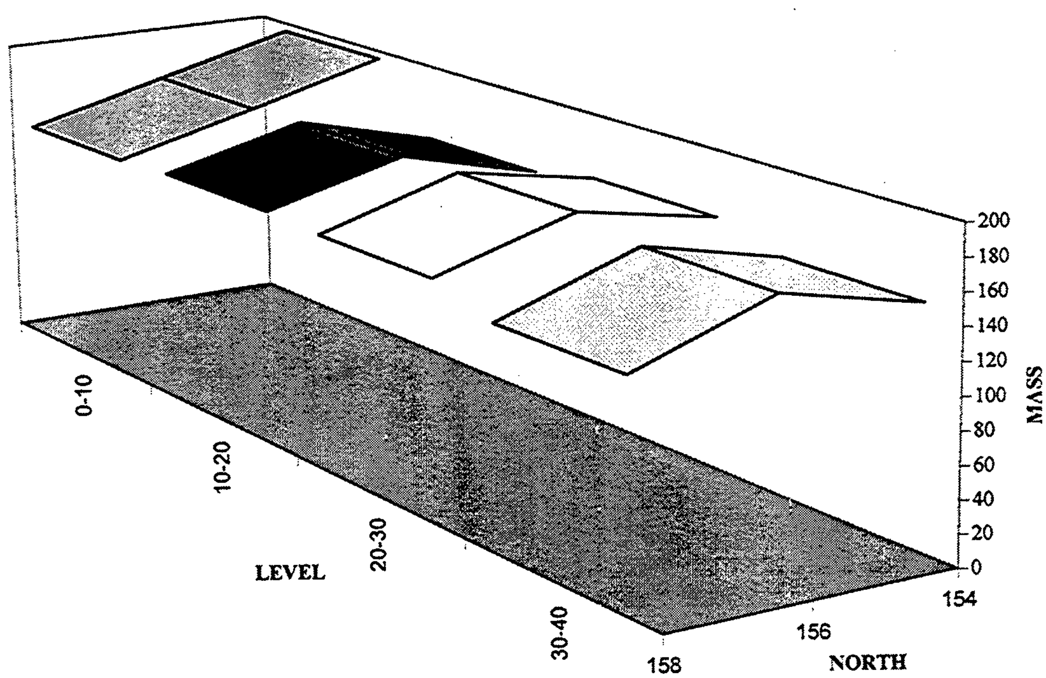


Figure 14.23b. Distribution of the mass of lithic material by excavation level for 64-66E transect.

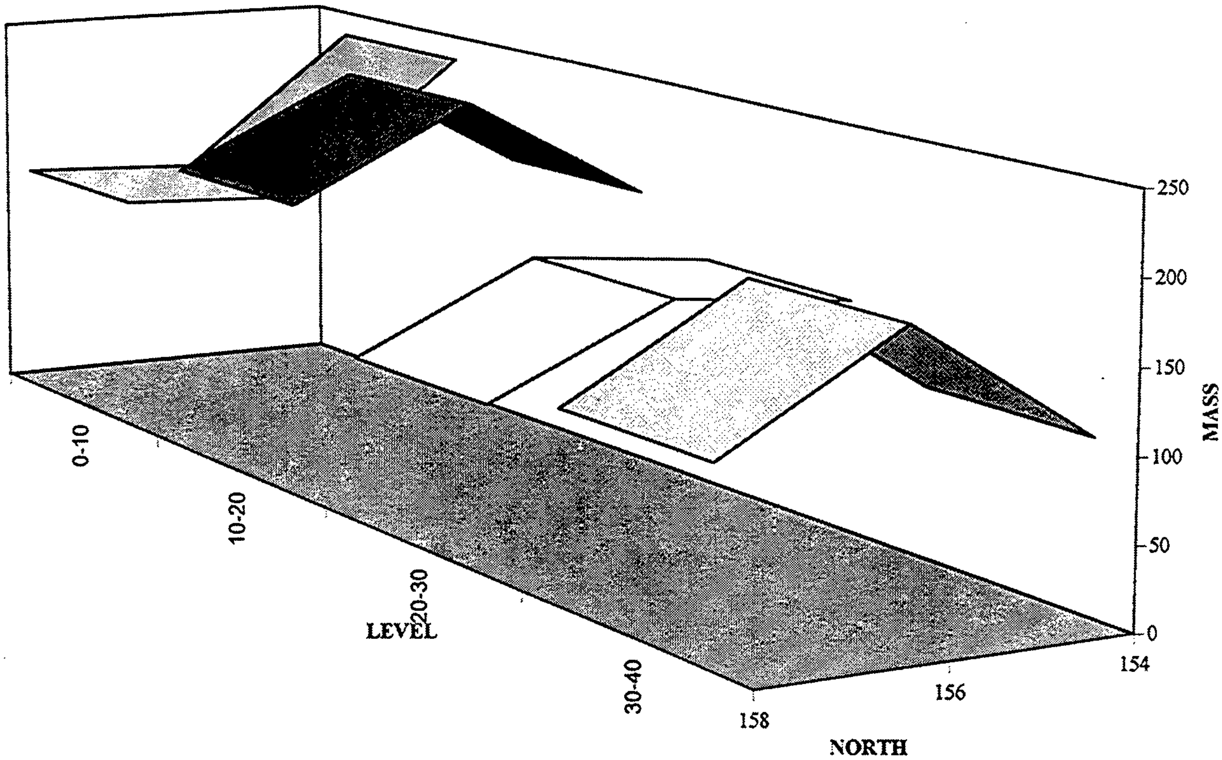


Figure 14.24a. Distribution of the mass of lithic material by excavation level for 66-68E transect.

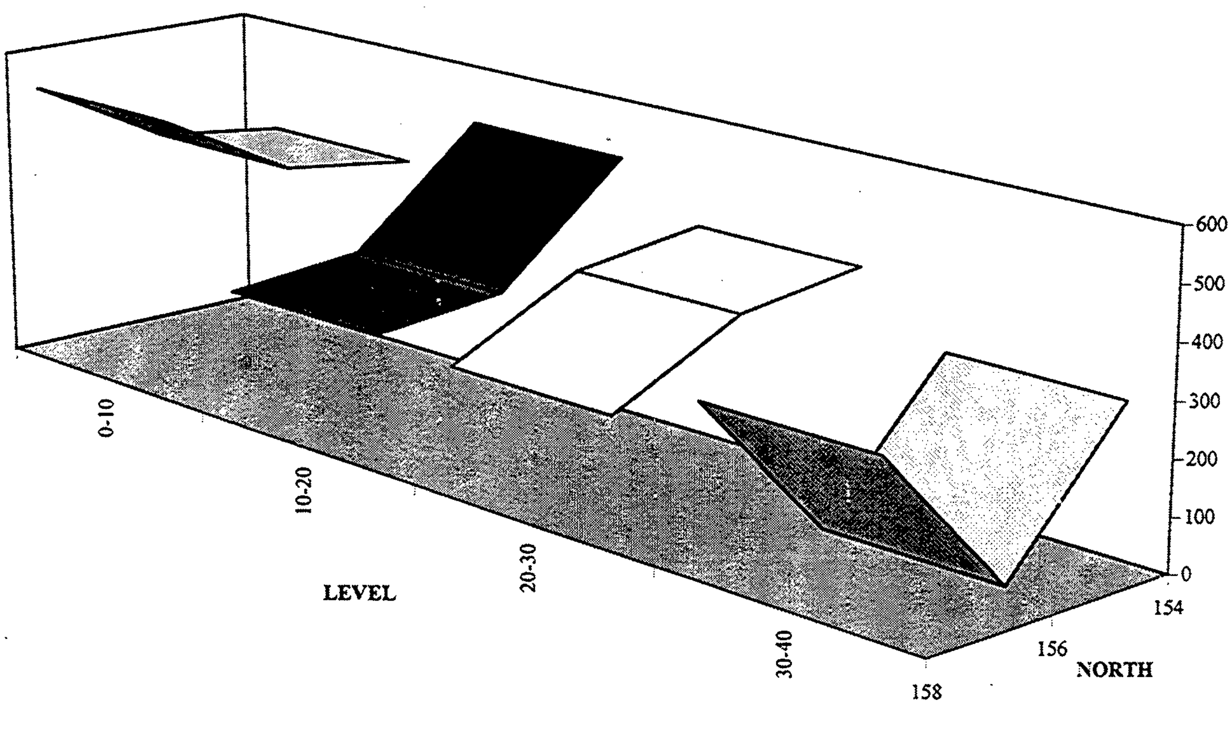


Figure 14.24b. Distribution of the mass of lithic material by excavation level for 68-70E transect.

The lower levels are a palimpsest of multiple, human occupations and taphonomic disturbances. The spatial distribution of artifacts from these lower levels cannot be attributed to any particular "occupation". Since we are more confident that the upper component represents a discrete, Late Prehistoric "occupation" we will examine the spatial distribution from this level.

Site structure refers to the spatial distribution of artifacts, features, and faunal remains at an archaeological site (Binford 1983:144; 1987). An analysis of site structure consists of identifying activity areas as well as areas of site facilities (e.g., site furniture) (Binford 1978a, 1979). Facilities can include hearths and roasting pits, wind breaks, latrines, and storage and residential structures (Binford 1983; Gargett and Hayden 1991:29). These are items or features that go with the site. They are not personal gear and are usually not transported upon site abandonment. The size, construction, and purpose of these facilities force the occupants to organize their activities around or away from certain facilities. For example, because certain activities produce a lot of waste (flintknapping) or obnoxious smells (latrines and carcass butchering), require large work areas (hide working), or are private (initiation rituals, birthing) they are commonly performed away from key facilities like houses, children play areas, and sleeping areas (Yellen 1977 Binford 1983; O'Connell 1987). Other activities generally occur in close proximity to a particular facility. Activities, such as talking, sleeping, food cooking and preparation, flintknapping, and craft activities commonly occur within a meter of a hearth (Binford 1978a, 1978b, 1983). Archaeologists wanting to analyze site structure need to identify these key facilities at a site, and then determine the distribution of activity areas around them.

Several methodological approaches have been forwarded for the analysis of site structure. Most spatial analyses utilize either artifact refitting (Cahen et al. 1980; Leroi-Gourhan and Brezillion 1966, 1972; Simek and Larick 1983; Hofman 1981; Hofman and Enloe 1992; Villa 1982; Villa and Courtin 1983), or some multivariate statistical technique (Carr 1984; Kroll and Price 1991; Whallon 1984) to identify activity areas. Neither of these approaches was possible for this study because of the amount of time and labor available, so this analysis examined the horizontal distribution of different artifacts. Simple density (mass/m^2) contour plots were produced for certain classes (i.e., daub, charcoal, burned bone, and lithic debitage) that are expected in association with site facility areas, such as hearths, structures, lithic reduction areas. Dense concentrations of this material are interpreted as the central location of these facilities. Activity areas were then identified by producing scatter plots of piece-plotted artifacts of different functions (i.e., stone tools, ceramic, and groundstone artifacts).

Site Facilities: The distribution of daub, burned earth with grass impressions, was used to identify possible house structures (Fig. 14.25). Although daub is ubiquitous across the excavation block, two dense (>200g/m^2) clusters are identified in the central part of it. The largest is an approximately 20m^2 area centered around 156N/64E. Seven meters to the west is another area of greater daub density. This area is much smaller (>1m^2), and the cluster apparently extends beyond the block.

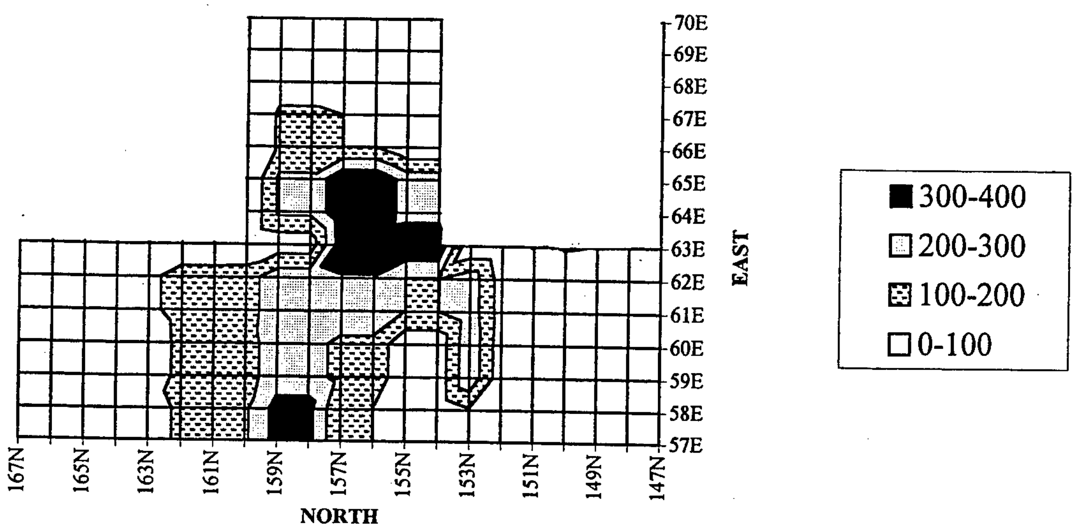


Figure 14.25. Density map (g/m²) of daub in the Late Prehistoric level (0-10cm bg).

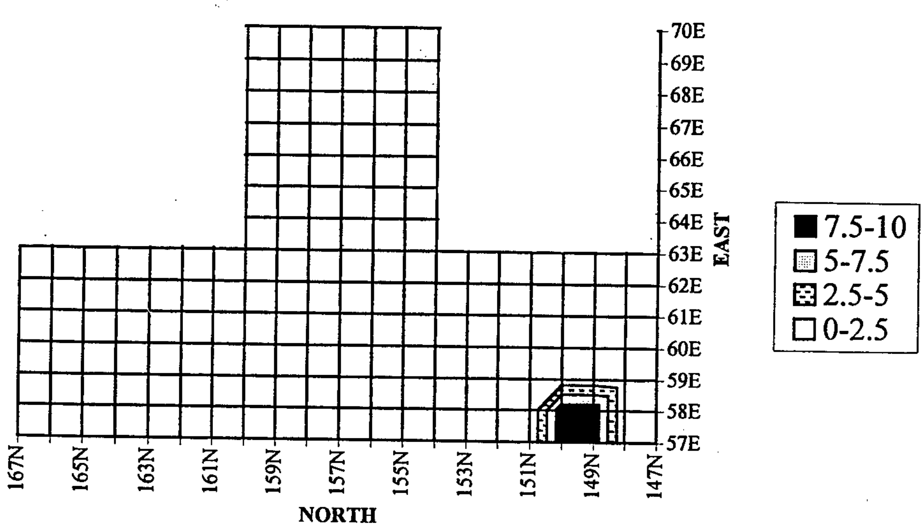


Figure 14.26. Density map (g/m²) of charcoal in the Late Prehistoric level (0-10cm bg).

The two dense areas are part of a larger (ca. 70m^2) smear of daub distributed throughout the central portion of the block. Considering the distance between these two peaks, the average size of Steed-Kisker houses, and that neither area is associated with any of the previously identified disturbed areas, I believe that these peaks represent different features. What follows is a review of published information on Steed-Kisker houses that provides the basis for the evaluation of these features as possible house structures.

Researchers (Brown and Simmons 1987; Calabrese 1969; Chapman 1980; Shippee 1960) have identified at least three different house forms at Steed-Kisker sites (Table 14.1). At the Steed-Kisker site there was a semi-subterranean, subrectangular house with an extended entryway (Wedel 1943; Shippee 1972). This structure covered an area of about 25m^2. Another house form, seen at the Gresham and Cloverdale sites, is rectangular in outline and lacks the extended entryway. These houses are slightly larger (ca. 29m^2) than the previous form. A very large, square structure without entryways was discovered at the Steed-Kisker site (House 3) and at the Young site (Shippee 1972). All the aforementioned structures were apparently of wattle-and-daub construction. A very different type of lodge construction was uncovered at the McClarnon site (Shippee 1972). This structure, similar in size and shape to House #1 at Steed-Kisker, was not made of daub but instead was apparently made entirely of thatch.

The size and shape of the large daub cluster in the center of the DB block matches other Steed-Kisker houses fairly well. In fact, the overall spread of daub is much larger than any single Steed-Kisker house. We cannot pinpoint, at this time, any taphonomic processes that might have laterally extended the daub. Some of the smearing may be attributable to the fact that not all of the plowzone had been stripped from the area prior to excavation. Grading was purposefully conservative, sparing the lower furrows in order to preserve intervening, unplowed areas. Rodent burrowing may have also moved material horizontally, as well as vertically. Thus, while the argument for two separate houses may be plausible, it cannot be substantiated.

Unlike most Steed-Kisker houses, the DB feature is not associated with any central post holes or hearth features. Rodent activity certainly caused the vertical displacement of daub (and other artifacts) in the area of the "house" feature. Alternatively, if this feature was a semi-subterranean structure it is possible that the combined effects of digging the house and human occupation may have contributed to the mixing of deposits. However, no evidence of sub-surface lodge construction was identified during the excavation.

In the 0-10cm bg level there is a very dense concentration (9.1g/m^2) of charcoal at 149N/57E (Fig. 14.26). This cluster is very unusual because the rest of the excavation yielded only trace amounts (<0.5g/m^2) of charcoal. The excavators of this and surrounding units noted occasional root casts, evidence of the plowzone, and a few krotovinas, but otherwise an overall low degree of bioturbation. This feature is, however, directly associated with an area of high dips. Some disturbance process, such as a tree throw, forest fire, or historic tree clearing operation, may have been responsible for this concentration of charcoal, but there is no evidence of it. Alternatively, this feature could be either a small unlined fire hearth or debris cleaned from one. The prehistoric camp fire explanation may be more accurate given that the

Table 1. Summary information of Steed-Kisker Phase House structures

Site	Size (m^2)	Shape	Material	References
Steed-Kisker Site #1 1948; Calabrese 1968	22 (4x5.5m)	subrectangular w/ entryway	wattle-and-daub	Wedel
Steed-Kisker Site #3 Shippee 1972	49 (7 x7 m)	square	wattle-and-daub	
Gresham #1 Shippee 1960, 1972	28 (4 x 7 m)	rectangular	wattle-and-daub	
Friend and Foe #2 Calabrese 1968,1969; Riley 1967	?	?	wattle-and-daub	
Friend and Foe #3 Calabrese 1968,1969; Riley 1967	?	?	wattle-and-daub	
McClarnon #1 Shippee 1972	25 (5 x 5)	square w/ entryway	Thatch?	
Cloverdale #1	30 (6x 5 m)	rectangle		Shippee 1972
W.W. Young #1 Shippee 1972	56 (8 x 7 m)	?	wattle-and-daub	
Coon Site O'Brien 1993	35 (5 x7)	square	wattle-and-daub	

excavators did not observe evidence for large scale disturbance in this area of the site. Also, since such disturbance processes would probably have occurred across the excavation block, we should have other peak areas of charcoal.

Burned bone is scattered across the southern portion of the block (Fig. 14.27). There is a notable concentration (0.9g/m^2) centered at 149N/57E and another 3m to its north. The distribution of burned bone supports the conclusion that the charcoal feature in 149N/57E is a hearth for several reasons. First, a natural fire would probably not make a concentration of burned bone as most faunal remains buried in woodland areas quickly disintegrate due to the acidity of the soil. The only reason that the burned bone survives is that it was burned prior to burial. Therefore, this material was inert to chemical degradation. Second, the pieces of burned bone are very small, and therefore are unlikely to have been moved from their initial place of deposition by human cleaning (see Binford 1983). This conclusion is based on the McKellar Principle (Stevenson 1991: 273), that states that very small items (<2cm) are less visible and obstructive than large items, and are therefore more likely to be missed during refuse removal, regardless of the diligence of the cleaners. These bone pieces are simply too small to be thoroughly collected in any cleaning effort.

To identify possible lithic workshop areas, a density contour plot of lithic debitage (i.e., flakes, chips, shatter) was produced for the 0-10cm bg excavation level (Fig. 14.28). Lithic debitage is fairly ubiquitous across the block. There are, however, four dense areas (>60g/m^2). Two peaks are in the southern portion of the excavation. One, about 6m^2, is located along the 147-148N transect. A second 6m^2 area of debitage is along the 153N transect. A small (1m^2) concentration of debitage is located within 156N/57E. A 3m^2 debitage cluster is situated around 154N/66E. At present, without intensive analysis of the debitage, it is not clear if these concentrations actually represent lithic workshops or are simply midden areas where debitage was dumped.

Activity Areas: Two maps of piece-plotted artifacts were produced. The first (Fig. 14.29) shows the distribution of ceramics and groundstone. The other is the distribution of lithic tools (Fig. 14.30). For reference, the open squares represent the general location of the daub concentrations, while the open circle represents the concentration of charcoal.

There are three distinctive clusters of groundstone and ceramic artifacts. A cluster of two rim sherds, three bodysherds, and a heat-altered groundstone piece were recovered from the general area of the possible hearth feature. East of the large daub feature are two abraders that may have been associated with stone tool production (see chapter 12). Between the two daub clusters is a small concentration of several bodysherds (n=4), a rimsherd, and an abrader. Surprisingly, only two artifacts (both bodysherds) are found within either of the two daub concentrations (as defined by the 300-400gm contour).

Lithic tools also cluster in the three areas just outlined, as well as in the northern portion of the block excavation. Near the possible hearth is a variety of different tools, including three scrapers, two points, five cores, and a knife. Between the daub clusters there are five cores,

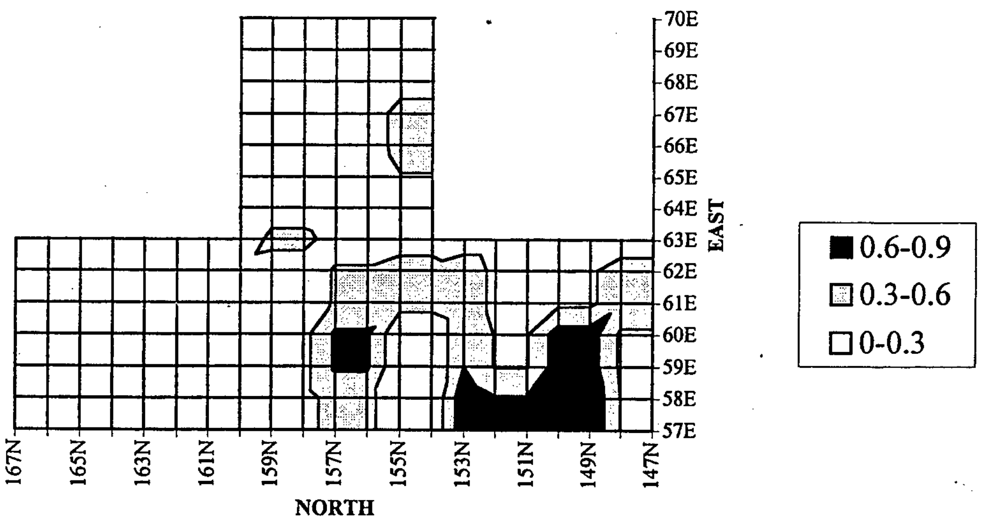


Figure 14.27. Density map (g/m²) of burned bone in the Late Prehistoric level (0-10cm bg).

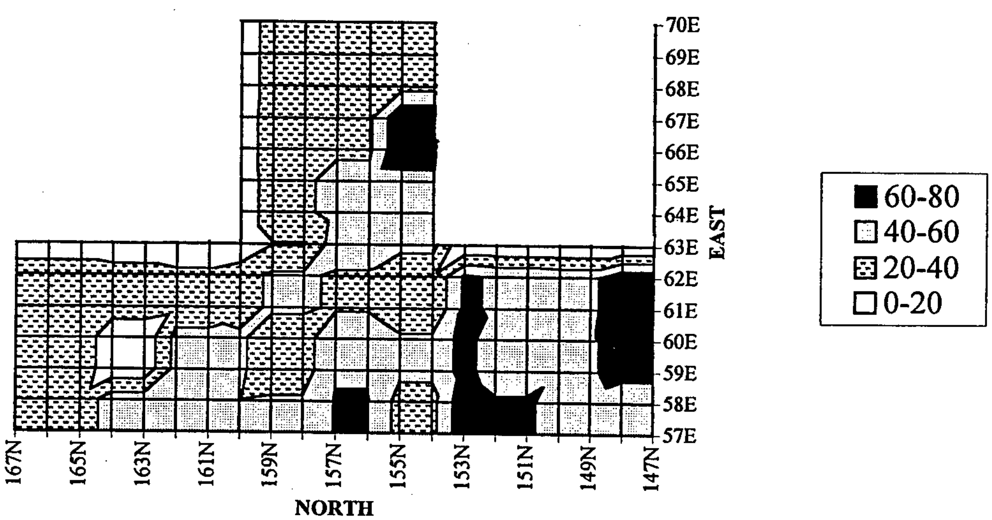


Figure 14.28. Density map (g/m²) of lithic debitage in the Late Prehistoric level (0-10cm bg).

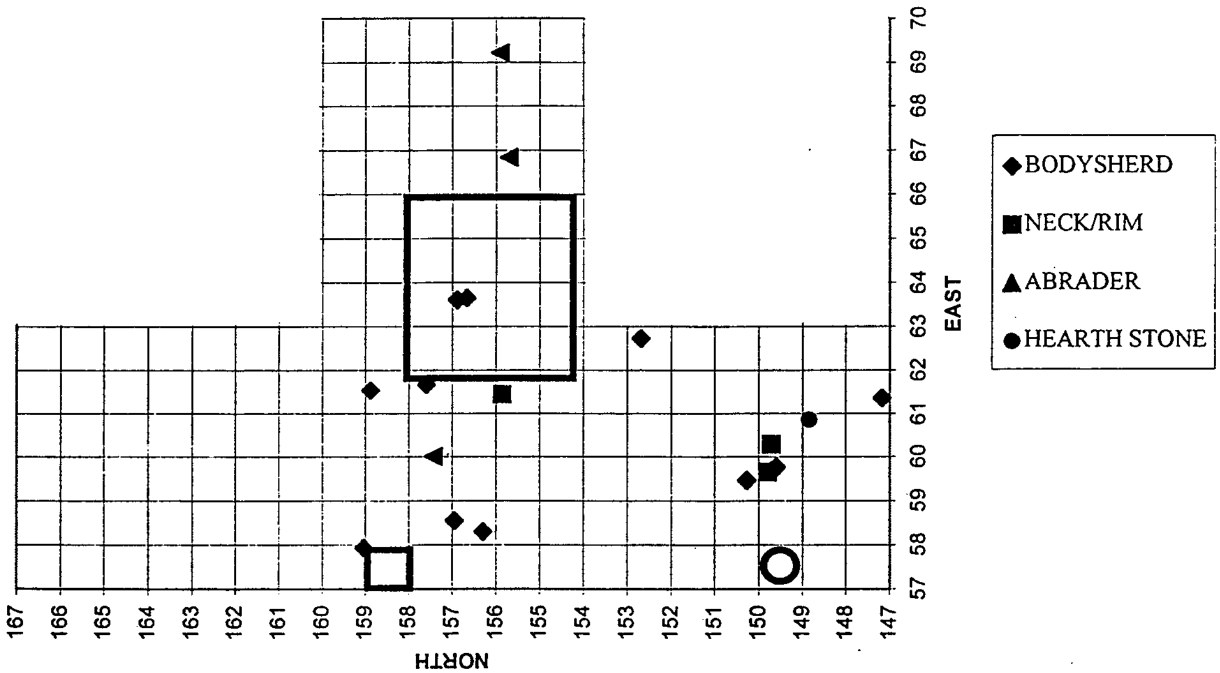


Figure 14.29. Horizontal distribution of piece-plotted ceramic and groundstone artifacts in the Late Prehistoric level (0-10cm bg).

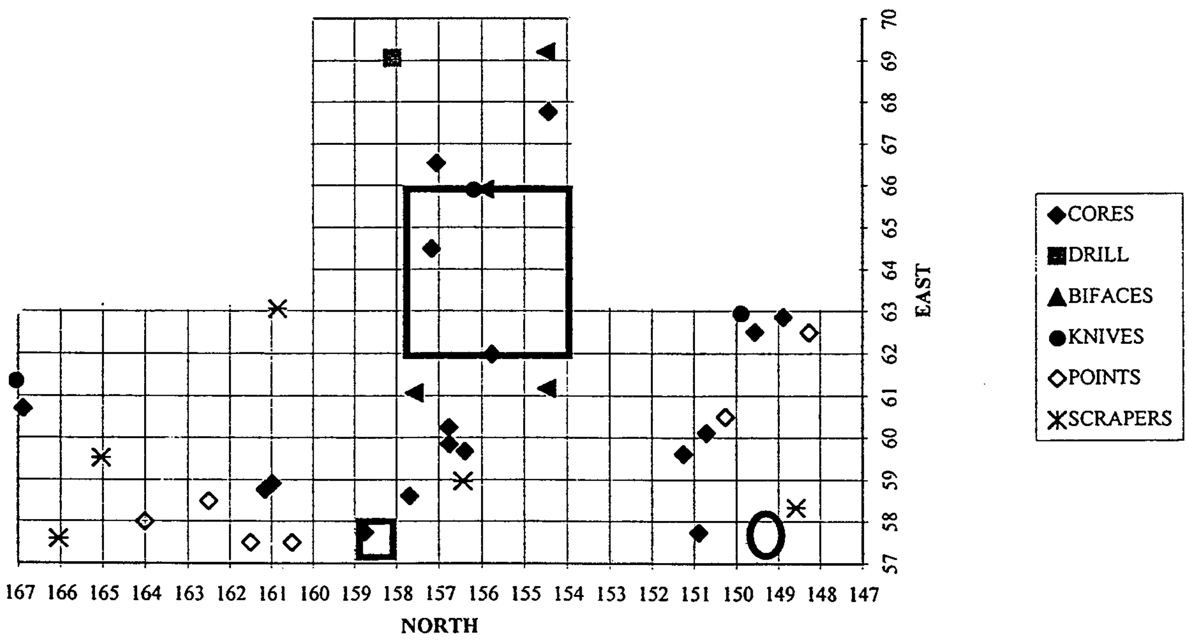


Figure 14.30. Horizontal distribution of piece-plotted formal lithic tools in the Late Prehistoric level (0-10cm bg).

two points, a scraper, and two early stage bifaces. East of the larger daub concentration are a knife, two early stage bifaces, two cores, a point, and a drill. The fourth area is a very diffuse scatter in the northern portion of the block that includes three scrapers, three cores, and a knife.

Summary of Spatial Analysis

Several processes, such as rodent burrowing, animal and human treadage, and surface erosion, are probably responsible for scattering the artifacts around the surface of the site. Because of this it is somewhat surprising that there is minimal overlap in the site facility clusters of the Late Prehistoric component. Neither is there much overlap in the major activity areas suggested to be associated with it. This may imply that different activities were responsible for creating these artifact clusters. Despite the "noise" caused by horizontal and vertical disturbance to this deposit, the overall impression is that this component represents a series of activity areas organized around one or more house structures (Fig. 31).

A possible hearth-based activity area (sensu Binford 1978a, 1983) is located in the southwestern portion of the block. The presence of burned bones around the hearth indicates that it may have been used to cook meat or for bone grease extraction. The ceramic fragments from this area may come from pots that were used as cooking vessels that broke during use and were discarded nearby. The concentration of lithic debitage may indicate that flintknapping occurred around the hearth. This is supported by the presence of several lithic cores. The other stone tools from this area are suggestive of hide or possibly woodworking (scrapers), cutting of meat (knives), and possibly the refurbishing of weapon tips (points). This hearth is clearly a major activity area where a variety of different tasks occurred.

Another knapping area may be located east of the major daub feature. There is a dense cluster of debitage associated with a couple of early stage bifaces, two cores, and a few stone abraders. All this material is associated with lithic reduction or stone tool resharpening. There is little evidence of other types of material, such as ceramics, burned bone, and charcoal, that would suggest this area was a midden rather than a lithic workshop.

Between the daub features is a large area containing formalized tools, debitage, and ceramic sherds. There is also a small cluster of burned bone in the center of this area that may represent a small hearth. However, because no charcoal is associated with this feature, it is probably not another hearth. The wide variety of functionally distinctive tools and the proximity to the hearth at 149N/57E suggest that this may be a trash midden or dump area. It is also possible that this area represents a palimpsest of multiple activities and dump episodes.

The cluster of stone tools in the northern section of the excavation is not associated with evidence of a hearth or concentrated debitage. The presence of a series of scrapers in a generally "clean" area may suggest a hide working or retooling area. An alternative explanation is that this area contains large pieces that were scattered beyond the midden area by human or animal treadage.

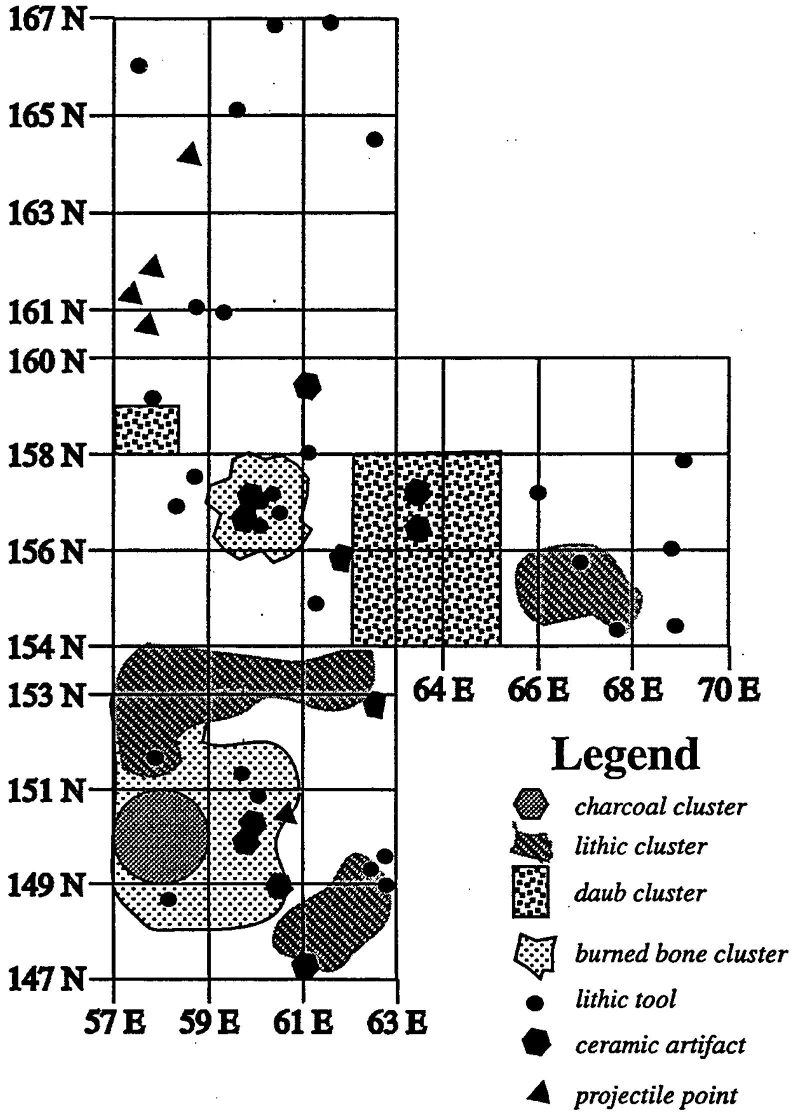


Figure 14.31. Combination of density maps and piece-plotted artifacts in the Late Prehistoric level (0-10cm bg).

If the daub concentrations do, in fact, represent house structures, they apparently did not have interior hearths. These features lack any evidence of charcoal or burned bones that would indicate a cooking or heating fire. This differs from most Steed-Kisker houses, which commonly have a centrally located hearth (Shippee 1960, 1972). If the structure was only occupied for a short period of time, or occupied during a warm period, there may not have been a need for an interior hearth. Alternatively, if the hearth was of ephemeral construction the destruction of the house and/or subsequent disturbance of the deposit may have destroyed any evidence of it. Also, the interiors of these features were generally "clean". There were very few formalized tools (only two bodysherds and two cores) associated with the high-mass daub area. While there was some debitage within these features, other artifactual material was generally very scarce.

END NOTES

[1] Confidence intervals are calculated by the formula: mean $\pm$ 1.96 x standard error. One can expect a 95% chance that the value of the true mean of the population falls between the two intervals. Stated another way, there is only a 5% chance that the true mean value is greater or less than these limits (see Sokal and Rohlf 1995: 137-143).

[2] Chi-Square values, degrees of freedom (df), sample size (n), and probability values (p) for the distribution of orientation values by 20 degree increments for DB site.

Level	Chi-Square	df	n	p
All	140.400	17	1153	<0.001
0-10 cm	50.342	17	197	<0.001
10-20	37.022	17	266	<0.005
20-30	25.448	17	343	$0.1<p>0.05$.
30-40	67.667	17	297	<0.001

Chapter 15

Synthesis and Interpretations

Brad Logan

Introduction

This chapter presents a synthesis of data presented in the previous chapters. This is done through a series of research domains, established in the Data Recovery Plan (DRP; Logan 1996a), that address the DB site with regard to the following general problems: taxonomy, chronology, geography, settlement patterns, subsistence economy, cultural relations, and technology. These domains are taken from *The Archaeology of Kansas: A Research Guide* (Logan 1996b), which supplements the *Kansas Prehistoric Archaeological Preservation Plan* (Brown and Simmons 1987). As noted in that work, each of these domains obviously intersects the others as it pertains to any human lifeway. Their distinction here, as in the *Research Guide*, is made only to facilitate discussion of that multifaceted adaptation of humans called culture. Not all of the hypotheses presented in the DRP are addressed here because data recovered during the excavation are not amenable to testing them. For example, hypotheses that focused extensively on a putative Nebo Hill phase component cannot be tested in the light of the slight evidence of Nebo Hill occupation of DB. At the same time, some new hypotheses are presented and tested, to the extent data permit, given unexpected findings of the Phase IV project. Thus, questions concerning the Middle Archaic and terminal (late Late) Archaic occupations are addressed in the light of evidence that was not anticipated following the Phase III and IIIA investigations.

Before we explore the data from the perspectives outlined above, it is useful to reiterate some significant points about the relative integrity of the cultural deposits at DB as they bear on several of the problems and limit our ability to test some hypotheses derived from them. Of the several prehistoric culture complexes represented, only one had integrity sufficient to address problems of formal content, site structure, and activities. The Steed-Kisker phase component was in the modern soil that developed in late Holocene loess. It was largely within the upper 30cm of the soil, the ten cm below that being transitional to the underlying Brady soil and its associated preceramic deposits. As the upper 20cm of this horizon had been plowed and time for mitigation was limited, it was mechanically stripped prior to block excavation. Thus, only the lower, less disturbed, portion (20-30cm bs) of this component was excavated. Nonetheless, Hill (chapter 14) shows how considerable insight to site structure and activities can be drawn from the spatial distribution of material within it.

Unfortunately, our attempts to derive comparable information from the lower levels, those within the Brady soil that developed in late Pleistocene (Peoria) loess, were less successful.

This is due to the fact that pre-ceramic occupations at DB occurred on a surface that was at best preserved in restricted areas (e.g, the vicinity of Backhoe Trench 1, Phase IV; chapter 3) but extensively eroded elsewhere. Deflation of the surface, reflected by the loss of the Brady A horizon throughout the block excavation, and subsequent natural and cultural disturbances, presented a mixed horizon of cultural material in lower levels (20-40cm bg; 40-60cm bs) that represents several Archaic occupations. These levels yielded projectile points of considerable morphological variability, and other tools, such as bifacial, hafted scrapers, that are generally considered temporally or culturally diagnostic in the Lower Missouri Valley and other regions. The extent to which we are able to sort these items into meaningful culture-temporal taxa is discussed in appropriate sections below. It must be noted here, however, that the mixing of artifacts makes it particularly difficult to recognize specific Archaic *assemblages*. For example, do all seven of the full-grooved axes from the site belong to the Middle or the terminal Archaic occupations, or both? The same condundrum applies to many other chipped stone and groundstone tools from this horizon (chapters 9, 11-12).

A more ephemeral Paleoindian occupation, or series of them, is represented by a half-dozen diagnostic projectile points (chapter 9) of the Folsom, Plano, and Dalton complexes. Four of the points were found in the block excavation and appear to have relative stratigraphic integrity as they all occur in the lower levels. However, the lack of other artifacts that can be reliably associated with them precludes much interpretation.

The relative lack of integrity or limited number of artifacts of the preceramic components at DB does not detract from the significance of their presence in a buried context. Because the loess deposition is not restricted to a specific site or small locality, we can be assured that the late Holocene loess at DB mantles the uplands along the Missouri River trench well beyond the Fort Leavenworth area. While this mantle may vary in thickness and, perhaps, have been eroded from some areas, it is likely present on many other ridges. Similarly, it is likely that some of these that offered amenities like those of the DB site, access to slope and upland resources and panoramic view, were occupied prehistorically. Thus, we have reason to believe that the archaeological cultures represented at DB may be found in similar contexts in the region. We can also hope that some of these sites were actually *less* popular, that is, that their buried deposits reflect culture-temporal occupations that are unique to them or at least more discrete. DB demonstrates the potential for future research of the problems presented below.

Taxonomy

Four hypotheses were presented under this heading in the DRP. They are repeated here:

1. Paleoindian (or Early/Middle Archaic) activity at the DB site is represented by diagnostic artifacts.

2. The Late Archaic component at the DB site is assignable to the Nebo Hill phase.

3. The Late Prehistoric component at the DB site is assignable to the Steed-Kisker phase.

4. A Middle Woodland (Kansas City Hopewell) component is represented at the DB site.

These hypotheses are evaluated and others are presented below according to appropriate culture-temporal categories.

Paleoindian: Recovery during the Phase IIIA project of a small, lanceolate point with evidence of basal thinning at a depth of 59-60cm bs (see Fig. 9.3-Ie) underlies the first statement above. The hypothesis for evidence of Early/Middle Archaic activity is based on its probable association with the Brady soil surface. As it developed, both of these hypotheses were verified to some extent.

As noted above, six projectile points from the site are identified as Paleoindian artifacts (Logan and Johnson 1997; Logan et al. 1998). The small lanceolate is considered a miscellaneous variety, given its lack of more telling attributes of any particular complex. Two basal fragments are Folsom points, two others are Dalton points, and one complete point is identified as Plainview, a type of that Plano complex. If we take these various points at face value, they would indicate use of the site by populations of three different late Pleistocene cultures. However, it should be noted that all the points share some attributes and it would be more parsimonious (though not necessarily correct) to interpret them as evidence of a single Paleoindian occupation. Particularly with regard to the Plainview point, it should be noted that "in some cases, Plainview has become a catchall category for any unfluted, lanceolate, edge-ground, basally thinned point" (Hofman 1996:64). Dalton and Folsom points are comparable with respect to some attributes such as a basal concavity and fluting (though the fluting on Folsom points is distinctive). Given the fragmentary nature of the Dalton and Folsom points, it is possible they are variants of a point type made by a single late Pleistocene population. The temporal ranges of these latter complexes also overlap, precluding elimination of this hypothesis. Lacking more information about the Paleoindian occupation(s), it cannot be tested further.

At least one other Paleoindian point has been found in the Leavenworth area. In 1966, archaeologists from the Kansas State Historical Society found an isolated Plainview point on a ridge 3.8km west of DB (Witty and Marshall 1968:40-41, Plate I-A). (They were actually seeking evidence of Fort de Cavagnial, an 18th century French fur-trade post that has eluded detection since it was seen by members of the expeditions of Lewis and Clark in 1804 and Stephen Long in 1819 [Hoffhaus 1984:53-88]). This find spot and a scatter of burned limestone, quartzite cobbles, and debitage some 300m from it, were recorded as 14LV314. The point is described and illustrated as a lanceolate with constricted shoulders, concave base, and evidence of grinding on the lower blade edges. It is made of a light gray, "irregularly banded chert" (Witty and Marshall 1968:41) and exhibits parallel flake scars that run perpendicularly to obliquely across both faces. This find also points to the potential for other evidence of Paleoindians on upland ridges in the region.

Archaic: We can be certain that the Archaic period in general is represented at the DB site. The problem we face, however, is being specific about the presence of certain cultures of the Early, Middle and Late Archaic. I have chosen to interpret the side-notched, and some of the expanding stemmed, projectile points in the assemblage as evidence of a Middle Archaic occupation. Some archaeologists place the Logan Creek complex and other taxa characterized by some forms of side-notched points in the Early Archaic period. Here we date the Middle Archaic period ca. 8600-5000 BP (ca. 6600-3000 BC; cf. McMillan 1976), or coeval with the Hypsithermal episode. Thus, it includes Logan Creek, as well as the Blue Springs and Jacomo phases (see chapter 5), which provide the basis for comparison to these artifacts.

While the side-notched points compare somewhat to those of the Logan Creek complex and Blue Springs phase, they also bear close resemblance to varieties from some of the late Middle Archaic and early Late Archaic cultures of eastern Missouri and western Illinois, particularly the Helton (Cook 1976) and Fallings Springs (McElrath 1986; McElrath et al. 1984:36-40) phases. These types include Matanzas, Godar, and Brannon. Some expanding stemmed points in the DB assemblage are similar to Helton points, which are also diagnostic of the Helton phase. The Helton phase is represented by components at the Koster site, where periodic colluvial deposition led to excellent stratigraphic separation of several Archaic occupations. The phase dates ca. 3500-3000 BC and geographically spans the Prairie Peninsula. Falling Springs is represented by sites, such as McLean, in the American Bottom near St. Louis. It dates ca. 3000-1300 BC.

Cook (1976) recognizes Helton phase equivalents in the side-notched points from a number of eastern Missouri and western Illinois sites, including Modoc Shelter (Fowler 1959) and Graham Cave (Klippel 1971). A late Middle Archaic component, dated ca. 5020±60 BP, is also present at Hermann, an upland ridge site in the Gasconade River drainage of central Missouri (Schmits 1983). This component yielded Matanzas-like points in a depositional context comparable to that of DB. Helton phase-like artifacts have also been recovered from other sites in central Missouri (e.g., Tick Creek Cave; McMillan 1965), northeastern Missouri (Pigeon Roost; O'Brien and Warren 1982), and southeastern Illinois (Jeffries 1982). The side-notched points from DB are suggested to be indicative of a wide-spread diffusion of this late Middle Archaic lithic technological style.

Chipped stone tools in both Helton and Falling Springs assemblages also include bifacial, hafted scrapers like some of those from DB. However, the stemmed scrapers from DB exhibit a fair amount of variation and artifacts of this type occur in many Middle and Late Archaic, as well as Middle Woodland, complexes (cf. Cook 1976:173; McElrath 1986:21-295; Wedel 1943: 53; Shippee 1967:76-77; Ahler and McMillan 1976:174). It is notable that none of the stemmed scrapers from DB are plano-convex, like those described for the Logan Creek complex (Kivett 1959; Thies and Witty 1992; Morrow 1984:94).

Given evidence of contact and diffusion between the St. Louis (i.e., Lower Illinois Valley, the American Bottom, and adjacent areas) and the Kansas City locality (Reid 1984a;

Johnson 1992) since the Late Archaic period, it is possible that the artifacts discussed above attest an earlier connection. Schmits (1989b) suggests this for the Jacomo phase, based on projectile points from the Cold Clay site. Unfortunately, without absolute temporal control, we cannot clarify the taxonomic identity of the DB artifacts that are compatible with a Middle Archaic affiliation. The humate date from the base of the B horizon of the Brady soil from Trench 1 of 6080$\pm$80 BP (chapter 2) might be taken as a basal date for the cultural material within it and support a late Middle Archaic assignment, one more contemporary with the Helton and Jacomo phases than Logan Creek. However, this date may also reflect the shallow burial of the soil and its contamination by later cultural occupations or naturally-derived organics. More convincing temporal control would be based on cultural material associated with the Middle Archaic artifacts. However, all AMS assays on archaeological samples returned terminal Archaic dates (chapter 7).

The hypothesis of a Nebo Hill phase affiliation is supported by two lanceolate bifaces diagnostic of that complex (chapter 9). Other artifacts indicative of Nebo Hill, such as fiber-tempered pottery, three-quarter grooved axes, and bifacial hoes and gouges, were not found. Ovate and rectangular manos, some with nutting pits, were recovered (chapter 11). However, it is suggested here that these artifacts should not be considered per se diagnostic of the Nebo Hill phase. They probably have a longer history as somewhat generic grinding tools than is suggested by Reid's (1983) adoption of them as Nebo Hill phase determinants. If the two Nebo Hill bifaces are, indeed, evidence of an earlier Late Archaic occupation and not evidence of a transition in point technology during terminal Archaic time (i.e., do not belong to the component described below), their rarity attests a brief stay at DB during that time.

The greatest surprise of the Phase IV investigation was the return of four AMS radiocarbon dates on charred plant remains, assumed to be culturally burned, of ca. 800-600 BC. Thus, the DB site has given evidence of a heretofore unknown terminal Archaic occupation of the Kansas City locality. It is suggested that these dates support a terminal Archaic affiliation of most, if not all, of the expanding stemmed points that were recovered at the site. Points identified by Hatfield (chapter 9) as Varieties VI, VII, and IX are broadly comparable to forms diagnostic of the Labras Lake and Prairie Lake phases of the Late Archaic in the American Bottom (McElrath et al. 1984:46-56). Some of these are also similar to types that Johnson (1992) considers typical of the Early Woodland period in the Central Plains. Given the close dates of that period (ca. 500 BC-AD 1) and those from the buried soil at DB (ca. 800-600 BC), it is plausible that the DB points simply date the slightly earlier appearance of these styles in the region. In this report, the transitional (and therefore problematic) nature of these points is reflected by reference to them as Archaic/Woodland.

Because artifacts in the preceramic horizon were mixed, it is impossible to recognize particular Archaic assemblages and, therefore, specific taxa for that period. Though a Logan Creek affiliation is suggested to be less likely than one dating to the late Middle Archaic, we cannot yet eliminate that alternative interpretation. At the same time, we can neither identify a distinctive Helton phase equivalent for the side-notched points at DB, nor a terminal Archaic taxon for the expanding-stemmed and corner-notched points. Similarly, we cannot taxonomically assign with confidence any of the other chipped stone and groundstone tools from the preceramic horizon. However, we can anticipate the discovery of more stratigraphically discrete Archaic components in buried alluvial or colluvial deposits in the Leavenworth vicinity that may make it possible to retroactively recognize distinctive artifact types from that horizon.

Middle Woodland: The hypothetical presence of a Middle Woodland component at DB was based on a small sample of plain, sand-tempered sherds, none of which exhibits rocker-marking or cross-hatched lines that would provide more convincing support for a Kansas City Hopewell affiliation. Site mitigation did not greatly augument the number nor alter the nature of that sample of body sherds (chapter 8). However, two rimsherds from what appears to have been one Edwardsville phase vessel were recovered. Both were found in situ, one in the block excavation and one from the graded area. These sherds support a late Middle Woodland (ca. AD 400-650) occupation of the site.

Given the sherds, it is possible that some of the Steuban-like projectile points from the upper levels of the excavation could also be evidence of this component. However, the Kansas City Hopewell settlement pattern is characterized by base villages and ancillary camps that contain much larger samples of pottery in association with such points. It is likely that even a relatively brief stay at DB by a Hopewell group would have resulted in the loss or discard of more pottery than points, unless the activity was restricted to refitting of hunting tools. No such limited activity site has been identified for the Kansas City Hopewell (Johnson 1976b, 1981). Limited excavations at the nearby Quarry Creek site yielded 41 projectile points and more than 7,000 pottery sherds (Logan 1993a; Fig. 15.1). It appears that wherever Hopewellians camped, they abandoned trash that included many more sherds than points. Thus, the loss of a few sherds at DB probably was accompanied by the loss or discard of few, if any, points. For this reason, the corner-notched and expanding-stemmed points in the DB assemblage are seen as evidence of the terminal Archaic component that has radiometric support. Only one projectile point, a Scallorn-like arrow point (chapter 9; fig. 9.9:XI4A), is more compatible with a late Middle Woodland occupation. Indeed, the paucity of Middle Woodland artifacts is intriguing, given the prolonged settlement of Quarry Creek just 2.2km distant (see Settlement Patterns below).

Late Prehistoric: The identity of the Late Prehistoric component is securely based on numerous sherds of Platte Valley ware, indicative of the Steed-Kisker phase (Calabrese 1969; Chapman 1980:159, 292-293). One Nebraska phase sherd from the block excavation may reflect interaction with CPt populations along the Missouri River trench upstream (see Cultural Relations). The Steed-Kisker assignment is supported by other evidence compatible with that phase, including notched and unnotched arrow points, end scrapers, sandstone arrowshaft abraders, worked and incised hematite, and remains of a structure of wattle-and-daub construction. AMS dates on charred maize, a tropical plant cultivated by Steed-Kisker farmers, are also compatible with the temporal placement of this phase (see Chronology).

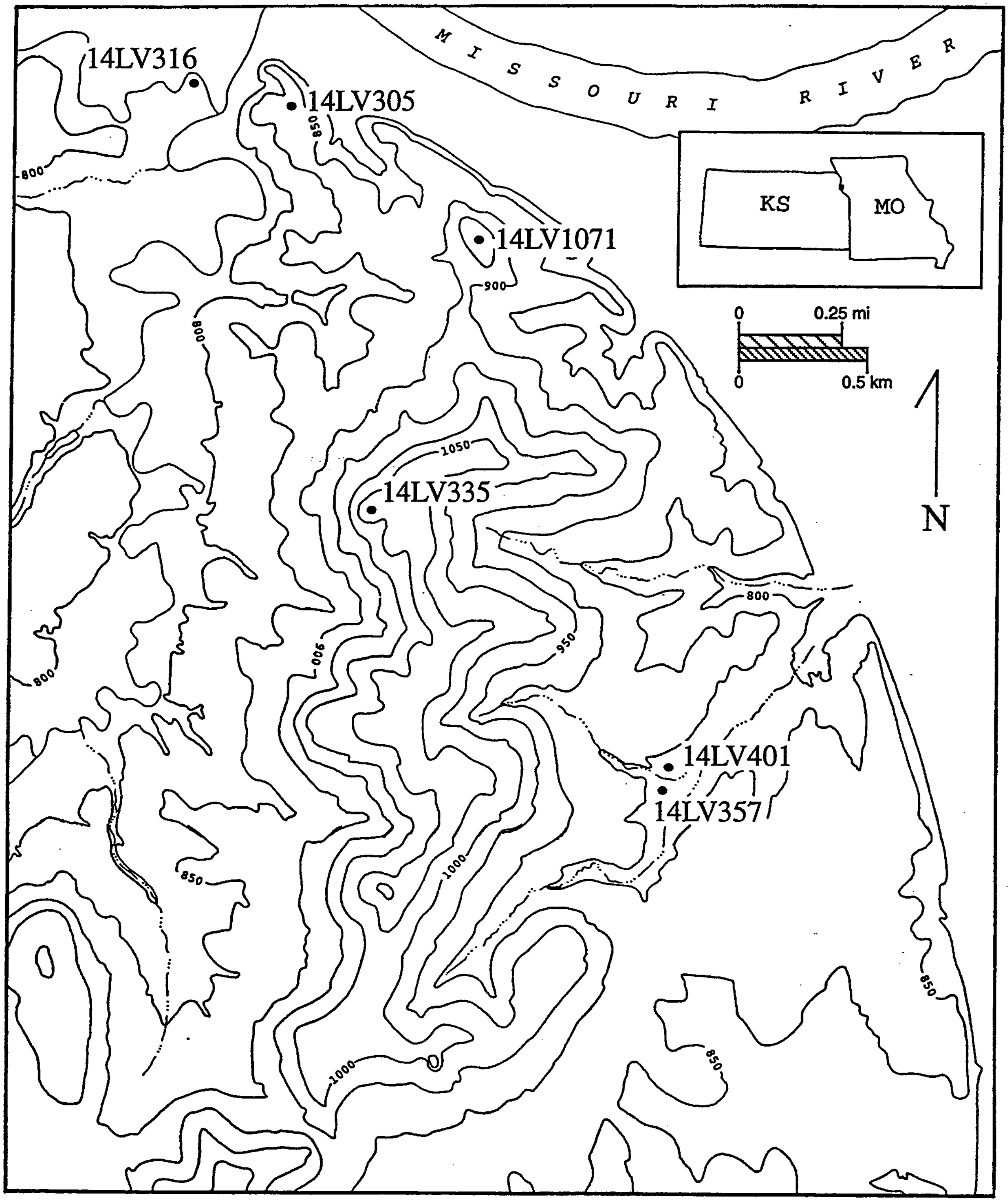


Figure 15.1. Map showing the location of some sites discussed in the text: DB (14LV1071), Quarry Creek-McPherson (14LV401-357), McCoy's Mounds (14LV335), Albrecht (14LV305), and 14LV316.

Chronology

1. The lower portion of the buried soil horizon at the DB site dates to the terminal Pleistocene.

2. The site was occupied during the late Pleistocene (early Holocene).

3. The Late Archaic component dates ca. 3000-500 B.C.

4. The Late Prehistoric component dates ca. A.D. 900-1400.

The above hypotheses, presented in the DRP, have all been tested. The following discussion addresses each one and presents interpretations that can be considered revised hypotheses. Significant insight was gained in the attempt to obtain absolute dates from geomorphological and archaeological samples of organic material. We were also successful in acquiring some temporally sensitive artifacts that make it possible to test some of the hypotheses in the absence of radiometric dates.

Chronostratigraphy: A suite of radiocarbon dates based on humates from soil samples taken from a deep profile exposed in a backhoe trench (Trench 1) during Phase IV provides a problematic, chronostratigraphic baseline for interpretation of the evolution of the DB ridge and the timing of its various prehistoric occupations (chapter 3). Dates from the upper portion of the unaltered Peoria loess fall within the late Pleistocene (ca. 9600-10,500 BP), though they are a bit younger than dates from comparable contexts elsewhere in the Central Plains. This is probably due to the shallow burial of the loess and its strong cultural overprint. The C horizon that contributed to development of the Brady soil dates ca. 8900-8220 BP and the lowest portion of the Btb horizon of that soil (1.1-1.15m bs) dates ca. 6080 BP. The Brady soil elsewhere in the Central Plains generally returns dates of 11,000-9000 BP, but the younger assays from the horizon at DB are also attributed to its shallow burial and the transfer of younger organic material. As noted in the previous section, this date might be taken as a base date for Archaic occupation of the site, but this interpretation needs direct testing on cultural remains.

Paleoindian: Late Pleistocene activity at DB is more strongly indicated by the Paleoindian projectile points recovered during Phase IV. Unlike a more ambiguous lanceolate point found during Phase IIIA, the five points described by Hatfield (chapter 9) more firmly attest Folsom, Dalton and Plano (Plainview) occupations (Logan and Johnson 1997). Alternatively, as noted in the previous section, they may reflect a single Paleoindian component characterized by a projectile point technology that combined attributes of all three complexes. These points suggest the earliest human occupation of the site occurred ca. 8,800-7000 BC.

Archaic: The number of absolute dates for the Late Archaic period in the Lower Missouri Valley is small. The Kansas State Plan (Brown and Simmons 1987:XIII) lists 50 dates from 13 sites in Kansas and 10 of these were provided by Gakushuin Laboratory, a source now recognized as unreliable (Blakeslee 1994). After the State Plan was completed and prior to the DB project, this number had been increased by only a few more dates (e.g., Logan 1990b:257-261). The third hypothesis was based on the anticipation of more dates from the Late Archaic component at DB that had been tentatively attributed to the Nebo Hill phase. While more evidence was found to substantiate Nebo Hill phase activity, it is limited to two lanceolate points. More surprising was the discovery of projectile points, both expanding-stemmed and corner-notched, compatible with five radiocarbon dates on organic samples from a depth of 50-60cm bs that point to occupation of the site ca. 800-600 BC (chapter 7). These data support tentative inference of a terminal Archaic occupation at DB contemporary with the Prairie Lake phase in the St. Louis locality. An alternative interpretation is that these artifacts and the dates are evidence of an earlier date for the Early Woodland occupation of the Lower Missouri Valley. However, this appears too early for an adaptation that in the American Bottom region has been dated no earlier than 600 BC. The lack of Liverpool like pottery at DB provides some support for a Late Archaic lifeway, though absence of data should not be weighted too highly.

The terminal Archaic dates from DB now fill a critical gap in the culture historical sequence of the region, one that bridges the time of Archaic and Woodland adaptations. Thus, archaeologists now can reasonably address issues of regional culture change related to subsistence practices (e.g., increasing reliance on indigenous domesticated plants), settlement patterns (e.g., increased sedentism), technology (e.g., greater reliance on ceramics), and cultural relations (e.g., with populations of the Midwest that experienced similar changes).

In the absence of radiocarbon dates that support late Middle Archaic placement of some DB projectile points, such as the side-notched forms, we have relied on relative dating based on points of cultures in other regions that we know had relations with those of the Kansas City locality. But it is emphasized here that this method is not as desirable as absolute dating of associated organic remains. Projectile point styles, like those of many artifacts, generally changed in relative frequency, not according to strict presence or absence in specific cultural contexts. For example, side-notched points were used throughout the Late Archaic in the Midwest. While they were most prevalent in the Middle Archaic levels at Modoc Shelter, they appear in smaller numbers until after 2000 BC (Fowler 1959:37). Matanzas and Godar points (side-notched) occur with Dryoff (expanding-stemmed) points at the Labras Lake site in the American Bottom. The first two points are generally considered diagnostic of the Helton phase (3500-3000 BC) and the latter of the Prairie Lake phase (1000-600 BC). These phases date to the late Middle Archaic and terminal Archaic respectively, yet their diagnostic points were found at Labras Lake in radiocarbon dated contexts (ca. 1460-830 BC) contemporary with the Labras Lake phase, which is characterized by its own distinctive projectile points. Given this association, Phillips and Gladfelter (1983:206-207) state: "For this reason it should be clear that the use of point typology for chronological markers should be avoided".

Despite the above admonition, the absence of radiocarbon dates of Middle Archaic age has forced us to rely on point typology for chronological interpretation. A strictly parsimonious view of the varied preceramic dart points and other hafted bifaces from DB would fit all with the only cultural C^{14} dates from the buried soil, thereby suggesting that the variability of the sample reflects changes in the relative frequency of certain types. Thus, all of the side-notched points would be attributed to the terminal Archaic occupation, together with lanceolates, expanding-stemmed, and corner-notched forms. That such parsimony is unwarranted can be demonstrated on two grounds. First, it would have to combine Paleoindian (i.e., the Folsom, Dalton, and Plainview artifacts) artifacts. This is clearly unreasonable. Thus, the same temporal distinction that is generally granted these forms should be granted, albeit more cautiously, points that elsewhere more frequently occur in Middle and terminal Archaic contexts. Second, the geomorphology of the DB ridge, deflated by post-Pleistocene erosion and not subject to significant deposition until after ca. 600 BC, provides the wherewithal for explaining the chance association of points of different ages within a relatively thin soil horizon. Thus, the suggested temporal affiliations of the dart points from DB are offered as hypotheses that can be better tested with lithic assemblages from better contexts.

Late Prehistoric: Two AMS radiocarbon assays on charred maize kernels from the Steed-Kisker phase component date it ca. A.D. 1300-1400 (chapter 7). In her most recent treatment of the Steed-Kisker phase, O'Brien (1993:66-67) offered the following discussion of its chronological placement:

> Steed-Kisker radiometric dates range from A.D. 690 to 1315..., dates in the 600s, 700s, and 800s are incorrect. If the A.D. 900s are accepted, Steed-Kisker can be placed betweeen [sp] ca. A.D. 950-1350. If the 900 dates are excluded, the phase would date between A.D. 1000-1300. Given these observations Steed-Kisker dates around A.D. 1000-1250, but the most conservative chronological placement of the phase would be A.D. 1050-1250.

O'Brien offers no rationale for discounting the earlier dates, let alone for constricting it to the final range provided. Rather, the radiometric range is trimmed piecemeal with no other apparent motive than that of defining a relatively brief culture complex.

Logan (1988a) critically examined 28 dates from 11 sites and interpreted their calibrated ranges (based on Stuiver and Becker 1986) in an effort to revise the chronology of the Steed-Kisker phase. He summarized his analysis as follows:

> Calibration broadens the range from A.D. 695-1382; however, the intercepts of 22 of these dates fall within a tight period-A.D. 966-1284. All but one of the remaining six dates fit this period when their calibrated age ranges are considered. A general range of A.D. 950-1300 appears, therefore, to be valid...

Acquistion of dates from the Zacharias site, revision of the calibration scale (Stuiver and Pearson 1993), and discounting of all dates from Gakashuin University Laboratory (cf. Blakeslee

1993, 1994) led Logan and Ritterbush (1994) to further refine the time span of the phase. Their final sample of 25 dates from 10 sites provided an initial range of A.D. 668-1405. Discounting the early ends of six date ranges that were scattered ca. A.D. 668-871, they suggested tentatively a beginning time of ca. A.D. 950. With regard to its terminus and overall range, they state:

> The more recent end of the one-sigma ranges of the sample includes a distinct cluster of six dates from A.D. 1379-1405. Such a cluster cannot be discounted at this time. Therefore, we interpret the temporal period of Steed-Kisker to be ca. A.D. 950-1400.

AMS radiocarbon dates from the Late Prehistoric component at DB, the first acquired through that new, more accurate technique, support the interpretation that the Steed-Kisker phase persisted into the 14th century AD, significantly later than O'Brien proposes. The dates are significant because they overlap those of Oneota occupations in the Lower Missouri Valley, such as that at the Leary site (Henning 1970), and those of the White Rock phase, a manifestation of a westward Oneota migration from that area (Logan 1997). Dates from Leary and two White Rock sites in the Lovewell Reservoir area range ca. A.D. 1250-1450. Thus, they raise the issue of relations between Steed-Kisker and Oneota, a topic addressed in the Cultural Relations section of this chapter.

Geography

1. The Black Vermillion phase extends as far east as the DB site.

2. Late Prehistoric sites just west of the Lower Missouri Valley in Kansas exhibit a mixture of Steed-Kisker and Pomona cultural materials.

The Phase IV excavation rendered moot the first of these two hypotheses from the DRP. No more substantive evidence of the Black Vermillion phase was recovered. The hypothesis was proferred on the basis of a basal notched Calf Creek- or Afton-like point found during Phase IIIa (Fig. 9.4-IIIa) comparable to the most prevalent type from the late Middle Archaic, Black Vermillion phase component at the Coffey site (Schmits 1978). While fragments of two other such points were found during Phase IV, they are not sufficient grounds for an eastward extension of Black Vermillion. Indeed, given only this point type, we can no longer entertain the presence of a Black Vermillion component at DB. Neither can we be too confident about a Middle Archaic affiliation of these points. Identical forms have been recovered from Boney Spring (Wood 1976:103) and Rodgers Shelter (Ahler and McMillan 1976:171) in the Ozark Highland of Missouri, where they date ca. 1500 BC. The type is also comparable to basal notched, expanding stemmed points of the Labras Lake phase in the American Bottom, where they date ca. 1900-1000 BC (McElrath et al. 1984:48). Thus, the basal-notched points from DB may be assignable to a Late Archaic occupation. While a Middle Archaic assignment seems reasonable, we can only interpret them at this time as Archaic in general.

A Munkers Creek knife (Fig. 9.11a) found during mechanical stripping of the site may be evidence that the Munkers Creek phase extended eastward to the Missouri River trench. Finds of such artifacts in the Delaware River Valley about 40km (25mi) to the west (Reichart 1984, 1988) had already made such extension plausible (Logan 1990b:258-259). The fact that the phase is centered in the Flint Hills and that the knife from DB is made of Florence chert from that province, strengthens the affiliation. However, extension of the geographic ranges of archaeological taxa on the basis of a few artifacts is not wise, given the possibility that they may have found their way into the record in distant areas through trade.

None of the other preceramic components at the site provides sufficient evidence for detailed geographic interpretation. The Paleoindian complexes represented had been documented previously in the area (Brown and Logan 1987). The presence of a possible Helton phase or Falling Springs phase equivalent in the Kansas City locality is likely, given side-notched and expanding-stemmed points comparable to some in the inventories of those complexes and the long history of a connection between the St. Louis and Kansas City localities. However, we do not have sufficient control over assemblage content to do more than offer the hypothesis that such a culture existed. Lacking such control, we also cannot place the DB artifacts within such previously defined Middle Archaic complexes of the area as the Blue Springs and Jacomo phases (Schmits and Bailey 1989).

The presence of a terminal Archaic occupation at DB is new geographic information. Unfortunately, mixing of preceramic cultural material precludes description of the artifact inventory of that component and, therefore, taxonomic definition. Convincing evidence of such occupation ca. 800-600 BC is provided by four radiocarbon dates on cultural plant remains and a fifth on humates from a soil sample taken at the same depth. Assignment to this component of expanding-stemmed and corner-notched dart points, hafted scrapers reworked from them, and groundstone tools such as full-grooved axes and ovate and rectangular manos is provisional.

The Steed-Kisker component at DB is not itself new geographic information, since even more extensive evidence of this Late Prehistoric culture comes from Zacharias (Logan 1988a, 1990a) and other sites of the phase have been recorded in Stranger Creek basin just west of the Salt Creek interfluve (Logan 1981b, 1985). We should not be surprised to find evidence of Steed-Kisker in the Leavenworth area as the type site is only 16 km southeast of DB. Nonetheless, O'Brien (1993:64) has suggested that that portion of the Steed-Kisker range west of the Missouri River trench saw only "intermittent" use (an interpretation of settlement patterning she attributes mistakenly to this author [Logan 1983]). However, it is more likely that the several Steed-Kisker sites recorded to date in Kansas are evidence that the core area included both sides of the Lower Missouri Valley. The extent to which their activities there differed is a topic discussed in the following section.

No evidence of the Pomona variant was found at DB. This contrasts with substantial evidence at Zacharias of both that culture and Steed-Kisker (Logan 1990a). Further discussion of interaction between these cultures is found in the Cultural Relations section.

Settlement Patterns

Seven hypotheses were presented in the discussion of this problem domain in the DRP. In this section they are shown under the appropriate temporal headings. Given the extent of information then available, they were limited to the Late Archaic, Woodland, and Late Prehistoric periods. Affirmation of a Paleoindian component and discovery of Middle Archaic material during the Phase IV project now necessitate discussion of those periods with regard to settlement patterns. Obviously, the single thread that unites the cultures represented at DB in this regard is their settlement, perhaps to varying extent, of the loess uplands of the Lower Missouri Valley. It is worth noting here that the our perceptions of prehistoric settlement patterns as they relate to utilization of uplands during the late Pleistocene and Holocene have been clouded by the assumption that upland surfaces are or have been stable, at best, or erosional environments. DB now demonstrates that buried deposits exist at relatively shallow depth and that exploration of them can shed light on a poorly known facet of past settlement behavior (see chapter 16).

Paleoindian: We have long known that the uplands along the Lower Missouri Valley were occupied during this time. This knowledge, however, was based on finds on eroded surfaces. All the Paleoindian points at the DB site were recovered from the buried (Brady) soil, which demonstrates the potential for burial in similar settings in the region (Logan and Johnson 1997; Logan et al. 1998). Johnson and Logan (1990:294) suggested that the loess mantled uplands within the Kansas River basin presented a moderate probability for in situ buried Paleoindian materials. The probability may be as high or higher along the Lower Missouri River, particularly on ridge summits where the Bignell loess has not been significantly eroded.

The evidence from DB is too sparse to infer more than that Paleoindian occupations were brief. Diagnostic finds are the few projectile points, only two of which were complete. This suggests the residence may have been limited to hunting and refitting tasks. Certainly the DB ridge would have provided a good view of game within a portion of the Missouri Valley and much of Salt Creek Valley. Palynological evidence from Muscotah Marsh in the Delaware River basin a short distance west of DB (Gruger 1973; chapter 2) indicates that by 11,000 BP spruce had all but disappeared from the region and had been replaced by a deciduous parkland. Non-arboreal pollen in the spectra from this period at Muscotah indicate some grassland, though it was to increase dramatically after 9000 BP (i.e., during the Hypsithermal). The environment undoubtedly supported herds of bison, fossil remains of which have been collected from gravel deposits containing Paleoindian artifacts near Bonner Springs on the Lower Kansas River (Rogers and Martin 1983; Wetherill 1995). Bison may have been visible to Paleoindian hunters from the DB ridge. If future investigations continue to yield only small Paleoindian assemblages from upland locales like DB, it may be inferred that more prolonged settlement (though still short-term relative to Holocene cultures) took place in the valleys. Evidence there has probably been removed from all deposits but those below higher (T2) terraces (Johnson and Logan 1990: 294). Consequently, we may never know the full range of Paleoindian settlement patterns.

Archaic: In their geoarchaeological model of the Kansas River basin, Johnson and Logan (1990:294) suggest that the loess uplands had low to no probability of containing in situ buried, cultural deposits younger than Paleoindian age. This prediction should be revised, particularly with respect to the lower part of that basin, which probably has a loess mantle comparable to that of the Lower Missouri River near Fort Leavenworth. It certainly does not apply to the latter area.

The following two hypotheses were presented in the DRP concerning Archaic settlement patterns:

1. Late Archaic settlement of the DB site was restricted to the warm season (late spring-early autumn).

2. Late Archaic settlement was by aggregate(s) of band-level groups.

These hypotheses can be applied to the Archaic components in general, though the second was based on Reid's (1984a) model for the Nebo Hill phase settlement pattern. Direct evidence of seasonality of occupation is sparse and insufficient to rule out cold season settlement. Late summer-autumn habitation is suggested by the charred remains of nutshells found throughout all levels of the block excavation. However, we cannot infer from their presence that the ridge was not occupied during winter or spring months. Other identifiable plant and animal remains that might have provided additional seasonal insight were not found because the environment was not conducive to their preservation. That the site was abandoned during cold seasons remains a logical assumption based on the observation that the DB ridge is exposed to cold, northerly winds at that time of the year. It is doubtful that even a wooded bluff top would have been as attractive at that time as a more sheltered valley (cf. Reid 1984a:70).

It does not appear that DB was settled by aggregates of band-level groups at any time. The ridge summit, a relatively flat surface of about 3500m^2 that contained the greatest density of cultural material, is not extensive enough to have attracted large groups. On the other hand, smaller groups, such as a single band of a few families or even a single, nuclear or extended family, would have found the site most accomodating. Indeed, in this context it is worth noting that the Steed-Kisker component, inferred to have been the result of settlement by one or two families for a single season (see below), is an apt model for the Archaic occupations. The many artifacts in the pre-ceramic horizon are suggested to have accumulated as the result of episodic, short-term occupations over a long period of time. Any single occupation probably contributed a relatively small amount of material.

Prolonged settlement probably would be reflected not only by greater amounts of debris, but by storage pits and the remains of relatively substantial shelters. The lack of this kind of evidence suggests the preceramic occupations were relatively brief. At the same time, the variety of chipped and groundstone tools and lithic debris suggests a range of activities occurred during the Archaic occupations. These included hunting and refitting of weapons (complete and broken projectile points), butchering and cleaning of game (knives), plant processing (grinding stones), cooking of food (cobbles that served as hearthstones and/or boiling stones), preparation of hides and clothing (scrapers, drills, gravers), tree felling and woodworking (axes), and lithic and bone tool manufacturing (hammerstones, cores, debitage, retouched and edge modified flakes, scoria abraders).

Whether all Archaic groups at DB carried out all of these activities is not clear, given mixing of assemblages in the preceramic horizon. The diagnostic projectile points indicate hunting and refitting were done by most, perhaps all, of them. Scrapers reworked from Helton-like and Steuban-like points suggest hide preparation occurred during both Middle and Late Archaic time. It seems reasonable to assume that harvesting and preparation of nuts was a common subsistence practice, though we cannot assign particular grinding stones to specific Archaic cultures. We can reasonably assume that lithic tool manufacture and maintenance, a frequent task of all stone-age peoples, also occurred during all occupations. Radiocarbon dates from Feature 5, a hearth in the block excavation, and from nutshells elsewhere in the block support the inference that the terminal Archaic habitation entailed harvesting and cooking of nutmeats and other foods. The dimensions of Feature 5, 40x40cm, are comparable to those of features at Nebo Hill that Reid (1984a:56-58) defines as Type I-A and II-A hearths. The former lack hearthstones but the latter are similar in nature to that at DB. The Type II-A hearths at Nebo Hill were interpreted as family cooking features, and this interpretation is applicable to Feature 5 at DB.

While the palimpsest nature of the preceramic horizon precludes analysis of site structure and the delineation of activity areas therein (see chapter 14), we can still draw the general conclusion that exploitation and settlement of the loess uplands along the Missouri River trench was part of Archaic settlement patterns during late Middle and Late Archaic time. In this regard, it should be noted that at least one other upland ridge in the DB vicinity has yielded a hint of contemporary settlement. The Albrecht site (14LV305; Fig. 15.1), located on a ridge about 900m northwest of DB, was surveyed and tested by archaeologists from the Kansas State Historical Society in 1966 (Witty and Marshall 1968:28-33). In addition to more extensive evidence of Late Prehistoric settlement (see below), they found three chipped stone tools, which they attribute to a Middle Woodland occupation, that are similar to some from the preceramic components at DB. Two are fragments of corner-notched points, one with a convex base and the other with a concave base. The third artifact is described as a "blunt" that was reworked from a corner-notched, convex-based projectile point. The latter, illustrated artifact is a hafted scraper like specimens found at DB (Witty and Marshal 1968:31, Plate II-K). Further investigations at Albrecht and other such sites in the Salt Creek-Plum Creek area may support the proposition that there are more Archaic occupations like DB.

It is ironic that the hypothesis of group-aggregate occupation of upland settings was based on the Nebo Hill model, given that there is relatively little evidence of that phase at DB. Perhaps this is a reflection of the merging of bands of those hunter-gatherers on other ridges. If earlier and later Archaic groups were more dispersed on this type of landscape, then we should anticipate discovery of other sites like DB that are characterized by smaller densities of cultural material than the Nebo Hill site.

Emerson and McElrath (1983) suggest a band aggregate model for the terminal Late Archaic (Prairie Lake phase) of the American Bottom. In their model bands occupy sites near lake and slough-talus slopes in that region that permitted prolonged residence of "base locales" from which, as seasonal availability dictated, specialized task groups departed to gather nuts on the bluffs and to "take advantage of the higher density of turkey and deer lured by the nuts" (Emerson and McElrath 1983:238-239). "Extractive loci", sites created by the latter groups, are occupied so briefly that little diagnostic material would be left. This model does not appear to apply to the terminal Archaic of the Kansas City locality, where no extensive base locales have been identified and where a culture contemporaneous with the Prairie Lake phase has just been discovered at DB. Future research may determine that a more diffuse population occupied the region near the latter site and that this represents a change from the band-aggregate adaptation of the Nebo Hill phase.

Woodland:

1. Middle Woodland occupation of the DB ridge was restricted to limited short-term, resource procurement.

Investigation in 1991-1992 of the long-term presence of Hopewell groups at the Quarry Creek site inspired the survey that led to discovery of the DB site two years later (Logan 1995a). It is ironic, then, that Middle Woodland occupation of DB left little trace in the archaeological record. Indeed, were it not for two rimsherds from what appears to have been one vessel of Edwardsville phase ware (chapter 8), we would not be able to support the hypothesis that any activity occurred at DB during this period. The sparse evidence suggests the ridge was not a major attraction for the Hopewell who lived for a long time at Quarry Creek, less than an hour's trek away. At least one other Hopewell habitation, buried by 3m of alluvium at the confluence of Plum and Salt Creeks (14LV316, Fig. 15.1; Witty and Marshall 1968:41-44; Logan 1993a: 178), also demonstrates settlement of lowland settings a short distance from DB. Given the relative popularity of DB for Archaic and Late Prehistoric groups in the area, the near absence of Hopewell there begs some explanation.

It is possible that the scarcity of Middle Woodland artifacts at DB and their abundance at Quarry Creek reflects a Hopewell preference for more sheltered terrain. The latter site is on an alluvial terrace along a small stream that drains the dissected uplands. It is 30m (100ft) above and one km from the Missouri River floodplain. Like DB, it offers easy access to a variety of upland and lowland resources. Since Quarry Creek offered most of the amenities of DB, except the broader view of surrounding terrain, its Hopewell occupants apparently had no incentive to occupy the latter. That they were not averse to upland settings with scenic vistas for other purposes is suggested by the presence of McCoy's Mounds (14LV335), a mortuary site on the Quarry Creek-Salt Creek divide just 1.6km distant (Logan 1995a:39-44). We may also speculate that the hydrology of the DB area had changed after ca. 600 BC. If the occupation of Quarry Creek occurred during the dry, Neo-Atlantic climatic regime (chapter 2), it is possible that springs near the ridge stopped flowing. Thus, Quarry Creek may have been a more reliable source of water.

Late Prehistoric:

1. Late Prehistoric occupancy of DB was limited to the warm months.

2. Late Prehistoric occupancy was long-term (i.e., at least one year).

3. Evidence of Late Prehistoric occupation includes the remains of only one lodge.

4. Dimensions of the Late Prehistoric structure indicate the lodge could have accommodated a nuclear (or extended) family.

The first of these DRP hypotheses cannot be substantiated for the same reasons of poor organic preservation that apply to the preceramic components. The fact that charred nutshells were recovered in comparable amounts from the Late Prehistoric levels as those of the Archaic suggests late summer-autumn occupation. Again, without direct evidence to the contrary we cannot rule out habitation during other seasons. Charred maize kernels from the Steed-Kisker component provide no seasonal insight since they may have been stored for use at any time of the year. Hill (chapter 14) suggests the absence of any hearth within the daub cluster, which is inferred to be remains of a shelter, may reflect warm-season occupation. While he also notes that the shelther might have had a hearth that was completely destroyed by natural processes, this is unlikely given the fact that the extramural, Late Prehistoric "hearth" could still be detected from small, but localized, amounts of burned bone and charcoal.

The other three hypotheses can be evaluated better, though the relevant data impose some limitations. First, it must be recalled that upland settlement during the Steed-Kisker phase is documented at only one other site, Cloverdale (23BN2; see chapter 5). The Steed-Kisker component at DB differs from Cloverdale in that it lacks the postmolds and burned posts of a sub-rectangular lodge, intramural hearth, and storage pit. In brief, the structural remains at Cloverdale are more substantive. The presence of one or more lodges at DB must be inferred from daub concentrations, taken here as evidence of one or two shelters of wattle-and-daub construction. In the previous chapter, Hill deduced the presence of these structures from the distribution of daub in the first level of the block excavation. His detection of a hearth a short distance beyond the daub clusters is based on the relatively high frequency of charcoal and burned bone there. The charcoal is concentrated within a two m^2 area and the bone is scattered more diffusely between it and the clusters. The largest vessel fragment was found less than four m from the charcoal zone and fragments of other pots were plotted in and between the daub areas. North and east of those areas, the block was free of plotted pottery sherds. Chipped stone tools, including scrapers and arrow points, were found north and south of the structures. The distribution of these latter items suggests they were lost or discarded during extramural activities.

Poor preservation of the structures cannot be attributed to destruction by plowing or natural disturbance processes. The former activity was not deep enough nor the latter pervasive enough to eradicate such features as postmolds, hearths or pits. We must conclude that they probably did not exist and that any structures were of light, relatively flimsy construction. At the same time, we cannot conclude, as does O'Brien (1978b:8), that "we can no longer make the assumption that a daub-debris cluster on the ground surface represents the remains of a structure". It is probable that such clusters do represent structures, though of a nature that we have not yet been able to discern. In her discussion of Steed-Kisker settlement patterns, O'Brien (1978b:5-10) suggests other ways in which daub may occur, such as "the by-product of the simple act of baking a bird or small animal in a jacket of mud or clay, that is a product of cooking" or as the remnants of the fired clay lining of storage pits. As an alternative explanation for sites with daub clusters and storage pits but no other evidence of house remains, she suggests they functioned as storage areas. But these scenarios neither explain daub, if it is defined as fired grass- or stick-impressed clay, nor the broad distribution of that material at sites, such as DB, where there are no pits.

O'Brien's concept of storage areas located some distance from a settlement is flawed not only because it is not accompanied by any interpretation of the motive for digging large, isolated cache pits but because it rests on her assumption that daub "is the by-product of a number of domestic activities" (O'Brien 1978b:6). Why would any Steed-Kisker people invest labor in digging storage pits, carry out domestic activities around them that generated "daub" and then fill the pits with an assortment of refuse, if they were living in structures elsewhere? It seems more likely that they occasionally made modest shelters of stick-and-pole framework that were covered with grass and patched with clay. The daub clusters at DB are probably the remains of such shelters.

It is unclear whether more than one shelter is represented in the block excavation. The smaller of the daub clusters was found on the western margin of the block and any evidence of if it beyond it would have been removed during site stripping. There was no striking evidence of this cluster on the surface created by removal of the plowzone prior to excavation. The larger cluster, defined by the 300g+ density contour in Hill's analysis (chapter 14), approximates the dimensions of an average Steed-Kisker lodge that could have accomodated a single family. The relatively light scatter of lithic and ceramic debris in the block, indeed, throughout the surface collected and graded areas, reflects a brief occupation, perhaps one that was not repeated.

It is intriguing that there were few cobbles in the upper level of the block, in contrast to their abundance in the lower levels. Rather than suggest that the Steed-Kisker occupants did not engage in any plant food processing (nutting, grinding, etc.) that entailed use of cobble tools, a difficult interpretation given the presence of charred nutshells and maize, we may speculate that they took their grinding stones with them upon departure. Since prolonged or repeated visits would likely have resulted in the breaking and discard or loss of such implements, this observation also supports interpretation of a single, perhaps season-long, stay. As such, the DB Steed-Kisker component differs from that at Cloverdale, where more effort was invested in the building of a lodge and cache to shelter a family for either a longer period or during a cooler season. Thus, we cannot recognize the two components as representatives of a common upland settlement pattern. They indicate variation in the way Steed-Kisker people lived on the Missouri River bluffs.

Finally, there is tantalizing evidence that Late Prehistoric people occupied the Albrecht site, described above. In addition to the few chipped stone tools reminiscent of some preceramic artifacts from DB, investigations at Albrecht (Fig. 15.1) revealed pit features below two, surface-exposed daub clusters. Associated artifacts included Late Prehistoric pottery, most of which was "clay tempered" and a few of which were tempered with shell. One sherd was incised. End scrapers and arrow points were also found. This component was tentatively attributed to a Nebraska "focus" occupation (Witty and Marshall 1968:33). However, from the description of the ceramics, probably Pomona and Steed-Kisker wares, this site is comparable to Zacharias, a few km up Salt Creek Valley, where the latter pottery predominated (chapter 5). Neither Zacharias nor Albrecht provided evidence of house structures like that at Cloverdale, though a single, large postmold was found near a hearth-like feature in one such cluster at the former (Logan 1990a) and pit basin features are described at the latter (Witty and Marshall 1968:29-30). Both sites attest Pomona and Steed-Kisker interaction, an interpretation discussed in the Cultural Relations section. In this context, Albrecht is mentioned because it offers additional evidence of upland settlement by local Late Prehistoric groups. Further investigation at sites like Albrecht may provide more comparative data for research of Late Prehistoric settlement pattern variability along the Lower Missouri Valley.

Lithic Resources: Sourcing lithic raw materials is another method that lends insight to past settlement patterns. While artifacts of exotic cherts or other stone may enter a site through trade, we can expect that mobile populations, such as those of the Paleoindian and Archaic periods, obtained such material during moves across the landscape. Thus, identification of the source of stone artifacts that are diagnostic of culture-temporal periods provides another means of tracking the shifting residency patterns of hunter-gatherer populations.

In her analysis of DB lithic raw materials, McLean (chapter 10) noted that non-local cherts were used for projectile point production by Paleoindian, Archaic, Archaic/Woodland, and Late Prehistoric groups. Paleoindian and Archaic points of both local and non-local materials show equal proportions of reworking, whereas Archaic/Woodland and Late Prehistoric points show more reworking of non-local materials. She suggests this may reflect the greater mobility and more restricted access to raw materials of the earlier groups. Paleoindian points were made of Mississippian and Permian cherts, reflecting movement east and west. Diagnostic Late Archaic points of these exotic materials are equally divided, showing similar movement or, perhaps in this case, exchange orientations. Thus, with respect to these culture-temporal periods, we may hypothesize that the settlement range of the DB inhabitants included the Flint Hills in Kansas, where Permian cherts were acquired, and central or southern Missouri, where Mississippian cherts were obtained. Given the presence of workable local cherts (Plattsmouth and Toronto) and near local cherts (Winterset and Westerville), it is unlikely that the preceramic DB residents took long range trips to obtain these exotic materials. Rather, the presence of the latter probably reflects an embedded strategy (sensu Binford 1979) that entailed their acquisition as part of a broader foraging strategy.

Subsistence Economy

With components of diverse prehistoric adaptations, the DB site offers a rare opportunity to compare subsistence economies with respect to one location in the Lower Missouri Valley. Because the ridge is a common factor of all components, the general settlement place is a constant against which variations in the nature of some activities can be attributed to the practice of varying economies and the application of different technologies. In was suggested in the DRP that, if data permitted reconstruction of the physical environment of the site proper and to some extent of neighboring areas (e.g., through catchment analysis, cf. Roper 1979) for all components, it might be possible to correlate these cultural adaptations with significant environmental changes. Conversely, if analyses showed that the physical environment remained stable, then contrasting adaptations could be seen as unaffected by environmental parameters. In that case, we could look for other factors that affected processes of regional, cultural change (see Cultural Relations).

These hypotheses were presented in the DRP in the hope that the analyses described above might permit their evaluation:

1. The subsistence evidence from the Late Archaic component reflects primarily late summer-autumn resource procurement (e.g., white-tailed deer, nut mast).

2. Middle Woodland subsistence plant remains include those of "camp follower" species (i.e., chenopod, amaranth, marshelder and sunflower).

3. Food remains from the Late Prehistoric component include cultigens (e.g., maize, beans, squash, sunflowers).

4. Evidence of hunting from all of the components reflects primary procurement of woodland-riverine game.

None of these statements addresses Paleoindian subsistence practices. Prior to Phase IV investigation, evidence of a Paleoindian component was too scant and ambiguous for the formulation of specific, testable propositions. Given more substantive, if still not numerous, and less ambiguous artifacts indicative of site-use during that time, we must now face this issue.

The only artifacts that clearly belong to the Paleoindian period are six projectile points, most of them basal fragments. These suggest that hunting and refitting were involved in what must have been transitory visits to the DB ridge. While plant gathering and processing cannot be discounted, neither can they be inferred from any firm evidence. Groundstone tools such as well-formed manos and metates are not generally accepted as part of the Paleoindian inventory and we therefore assume that such artifacts from the preceramic horizon are part of one or more Archaic occupations. Given this, we may speculate that Paleoindian hunters came to DB either to hunt or to rehaft hunting weapons while they watched for game from this vantage point.

As for evaluation of the hypotheses presented in the DRP, the DB site has not been cooperative. None of the DB excavations has yielded much animal bone, from which we might have been able to infer hunting preferences. As noted in chapter 13, burned bone from all levels has a total mass of 188.2g and is so fragmentary as to preclude identification of species. The mass (205.4g) of charred plant remains is comparable. Obviously, we cannot infer from these scanty remains that DB's prehistoric occupants rarely engaged in subsistence activities. The relative abundance of hunting and butchering tools and plant food processing implements is evidence that they did. Rather, the paucity of biological remains is clearly due to taphonomic factors that significantly reduced what must have been more extensive floral and faunal remains. The evaluation of the hypotheses must be based on a small amount of direct evidence and prior understanding of post-Pleistocene, regional, cultural and environmental change.

The Middle Archaic component raises the issue of adaptation to the Hypsithermal and its impact on floral and faunal resources in northeastern Kansas. Gruger (1973:245) has suggested from pollen spectra at Muscotah Marsh that this arid episode was severe enough that the Delaware River floodplain "dried out over extensive areas". Gruger dates the Hypsithermal in the region ca. 9930±330-5100±250 BP (ca. 7980-3150 BC). This range would embrace the Middle Archaic period in the region, to which some artifacts from DB, specifically side-notched dart points and scrapers, and a Munkers Creek knife, have been assigned. This episode would have diminished woodland habitat at the expense of prairie and, consequently, may have contributed to shifts in human adaptations. The populations of some game animals, such as deer, may have been reduced or become concentrated along the smaller woodland-prairie edge habitat available. Others that prefer grasslands, such as bison, may have expanded in range and number. The dominance of bison remains in Logan Creek faunal assemblages probably reflects an emphasis on prairie game in the Lower Missouri Valley during this time. At the same time, faunal remains in the late Middle Archaic (ca. 3500-3000 BC) horizons at the Coffey site in the northern Flint Hills reflect a generalized economy based on the hunting and gathering of a wider variety of animals.

Though faunal material at DB is sparse and of uncertain culture-temporal affiliation, the elements represented in the assemblage do not include thick, robust bison elements (see chapter 14). The compact (shaft) portions of all long bone pieces, are relatively thin, suggesting they were from game the size of deer or smaller. Charred nutshells are ubiquitous in all levels, as well, indicative of woodland resource exploitation. These hints suggest that, while prairie resources were undoubtedly present throughout the Holocene and were probably exploited by DB residents, the direct evidence available points to the use of woodland or woodland-edge resources.

The Middle Archaic occupation of DB is suggested to have been roughly contemporary with the late Middle Archaic components at Coffey (Schmits 1978) and William Young (14MO304; Witty 1982), both of which are in the Flint Hills. It is also suggested to have been contemporary with the Helton phase of the St. Louis locality, which, like the Flint Hills complexes, dates roughly 3500-3000 BC. The side-notched points and some of the hafted scrapers are also comparable to artifacts of the Falling Springs phase of the St. Louis area,

which dates to the early Late Archaic, ca. 3000-2300 BC. Thus, the inferred Middle Archaic occupation of DB occurred during the late Hypsithermal or early Sub-Boreal episodes, when deciduous woodland habitats, particularly along the eastern Great Plains, were expanding. This interpretation is compatible with the inferred woodland-oriented subsistence behavior.
As noted in the previous section, Permian chert artifacts assigned to the Middle and Late Archaic components may reflect trips to the Flint Hills. Bison, more plentiful in that prairie environment, may have motivated groups to make periodic (seasonal?) moves there.

Again, lacking seasonal information from faunal and more extensive and well provenienced floral remains, we cannot directly test the hypothesis that the biological resources targeted by DB inhabitants point only to late summer-autumn settlement. We must evaluate the hypothesis more obliquely. The following deduction about resource scheduling applies to all Holocene residents of the site (i.e., excluding Paleoindians). The carbonized nutshells throughout the excavation support the late summer-fall season of habitation but do not rule out other seasons. However, more prolonged settlement of the ridge by Archaic or Late Prehistoric groups would have resulted in the accumulation of greater amounts of cultural debris and the construction of more features such as shelters, hearths, and storage pits. That such evidence is lacking may be taken as indirect testimony that winter-spring-early summer occupations did not occur. Thus, the Archaic and Late Prehistoric components are suggested to be the result of late summer-autumn encampments that facilitated the harvesting of nuts and the hunting of game attracted by the same mast. These resources were concentrated during those times of the year on wooded slopes of the Lower Missouri Valley, such as the DB ridge (cf. Reid 1980a:34-35, 41).

The hypothesis concerning Middle Woodland subsistence practices is negated by the observation that only the most transitory of visits to the site was made by any Hopewell group. More fruitful pursuit of evidence to test the statement should be made with data from sites such as Quarry Creek (Logan 1993a).

In the DRP it was suggested that the relative paucity of manos and other grinding stones in the Late Prehistoric component, an observation strengthened by more extensive excavation, indicated that plant food processing was a relatively infrequent activity. Alternatively, it was suggested that it took some form that did not require stone grinding implements. Plant foods such as maize could have been immediately boiled or dried, stored for future use, and later parboiled for consumption without the use of mealing stones (cf. Wedel 1986:121-122). However, it was considered unlikely that prolonged occupation, thought to be reflected by the limited evidence of lodge remains recovered during Phase IIIA, would have happened without use by these farming people of some of the grinding or processing implements generally found at Late Prehistoric sites. It was suggested that greater reliance on stored cultigens, such as maize, beans, squash, and sunflowers, may have diminished dependence on wild plants. This does not appear to have been the case.

Not all of the charred nutshells found throughout the upper levels of the excavation can be attributed to upward dislocation through natural or cultural disturbance. If such homogenization of the deposits of the Brady and modern soil horizons had occurred, we would have recovered more Late Prehistoric diagnostics such as maize, daub, arrow points and sherds in the lower levels. However, these materials show fairly clear stratification with downward transport through burrowing being the most predominant disturbance process. Daub occurs in significantly greater amounts in the upper ten cm of the block; maize was not found at all below the second level; only a single arrow point was found below 20cm bg (40cm bs); and the few sherds in the lower levels generally showed clear evidence of faunalturbation (see chapter 7, Fig. 7.3). Thus, it appears that harvesting and processing of nuts was one activity of the Steed-Kisker occupants. As noted in the previous section, the absence of grinding stones in the Late Prehistoric component may be attributed to a single, brief occupation. The Steed-Kisker people may well have used manos, metates and other plant processing tools but, being valued items, these were curated to their next settlement.

In the DRP it was suggested that the mitigation effort might yield evidence that Late Prehistoric inhabitants cultivated crops near their upland settlement. Tillage of alluvial soils in the vicinity of valley-terrace habitations has been considered a more common practice. It has generally been assumed that upland soils were not as productive or harder to turn, given the simple technology used by these early farmers. But could the Late Prehistoric occupants have practiced slash-and-burn farming on the wooded DB ridge? If the site was occupied during the warmer months, an assumption based on the premises that were applied to the Archaic components, then the Late Prehistoric people who made the lodge(s) represented by the daub must have been farming land somewhere during that time. While a garden could have been in a nearby valley, could one have been located on one of the nearby ridges, if not DB itself? Woodland soils are not as difficult to turn as grassland sod and a few select trees could have been left to shade crops from the harsh sunlight of the mid-latitudes. If the ridge or nearby upland soils were not cultivated, then why did Late Prehistoric farmers choose to settle this spot? Unfortunately, these intriguing questions must go unanswered. While the few maize kernals and cupule fragments from the Steed-Kisker component attest farming, no other evidence was found to indicate when or where the crops were raised. Finally, no cultigens other than maize were found in the flotation and waterscreen samples examined by Adair (chapter 13). While farming as a subsistence practice is evident, we cannot infer how intensive it might have been. Again, taphonomic processes have likely deprived us of the wherewithal to address these questions.

Cultural Relations

As noted in *The Archaeology of Kansas: A Research Guide* (Logan 1996b:42-44), this problem domain "embraces an array of intra-group and inter-group interactions [including] demographics, social organization, residence patterns, trade, and ideology". The hypotheses repeated below were presented in the DRP in regard to some of these aspects of cultural relations. Given the paucity of evidence, those aspects that concern the Middle Woodland period are not addressed. The first hypothesis is applied to all the Archaic components.

1. Late Archaic intra-regional relations are represented by chipped stone tools of Permian (Flint Hills) cherts in the lithic assemblage of the DB site.

2. Middle Woodland intra-regional relations are represented by the relative proportion (i.e., fall-off rate) of artifacts made of central Missouri cherts in the trans-Missouri (Kansas City Hopewell) area.

3. Middle Woodland inter-regional relations are represented by Hopewell Interaction Sphere-like artifacts.

4. Late Prehistoric regional interaction is reflected in the association of Pomona and Steed-Kisker ceramic wares.

5. Late Prehistoric pottery was made exclusively from local clay sources.

Archaic: While artifacts of Permian cherts might point to inclusion of the Flint Hills in the range of DB's Archaic foragers, they might also reflect interaction among Archaic populations of the Flint Hills and Dissected Till Plains provinces. For example, the Munkers Creek knife from DB might be evidence of such interaction. Conversely, that knife and others of the type from the Delaware River Valley (see Taxonomy) might have been deposited by eastward ranging groups of the Munkers Creek phase from their core area in the Flint Hills. Lacking other evidence of a Munkers Creek occupation at DB, this latter interpretation is tenuous. Exchange or interaction seems, at this point, a viable alternative hypothesis.

A miscellaneous projectile point (X1i; chapter 9) in the DB assemblage can also be viewed in the same way, though with regard to a later time. This artifact (A7197-0296) is nearly identical (including the breakage pattern) to one from the Walnut phase horizon at the southern Flint Hills, Snyder site (Grosser 1973:232). The DB point is made of Florence chert, which outcrops in that region. Thus, it may be evidence of interaction between Walnut phase groups and the terminal Archaic occupants of DB.

The recovery of Middle Archaic projectile points comparable in some respects to those of the Logan Creek, Helton, Blue Springs and Jacomo phases and Late Archaic points that are similar to those of the Labras and Prairie Lake phases underlies the following discussion. It is suggested that, while the side-notched projectile points are similar to Logan Creek points and may attest an early Middle Archaic occupation, they are also much like points of the Helton phase in the St. Louis locality (i.e., that area centered near the confluences of the Lower Illinois, Mississippi, and Missouri Rivers). Godar- and Helton-like points, some reworked into hafted scrapers, and the absence of bison bone lend more, albeit tenuous, support to this interpretation. If future research in the Kansas City locality validates the proposition, then we can state that the diffusion of technologies and ideas and/or the migration of people from the St. Louis locality began sometime after 3500 BC. Reid (1984a) has suggested that this process was underway by Late Archaic time, specifically with regard to the Nebo Hill phase. If it began earlier, what role did populations of the western locality play in the cultural dynamics of that to the east. Was the diffusion, as Johnson (1992) suggests for the Woodland periods, largely one-way, up the Missouri Valley? Does this process reflect down-the-line exchange along that route? How were any relations maintained or were they tenuous and intermittant?

The radiocarbon dated terminal Archaic component at DB not only fills a gap in regional chronology but, given some similarity in lithic technologies (e.g., expanding-stemmed and cormer-notched projectile points and hafted scrapers made from them), suggests that the Missouri Valley avenue was still open at that time, though how much traffic moved along it is unclear. Thus, the same questions posed above apply to any future investigation of that period in the Kansas City locality. We cannot delineate a well-rounded material culture inventory for the terminal Archaic occupation of DB because of the stratigraphic compression and artifact mixing of the multicomponent, preceramic horizon. This precludes our answering these questions with any confidence at this time.

Discerning social organization in the Archaic assemblages is problematic. The potential for making specific inferences about prehistoric social organization, a promise of the New Archaeology of the 1960s-1980s, has frequently proved illusory. However, we may be able to gain general insight to such cultural information from structural remains, such as those in the Late Prehistoric component at DB. Lacking evidence of shelters in the preceramic horizon of the site, we cannot estimate the population size of its Archaic occupants. If the Steed-Kisker occupation is an appropriate model for the latter, however, we may reasonably suppose that no more than a few families lived there at any given time.

Late Prehistoric: Just as we can infer group size from the floor dimensions of a lodge, the maximum potential number of occupants can be roughly translated into social organization. That is, a lodge of a given size may accommodate a nuclear or extended family (Wedel 1979; Blakeslee 1989). In discussing settlement patterns, I noted that the amount and horizontal extent of debris on the DB ridge is what we would expect of intermittant visits by small groups of the various cultures represented. Inferring whether the occupants practiced a certain kind of post-marital residence pattern is a more hazardous undertaking. However, with regard to the Steed-Kisker component, we can address the question of how Late Prehistoric groups in the Central Plains were organized in a general sense. Roper (1995) has suggested that Central Plains tradition groups were organized at the family level. Blakeslee and Caldwell (1979) have inferred a band level organization for CPt. More recently, Blakeslee (1990) suggests that Nebraska phase people were swidden farmers who moved as extended families from one location to another as soils were depleted. From the extent of the larger daub cluster in the block excavation, we can infer that the shelter would have accomodated a group no larger than a nuclear family. The presence of no more than two such clusters, a pattern noted by Witty and Marshall (1968) at Albrecht, suggests site occupancy by an extended, Steed-Kisker family (assuming contemporaneity of lodge occupation). This is consistent with the family level organization suggested by Roper and Blakeslee.

With regard to exchange systems and the Late Prehistoric component, we can infer that the presence of exotic goods attests trade with adjacent or far flung groups. Beck (1995) has suggested that CPt groups during this period were organized as a series of overlapping networks that maintained ties through a nearest-neighbor or down-the-line form of contact. According to her model (Beck 1995:117-118), which borrows concepts from Hantmann and Plog (1982:250-251):

> one would expect to find that contact took place primarily between households and their immediate neighbors, rather than through a widespread trading network. Exchanges of food, marriage partners, and material items such as pottery vessels should be commonplace, and contact between those households would be on a fairly regular basis. Therefore, goods at a site should be primarily local or from a nearby area.

Thus, "exotic" goods may be limited to commodities from areas not too distant, reflecting the relative importance of cementing social ties with neighbors, as compared to maintaining connections with distant groups. We might find evidence of this kind of exchange, for example, in the source of clays used in the manufacture of ceramics. While this research avenue was not taken during the Phase IV project, some hint that it would be worthwhile is provided by one sherd of "Nebraska" ware (see chapter 8 and below).

Documenting Late Prehistoric cultural interaction in northeastern Kansas has been a research focus of this author since 1979 (Logan 1981b, 1983, 1985, 1988a, 1990a; Logan and Ritterbush 1994). As mentioned in a previous section, the Zacharias site yielded ceramic evidence of contact between Pomona and Steed-Kisker groups and the Albrect site may also attest to it. In the DRP, it was suggested that Phase IV excavation might encounter similar evidence at DB. Conversely, its absence would beggar explanation. Perhaps such contact occurred prior to or after Late Prehistoric settlement at DB. As it was, no identifiable Pomona artifacts were found during Phase IV.

The 14th century AD radiocarbon dates of the DB Steed-Kisker component indicate it post-dates, so far as we now know, the occupation of Zacharias (cf. chapter 8). At the same time, early 16th century dates from the Shadow Glen site in Johnson County, Kansas demonstrate that Pomona groups were then in northeastern Kansas. Thus, we cannot conclude that the absence of Pomona evidence at DB reflects Pomona abandonment of the region.

The DRP did not include the hypothesis that ceramics of another contemporary culture are evidence of regional interaction among different cultural groups. The Nebraska sherd mentioned above, however singular it appears in the overall DB ceramic assemblage, is sufficient grounds for considering such an hypothesis. The sherd, of the Beckman Pinched Rim type, was found <u>in situ</u> near the major daub cluster, the shadow of a Steed-Kisker shelter, though at greater depth (20-30cm bg; 40-50cm bs). Its depth is attributed to taphonomic disturbance, rather than to an earlier, Late Prehistoric occupation. It is probably contemporary with the Steed-Kisker component.

It is not unusual to find Nebraska ceramics at Steed-Kisker sites. The extensive lowland component at Cloverdale, in the valley below the upland lodge previously described, contained a large ceramic assemblage with many sherds of Platte Valley ware, though Nebraska pottery is clearly dominant (see chapter 5). The relatively high frequency of Steed-Kisker pottery at Cloverdale may reflect the location of that site in the northernmost range of the Steed-Kisker phase and the southernmost range of the Nebraska phase. In effect, the site is located where the core areas of both complexes overlap. Beck's (1995) model of overlapping exchange networks would predict a ceramic assemblage of a Late Prehistoric site near St. Joseph, Missouri that looks very much like Cloverdale's. A hypothesis based on that model would then posit that the singular instance of a Nebraska ware sherd at DB reflects the site's location "down-the-line" and, perhaps, its position on the western side of the Missouri River Valley. Whether the Beckman Pinched Rim vessel came to DB through intermarriage, the trade of foodstuffs, or the exchange of the pot itself has not been determined. Examination of its paste and comparison to that of Platte Valley ware sherds from the site might determine whether it was locally made or brought from a locality further upstream. It is intriguing that it is shell-tempered, an attribute significantly more common in Steed-Kisker pottery than that of Nebraska. Whether this points to its local manufacture, or that one group was making both wares (cf. Greatorex 1998), remains to be seen.

One other artifact, believed to be Late Prehistoric (its provenience in the graded area, though mapped, is not as accurately determined as that of artifacts in the block), raises questions about cultural relations. This find is the hematite "celt" described by Beck and Begeman (chapter 12; Fig. 12.2c). Its unique attributes render any interpretation speculative; artifacts that occur more frequently and are patterned with regard to form, function, and context provide more information than those of a singular nature. Nonetheless, the piece begs interpretation. Its context at DB provides no clue to its function. It was not associated with other finds in any meaningful way. Worked, faceted, and incised pieces of the same material have been found at other Steed-Kisker sites (indeed, a few faceted pieces of dense hematite are included in the DB assemblage) and at least one, from the Friend and Foe site, has been identified as a celt (Calabrese 1969:134). However, none of these exhibits the markings of the DB "celt". These markings, a set of four Xs in each corner of one face and three of the same sort on the obverse (a fourth may have been removed with a spall), are so deliberate as to indicate they had some meaning. We may never know what that was, but it is notable that the number four had special significance to many North American historic Indian groups, and it figured prominently in the Mississippian world as expressed at Cahokia. This major center has long been identified as the source of the "Mississippianization" of cultures in the Kansas City locality (Wedel 1943; O'Brien 1978a, 1981, 1988, 1993; cf. Henning 1967). Pauketat and Emerson (1991, 1997:271-272) have described the Ramey-Incised pot, with its quadripartite design field, as "signatures of domination" that were used for the "dispersion of goods and ideas of twelfth century Cahokia". O'Brien (1993:66, 81) describes one sherd of this pottery from the Coons site, near Parkville, Missouri. She also notes the "four-part pattern" of motifs on the shoulder of incised Steed-Kisker pottery as one attribute of the symbol system of the Southeastern Ceremonial Complex (Howard 1968). Clearly, the number four held special ideological significance among Mississippian populations and we may speculate that some aspect of this ideology is symbolically represented on the "celt" from the DB site.

It is also notable that the artifact is made of hematite. While slabs and chunks of ferrous oxide occur in the local till deposits (chapter 12), this does not preclude the introduction through trade of other hematite objects. O'Brien (1993:72-73) counts hematite items, both in raw and processed states, as objects of trade. This is probably an overstatement, given the ubiquity of ferrous oxide at Steed-Kisker sites and its easy access in the region. O'Brien (1993:73) states that

> [w]hile pebbles of hematite occasionally occur in glacial till at a ratio of 1 or 2 pebbles per 1000 in the lowland Central Plains, their presence is unpredictable ... and they are economically unimportant.

The economic importance that O'Brien cites is probably with regard to modern industry, not prehistoric procurement. Beck (chapter 11) had no trouble locating a till deposit with large pieces of ferrous oxide on Hancock Hill, a short distance from DB, within hours of her first attempt. Examples of this same material, including large worked pieces in the preceramic levels, were recovered throughout the block excavation. Ferrous oxide was also plentiful at the Zacharias site. Despite this apparent disclaimer of the trade of hematite objects, I do not suggest that local availability precluded its acquisition in other forms through exchange. Either the southeastern, central or southern Missouri sources of hematite that O'Brien identifies may well have been the source of the DB "celt". Rather than assume such provenience, however, the artifact should be subjected (if such analysis is non-destructive) to trace element analysis or some other objective technique. The results of such examination may shed more light on this peculiar artifact. In the meantime, we can only speculate that it may have conferred on its owner, whether an individual or corporate group, some special status and that it served some ritual function.

The 14th century dating of the Late Prehistoric component raises another issue about cultural relations, that is, the possible interaction of Steed-Kisker with Oneota groups. As noted in the Chronology section, the Oneota occupations at the Leary site in extreme southeastern Nebraska and at the Warne and White Rock sites in Jewell County, north-central Kansas date to the same century. Previous interpretations of the temporal range of Steed-Kisker, with a suggested terminus ca. AD 1250, appeared to preclude discussion of this problem. It is interesting that it has not been pursued since Henning (1970:158-159) suggested the cultures "flourished simultaneously" and that there was "slight intercommunication" between them. The DB dates are additional evidence that contemporaneity and its implications must be addressed. Henning threw down the gauntlet when he suggested that some ceramic similarities (i.e., low rolled rims, a Steed-Kisker ceramic attribute, on the earliest Oneota vessels from the western prairies) might indicate the two cultures shared a similar ancestor. It must be taken up.

One avenue of inquiry comes from recent insights concerning Oneota (Benn 1989; Green 1995). It is now perceived by some as an aggressively expanding culture that displaced or incorporated others. This process began in centers in Iowa and adjacent regions in the 13th century. Logan (1997) suggests that the White Rock phase is the westernmost expression of this hegemonic process and that the Oneota migration that led to its manifestation may have displaced

Central Plains tradition groups in the Lower Republican Valley. Could the disappearance of Steed-Kisker ca. AD 1400 have been due to its assimilation by Oneota groups elsewhere in the Lower Missouri Valley?

Technology

1. The material culture assemblage of the Late Archaic component includes fiber-tempered pottery.

2. The proportions of local vs. non-local cherts in the lithic assemblages from the components do not vary significantly.

3. The proportion of local vs. non-local cherts in the Late Archaic lithic assemblage reflects greater mobility than later component(s).

4. The reduction sequence in the production of chipped stone tools does not vary significantly among or between the different components.

Since nearly all artifacts from DB are of stone and pottery, discussion of this problem is restricted to lithic and ceramic technologies. To the extent the data would allow, McLean (chapter 10) tested the DRP hypotheses that concerned lithic raw materials. The most prevalent raw material for chipped stone tools by all occupant cultures, based on her analysis of 380 artifacts, is the local ($\leq$15km from DB) Plattsmouth and Toronto cherts. When combined with near-local cherts (15-45km), Westerville and Winterset, these materials account for ca. 60% of the sample. Exotic cherts, mostly Permian material from the Flint Hills and Mississippian cherts from central and southern Missouri, account for the balance. There is no significant difference in these proportions among components, though this may be due to stratigraphic mixing rather than differences in technological preferences of the different cultures represented.

To control for the affects of such mixing, McLean applied the same statistical tests to the diagnostic projectile points. When the Late Prehistoric points are compared to the combined preceramic assemblage, there is no significant difference in lithic material types. However, when she divided them by broad temporal classes (Paleoindian, Archaic, Archaic/ Woodland, and Late Prehistoric), McLean found some interesting differences. Paleoindian points were equally divided between non-local and local; Archaic points had a 3:1, local:non-local ratio; and both Archaic/Woodland and Late Prehistoric had 1.5:1 ratios. These comparisons may reflect relative mobility and raw material access, a settlement pattern concern. However, McLean noted that the relative frequencies of reworked points vis-a-vis chert type revealed patterns that indicate how socioeconomic concerns impact lithic technology. More mobile groups did not discriminate with regard to material type when it came to reworking points because there was a greater need to conserve all tools. Groups longer resident in the Kansas City locality and with consequent greater access to local cherts, were more cavalier in their treatment of broken points or conservative with regard to points of materials less frequently accessed.

Reconstruction of lithic reduction sequences, the subject of the fourth hypothesis from the DRP, may also reveal significant changes in chipped stone tool technologies between components. Such changes might be correlated with shifts in economic pursuits, including hunting, butchering, hide preparation, and woodworking. Unfortunately, we cannot control for culture-temporal affiliation of cores and debitage from the DB horizons, which show evidence of mixing, and this prevents testing of that statement.

To address the first hypothesis last, no fiber-tempered pottery was found during Phase IV excavation. While taphonomic processes such as freeze-thaw cycles (Reid 1984b) may have erased any ceramic evidence, it is more likely that their absence is due to the brevity of a Nebo Hill occupation. The paucity of Nebo Hill artifacts points to a brief stay during that phase of the Late Archaic and a party of hunter-gatherers on a short-term foray would not likely carry fragile, ceramic containers.

Some discoveries at DB raise new questions about technology not addressed in the DRP. For example, several pieces of scoria (or clinker; see Porter [1962:267-268] for the distinction among clinker, scoria and pumice), that exhibit grooves attesting their use as abraders (for honing bone tools or dart shafts, or for grinding chipped stone tools), were found in the preceramic horizon (chapter 12). None was found in Late Prehistoric levels, where sandstone arrow shaft abraders were recovered. The material called clinker by Porter (1962:268) forms when the sediments associated with burning lignite coal seams in the Dakotas are baked "into a frothy mass". The modified sediment then is eroded by streams that drain the Missouri River basin and floats downstream, where it can be collected from channel deposits. Among historic Indians the material was used "primarily as an abrasive in smoothing wood, sharpening bone, and as hide grainers" (Porter 1962:268).

Whether clinker or scoria, stone of their qualities has a long history of use by prehistoric and historic people of the Missouri Valley. Pieces of clinker from the Early Archaic horizon at the Cherokee Sewer site (Anderson 1980:225) document the first appearance of that material in the archaeological record of the eastern Great Plains (Anderson et al. 1980:266). Material that Wedel (1943:60-61) calls "pumice, or scoria" was found at Renner, the type site of the Kansas City Hopewell culture. The largest piece found there was 9.5cm along the longest dimension and none of the fragments had "grooves such as would result from the grinding of bone awls, wooden arrowshafts, or similar materials" (Wedel 1943:61). Wedel infers from flattened surfaces that the Renner material may have been used in the manner of the historic Omaha, who used it to rub down animal hides (Wedel 1943:61).

It is intriguing that no such stone was found in the Late Prehistoric component and I do not recall that such material was recovered at Quarry Creek and Zacharias. Given the small numbers of clinker or scoria at any prehistoric site in the Kansas City locality, it does not appear to have been an intensively exploited material and this suggests sources may have been spotty or unpredictable (reflecting the fickle nature of the Missouri River). Indians throughout time in the region probably used it ad hoc, gathering fortuitously those pieces of the stone they encountered during moves about the floodplain. Thus, it is not suggested that the absence of clinker/scoria at Quarry Creek, Zacharias and Late Prehistoric DB reflects a change in technological preferences. Its presence at Renner attests use by the Hopewell. However, its absence from some ceramic age sites in the Leavenworth area might indicate that it was no longer readily available there. Lateral shifts of Missouri River meanders could have eliminated nearby gravel deposits that had contained this stone during Archaic time.

Were it not for the mixing of cultural materials from the different Archaic components in the Brady soil, the groundstone assemblage might offer some technological insights. Reid (1983:14-17) has identified rectangular and ovoid manos, sometimes bearing "nutting" pits on one face, and three-quarter grooved axes as some of the formal determinants of the Nebo Hill phase. The latter are not part of the DB groundstone assemblage; all seven axes are full-grooved. However, the late Middle Archaic Helton phase includes in its material culture inventory both full- and three-quarter grooved axes, suggesting the latter axe form is not strictly indicative of Late Archaic cultures (Cook 1976). Beck and Begeman (chapter 12) note that, because full-grooved axes were used from the Early Archaic to historic time, they offer no chronological information. In sum, the presence of full-grooved axes and the lack of three-quarter grooved axes at DB provide no useful chronological insight regarding any of its preceramic components. The seven axes in the Archaic levels do point to utilization of wooded habitat, if not at the site per se (though that is likely) then in its vicinity. These, the pitted "nutting" stones, and the charred remains of nutshells attest a woodland-oriented technology.

Two of the manos, one formal and one fortuitously shaped for the purpose, yielded phytoliths that attest their use for grinding wild grass seeds. These artifacts then point to the exploitation of prairie habitat and the development of a groundstone technology geared to that end. At present, we cannot say whether the prairie-oriented manos and the woodland-oriented axes were used by the Middle or Late Archaic occupants of DB, or both. Cutting-edge research on the phytolith frontier suggests it may be possible to determine the temporal affiliation of manos that yield plant silicates. Phytoliths are known to encapsulate organic matter, metaphorically like the resin that encaptures insects and preserves them in amber. AMS radiocarbon dating makes it possible to obtain absolute dates on the enclosed carbon-based material and determine when the tool was used or deposited (Dr. Steven Bozarth, personal communication). Information such as this will make it possible to affiliate temporally those kinds of artifacts that now appear chronologically generic and to track the development of food processing technologies.

Finally, I note what appears to have been a contrast in the technology of home-building between the Late Prehistoric and Archaic occupants. If the hypothesis that the former did not differ from the latter in season of occupation, duration of stay, or nature of activities performed is valid, then we must ask why the former had shelters that left daub and the latter lived in shelters that did not (assuming they used shelter of some kind, which seems reasonable). Two alternatives, among the several that could be posed, are offered: 1) the different groups occupied similar structures and exposure of the remains of Archaic shelters on the eroding Brady soil led to their total destruction; 2) the different groups occupied contrasting structures and those of the Archaic groups did not entail the use of wattle-and-daub. If the latter were true (and it could not be if the former were, as the alternatives are mutually exclusive), then it might indicate the greater sedentism of the Steed-Kisker groups and their investment in building more substantive shelters of wattle-and-daub. The sedentism, of course, is relative. We now know that the settlement pattern of the Steed-Kisker culture included farmsteads on valley terraces (O'Brien 1978b) and seasonal camps on upland ridges, such as Cloverdale, DB, and, apparently, Albrecht.[1] The upland sites show variation in house form (Settlement Patterns); they entailed the building of either a substantial lodge (Cloverdale) or more ephemeral shelters (DB).

[1]According to Calabrese (1969:193), the Steed-Kisker settlement pattern included "individual [houses] on bluffs [and] ... small clusters as villages in the valley floors". The former type was based solely on Cloverdale, with additional reference to bluff top sites of the Nebraska phase; the latter, concerning villages, is no longer considered valid.

Chapter 16

Conclusions

Brad Logan

Introduction

The DB site will soon be a prison. But the DB project has shown that it is a prism, resolving the light of regional prehistory into a spectrum that reveals many of its cultural components. We have shown that the prism is somewhat flawed, presenting us with a buried soil that contains evidence of several preceramic cultures that was deposited on an eroded, disturbed surface. While its resolution is not perfect, we can still see in the light it refracts evidence of DB's attraction to people of the Lower Missouri Valley for more than 10,000 years. No other excavated site on the loess hills of Kansas or Missouri has revealed the stratified remains of Paleoindian, Middle Archaic, Late Archaic, late Middle Woodland, Late Prehistoric, and Historic periods. It is significant because it: 1) contains evidence of a long tradition of upland settlement in the region, 2) contains deposits that are stratified, albeit imperfectly, and 3) points to the presence of other such sites in the loess hills of the Lower Missouri River.

Upland Site Burial

One of the most significant findings of the DB project has been the discovery of buried Paleoindian and Archaic deposits on a loess hill where previous geoarchaeological models (e.g., Johnson and Logan 1990:294) had suggested probabilities for such were moderate (Paleoindian), low (Early Archaic), or none (Middle Archaic-Historic). Recent research in the Midwest and northern Great Plains shows that the potential for upland site burial is geographically extensive. In western Illinois, sites of Archaic age have been buried on dissected loess summits through eolian deposition and soil development (e.g., developmental upbuilding and biomantle formation) (Van Nest 1993). The latter processes have been more important in leading to the shallow burial of archaeological materials on upland summits. At DB, eolian deposition of Holocene loess led to shallow burial of the Brady soil and its preceramic artifacts. Still, the conclusion reached by Van Nest (1993:307) is relevant to the Lower Missouri Valley in the Kansas City locality:

> ...much of what is presently known about upland archaeology is based on disturbed surface sites. Considering that archaeological remains are mostly buried in some landscape components, such data present a distorted view of site distributions.... Despite perceptions to the contrary, much of the Archaic record of the uplands is also buried. Many of these occupations represent discrete unmixed components. They are often shallowly buried, hence readily accessible

to hand excavation. Thus, an untapped archaeological record, potentially as informative as that from the intensively investigated large valleys, awaits recovery from upland settings.

In an overview of geoarchaeological research in the Upper Midwest, Bettis and Hajic (1995:90-92, 97) reach the same conclusion. They, too, debunk the assumption that the uplands present stable or erosional surfaces with shallow deposits of artifacts. This applies, at best, to hillslopes, particularly where artifacts of Paleoindian and Archaic age are frequently encountered "where the shoulder slope gives way to the summit, suggestive of an erosional outcrop pattern of cultural debris" (Bettis and Hajic 1995:91). They note that studies in Missouri (Reagan et al. 1978), Iowa (Artz 1991, Tiffany et al. 1977) and Wisconsin (Stoltman et al. 1984) "have discovered in situ cultural deposits of Holocene age within the upper meter or so of loess or loess-derived deposits in upland areas" (Bettis and Hajic 1995:91). In Iowa, upland site burial has apparently been dominated by pedogenic processes (Artz 1991), in contrast to the eolian deposition that buried Paleoindian and Archaic age materials at DB. As at the latter site, however, natural disturbance processes adversely affected the integrity of the cultural deposits.

Geoarchaeological research in the North Dakota Badlands also reveals a record of upland settlement, which in that region of the Little Missouri River extends from at least Middle Archaic (ca. 3500 BC) through Late Prehistoric time. According to Waters and Kuehn (1996:488), groups of these periods "concentrated their upland activities along the edges of ridges and buttes, rather than in the interiors, in order to take advantage of superior views". They suggest that Paleoindian and Early Archaic groups had similar settlement patterns but that the paucity of evidence in support of that is attributable to hillslope erosion during the middle Holocene (Hypsithermal). They note that the removal of alluvial fills of preceramic age from the valley precludes full understanding of settlement patterns for the Paleoindian to Late Archaic periods. Thus, archaeologists in the Badlands who address the problem of settlement patterns of Middle and Late Archaic cultures are limited to an upland data base.

Geoarchaeologists in the Central Plains and Midwest have also addressed the problem of the "missing record" (Johnson and Logan 1990:281; Thompson and Bettis 1980; Bettis and Benn 1984; Logan 1985, 1988b; Mandel 1994; Bettis and Hajic 1995). Our understanding of past cultures is limited to what can be derived from a record inherited after it has suffered periods of erosion, burial and/or disturbance. To the extent that we understand processes of terrain evolution, we can aim our research at landscape targets that hold the greatest potential for preserving that record. The DB site now indicates that the summits of the loess hills along the Missouri River trench in the Central Plains are one such target. They have considerable potential for buried sites of preceramic age. Despite erosion and disturbance, the Brady soil at DB still contained Paleoindian remains in their proper stratigraphic position with respect to later cultural material. This indicates that where Bignell loess mantles the uplands along the Missouri River trench, in situ evidence of Paleoindian activity may be found. While the Archaic components at DB are mixed, this is due as much to the frequency of occupation as to erosion and pedoturbation. Had the DB summit been occupied but once by an Archaic group, or periodically by groups of one archaeological culture, late Holocene loess would have shielded their evidence as well. In that case, we could have better defined formally such an Archaic component. Despite the constraints of the site's stratigraphy, it is important because it tells us that this idealized component may be out there, waiting for us. We can realistically hope that there are ridge summits in the region that were less popular than DB.

Recently, Van Nest (1997:323) posed a series of questions concerning the nature of buried upland sites; their relevance to DB is obvious:

> 1) To what degree does burial affect site visibility, and therefore the methods and probable success of site discovery?
>
> 2) How effective is the burial process; Does it result in the burial of all artifacts below the plow zone? Are the sub-plow zone artifacts different from those in the plow zone?
>
> 3) At multicomponent sites, are the sub-plow zone artifact assemblages stratigraphically separated, or do they represent superimposed activities (palimpsests) with little or no vertical separation? Can multicomponency be established? Or disproved?
>
> 4) Are multiple occupations horizontally segregated?
>
> 5) Does the burial process result in systematic size sorting of artifacts? If so, what size classes are affected, and how mobile are they?
>
> 6) Does the burial process differentially destroy some artifact classes? Which classes are affected, and how?
>
> 7) Does the burial process destroy older (Archaic period) structures such as pits and hearths, rendering them less visible than their younger (Woodland period) counterparts?

An obvious strain that runs through these questions is the role of taphonomic processes, soil formation and bioturbation, on upland cultural deposits. If we are to address these questions appropriately, it is apparent that field data must be acquired in the most meticulous manner. We have noted how water screening at DB resulted in recovery of an abundance of small-size material (e.g., daub, burned bone, charcoal) and how spatial analyses of their vertical and horizontal distributions go far to answer some of the questions raised by Van Nest. Still, we can recommend here one approach that might have further refined our analyses and enhanced their results. For example, one way to clarify site stratigraphy is to treat separately all obvious natural disturbance features, such as tree-cradles and krotovinas. If their fills are dug and screened like those of cultural features, any material in them can be excluded from analyses of artifacts in those horizons into which they have intruded. While this method is more time consuming and, therefore, more costly, the information gained would be worth the investment.

Each of Van Nest's questions is addressed below with regard to the DB site. The numbers correspond to hers as presented above:

1-2) These questions are related and, thus, addressed together. The DB site had been plowed, though not for many years at the time of its discovery, and this had brought some artifacts within range of the relatively shallow (ca. 30cm) shovel tests dug at that time. It is likely that even without plowing, the Late Prehistoric component would have been within 30cm of the surface since the first sub-grade (i.e., 20-30cm bs) level of all excavations yielded relatively undisturbed deposits (see chapter 14). Bioturbation also brought Archaic materials within range of shovel tests, indicating preceramic deposits were not effectively buried by late Holocene loess.

3) DB is a multicomponent site and, as discussed throughout this report, its oldest and youngest components retained some stratigraphic integrity. All Paleoindian points in the block excavation were found in the lowest levels; all Late Prehistoric arrow points were found in the upper levels. Plant growth and decay and animal burrowing had transported some daub and ceramics to lower levels, attesting some disturbance of the uppermost component. The Archaic components, however, exhibited a greater degree of mixing. While some of this is due to natural processes, periodic occupation of the eroded or eroding ridge from ca. 5500 to 2600 BP resulted in cultural disturbance as well. Trampling, artifact and hearth scavenging, and transformation processes undoubtedly contributed to the palimpsest nature of the Archaic deposits.

4) The multiple occupations at DB do not appear to have been horizontally segregated. The ridge summit, the apparent focus of all prehistoric occupations, is not very extensive and did not provide much potential for disparate encampments. It does appear, however, that the Late Prehistoric occupation, which is suggested to have been singular or, at least, less frequent than Archaic settlements, was centered within the area encompassed by the Phase IV block excavation.

5) Hill (chapter 14) addressed the issue of size sorting of artifacts. He demonstrated that sorting of artifacts of various size classes had not occurred significantly at DB. Logan (chapter 7) attributes the greater numbers of cobbles, among the largest artifacts at the site, in the lower levels to their loss and discard during more frequent Archaic occupations. While such artifacts may have been used by the site's ceramic-age inhabitants, their stays were fewer and, therefore, resulted in less loss and discard of till-derived materials.

6-7) These related questions are treated jointly here. They are quite relevant to the DB site, with the substitution of Late Prehistoric for Van Nest's example of Woodland period structures and features as the younger counterpart of Archaic period materials. Recall, however, that DB has yielded evidence of a late Middle Woodland occupation. It appears to have been one of such brevity, though, that questions of site taphonomy cannot concern it.

We cannot attribute the destruction of any artifact class at DB to the burial process *per se*. Indeed, it is more likely that some materials were differentially destroyed through *exposure*. The burial process at the site appears to have been relatively slow. This apparently prevented the survival of most organic debris, such as unburned bone, and any features, such as hearths that might have been composed of ash and charcoal concentrations. Most charred plant and animal remains were widely dispersed, reflecting their dissipation from shallow middens or campfires that had been dismantled, scavenged, or exposed to the elements. The only exceptions to this general observation were the features in the Late Prehistoric component (see chapter 14). Here the remains of one or two structures, a concentration of charcoal and associated burned bone that are interpreted as the shadow of a hearth, and a few other domestic work areas were discernible. These features probably survived for two reasons: 1) they dated to the last prehistoric encampment, and 2) after that occupation the DB ridge received sufficient loess, incorporated into its uppermost soil horizon, to bury traces of them below the plowzone.

Prehistoric Upland Settlement

It is evident that the loess hills of the Lower Missouri River were settled by peoples of diverse adaptations. In the previous chapter, it was suggested that with respect to all but, perhaps, the Paleoindian component, the DB site attracted groups of them for the same reason. Archaic and Late Prehistoric peoples exploited it with different technologies, but the seasonal availability of certain woodland resources (e.g., deer and nuts) of the summit and hillslope was the common magnet. While DB offered easy access to a variety of habitats, both upland and lowland, resources in the latter would have been more easily procured from valley settlements. Thus, the primary reason why representatives of various cultures occupied DB intermittantly over a long period of time is that it was a practical place to obtain and process upland resources. Scaling a 50m (160ft), 25-30% slope on a daily basis may not have been overly demanding, but who would have done so bearing many kg of stone tools, raw materials and other equipage (e.g., those of wood, bone, hide and other perishables) just for the wonderful view? Obviously, upland plants and animals are better obtained and processed from such ridge top locales during the late summer and autumn. Moreover, fresh water may have been obtained at a source 400m distant (see chapter 2). The hydrology of the site may have changed, that is, the spring may have dried up seasonally or periodically, and the vegetation may have shifted with respect to the proportion of woodland and grassland communities, but it is likely that the DB ridge offered the same amenities to prehistoric hunter-gatherers and hunter-gatherer-gardeners from the waning years of the Hypsithermal some 5500 years ago.

We are unable to distinguish the assemblages of the different Archaic cultures that lived at DB but it is probable that they obtained resources with the same technology. The general Woodland hiatus (ca. 500 BC-AD 900; excepting a brief stay during the Edwardsville phase, ca. AD 400-650) is intriguing, given the well-represented presence of Hopewell and Plains Woodland groups at the nearby Quarry Creek and Zacharias sites respectively. But it is possible these peoples preferred other ridges or that, as suggested in the previous chapter, they sought more sheltered terrain that offered access to the same resources.

The Steed-Kisker component offers a model for the Archaic occupations, in that it appears to have been the result of a brief, seasonal stay that included the harvest of nuts. It reveals, however, the application of different technologies to these ends by Late Prehistoric cultures in the region. That encampment included the consumption of at least a small amount of maize, reflecting the practice of agriculture nearby, if not at the DB site. It entailed the use of ceramic vessels as containers and cooking vessels, reflecting a settlement pattern less mobile than that of Archaic cultures. The construction of shelters of wattle-and-daub may attest the same change. The bow-and-arrow had supplanted the atlatl-and-dart of the Archaic and Woodland peoples. Unifacially retouched end scrapers had replaced the reworked, bifacial, stemmed scrapers of DB's preceramic inhabitants. In sum, the archaeological record at the DB site shows that both continuity and change characterized the prehistoric adaptations of the Lower Missouri Valley.

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Appendix 1

Chipped Stone Tool Data

Virginia Hatfield

Chip Stone Tool Analysis

Catalogue #	FN #	N	E	Depth, cmbg	Raw Material	Class	Func	Port	Stage/Type	L	W	Th	Wt	Stem W	Base W	Base L	Bcon	Notch W	Notch D
A2271-0296-2		158	57	0-10	Winterset	FT	C	dist	k/ mod flake	14.13	19.79	4.99	1.3	n a	n a	n a	n a	n a	n a
A4494-0296		151	61	10-20	Plattsmouth A	B	C	med	ppk/scr	20.76	23.48	7.76	4.3	n a	n a	n a	n a	n a	n a
A4723-0296-1		154	61	10-20	Florence	B	C	med	ppk/scr	12.56	14.09	3.79	0.7	n a	n a	n a	n a	n a	n a
A7176-0296	1512			Surface	Florence	B	C	med	ppk/scr	17.15	10.83	8.31	1.4	n a	n a	n a	n a	n a	n a
A6071-0296	1342	154	64	30-40	Plattsmouth C	B	C	comp	Scr/gouge	77.44	34.24	15.65	45.9	n a	n a	n a	n a	n a	n a
A7175-0296	1511			Surface T3	Plattsmouth A	B	C	comp	Scr/gouge	45.47	43.89	14.70	31.9	n a	n a	n a	n a	n a	n a
A7226-0296				graded Surf	Wreford	SB	C	dist	Scr/gouge/ k	48.43	44.06	11.86	24.6	23.48	n a	n a	n a	n a	n a
A4090-0296	929	163	59	30-40	Plattsmouth	FT	C	comp	Scr/k	44.41	37.74	11.43	20.3	n a	n a	n a	n a	n a	n a
A2580-0296	1036	160	57	30-40	Wreford	FT	C	comp	Scr/k	42.93	30.00	11.35	15.7	n a	n a	n a	n a	n a	n a
A3382-0296	297	151	59	40-50	Florence	FT	C	comp	Scr/k	29.39	23.59	6.98	6.4	n a	n a	n a	n a	n a	n a
A5322-0296		161	61	30-40	Plattsmouth C	FT	C	comp	Scr/k	43.02	24.30	10.68	8.8	n a	n a	n a	n a	n a	n a
A7159-0296	1621			Surface T5	Florence	FT	C	comp	Scr/k	58.35	32.81	7.31	14.9	n a	n a	n a	n a	n a	n a
A7207-0296	1338			Surface T1	Plattsmouth	B	C	comp	Scr/k	36.17	28.65	9.90	8.8	n a	n a	n a	n a	n a	n a
A4408-0296	109	149	61	10-20	Winterset	B	C	comp	Scr/k	56.39	42.79	16.57	33.0	n a	n a	n a	n a	n a	n a
A7179-0296	1510			Surface T3	Mississippian	B	C	prox	Scr/k	35.32	36.10	10.86	16.6	n a	n a	n a	n a	n a	n a
A7216-0296	1495			Surface	Toronto	B	C	dist	Scr/k	34.08	23.46	8.24	6.0	n a	n a	n a	n a	n a	n a
A6210-0296	1376	156	64	30-40	Ferrous Oxide	B	CH	comp	tk	107.48	73.89	32.15	296.6	n a	n a	n a	n a	n a	n a
A7169-0296	703	158	61	out of wall	TRSS	B	CH	comp	tk	117.64	114.49	24.06	427.0	n a	n a	n a	n a	n a	n a
A6692-0296	1265	158	66	30-40	Plattsmouth A	FT	D	comp	F	42.99	23.42	7.44	6.3	n a	n a	n a	n a	n a	n a
A0387-0495		138.51	69.48	54 cm	Florence	SB	D	comp	tn	45.18	20.16	7.79	4.7	20.40	17.79	14.04	n a	n a	n a
A1723-0296-2		147	57	20-30	Mississippian	B	D	dist	tn	17.38	6.31	3.92	0.5	n a	n a	n a	n a	n a	n a
A2847-0296		163	57	30-40	Mississippian	B	D	prox	tn	33.87	17.90	8.26	4.3	n a	n a	n a	n a	n a	n a
A3203-0296		149	59	20-30	Toronto	B	D	dist	tn	29.00	9.03	6.09	1.2	n a	n a	n a	n a	n a	n a
A3944-0296-2		161	59	20-30	Florence	B	D	med	tn	12.82	8.65	4.34	0.6	n a	n a	n a	n a	n a	n a
A4360-0296-1		149	61	0-10	Toronto	B	D	dist	tn	20.88	10.07	5.93	1.3	n a	n a	n a	n a	n a	n a
A4463-0296-1		151	61	0-10	Unidentified	B	D	dist	tn	20.31	9.06	3.95	0.7	n a	n a	n a	n a	n a	n a
A4558-0296		151	61	30-40	Toronto	B	D	dist	tn	25.02	8.70	6.68	1.5	n a	n a	n a	n a	n a	n a
A4827-0296-2		156	61	0-10	Plattsmouth A	B	D	dist	tn	25.87	8.70	5.62	1.2	n a	n a	n a	n a	n a	n a
A5534-0296-1		165	61	30-40	Plattsmouth B	B	D	prox	tn	12.80	15.84	4.77	1.0	15.84	15.84	12.80	n a	n a	n a
A5647-0296	1410	154	63	20-30	Plattsmouth C	B	D	prox	tn	25.35	27.69	7.73	4.4	14.44	25.81	13.83	n a	n a	n a
A5806-0296		158	63	0-10	Plattsmouth A	B	D	dist	tn	20.49	9.88	4.61	0.7	n a	n a	n a	n a	n a	n a
A6447-0296-2		156	66	0-10	Toronto	B	D	dist	tn	24.24	8.84	6.23	1.1	n a	n a	n a	n a	n a	n a
A7091-0296	1064	154	64	0-10	Plattsmouth C	B	D	dist	tn	28.43	9.00	6.66	1.2	n a	n a	n a	n a	n a	n a
A7149-0296	567			Surface	Florence	B	D	med	tn	29.97	18.54	6.45	3.7	n a	n a	n a	n a	n a	n a
A7152-0296	1052	165	85	Surface	Plattsmouth C	B	D	dist	tn	37.54	9.82	6.70	2.4	n a	n a	n a	n a	n a	n a
A7153-0296	1334			Surface T1	Unidentified	SB	D	prox	tn	26.50	21.74	7.94	4.0	15.40	(21.44)	9.67	n a	n a	n a
A7154-0296	1513			graded Surf	Plattsmouth	SB	D	prox	tn	36.38	21.22	6.39	4.6	21.15	n a	8.86	n a	n a	n a
A6953-0296	1060	158	68	0-10	Winterset	B	D	comp	tn	32.00	27.87	7.72	6.0	n a	n a	n a	n a	n a	n a
A7224-0296				graded Surf	Plattsmouth A	B	D	comp	tn	57.77	16.59	5.95	5.1	n a	n a	n a	n a	n a	n a
A3130-0296-3		149	59	0-10	Plattsmouth C	B	ESB	med	tk	39.65	37.75	17.66	26.5	n a	n a	n a	n a	n a	n a
A3379-0296		151	59	40-50	Ferrous Oxide	B	ESB	med	tk	80.58	53.35	25.12	102.6	n a	n a	n a	n a	n a	n a
A4720-0296	357	154	61	0-10	Plattsmouth C	B	ESB	med	tk	32.58	29.80	15.75	9.8	n a	n a	n a	n a	n a	n a
A5904-0296	1453	158	63	30-40	Ferrous Oxide	B	ESB	dist	tk	45.28	35.00	22.14	26.8	n a	n a	n a	n a	n a	n a
A6170-0296	1253	156	64	20-30	Plattsmouth	B	ESB	dist	tk	47.91	25.68	17.06	16.8	n a	n a	n a	n a	n a	n a
A6794-0296	1325	154	68	30-40	Ferrous Oxide	B	ESB	comp	tk	104.91	70.06	32.89	221.9	n a	n a	n a	n a	n a	n a
A7036-0296	1178	158	68	40-50	Plattsmouth A	B	ESB	comp	tk	38.32	34.81	19.67	19.7	n a	n a	n a	n a	n a	n a
A7198-0296-1	566			Surface	Unidentified	B	ESB	prox	tk	41.53	46.19	17.56	36.2	n a	n a	n a	n a	n a	n a
A7222-0296				Surface T2	Toronto	B	ESB	prox	tn	24.16	33.27	6.25	5.0	n a	n a	n a	n a	n a	n a
A1832-0296	148	149	57	10-20	Plattsmouth B	B	ESB	dist	tn	22.89	28.00	7.78	4.2	n a	n a	n a	n a	n a	n a
A2039-0296		154	57	0-10	Plattsmouth A	B	ESB	dist	tn	14.27	22.52	8.03	1.7	n a	n a	n a	n a	n a	n a
A2175-0296		156	57	10-20	Unidentified	B	ESB	med	tn	21.72	14.69	6.45	1.9	n a	n a	n a	n a	n a	n a
A2490-0296	635	158	57	30?	Plattsmouth A	B	ESB	med	tn	38.90	39.40	11.54	12.2	n a	n a	n a	n a	n a	n a
A2948-0296-2		165	57	30-40	Unidentified	B	ESB	dist	tn	28.16	24.57	8.15	5.8	n a	n a	n a	n a	n a	n a
A3172-0296-2		149	59	10-20	Florence	B	ESB	med	tn	10.91	18.36	7.06	1.5	n a	n a	n a	n a	n a	n a
A3364-0296		151	59	40-50	Mississippian	B	ESB	prox	tn	23.2	12.0	5.2	1.7	n a	n a	n a	n a	n a	n a

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	Reworking	Stem	Base	Shoulders	Notch/ lateral indentation	Angle 1	Angle 2	Scr edges worked	Basal Grnding	Basal Thinning	St Bev	Bl Bev	Bl Serr	Heat Altered
A2271-0296-2	y-edge mod	na	na	na	na	na	na	3	na	na	na	na	na	
A4494-0296	y-retouch/bev	na	na	na	na	na	na	na	na	na	na	y?	na	
A4723-0296-1	y	na	na	na	na	na	na	na	na	na	na	na	na	
A7176-0296	y-retouch	na	na	na	na	60	na	na	na	na	na	na	na	
A6071-0296	y	na	na	na	na	60	55	2	na	na	na	na	na	
A7175-0296	n	na	na	na	na	60	na	na	na	na	na	na	na	
A7226-0296	y-bev	?	concave	barbed	na	75	na	na	na	na	na	na	na	
A4090-0296	n	na	na	na	na	na	na	3	na	na	na	na	na	
A2580-0296	y-retouch	na	na	na	na	55	na	1	na	na	na	na	na	
A3382-0296	y-retouch	na	na	na	na	75	35	2	na	na	na	na	na	
A5322-0296	y-retouch	na	na	na	na	55=side	na	2	na	na	na	na	na	
A7159-0296	y-retouch	na	na	na	na	50's	na	3	na	na	na	na	na	
A7207-0296	y	na	na	na	na	55	na	5	na	na	na	na	na	
A4408-0296	y	na	na	na	na	na	na	na	na	na	na	na	na	
A7179-0296	y	na	na	na	na	85=end	55=side	na	na	na	na	na	na	
A7216-0296	y-bev, retouch	na	na	na	na	na	na	na	na	na	na	y	n	
A6210-0296	na	na	na	na	na	na	na	na	na	na	na	na	na	
A7169-0296	y	na	na	na	na	na	na	na	na	na	na	na	na	
A6692-0296	y	na	na	na	na	na	na	na	na	na	na	y	na	
A0387-0495	y	straight	straight	na	na	na	na	na	n	y	y	y	n	
A1723-0296-2	y	na	na	na	na	na	na	na	na	na	na	y	n	
A2847-0296	n	straight	concave	na	na	60	na	na	y	n	n	y	n	
A3203-0296	y	na	na	na	na	50		na	na	na	na	y	n	
A3944-0296-2	y	na	na	na	na	na	na	na	na	na	na	y	na	
A4360-0296-1	y	na	na	na	na	na	na	na	na	na	na	y	n	
A4463-0296-1	y	na	na	na	na	na	na	na	na	na	na	y	n	y
A4558-0296	y	na	na	na	na	na	na	na	na	na	na	y	na	y
A4827-0296-2	y	na	na	na	na	na	na	na	na	na	na	y	n	
A5534-0296-1	n	na	na	na	na	na	na	na	n	n	n	na	na	
A5647-0296	?	expanding	convex	na	na	na	na	na	n	y	n	y	n	
A5806-0296	y-mod after break	na	na	na	na	na	na	na	na	na	na	na	na	
A6447-0296-2	y	na	na	na	na	na	na	na	na	na	na	y	na	
A7091-0296	y	na	na	na	na	55	na	1	na	na	na	y	na	
A7149-0296	y	na	na	na	na	na	na	na	na	na	na	y	n	
A7152-0296	y	na	na	na	na	na	na	na	na	na	na	y	na	
A7153-0296	y	expanding	straight	na	na	na	na	na	n	y	n	y	n	
A7154-0296	y	expanding	concave	na	na	na	30	na	n	n	n	y	n	y
A6953-0296	y	straight	straight	na	na	na	na	na	na	na	na	y	n	
A7224-0296	y	straight	convex	na	na	<30	na	na	n	y	n	y	n	
A3130-0296-3	y-one edge used	na	na	na	na	na	na	na	na	na	na	na	na	
A3379-0296	n	na	na	na	na	na	na	na	na	na	na	na	na	
A4720-0296	n	na	na	na	na	na	na	na	na	na	na	na	na	
A5904-0296	n	na	na	na	na	na	na	na	na	na	na	na	na	
A6170-0296	na	na	na	na	na	na	na	na	na	na	na	na	na	
A6794-0296	n	na	na	na	na	na	na	na	na	na	na	na	na	
A7036-0296	n	na	na	na	na	na	na	na	na	na	na	na	na	
A7198-0296-1	na	na	na	na	na	na	na	na	na	na	na	na	na	
A7222-0296	y-retouch	na	na	na	na	na	na	na	na	na	na	na	na	
A1832-0296	y-retouch	na	na	na	na	na	na	na	na	na	na	na	na	y
A2039-0296	n	na	na	na	na	na	na	na	na	na	na	na	na	
A2175-0296	n	na	na	na	na	na	na	na	na	na	na	na	na	y
A2490-0296	n	na	na	na	na	na	na	na	na	na	na	na	na	
A2948-0296-2	n	na	na	na	na	na	na	na	na	na	na	n	n	
A3172-0296-2	n	na	na	na	na	na	na	na	na	na	na	na	na	
A3364-0296	n	na	na	na	na	na	na	na	na	na	na	na	na	

Catalogue #	Comments
A2271-0296-2	edge mod, VD, VL,VL
A4494-0296	snap frac
A4723-0296-1	
A7176-0296	Poss beveled
A6071-0296	retouch-usewear
A7175-0296	usewear (oval shaped)
A7226-0296	knife edge, scraper end -gouge
A4090-0296	edge crushing/usewear -DD,2DL
A2580-0296	all sides modified
A3382-0296	knife=DL(1); scraper=DD
A5322-0296	DL=scr, DL=k
A7159-0296	DL-scr/DL k/DP-I
A7207-0296	2DL,DD,1VL, VP
A4408-0296	
A7179-0296	DD, DL edges worked
A7216-0296	snap frac, poss once stemmed
A6210-0296	cortex -frgs
A7169-0296	only one edge mod bifacially-rest unmod
A6692-0296	other edges mod
A0387-0495	
A1723-0296-2	
A2847-0296	snap frac
A3203-0296	snap frac
A3944-0296-2	snap frac
A4360-0296-1	
A4463-0296-1	impact frac/ snap frac
A4558-0296	snap frac
A4827-0296-2	
A5534-0296-1	possibly base of drill-snap frac
A5647-0296	snap?
A5806-0296	edge mod on break
A6447-0296-2	
A7091-0296	snap frac
A7149-0296	snap both distal and prx
A7152-0296	snap
A7153-0296	inclusion/disconformity@break
A7154-0296	snap ffrac/base end used as scr? C
A6953-0296	small bit=3.6 mm, graver?
A7224-0296	stemmed? knife
A3130-0296-3	utilized as scraper?
A3379-0296	flaked ferrous oxide
A4720-0296	
A5904-0296	
A6170-0296	
A6794-0296	
A7036-0296	
A7198-0296-1	
A7222-0296	preform, knife??
A1832-0296	edge use/retouch
A2039-0296	
A2175-0296	hinge frac
A2490-0296	
A2948-0296-2	snap fracture
A3172-0296-2	
A3364-0296	crappy little fragment

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	FN #	N	E	Depth, cmbg	Raw Material	Class	Func	Port	Stage/Type	L	W	Th	Wt	Stem W	Base W	Base L	Bcon	Notch W	Notch D
A3457-0296		153	59	30-40	Unidentified	B	ESB	prox	tn	25.30	33.31	8.92	7.2	na	na	na	na	na	na
A3664-0296-3		156	59	30-40	Toronto	B	ESB	med	tn	33.81	23.07	10.93	8.1	na	na	na	na	na	na
A3664-0296-2		156	59	30-40	Unidentified	B	ESB	dist	tn	30.62	27.09	8.32	4.6	na	na	na	na	na	na
A3847-0296		160	59	20-30	Toronto	B	ESB	med	tn	23.35	27.40	8.33	6.1	na	na	na	na	na	na
A3870-0296-2		160	59	30-40	Plattsmouth C	B	ESB	dist	tn	42.07	32.65	11.07	18.3	na	na	na	na	na	na
A4170-0296		165	69	20-30	TRSS	SB	ESB	comp	tn	30.82	18.43	7.37	3.4	na	na	na	na	na	na
A4194-0296		165	69	30-40	Plattsmouth A	B	ESB	med	tn	19.06	19.53	11.70	6.2	na	na	na	na	na	na
A4652-0296-1		153	61	20-30	Toronto	B	ESB	dist	tn	30.81	21.16	6.21	4.0	na	na	na	na	na	na
A4673-0296-2		153	61	30-40	Plattsmouth A	B	ESB	med	tn	18.29	23.72	9.39	3.8	na	na	na	na	na	na
A4851-0296-1		156	61	10-20	Winterset	B	ESB	dist	tn	20.99	28.90	10.82	6.2	na	na	na	na	na	na
A5032-0296	377	168	61	10-20	Plattsmouth A	B	ESB	med	tn	31.75	18.89	11.54	4.8	na	na	na	na	na	na
A5296-0296		161	61	20-30	Plattsmouth	B	ESB	med	tn	31.00	9.77	6.83	1.4	na	na	na	na	na	na
A5534-0296-2		165	61	30-40	Plattsmouth B	B	ESB	med	tn	35.92	11.82	7.48	2.6	na	na	na	na	na	na
A5846-0296	1396	158	63	10-20	Toronto	B	ESB	med	tn	25.70	16.56	10.00	2.8	na	na	na	na	na	na
A5962-0296	1077	154	64	0-10	Plattsmouth A	B	ESB	med	tn	26.06	10.79	9.82	2.2	na	na	na	na	na	na
A5988-0296-4	1127	154	64	20-30	Mississippian	B	ESB	med	tn	45.69	23.44	12.29	13.9	na	na	na	na	na	na
A6247-0296		156	64	10-20	Plattsmouth	B	ESB	dist	tn	27.60	50.45	11.09	12.1	na	na	na	na	na	na
A6269-0296-1		156	64	20-30	Toronto	B	ESB	dist	tn	19.43	30.99	10.32	5.4	na	na	na	na	na	na
A6745-0296	1061	154	68	0-10	Toronto	B	ESB	prox	tn	40.14	44.75	12.06	22.06	na	na	na	na	na	na
A6975-0296-2		158	68	20-30	Plattsmouth A	B	ESB	med	tn	16.08	22.17	8.49	2.8	na	na	na	na	na	na
A7134-0296	1259	154	66	20-30	Plattsmouth C	B	ESB	prox	tn	25.77	21.19	8.62	5.1	na	na	na	na	na	na
A7150-0296				Surface T3	Plattsmouth A	B	ESB	prox	tn	45.69	58.00	10.51	37.8	na	na	na	na	na	na
A7184-0296	1479			Surface T2	Toronto	B	ESB	dist	tn	62.14	48.42	10.76	30.1	na	na	na	na	na	na
A7147-0296	1522			Surface T4	Plattsmouth B	B	ESB	dist	tn	46.11	29.38	8.42	11.4	na	na	na	na	na	na
A5100-0296	502	158	61	30-40	Plattsmouth C	B	ESB	dist	tn	22.68	16.44	8.41	2.6	na	na	na	na	na	na
A5101-0296	460	158	61	?	Toronto	B	ESB	dist	tn	14.76	29.09	4.31	14.4	na	na	na	na	na	na
A2799-0296		163	57	20-30	Unidentified	FT	GR	comp	F	14.82	9.77	1.80	0.3	na	na	na	na	na	na
A6216-0296		156	64	0-10	Florence	FT	GR	comp	F	18.85	15.63	2.33	0.5	na	na	na	na	na	na
A2210-0296		156	57	20-30	Toronto	FT	GR	comp	F	22.71	19.12	6.59	1.9	15.41	16.65	8.83	na	na	na
A6925-0296-2	1315	156	68	30-40	Ferrous Oxide	FT	Ind	comp	?	92.99	7122	19.16	76.6	na			na	na	na
A2683-0296		161	57	30-40	Plattsmouth C	FT	Ind	comp	?	17.72	13.21	2.13	0.4	na	na	na	na	na	na
A4295-0296	115	147	61	10-20	Winterset	FT	Ind	prox	?	91.24	60.05	14.17	81.3	na	na	na	na	na	na
A6971-0296	1073	158	68	10-20	Toronto	FT	Ind	prox	?	60.07	45.46	9.12	17.3	na	na	na	na	na	na
A2544-0296		160	57	20-30	Plattsmouth A	FT	Ind	comp	?	19.13	18.50	4.58	1.2	na	na	na	na	na	na
A5854-0296		158	63	20-30	Toronto	B	Ind	med	?	18.17	24.40	8.38	3.3	na	na	na	na	na	na
A2166-0296	389	156	57	0-10	Unidentified	B	Ind	med	?	15.30	32.15	11.84	7.3	na	na	na	na	na	na
A3870-0296-1		160	59	30-40	Plattsmouth C	B	Ind	med	tn	17.13	20.76	7.94	1.7	na	na	na	na	na	na
A2467-0296-1		158	57	30-40	Plattsmouth	B	Ind	dist	tn	7.19	9.38	4.07	0.2	na	na	na	na	na	na
A3944-0296-1		161	59	20-30	Plattsmouth A	B	Ind	med	tn	27.34	27.35	8.06	6.2	na	na	an	na	na	na
A4522-0296		151	61	20-30	Unidentified	B	Ind	med	tn	12.81	11.31	6.50	1.2	na	na	na	na	na	na
A6706-0296-3		158	66	40-45	Winterset	B	Ind	med	tn	14.32	13.65	7.84	1.7	na	na	na	na	na	na
A2128-0296	690	154	57	30-40	Plattsmouth C	B	K	dist	tn	36.58	35.39	9.06	10.8	na	na	na	na	na	na
A2163-0296-1		156	57	0-10	Toronto	B	K	dist	tn	23.26	21.86	7.01	3.2	na	na	na	na	na	na
A2271-0296-1		158	57	0-10	Florence	B	K	med	tn	23.70	19.40	4.58	2.1	na	na	na	na	na	na
A2579-0296	1042	160	57	30-40	Plattsmouth C	B	K	prox	tn	43.05	30.23	8.39	12.2	na	na	na	na	na	na
A2624-0296-3		161	51	10-20	Plattsmouth B	B	K	dist	tn	36.19	26.03	8.09	6.2	na	na	na	na	na	na
A3770-0296	483	158	59	20-30	Plattsmouth A	B	K	comp	tn	46.54	35.68	9.46	16.6	na	na	na	na	na	na
A3895-0296	1046	160	59	40-45	Toronto	B	K	dist	tn	49.54	40.05	7.22	15.9	na	na	na	na	na	na
A4327-0296		147	61	20-30	Permian	B	K	med	tn	32.02	28.87	9.78	10.3	na	na	na	na	na	na
A4379-0296	25	149	61	0-10	Toronto	B	K	comp	tn	48.48	31.53	7.08	8.1	na	na	na	na	na	na
A6119-0296	1081	156	64	0-10	Plattsmouth A	B	K	prox	tn	16.88	32.21	6.82	3.8	na	na	na	na	na	na
A7020-0296-1		158	68	40-50	Toronto	B	K	prox	tn	18.82	24.06	7.12	3.7	na	na	na	na	na	na
A7144-0296	1345	154	66	30-40	Plattsmouth	B	K	med	tn	41.96	27.74	8.14	7.8	na	na	na	na	na	na
A7146-0296	1565			Surface T2	Toronto	B	K	dist	tn	45.35	35.72	8.13	10.6	na	na	na	na	na	na
A7148-0296	1506			Surface	Florence	B	K	dist	tn	33.18	35.44	6.50	6.7	na	na	na	na	na	na

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	Reworking	Stem	Base	Shoulders	Notch/ lateral indentation	Angle 1	Angle 2	Scr edges worked	Basal Grnding	Basal Thinning	St Bev	Bl Bev	Bl Serr	Heat Altered
A3457-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A3664-0296-3	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A3664-0296-2	y tip retouched	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A3847-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A3870-0296-2	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A4170-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A4194-0296		n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A4652-0296-1	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A4673-0296-2	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A4851-0296-1		n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A5032-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A5296-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A5534-0296-2	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A5846-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A5962-0296		n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A5988-0296-4	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6247-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6269-0296-1	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6745-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6975-0296-2	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7134-0296	n	n a	n a	n a	n a	n a	n a	n a	n	n	n	n a	n a	
A7150-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7184-0296	y-edge retouch/usewear	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7147-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A5100-0296	n	n a	n a	n a	n a	n a	n a		n a	n a	n a	n	n	
A5101-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A2799-0296	?	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6216-0296	edge mod	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2210-0296	n a	n a	n a	n a	n a	n a	n a	1	n a	n a	n a	n a	n a	
A6925-0296-2	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2683-0296	y-retouched flake	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A4295-0296	y-retouch	n a	n a	n a	n a	n a	n a	1	n a	n a	n a	n a	n a	
A6971-0296	t-retouch	n a	n a	n a	n a	n a	35	2	n a	n a	n a	n a	n a	
A2544-0296	y-retouched flake	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A5854-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2166-0296		n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y?	n a	
A3870-0296-1	n(L/W)	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A2467-0296-1	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y?	n	
A3944-0296-1	y-edge modified	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A4522-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6706-0296-3	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A2128-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A2163-0296-1	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	y
A2271-0296-1	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2579-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2624-0296-3	y		n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A3770-0296		n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A3895-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A4327-0296	y-retouch	n a	n a	n a	n a	75=e	75=s	n a	n a	n a	n a	n a	n a	
A4379-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6119-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7020-0296-1	y-retouch on stem	n a	n a	n a	n a	n a	n a	n a	n	y-one side	n	n a	n a	
A7144-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A7146-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n	
A7148-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	Comments
A3457-0296	Snap frac, thinning, hinged
A3664-0296-3	
A3664-0296-2	sinuous edge, radial frac
A3847-0296	
A3870-0296-2	
A4170-0296	crude flaking
A4194-0296	
A4652-0296-1	sinuous edge, snap frac
A4673-0296-2	
A4851-0296-1	
A5032-0296	
A5296-0296	biface thinning ?
A5534-0296-2	sinuous edge
A5846-0296	
A5962-0296	
A5988-0296-4	
A6247-0296	
A6269-0296-1	
A6745-0296	snap frac
A6975-0296-2	sinuous edge-preform
A7134-0296	
A7150-0296	usewear, retouch on sides
A7184-0296	sinuous edge
A7147-0296	sinuous edge, rwkd tip, snap frac
A5100-0296	snap frac
A5101-0296	
A2799-0296	
A6216-0296	intentionally mod graver
A2210-0296	edgemod, DD
A6925-0296-2	edges possibly. wkd - modified
A2683-0296	edge mod flake -graver/drill
A4295-0296	cortex-prox end-DL endwk 1 edge
A6971-0296	2DL
A2544-0296	edge mod flake/K? 2 edges DD
A5854-0296	snap frac?
A2166-0296	thick biface - scraper
A3870-0296-1	fire fractured-indeterminate form/function
A2467-0296-1	too thick for ppk
A3944-0296-1	edge modified -possibly scraper
A4522-0296	fire frac
A6706-0296-3	burned past ID
A2128-0296	
A2163-0296-1	edge crushing
A2271-0296-1	very thin, snap frac
A2579-0296	rect frg
A2624-0296-3	steepish edge, edge crushing
A3770-0296	usewear
A3895-0296	steepish edge
A4327-0296	snap frac-prob during mod
A4379-0296	tear dropped shape
A6119-0296	snap frac
A7020-0296-1	snap
A7144-0296	burned/fire fractured
A7146-0296	tip slightly bev from rewking
A7148-0296	very thin, well flaked

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	FN #	N	E	Depth, cmbg	Raw Material	Class	Func	Port	Stage/Type	L	W	Th	Wt	Stem W	Base W	Base L	Bcon	Notch W	Notch D
A7151-0296	1540			Surface T4	Toronto	B	K	dist	t n	65.92	49.84	11.48	36.8	n a	n a	n a	n a	n a	n a
A7156-0296	1586			Surface T4	Permian	B	K	comp	t n	115.09	50.04	7.00	57.9	n a	n a	n a	n a	n a	n a
A7162-0296	484	158	59	20-30	Florence	B	K	comp	t n	67.66	38.52	10.03	26.7	n a	n a	n a	n a	n a	n a
A7172-0296	960			Surface	Permian	B	K	dist	t n	32.12	23.40	7.19	4.0	n a	n a	n a	n a	n a	n a
A7210-0296	1499			graded Surf	Plattsmouth A	B	K	dist	t n	26.57	33.63	6.22	5.0	n a	n a	n a	n a	n a	n a
A7212-0296	1456b			Surface T2	Plattsmouth	B	K	prox	t n	56.72	41.11	10.38	26.5	n a	n a	n a	n a	n a	n a
A7223-0296				Surface T4	Wreford	B	K	comp	t n	109.34	36.84	12.08	45.5	n a	n a	n a	n a	n a	n a
A7225-0296	1516			Surface T3	Florence	B	K	comp	t n	90.15	43.64	8.41	32.9	n a	n a	n a	n a	n a	n a
A7236-0296				graded Surf	Toronto	B	K	comp	t n	82.77	49.09	7.77	31.5	n a	n a	n a	n a	n a	n a
A7243-0296	1162	175	75	Surface 10x	Florence	B	K	comp	t n	102.79	49.00	7.84	45.6	n a	n a	n a	n a	n a	n a
A7330-0296	1009	166	50	0-10	Toronto	B	K	med	t n	33.31	23.97	8.51	6.1	n a	n a	n a	n a	n a	n a
A7353-0296	1021	167	61	0-10	Toronto	B	K	med	t n	43.99	23.38	9.41	9.7	n a	n a	n a	n a	n a	n a
A2862-0296-1		165	57	0-10	Winterset	FT	MF	prox	F	22.52	30.18	5.20	3.3	n a	n a	n a	n a	n a	n a
A5239-0296		160	61	30-40	Plattsmouth C	FT	MF	comp	F	49.00	39.84	21.00	31.0	n a	n a	n a	n a	n a	n a
A7202-0296	248			Surface	Toronto	FT	MF	prox	F	18.92	18.81	4.38	1.6	n a	n a	n a	n a	n a	n a
A4673-0296-1		153	61	30-40	Unidentified	FT	PPK	med	F	14.01	16.75	4.16	1.2	n a	n a	n a	n a	n a	n a
A6001-0296-1		154	64	20-30	Florence	FT	PPK	dist	F	14.94	16.63	4.59	0.9	n a	n a	n a	n a	n a	n a
A3923-0296-2		161	59	10-20	Unidentified	SB	PPK	dist	t n	8.95	8.03	1.65	0.1	n a	n a	n a	n a	n a	n a
A5177-0296		160	61	10-20	Unidentified	SB	PPK	med	t n	9.03	11.00	2.57	0.2	n a	n a	n a	n a	n a	n a
A6001-0296-2		154	64	20-30	Florence	SB	PPK	dist	t n	8.32	11.65	2.98	0.2	n a	n a	n a	n a	n a	n a
A6525-0296-1		156	66	30-40	Unidentified	SB	PPK	prox	t n	5.05	14.47	2.55	0.1	n a	n a	n a	n a	n a	n a
A7157-0296	959			Surface	Winterset	SB	PPK	dist	t n	14.52	8.00	2.35	0.3	n a	n a	n a	n a	n a	n a
A1845-0296		149	57	20-30	Unidentified	SB	PPK	prox	t n	6.91	9.26	4.14	0.2	n a	n a	n a	n a	n a	n a
A4145-0296		165	59	10-20	Toronto	SB	PPK	med	t n	20.42	11.59	5.73	1.5	n a	n a	n a	n a	n a	n a
A2798-0296		163	57	20-30	Unidentified	SB	PPK	med	t n	23.68	24.23	6.80	4.0	n a	n a	n a	n a	n a	n a
A6476-0296		156	66	10-20	Unidentified	SB	PPK	dist	t n	9.89	14.50	3.46	0.5	n a	n a	n a	n a	n a	n a
A7198-0296-2	566			surface	Plattsmouth A	SB	PPK	dist	t n	18.91	22.56	7.94	?	n a	n a	n a	n a	n a	n a
A2084-0296		154	57	20-30	Toronto	SB	PPK	prox	t n	11.91	17.99	5.29	0.6	n a	n a	n a	n a	n a	n a
A3130-0296-1		149	59	0-10	Winterset	SB	PPK	prox	t n	10.15	9.16	6.67	0.8	n a	n a	n a	n a	n a	n a
A3255-0296		151	59	0-10	Plattsmouth A	SB	PPK	prox	t n	10.22	14.22	2.00	0.6	n a	n a	n a	n a	n a	n a
A4360-0296-2		149	61	0-10	Florence	SB	PPK	prox	t n	12.41	19.72	4.50	0.8	n a	n a	n a	n a	n a	n a
A5695-0296		156	63	0-10	Florence	SB	PPK	prox	t n	9.06	13.28	3.09	0.4	n a	n a	n a	n a	n a	n a
A6706-0296-1		158	66	40-45	Winterset	SB	PPK	med	t n	10.86	17.94	4.83	1.0	n a	n a	n a	n a	n a	n a
A7168-0296 (2?)	957			Surface	Toronto	SB	PPK	med	t n	31.99	12.00	6.44	2.6	n a	n a	n a	n a	n a	n a
A7241-0296				graded Surf	Wreford	SB	PPK	prox	t n	19.54	10.69	7.14	1.2	n a	n a	n a	n a	n a	n a
A7233-0296-1				plowed Surface		SB	PPK	prox	t n	12.76	19.09	4.83	13.84	19.06	19.09	12.76	n a	n a	n a
A0681-0495		149	107	63 cm	Wreford	SB	PPK	med	t n	24.81	21.24	6.04	3.0	n a	n a	n a	n a	n a	n a
A1665-0296-1		147	57	10-20	Plattsmouth B	B	PPK	dist	t n	25.32	18.62	5.82	2.2	n a	n a	n a	n a	n a	n a
A1665-0296-3		147	57	0-10	Winterset	B	PPK	med	t n	18.96	13.67	5.02	1.0	n a	n a	n a	n a	n a	n a
A1864-0296-1		149	57	30-40	Plattsmouth C	B	PPK	dist	t n	11.62	15.80	4.37	0.5	n a	n a	n a	n a	n a	n a
A1997-0296		153	57	10-20	Toronto	B	PPK	med	t n	15.36	13.92	4.31	0.9	n a	n a	n a	n a	n a	n a
A2011-0296	723	153	57	10-20	Plattsmouth C	B	PPK	prox	t n	24.30	16.05	7.41	3.1	(15.58)	(15.78)	(22.37)	n a	n a	n a
A2129-0296	652	154	57	30-40	Toronto	B	PPK	dist	t n	27.90	21.08	6.86	2.8	n a	n a	n a	n a	n a	n a
A2163-0296-2		156	57	0-10	Unidentified	B	PPK	med	t n	20.64	16.21	4.67	1.2	n a	n a	n a	n a	n a	n a
A2209-0296		156	57	20-30	Plattsmouth B	SB	PPK	med	t n	15.91	18.02	4.66	1.5	n a	n a	n a	n a	n a	n a
A2294-0296	336	158	57	0-10	Florence	SB	PPK	med	t n	18.38	32.56	6.96	4.1	n a	n a	n a	n a	n a	n a
A2295-0296	323	158	57	0-10	Plattsmouth A	B	PPK	med	t n	30.50	14.91	8.86	2.9	n a	n a	n a	n a	n a	n a
A2307-0296-1		158	57	10-20	Toronto	B	PPK	dist	t n	17.96	13.90	5.40	1.1	n a	n a	n a	n a	n a	n a
A2335-0296		158	57	20-30	Plattsmouth C	B	PPK	dist	t n	20.17	24.90	4.97	2.1	n a	n a	n a	n a	n a	n a
A2503-0296		160	57	0-10	Plattsmouth C	B	PPK	med	t n	20.60	12.47	6.18	1.1	n a	n a	n a	n a	n a	n a
A2527-0296		160	57	10-20	Winterset	SB	PPK	med	t n	15.96	32.21	8.08	4.1	n a	n a	n a	n a	n a	n a
A2624-0296-4		161	57	10-20	Plattsmouth	B	PPK	med	t n	13.49	15.97	4.15	0.8	n a	n a	n a	n a	n a	n a
A2651-0296		161	57	20-30	Unidentified	B	PPK	med	t n	16.16	9.97	6.35	0.9	n a	n a	n a	n a	n a	n a
A2739-0296-3		163	57	0-10	Toronto	SB	PPK	med	t n	13.15	8.18	5.19	0.4	n a	n a	n a	n a	n a	n a
A2739-0296-4		163	57	0-10	Unidentified	B	PPK	med	t n	19.01	22.31	4.91	2.0	n a	n a	n a	n a	n a	n a

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	Reworking	Stem	Base	Shoulders	Notch/ lateral indentation	Angle 1	Angle 2	Scr edges worked	Basal Grnding	Basal Thinning	St Bev	Bl Bev	Bl Serr	Heat Altered
A7151-0296	y-bev edge	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7156-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7162-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7172-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7210-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7212-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7223-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7225-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A7236-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	a n	y
A7243-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7330-0296	retouch edges	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A7353-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2862-0296-1	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A5239-0296	n	n a	n a	n a	n a	30	n a	n a	n a	n a	n a	n a	n a	
A7202-0296	y-retouch edge	n a	n a	n a	n a	25=s	n a	3	n a	n a	n a	n a	n a	
A4673-0296-1	y-retouch	n a	n a	n a	n a	n a	n a	2	n a	n a	n a	n a	n a	
A6001-0296-1	y	n a	n a	n a	n a	n a	n a	2	n a	n a	n a	n a	y	
A3923-0296-2	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A5177-0296	?	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6001-0296-2	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n	
A6525-0296-1	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A7157-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A1845-0296	n	exp?	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A4145-0296	y-scraperish	expanding	?	barbed		40	n a	n a	n a	n a	n a	n a	n a	
A2798-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A6476-0296	n	n a	n a	n a	n a	n a	n a	n a	a n	n a	n a	n a	n a	
A7198-0296-2	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2084-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n a	n a	n a	
A3130-0296-1	n a	exp?	straight	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A3255-0296	n	straight	concave	n a	n a	n a	n a	n a	y base only	y	n a	n a	n a	
A4360-0296-2	n	?	concave	n a	n a	40	60	n a	n?	y	n a	n a	n a	
A5695-0296	n	n a	n a	n a	n a	n a	n a	n a	y?	y	n a	n a	n a	
A6706-0296-1	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7168-0296 (2?)	y	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7241-0296	n a	expanding	convex?	barbed	side?	n a	n a	n a	n a	y	n a	n a	n a	
A7233-0296-1		expanding	convex	n a	n a	n a	n a	n a	n	n	n	n a	n a	
A0681-0495	n a	exp?	n a	barbed	corner	n a	n a	n a	n	n a	n a	n a	n a	y
A1665-0296-1	y-bev,blade retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y-alt	n	
A1665-0296-3		n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A1864-0296-1	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A1997-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2011-0296	n	straight	n a	n a	n a	n a	n a	n a	n	y	n	n a	n a	
A2129-0296		n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n	
A2163-0296-2		n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	
A2209-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2294-0296	y-retouch	n a	n a	barbed	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A2295-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2307-0296-1	y-bev	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n	
A2335-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A2503-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2527-0296	y	n a	n a	square	corner	n a	n a	n a	n a	n a	n a	n a	n a	
A2624-0296-4	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2651-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2739-0296-3	n	n a	n a	barbed	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2739-0296-4	y-retouch/bev	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n a	y

Catalogue #	Comments
A7151-0296	usewear
A7156-0296	usewear
A7162-0296	usewear
A7172-0296	
A7210-0296	
A7212-0296	edge crushing
A7223-0296	usewear?
A7225-0296	usewear on edges
A7236-0296	usewear/retouch
A7243-0296	parallel flakingg - usewear
A7330-0296	snap fraac
A7353-0296	snap -rewkd edges
A2862-0296-1	
A5239-0296	DD
A7202-0296	possibly arrow pt preform
A4673-0296-1	lateral edges both wked
A6001-0296-1	2 side wkd
A3923-0296-2	arrow point fragment
A5177-0296	arrow point fragment
A6001-0296-2	alt edge bev, snap frac, arrow pt frag
A6525-0296-1	Arrow pt frg
A7157-0296	Arrow pt frg
A1845-0296	snap frac
A4145-0296	1/2 frg, possibly Logan's Creek Scraper
A2798-0296	burned past ID
A6476-0296	
A7198-0296-2	snap frac
A2084-0296	partial base frg
A3130-0296-1	small frg, hard to id
A3255-0296	snap?
A4360-0296-2	bse frg, hard to id
A5695-0296	snap frac; too teeny to id
A6706-0296-1	possibly base frg of SB
A7168-0296 (2?)	side of biface
A7241-0296	base frg (Barb frg?) hard to ID
A7233-0296-1	snap frac
A0681-0495	fire fractured
A1665-0296-1	snap frac
A1665-0296-3	
A1864-0296-1	
A1997-0296	
A2011-0296	base, broken
A2129-0296	snap frac
A2163-0296-2	
A2209-0296	
A2294-0296	burned
A2295-0296	
A2307-0296-1	snap frac
A2335-0296	snap frac
A2503-0296	possibly bifacial thinning flake
A2527-0296	portion base/shoulder
A2624-0296-4	Snap Frac
A2651-0296	
A2739-0296-3	corner at barb
A2739-0296-4	burned

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	FN #	N	E	Depth, cmbg	Raw Material	Class	Func	Port	Stage/Type	L	W	Th	Wt	Stem W	Base W	Base L	Bcon	Notch W	Notch D
A2862-0296-2		165	57	0-10	Toronto	B	PPK	med	tn	14.96	20.54	7.06	1.7	na	na	na	na	na	na
A2948-0296-1		165	57	30-40	Plattsmouth	B	PPK	dist	tn	4.76	6.56	3.05	0.1	na	na	na	na	na	na
A2948-0296-3		165	57	30-40	Westerville	SB	PPK	med	tn	17.48	8.32	5.87	0.7	na	na	na	na	na	na
A2975-0296		165	57	20-30	Plattsmouth C	B	PPK	dist	tn	22.17	19.48	4.19	1.5	na	na	na	na	na	na
A2976-0296		165	57	40-45	Plattsmouth A	B	PPK	med	tn	18.91	13.49	5.60	1.0	na	na	na	na	na	na
A2998-0296		147	59	0-10	Unidentified	B	PPK	med	tn	20.63	11.92	5.74	1.1	na	na	na	na	na	na
A3017-0296	35	147	59	0-10	Winterset	SB	PPK	med	tn	13.81	15.81	5.72	0.7	na	na	na	na	na	na
A3096-0296	277	147	59	30-40	Winterset	B	PPK	med	tn	25.95	16.66	5.20	2.9	na	na	na	na	na	na
A3172-0296-1		149	59	10-20	Mississippian	B	PPK	med	tn	12.33	8.91	3.76	0.3	na	na	na	na	na	na
A3223-0296	197	149	59	20-30	Plattsmouth C	B	PPK	dist	tn	31.40	19.50	6.23	2.7	na	na	na	na	na	na
A3280-0296		151	59	10-20	Toronto	B	PPK	med	tn	20.58	27.42	5.06	2.8	na	na	na	na	na	na
A3414-0296		153	59	10-20	Unidentified	SB	PPK	med	tn	12.29	12.40	4.38	0.4	na	na	na	na	na	na
A3525-0296		154	59	20-30	Plattsmouth A	B	PPK	med	tn	18.35	15.50	8.80	2.1	na	na	na	na	na	na
A3584-0296-1		156	59	0-10	Plattsmouth A	B	PPK	med	tn	18.68	9.99	5.33	1.0	na	na	na	na	na	na
A3617-0296-1		156	59	10-20	Plattsmouth C	SB	PPK	prox	tn	8.10	18.62	4.48	0.6	12.00	18.61	8.10	1.59	na	na
A3617-0296-2		156	59	10-20	Plattsmouth A	B	PPK	med	tn	27.48	13.38	5.63	1.9	na	na	na	na	na	na
A3644-0296-1		156	59	20-30	Toronto	FT	PPK	dist	tn	11.70	8.73	2.64	0.2	na	na	na	na	na	na
A3644-0296-2		156	59	20-30	Plattsmouth C	B	PPK	comp	tn	35.25	19.65	8.06	4.5	na	na	na	na	na	na
A3694-0296-1		158	59	0-10	Plattsmouth A	B	PPK	med	tn	10.05	14.15	5.36	1.0	na	na	na	na	na	na
A3694-0296-2		158	59	0-10	Unidentified	SB	PPK	prox	tn	14.14	16.42	5.45	1.2	na	na	na	na	na	na
A3694-0296-3		158	59	0-10	Toronto	B	PPK	med	tn	18.72	15.42	5.39	1.3	na	na	na	na	na	na
A3825-0296-1		160	59	10-20	Unidentified	B	PPK	dist	tn	30.94	16.51	8.71	3.1	na	na	na	na	na	na
A3866-0296	1024	160	59	20-30	Florence	B	PPK	dist	tn	26.69	17.29	3.76	1.6	na	na	na	na	na	na
A3923-0296-1		161	59	10-20	Toronto	B	PPK	dist	tn	25.60	21.47	9.44	3.3	na	na	na	na	na	na
A3923-0296-3		161	59	10-20	Florence	B	PPK	med	tn	11.77	16.44	5.62	1.2	na	na	na	na	na	na
A3974-0296-1		161	59	30-40	Winterset	B	PPK	med	tn	6.35	6.47	2.95	0.2	na	na	na	na	na	na
A3974-0296-2		161	59	30-40	Toronto	B	PPK	med	tn	10.26	18.33	5.03	0.6	na	na	na	na	na	na
A4089-0296	921	163	59	30-40	Florence	B	PPK	dist	tn	24.36	27.82	7.38	3.6	na	na	na	na	na	na
A4112-0296		165	59	0-10	Plattsmouth A	B	PPK	med	tn	14.96	11.87	6.24	1.0	na	na	na	na	na	na
A4138-0296	709	165	59	0-10	Mississippian	B	PPK	med	tn	14.42	21.36	5.14	1.5	na	na	na	na	na	na
A4156-0296	756	165	59	10-20	Toronto	SB	PPK	dist	tn	25.51	22.86	6.32	3.2	na	na	na	na	na	na
A4274-0296		147	61	10-20	Toronto	B	PPK	dist	tn	11.06	11.94	4.98	0.5	na	na	na	na	na	na
A4339-0296		147	61	30-40	Plattsmouth C	B	PPK	dist	tn	10.41	10.66	3.35	0.2	na	na	na	na	na	na
A4463-0296-2		151	61	0-10	Unidentified	B	PPK	med	tn	10.56	25.58	6.66	1.7	na	na	na	na	na	na
A4652-0296-2		153	61	20-30	Florence	SB	PPK	med	tn	18.27	18.05	6.37	1.8	na	na	na	na	na	na
A4723-0296-2		154	61	10-20	Unidentified	B	PPK	prox	tn	19.24	19.56	1.02	2.7	17.44	17.14	na	na	na	na
A4849-0296		156	61	0-10	Winterset	B	PPK	dist	tn	26.17	28.39	6.83	4.3	na	na	na	na	na	na
A4892-0296-1		156	61	20-30	Toronto	B	PPK	dist	tn	26.30	17.40	4.71	1.7	na	na	na	na	na	na
A4966-0296		158	61	0-10	Plattsmouth	B	PPK	med	tn	6.19	6.09	2.54	0.1	na	na	na	na	na	na
A5076-0296-1		158	61	30-40	Toronto	B	PPK	prox	tn	15.02	15.23	5.39	0.7	na	na	na	na	na	na
A5140-0296	539	158	61	40-50	Florence	B	PPK	med	tn	25.22	24.44	8.41	4.9	na	na	na	na	na	na
A5198-0296-1		160	61	20-30	Plattsmouth	B	PPK	dist	tn	17.14	13.71	4.99	1.5	na	na	na	na	na	na
A5198-0296-2		160	61	20-30	Unidentified	B	PPK	dist	tn	14.76	20.09	4.31	1.1	na	na	na	na	na	na
A5317-0296	915	161	61	20-30	Toronto	B	PPK	med	tn	29.73	35.26	10.22	7.5	na	na	na	na	na	na
A5342-0296		163	61	0-10	Florence	B	PPK	prox	tn	9.85	9.19	5.98	0.6	na	na	na	na	na	na
A5369-0296		163	61	10-20	Florence	B	PPK	med	tn	9.11	8.73	4.37	0.4	na	na	na	na	na	na
A5397-0296-2	986	163	61	20-30	Toronto	SB	PPK	med	tn	23.56	13.41	5.33	1.5	(10.24)	(9.18)	6.64	na	na	na
A5426-0296		163	61	30-40	Plattsmouth	SB	PPK	med	tn	14.84	9.78	4.35	0.6	na	na	na	na	na	na
A5480-0296		165	61	10-20	Toronto	B	PPK	dist	tn	8.58	5.66	2.07	<0.1	na	na	na	na	na	na
A5512-0296-1		165	61	20-30	Plattsmouth A	B	PPK	med	tn	35.16	10.76	7.32	2.8	na	na	na	na	na	na
A5512-0296-2		165	61	20-30	Plattsmouth A	B	PPK	med	tn	10.87	21.98	5.45	1.2	na	na	na	na	na	na
A5722-0296		156	63	10-20	Toronto	B	PPK	dist	tn	13.76	10.51	2.38	0.2	na	na	na	na	na	na
A5744-0296-1		156	63	20-30	Plattsmouth A	B	PPK	med	tn	9.14	18.32	6.86	1.1	na	na	na	na	na	na
A5744-0296-3		156	63	20-30	Florence	SB	PPK	med	tn	12.75	8.81	3.31	0.2	na	na	na	na	na	na
A5763-0296	1437	156	63	20-30	Westerville	B	PPK	dist	tn	19.95	13.34	4.38	0.9	na	na	na	na	na	na

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	Reworking	Stem	Base	Shoulders	Notch/ lateral indentation	Angle 1	Angle 2	Scr edges worked	Basal Grnding	Basal Thinning	St Bev	Bl Bev	Bl Serr	Heat Altered
A2862-0296-2		n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2948-0296-1	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A2948-0296-3	n	n a	n a	barbed	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2975-0296	y-edge retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A2976-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2998-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A3017-0296	n	n a	n a	square	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A3096-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A3172-0296-1	?	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A3223-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A3280-0296	y-tip retouched	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A3414-0296	n	n a	n a	barbed	?	n a	n a	n a	n a	n a	n a	n a	n a	
A3525-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A3584-0296-1	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A3617-0296-1	n a	expanding	concave	n a	side	n a	n a	n a	n	n	n	n a	n a	
A3617-0296-2	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A3644-0296-1	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A3644-0296-2	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n	
A3694-0296-1	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A3694-0296-2	n	n a	n a	n a	n a	n a	n a	n a	n	y	n a	n a	n a	
A3694-0296-3	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A3825-0296-1	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A3866-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	y	
A3923-0296-1	y-beveling	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n	
A3923-0296-3	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A3974-0296-1	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y?
A3974-0296-2	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A4089-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	y
A4112-0296	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A4138-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A4156-0296	y-broken end rwkd	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n	y
A4274-0296	y?	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n	
A4339-0296	y	n a	n a	n a	n a	40	n a	n a	n a	n a	n a	n	n	
A4463-0296-2	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A4652-0296-2	y-retouch	n a	square	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A4723-0296-2	n	straight	n a	n a	n a	n a	n a	n a	n	y	n	n a	n a	
A4849-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A4892-0296-1	y-bev	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n	
A4966-0296	n	n a	n a	barbed	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A5076-0296-1	n	straight		barbed		n a	n a	n a	n	n a	n a	n a	n a	
A5140-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A5198-0296-1	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n	
A5198-0296-2	y	n a	n a	n a	n a	n a	n a	n a	n a	y	n a	n a	n a	
A5317-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A5342-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A5369-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A5397-0296-2	n	straight	barbed	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A5426-0296	n a	n a	n a	barbed	basal	n a	n a	n a	n a	n a	n a	n a	n a	
A5480-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A5512-0296-1	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A5512-0296-2	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A5722-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	y	
A5744-0296-1	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A5744-0296-3	n	n a	n a	n a	base/side	n a	n a	n a	n a	n a	n a	n a	n a	
A5763-0296	y-bev	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n	

Catalogue #	Comments
A2862-0296-2	snap frac-very thhin edge
A2948-0296-1	
A2948-0296-3	point barb
A2975-0296	
A2976-0296	
A2998-0296	fire fractured
A3017-0296	notch present only
A3096-0296	burned
A3172-0296-1	possibly thinning flake
A3223-0296	burned; edge crushing; fire fractured
A3280-0296	reworked blade distal den; snap frac @ prox
A3414-0296	Barb frg, Hinge and snap fracs
A3525-0296	
A3584-0296-1	
A3617-0296-1	snap frac
A3617-0296-2	
A3644-0296-1	all edges worked, into ppk
A3644-0296-2	crude biface with drill bit-not hafted
A3694-0296-1	
A3694-0296-2	
A3694-0296-3	
A3825-0296-1	snap frac
A3866-0296	
A3923-0296-1	hinge fractures
A3923-0296-3	burned
A3974-0296-1	fire fractured
A3974-0296-2	snap frac
A4089-0296	burned/potlidded
A4112-0296	
A4138-0296	snap fracture
A4156-0296	usewear
A4274-0296	
A4339-0296	
A4463-0296-2	
A4652-0296-2	reworked ppk, shoulder evident
A4723-0296-2	side notched one side/ corner tang-like
A4849-0296	edge crushing
A4892-0296-1	snap frac
A4966-0296	barb of point
A5076-0296-1	basally notched??-small frg
A5140-0296	burned
A5198-0296-1	snap frac
A5198-0296-2	
A5317-0296	usewear
A5342-0296	small corner, snap frac
A5369-0296	
A5397-0296-2	
A5426-0296	barb from point
A5480-0296	
A5512-0296-1	snap frac
A5512-0296-2	fire frac
A5722-0296	
A5744-0296-1	fire fractured
A5744-0296-3	small frg, base and side notch
A5763-0296	snap frac

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	FN #	N	E	Depth, cmbg	Raw Material	Class	Func	Port	Stage/Type	L	W	Th	Wt	Stem W	Base W	Base L	Bcon	Notch W	Notch D
A5902-0296	1451	158	63	30-40	Plattsmouth C	SB	PPK	med	tn	25.57	14.40	5.46	1.7	na	na	na	na	na	na
A5926-0296		154	64	0-10	Plattsmouth	B	PPK	dist	tn	16.63	17.66	6.53	1.9	na	na	na	na	na	na
A5968-0296-1		154	64	10-20	Plattsmouth B	SB	PPK	prox	tn	8.80	16.21	4.33	0.5	na	na	na	na	na	na
A5968-0296-2		154	64	10-20	Plattsmouth A	B	PPK	med	tn	14.83	17.18	5.60	1.4	na	na	na	na	na	na
A6001-0296-4		154	64	20-30	Plattsmouth A	SB	PPK	med	tn	13.75	10.20	4.63	0.4	na	na	na	na	na	na
A6050-0296		154	64	30-40	Toronto	SB	PPK	med	tn	29.49	15.98	8.18	4.1	na	na	na	na	na	na
A6095-0296-2		154	66	0-10	Plattsmouth C	B	PPK	med	tn	12.41	18.54	7.96	1.7	na	na	na	na	na	na
A6095-0296-4		154	66	0-10	Unidentified	B	PPK	med	tn	10.57	18.08	5.43	0.8	na	na	na	na	na	na
A6095-0296-5		154	66	0-10	Plattsmouth C	B	PPK	dist	tn	11.42	20.44	4.83	1.1	na	na	na	na	na	na
A6095-0296-6		154	66	0-10	Plattsmouth C	B	PPK	dist	tn	12.27	17.37	4.35	0.8	na	na	na	na	na	na
A6269-0296-2		156	64	20-30	Winterset	B	PPK	med	tn	22.91	23.04	6.16	3.6	na	na	na	na	na	na
A6321-0296-1		158	64	0-10	Unidentified	SB	PPK	prox	tn	11.06	12.06	6.14	0.7	na	na	na	na	na	na
A6321-0296-2		158	64	0-10	Mississippian	SB	PPK	med	tn	5.66	6.77	2.18	0.1	na	na	na	na	na	na
A6405-0296	1218	158	64	10-20	Plattsmouth A	B	PPK	med	tn	31.46	17.35	5.09	3.4	na	na	na	na	na	na
A6447-0296-1		156	66	0-10	Plattsmouth	B	PPK	med	tn	14.14	5.14	2.87	0.1	na	na	na	na	na	na
A6525-0296-3		156	66	30-40	Toronto	SB	PPK	med	tn	11.41	11.48	2.97	0.2	na	na	na	na	na	na
A6624-0296		158	66	10-20	Unidentified	B	PPK	dist	tn	25.82	15.37	3.94	1.2	na	na	na	na	na	na
A6673-0296-1		158	66	30-40	Toronto	B	PPK	med	tn	20.17	6.51	4.51	0.5	na	na	na	na	na	na
A6775-0296-1		154	68	20-30	Toronto	B	PPK	dist	tn	17.11	17.65	4.61	1.1	na	na	na	na	na	na
A6874-0296	1255	156	68	10-20	Winterset	SB	PPK	med	tn	15.81	12.41	4.27	0.7	na	na	na	na	7.46	3.37
A6876-0296-1		156	68	20-30	Plattsmouth B	SB	PPK	prox	tn	13.86	10.16	4.75	0.6	na	na	na	na	na	na
A6897-0296		156	68	30-40	Unidentified	B	PPK	dist	tn	6.78	9.97	3.44	0.2	na	na	na	na	na	na
A6975-0296-1		158	68	20-30	Toronto	B	PPK	med	tn	15.96	21.52	6.94	2.2	na	na	na	na	na	na
A7114-0296	1180	154	66	20-30	Plattsmouth A	B	PPK	dist	tn	24.36	21.92	7.50	2.8	na	na	na	na	na	na
A7155-0296	13			Surface	Toronto	SB	PPK	prox	tn	10.57	13.22	4.82	0.6	na	13.22	10.57	na	na	na
A7158-0296	2			Surface	Toronto	B	PPK	med	tn	13.50	17.48	6.09	1.6	na	na	na	na	na	na
A7170-0296	1144			Surface	Unidentified	B	PPK	dist	tn	18.57	17.97	5.66	1.5	na	na	na	na	na	na
A7194-0296	1527			Surface T5	Mississippian	B	PPK	med	tn	10.98	18.34	7.10	1.9	na	na	na	na	na	na
A7208-0296	7	175	25	Surface 10x	Plattsmouth B	B	PPK	med	tn	16.96	25.87	4.80	1.8	na	na	na	na	na	na
A7209-0296	1642			Surface T6	Plattsmouth B	B	PPK	dist	tn	32.03	23.97	5.46	3.6	na	na	na	na	na	na
A7214-0296	1298			graded Surf	Wreford	B	PPK	dist	tn	11.92	13.13	3.67	0.7	na	na	na	na	na	na
A7220-0296				plowed Surf	Unidentified	B	PPK	dist	tn	32.14	16.55	5.21	2.6	na	na	na	na	na	na
A7235-0296		165	85	Surface 10x	Unidentified	B	PPK	prox	tn	10.51	16.34	3.47	0.5	?	15.89	?	na	4.14	2.77
A7238-0296		165	185	Surface 10x	Mississippian	B	PPK	dist	tn	16.47	17.28	4.95	0.9	na	na	na	na	na	na
A7239-0296				graded Surf	Plattsmouth B	SB	PPK	prox	tn	15.35	17.97	5.61	1.1	(13.35)	(18.87)	(6.00)	na	na	na
A7240-0296				graded Surf	Plattsmouth C	B	PPK	dist	tn	29.81	21.97	5.25	45.6	na	na	na	na	na	na
A7247-0296				graded Surf	Florence	B	PPK	med	tn	10.47	18.82	4.22	1.2	na	na	na	na	na	na
A7311-0296	693	164	53	30-40	Florence	B	PPK	med	tn	18.19	26.46	5.73	3.3	na	na	na	na	na	na
A2739-0296-1		163	57	0-10	Plattsmouth	B	PPK	prox	tn	18.01	13.18	3.50	0.9	13.12	9.44	na	na	na	na
A3664-0296-1		156	59	30-40		B	PPK	med	tn	24.84	12.41	5.45	1.7	na	na	na	na	na	na
A6691-0296	1279	158	66	30-40	Mississippian	SB	PPK	prox	Var I a	13.64	17.18	4.46	1.1	na	na	na	na	na	na
A3095-0296	276	147	59	30-40	Wreford	SB	PPK	prox	Var I b	15.34	27.32	4.23	1.8	na	na	na	(3.16)	na	na
A7427-0296	1514			trans 3	Plattsmouth A	SB	PPK	prox	Var I c	44.40	36.55	8.09	10.6	na	34.11	(35.43)	5.52	na	na
A5744-0296-2		156	63	20-30	Permian	SB	PPK	prox	Var I d	14.33	25.04	6.67	2.4	22.33	24.93	14.33	2.71	na	na
A1176-0495		161	73	69 cm	Unidentified	SB	PPK	comp	Var I e	27.56	12.57	5.92	2.3	12.23	12.48	9.23	0.95	na	na
A7199-0296	1385			Surface T2	Plattsmouth A	SB	PPK	comp	Var I f	48.59	21.68	5.40	5.1	na	20.25	na	2.00	na	na
A7231-0296				Surface T2	Plattsmouth	SB	PPK	comp	Var I g	42.34	17.65	5.43	1.1	na	na	na	na	na	na
A7180-0296	1388			Surface T2	Winterset	SB	PPK	comp	Var II a	62.08	23.81	11.76	16.2	na	16.88	na	na	na	na
A7163-0296	1533			Surface T2	Plattsmouth A	SB	PPK	comp	Var II b	57.66	20.42	9.50	11.8	na	16.52	na	na	na	na
A0193-0495		136.9	70.15	37 cm	Winterset	SB	PPK	comp	Var III a	44.11	(31.94)	7.32	8.5	17.83	22.52	10.49	na	6.42	10.80
A7195-0296	9			Surface	Mississippian	SB	PPK	med	Var III b	26.80	15.97	5.65	1.7	na	na	na	na	na	na
A7248-0296				graded Surf	Mississippian	SB	PPK	med	Var III c	16.61	9.97	3.38	0.4	na	na	na	na	na	na
A5719-0296	1387	156	63	0-10	Winterset	SB	PPK	prox	Var III d	30.21	31.12	8.02	6.2	16.46	19.01	13.50	na	10.55	7.66
A7188-0296	387	158	57	10-20	Toronto	SB	PPK	comp	Var IV a	76.64	25.65	7.99	13.4	14.27	10.92	13.79	na	15.69	3.40
A7177-0296	1505			Surface T3	Florence	SB	PPK	med	Var IV b	16.11	13.63	5.28	1.5	na	na	na	na	na	na

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	Reworking	Stem	Base	Shoulders	Notch/ lateral indentation	Angle 1	Angle 2	Scr edges worked	Basal Grnding	Basal Thinning	St Bev	Bl Bev	Bl Serr	Heat Altered
A5902-0296	y-bev	n a	n a	square	corner	n a	n a	n a	n a	n a	n a	y	n	
A5926-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y-sligh	n	
A5968-0296-1	n	expanding	concave	n a	n a	n a	n a	n a	n a	y	n a	n a	n a	
A5968-0296-2	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A6001-0296-4	n a	n a	n a	barbed	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6050-0296	y-tip retouch	n a	n a	rounded	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6095-0296-2	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A6095-0296-4	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A6095-0296-5	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A6095-0296-6	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6269-0296-2	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A6321-0296-1	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A6321-0296-2	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6405-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A6447-0296-1	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6525-0296-3	n a	n a	n a	barbed	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A6624-0296	y-tip retouch	?	?	rounded		n a	n a	n a	n a	n a	n a	y	n	
A6673-0296-1	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6775-0296-1	y-edge retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A6874-0296	n a	expanding	concave	squ-barbed	side	n a	n a	n a	n a	n a	n a	n a	n a	y
A6876-0296-1	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6897-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6975-0296-1	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7114-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y	n	
A7155-0296	n a	straight	straight	n a	n a	n a	n a	n a	n	n	n	n a	n a	
A7158-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7170-0296	y-edge retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A7194-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7208-0296	n	n a	n a	barbed	n a	n a	n a	n a	n a	n a	n a	n a	y	
A7209-0296	y-edge retouch, slightly bev	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A7214-0296	y	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	y
A7220-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A7235-0296		expanding	straight	barbed	side	n a	n a	n a	n	n	n	n a	n a	
A7238-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n	n	
A7239-0296	n a	expanding	concave	square	side/corner	n a	n a	n a	n	y	n	n a	n a	
A7240-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7247-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7311-0296	y	n a	n a	square	n a	n a	n a		n a	n a	n a	n a	n a	
A2739-0296-1	n	n a	n a	n a	n a	n a	n a	n a	n	n	n	n a	n a	
A3664-0296-1	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A6691-0296	n a	lanceolate	concave	absent	absent	n a	n a	n a	y	y-fluting	n a	n a	n a	
A3095-0296	n a	straight?	straight	n a	n a	n a	n a	n a	y, s&b	y	n	n a	n a	y
A7427-0296	y?	lanceolate	concave	absent	absent	n a	n a	n a	y	y	n	n a	n a	
A5744-0296-2	n a	lanceolate	concave	absent	absent	n a	n a	n a	n	y-flute	n	n a	n a	
A1176-0495	y-baled retouch	laanceolate	concave	n a	n a	n a	n a	n a	y	y	n	n	n	
A7199-0296	y-bev, retouch	str-contracting	concave	absent	absent	n a	n a	n a	n	y	n	y	n	
A7231-0296	y-retouch	n a	n a	n a	n a	n a	n a	n a	n	y	n	n	n	
A7180-0296	y-retouch, bev on blade	str-contract	straight	absent	absent	n a	n a	n a	n	n	n	y	n	
A7163-0296	y-blade retouch	str	str-concave	absent	absent	n a	n a	n a	n	n	n	n	n	
A0193-0495	y-blade retouch	expanding	straight	barbed	basal	n a	n a	n a	n	y	n	y	n	
A7195-0296	n a	n a	n a	barbed	basal	n a	n a	n a	n a	n a	n a	n a	n a	
A7248-0296	n a	n a	n a	barbed	basal	n a	n a	n a	n a	n a	n a	n a	n a	
A5719-0296	y-blade retouch-into scr	expanding	convex	barbed	corner	n a	n a	n a	n	y	n	y	n	
A7188-0296	y-blade retouch	straight	convex	barbed	basal	n a	n a	n a	n	n	n	n	n	
A7177-0296	n a	straight?	n a	n a	n a	n a	n a	n a	n	n a	y	n a	n a	

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	Comments
A5902-0296	
A5926-0296	
A5968-0296-1	base frg
A5968-0296-2	snap?; fire fractured
A6001-0296-4	barb frg
A6050-0296	appears unfinished, tip used
A6095-0296-2	
A6095-0296-4	burned
A6095-0296-5	snap frac
A6095-0296-6	hinge frcs at tip, snap frac
A6269-0296-2	snap frac
A6321-0296-1	burned, fire frac
A6321-0296-2	point barb frg
A6405-0296	burned
A6447-0296-1	lateral edge fragment
A6525-0296-3	fire fractured/pot lidded
A6624-0296	
A6673-0296-1	lateral edge
A6775-0296-1	
A6874-0296	side frg; fire frac
A6876-0296-1	barb or base frg
A6897-0296	
A6975-0296-1	
A7114-0296	
A7155-0296	base frac
A7158-0296	snap frac
A7170-0296	snap frac
A7194-0296	possibly drill?
A7208-0296	med frg w/barb -snap frac at distal
A7209-0296	blade has slight bevel one side, serration on other
A7214-0296	burned/potlidded
A7220-0296	very nice, snap frac
A7235-0296	arrow pt rwkd into drill? snap frac
A7238-0296	snap frac
A7239-0296	snap frac; medial w/barb frg
A7240-0296	snap frac
A7247-0296	
A7311-0296	snap frac
A2739-0296-1	oblique flaking?
A3664-0296-1	
A6691-0296	fluted on one side; Folsom; Flute Th= 3.81
A3095-0296	Folsom; fire fractured, flute thickness unknown
A7427-0296	Dalton base
A5744-0296-2	Dalton base
A1176-0495	Paleoindian
A7199-0296	Possibly Plainview
A7231-0296	triangular biface, very thin, point preform/ knife
A7180-0296	Nebo Hill
A7163-0296	Nebo Hill
A0193-0495	Calf Creek - missing one lateral edge
A7195-0296	very prominent barb fragment probably Calf Creek
A7248-0296	barb from dart point-Calf Creek
A5719-0296	hafted scraper - Possibly Calf Creek or Helton
A7188-0296	Early Woodland - Little Bear Creek/Ponchartrain?
A7177-0296	a haft fragmetn, possibly early woodland, unknown

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	FN #	N	E	Depth, cmbg	Raw Material	Class	Func	Port	Stage/Type	L	W	Th	Wt	Stem W	Base W	Base L	Bcon	Notch W	Notch D
A7167-0296	12			Surface	Westerville	SB	PPK	prox	Var IX a	35.56	21.02	8.00	5.7	18.14	21.60	14.19	n a	8.44	2.53
A7196-0296	1580			Surface T4	Unidentified	SB	PPK	comp	Var IX b	44.42	22.68	8.54	8.8	19.43	23.26	10.70	n a	12.72	2.47
A7191-0296	684	154	59	30-40	Wreford	SB	PPK	comp	Var IX c	37.71	21.70	8.67	6.8	16.91	19.52	12.07	n a	11.18	2.30
A2616-0296	727	161	57	0-10	Plattsmouth A	SB	PPK	comp	Var IX d	48.59	25.95	10.14	6.9	18.50	20.30	10.05	2.06	11.59	1.28
A5295-0296	802	161	61	10-20	Mississippian	SB	PPK	comp	Var Vp	39.19	21.55	6.20	5.4	16.77	20.33	10.31	n a	8.96	2.82
A7183-0296	1275	158	64	20-30	Westerville	SB	PPK	comp	Var IX e	29.23	28.72	8.36	5.7	19.67	25.72	10.79	n a	12.75	2.67
A7237-0296				Surface T1	Plattsmouth C	SB	PPK	prox	Var Vq	33.02	21.33	7.18	5.4	18.48	21.77	8.95	1.56	7.62	1.95
A7165-0296	1			Surface	Plattsmouth C	SB	PPK	comp	Var Vr	39.85	24.76	9.80	8.9	19.08	24.78	9.09	n a	8.15	1.96
A7206-0296	1606			Surface T4	Florence	SB	PPK	comp	Var IX f	64.11	28.82	7.22	12.2	16.89	19.67	13.38	n a	12.06	3.81
A7174-0296	1457			Surface	Toronto	SB	PPK	comp	Var IX g	46.57	28.27	6.12	7.0	15.33	18.47	10.48	n a	7.87	3.81
A7178-0296	1587			Surface T4	Mississippian	SB	PPK	comp	Var IX h	51.27	30.62	8.38	12.1	17.28	21.53	12.33	0.87	14.00	3.66
A2229-0296	564	156	57	20-30	Mississippian	SB	PPK	comp	Var IX i	38.12	(28.46)	6.97	7.7	15.35	17.48	8.89	n a	8.02	3.61
A7193-0296	520	155	55	Surface 10x	Mississippian	SB	PPK	prox	Var IX j	(33.62)	(10.75)	6.84	3.9	13.58	16.20	12.77	n a	12.64	4.87
A7219-0296	1360			Surface T2	Plattsmouth A	SB	PPK	prox	Var IX k	13.54	21.80	5.40	1.9	16.85	21.80	13.54	2.44	n a	n a
A3944-0296-3		161	59	20-30	Plattsmouth C	SB	PPK	prox	Var IX L	10.09	19.59	5.49	1.0	15.71	19.15	10.09	n a	n a	n a
A7173-0296	1039			Surface	Plattsmouth C	SB	PPK	prox	Var IX m	14.51	21.32	6.70	2.2	16.86	21.32	14.51	n a	n a	n a
A7228-0296				graded Surf	Toronto	SB	PPK	prox	Var IX n	19.10	20.10	5.25	1.9	16.15	20.59	10.60	n a	n a	n a
A4586-0296		151	61	40-50	Toronto	SB	PPK	prox	Var IX o	10.85	19.52	5.18	1.2	n a	n a	n a	n a	n a	n a
A7166-0296	1520			Surface T4	Winterset	SB	PPK	prox	Var IX p	19.34	21.74	6.23	2.7	15.19	22.30	10.40	n a	n a	n a
A7331-0296	839	149	63	surface	Florence	SB	PPK	prox	Var IX q	11.52	25.52	6.15	1.7	n a	n a	n a	n a	n a	n a
A4698-0296		154	61	0-10	Florence	SB	PPK	prox	Var IX r	7.25	22.04	4.79	0.7	n a	n a	n a	n a	n a	n a
A4793-0296		154	61	30-40	Toronto	SB	PPK	prox	Var IX s	24.70	10.41	3.26	1.0	n a	n a	n a	n a	n a	n a
A4019-0296	777	163	59	0-10	Unidentified	SB	PPK	comp	Var V a	43.62	20.31	5.10	4.5	13.04	19.07	8.58	0.98	5.94	3.18
A3803-0296		160	59	0-10	Toronto	SB	PPK	prox	Var V b	7.83	14.95	2.41	0.3	n a	n a	n a	n a	n a	n a
A1882-0296		151	57	0-10	Toronto	SB	PPK	prox	Var V c	13.57	21.32	5.34	1.2	15.22	(11.26)	9.25	n a	(7.39)	2.72
A2271-0296-3		158	57	0-10	Plattsmouth C	SB	PPK	comp	Var V d	9.92	19.39	4.17	0.9	13.21	19.39	9.92	n a	n a	n a
A2828.5-0296		163	57	30-40	Unidentified	SB	PPK	prox	Var V e	13.30	15.65	5.17	1.1	(12.26)	(14.95)	5.42	n a	4.48	3.37
A2380-0296	69	149	61	0-10	Plattsmouth B	SB	PPK	prox	Var V f	21.71	17.45	6.30	2.5	12.15	16.81	6.92	1.78	5.60	2.82
A3617-0296-3		156	59	10-20	Plattsmouth	SB	PPK	med	Var V g	19.50	13.62	5.36	0.9	n a	n a	n a	n a	n a	n a
A5076-0296-4		158	61	30-40	Plattsmouth A	SB	PPK	prox	Var V h	7.34	17.93	4.17	0.4	n a	n a	n a	n a	n a	n a
A6852-0296-2		156	68	10-20	Plattsmouth A	SB	PPK	prox	Var V i	7.51	18.64	4.07	0.5	n a	n a	n a	1.47	n a	n a
A7229-0296				Surface T4	Winterset	SB	PPK	comp	Var V j	31.39	17.73	6.02	3.1	16.58	10.44	7.70	1.88	8.16	3.38
A4262-0296	102	147	61	0-10	Toronto	SB	PPK	prox	Var V k	18.18	17.41	5.56	1.6	10.91	(13.67)	8.07	1.33	5.25	2.74
A7232-0296				graded Surf	Plattsmouth A	SB	PPK	prox	Var V L	21.89	23.35	6.18	3.4	15.69	20.10	6.52	2.37	10.36	3.02
A4892-0296-3		156	61	20-30	Plattsmouth C	SB	PPK	prox	Var V m	12.48	19.18	5.35	1.1	13.59	18.83	9.14	1.97	n a	n a
A2163-0296-3		156	57	0-10	Wreford	SB	PPK	prox	Var V n	25.44	19.22	6.38	2.9	14.53	18.36	7.30	n a	(7.02)	2.58
A5076-0296-3		158	61	30-40	Plattsmouth	SB	PPK	prox	Var V o	19.50	18.77	5.46	0.6	15.31	(17.00)	5.87	0.74	3.50	1.10
A5646-0296	1408	154	63	20-30	Unidentified	SB	PPK	comp	Var VI a	56.98	32.85	7.68	11.9	16.07	19.50	10.65	n a	6.66	4.61
A1811-0296	75	149	57	0-10	Winterset	SB	PPK	comp	Var VI b	22.55	25.14	6.35	3.3	15.69	21.04	11.08	n a	8.25	3.79
A5273-0296	721	161	61	0-10	Toronto	SB	PPK	comp	Var VI c	23.50	22.68	7.45	3.4	(16.28)	20.70	14.98	n a	10.58	3.80
A7221-0296				graded Surf	Unidentified	SB	PPK	prox	Var VII a	15.33	19.78	6.89	2.3	17.37	19.79	11.43	n a	n a	n a
A7171-0296	963			Surface	Toronto	SB	PPK	prox	Var VII b	11.94	17.84	6.58	1.3	n a	n a	n a	n a	n a	n a
A2307-0296-2		158	57	10-20	Toronto	SB	PPK	prox	Var VII c	12.47	18.86	6.11	1.2	16.60	18.74	8.35	n a	n a	n a
A7190-0296	1578			Surface T4	Mississippian	SB	PPK	comp	Var VIII a	42.08	26.33	6.48	6.3	17.22	20.43	9.49	n a	9.97	4.80
A1747-0495	(44)	180.15	42.02	23cmbd	Mississippian	SB	PPK	comp	Var VIII b	39.47	29.25	7.27	6.7	15.86	18.40	9.24	n a	9.15	3.51
A2624-0296-1		161	57	10-20	Plattsmouth C	SB	PPK	prox	Var X 1 a	9.55	19.60	4.20	0.7	(11.90)	19.60	9.55	n a	n a	n a
A2615-0296	725	161	57	0-10	Plattsmouth C	SB	PPK	prox	Var X 1 b	10.67	19.69	4.31	0.9	12.89	19.69	10.67	n a	n a	n a
A7161-0296	10			Surface	Winterset	SB	PPK	prox	Var X 1 c	11.23	19.43	5.72	1.1	12.25	19.42	11.05	n a	n a	n a
A7233-0296-2		165	75	plowed surf	Unidentified	SB	PPK	prox	Var X 1 d	13.57	19.02	4.76	1.4	n a	n a	n a	n a	n a	n a
A6321-0296-3		158	64	0-10	Toronto	SB	PPK	prox	Var X 1 e	23.72	18.39	5.92	2.3	14.01	17.20	15.16	n a	n a	n a
A6215-0296		156	64	0-10	Westerville	SB	PPK	prox	Var X 1 f	17.34	17.56	5.31	1.8	13.34	15.54	11.43	n a	n a	n a
A7164-0296	1363			Surface T2	Toronto	SB	PPK	prox	Var X 1 g	41.12	37.26	8.27	12.9	20.17	23.52	13.19	n a	10.68	6.18
A7181-0296	1563			Surface T1	Permian	SB	PPK	comp	Var X 1 h	50.85	19.91	7.44	6.2	10.62	15.92	7.00	n a	8.80	3.60
A7197-0296	11			Surface	Florence	SB	PPK	prox	Var X 1 i	16.84	25.11	4.99	1.5	9.53	12.06)	5.70	n a	4.28	6.59
A4141-0296	728	165	59	0-10	Plattsmouth C	SB	PPK	prox	Var X 1 j	23.29	24.81	7.30	3.3	11.53	(11.86)	7.31	n a	6.09	4.23

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	Reworking	Stem	Base	Shoulders	Notch/ lateral indentation	Angle 1	Angle 2	Scr edges worked	Basal Grnding	Basal Thinning	St Bev	Bl Bev	Bl Serr	Heat Altered
A7167-0296	n a	expanding	convex	square	side	n a	n a	n a	n	y	n	n a	n a	
A7196-0296	y-retouch/bev blade	expanding	convex	rounded	side	n a	n a	n a	n	n	n	y	n	
A7191-0296	y-retouch	straight	straight	rounded	side	n a	n a	n a	n	y	n	n	n	
A2616-0296	y-retouch, flake island 1 side	str-exp	concave	rounded	side	n a	n a	n a	n	y	n	n	n	
A5295-0296	y-bev, retouch of blade	expanding	straight	square	side	n a	n a	n a	n	n	n	y	n	
A7183-0296	y-rwked into scr	expanding	convex	rounded	side	n a	n a	n a	n	y	n	y	n	
A7237-0296	y-bev, retouch blade	expanding	concave	rounded	side	n a	n a	n a	n	y	y	y	n	
A7165-0296	y	expanding	straight	square	side	n a	n a	n a	n	y	n	y	n	
A7206-0296	y-blade retouch	str-exp	convex	sq-barbed	corner	n a	n a	n a	n	y	n	y	n	
A7174-0296	y-retouched edge, tip	expanding	convex	barbed	corner	n a	n a	n a	n	y	n	y	n	
A7178-0296	y-blade retouch	expanding	slght concave	square	corner	n a	n a	n a	n	y	n	y	n	
A2229-0296	tip retouched	expanding	straight	barbed	corner	n a	n a	n a	n	n	n	n	n	
A7193-0296	y - blade retouch	expanding	convex	barbed	corner	n a	n a	n a	n	y	n	n a	n a	
A7219-0296	n a	expanding	concave	n a	n a	n a	n a	n a	n	y	n	n a	n a	
A3944-0296-3	n a	expanding	str - ccave	n a	n a	n a	n a	n a	n	y	n	n a	n a	
A7173-0296	n a	expanding	straight	n a	n a	n a	n a	n a	n	y	n	n a	n a	
A7228-0296	n a	expanding	straight	n a	n a	n a	n a	n a	y	y	y	n a	n a	
A4586-0296	n a	expanding	straight	n a	n a	n a	n a	n a	n	y	n	n a	n a	
A7166-0296	n a	expanding	convex	barbed?	side	n a	n a	n a	n	y	n	n a	n a	
A7331-0296	n	expanding	concave	n a	n a	n a	n a	n a	n	n	n a	n a	n a	
A4698-0296	n a	expanding	straight	n a	side	n a	n a	n a	n	n	n a	n a	n a	
A4793-0296	n	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A4019-0296	y-bev of blade, retouch	straight	concave	square	side	n a	n a	n a	y(b)	y	n	y	n	
A3803-0296	n a	expanding	straight	barbed	side	n a	n a	n a	n a	n	n a	n a	n a	
A1882-0296	n a	expanding	straight?	square	side	n a	n a	n a	n a	n a	n a	n a	n a	
A2271-0296-3	n a	expanding	straight	n a	side	n a	n a	n a	y	y	n	n a	n a	
A2828.5-0296	n a	expanding	straight	square	side	n a	n a	n a	n	y	n	n a	n a	y
A2380-0296	y-retouch	expanding	concave	square	side	n a	n a	n a	y	y	n	n	n	
A3617-0296-3	y-retouch	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A5076-0296-4	n a	expanding	n a	n a	side	n a	n a	n a	n a	n a	n a	n a	n a	
A6852-0296-2	n a	expanding	concave	n a	side	n a	n a	n a	n	n	n	n a	n a	
A7229-0296	y? retouch on blade	expanding	concave	square	side	n a	n a	n a	n	n	n	n	n	
A4262-0296	n a	expanding	concave	rounded	side	n a	n a	n a	n	y	n a	y	n a	
A7232-0296	y retouch	expanding	concave	square	side	n a	n a	n a	n	y	n	n	n a	
A4892-0296-3	n a	expanding	concave	n a	n a	n a	n a	n a	n	y	n	n a	n a	
A2163-0296-3	n a	expanding	straight	rounded	side	n a	n a	n a	n	y	y	n a	n a	y?
A5076-0296-3	y-bev, retouch	expanding	concave	square	side	n a	n a	n a	n	y	n	y	n	
A5646-0296	y-retouch	expanding	convex	barbed	corner	n a	n a	n a	n	n	y	n	n	
A1811-0296	y-rwkd into scr	expanding	convex	barbed	side	n a	n a	n a	n	y	n	n	n	
A5273-0296	y-into scr	expanding	convex	barbed	side	n a	n a	n a	n	n	n	n a	n a	
A7221-0296		expanding	convex	n a	side?	n a	n a	n a	n	y	n	n a	n a	
A7171-0296	n a	expanding	convex	n a	n a	n a	n a	n a	n	n	n	n a	n a	
A2307-0296-2	n a	slightly exp	straight	n a	side	n a	n a	n a	n	n	n	n a	n a	
A7190-0296	y-blade retouch	expanding	straight	square	side	n a	n a	n a	n	y	n	n	n	
A1747-0495	blade retouch	straight	straight	barbed	side	n a	n a	n a	n	n	n	n	n	y
A2624-0296-1	n a	expanding	straight	n a	n a	n a	n a	n a	n	y	n	n a	n a	
A2615-0296	n a	expanding	straight	n a	side	n a	n a	n a	n	y	n	n a	n a	
A7161-0296	n a	expanding	convex	n a	side	n a	n a	n a	n	y	n	n a	n a	
A7233-0296-2	n a	expanding	convex	n a	side?	n a	n a	n a	n	n	n	n a	n a	
A6321-0296-3	n a	expanding	straight	n a	n a	n a	n a	n a	n	y	n	y	n a	
A6215-0296	n a	str-exp	straight	barbed	corner	n a	n a	n a	n	y	n	n a	n a	
A7164-0296	n? (damaged, hard toID)	expanding	straight	barbed	corner	n a	n a	n a	n	y	n	n a	n a	
A7181-0296	y-blade retouch	expanding	straight	square	side	n a	n a	n a	n	y	n	y	y	
A7197-0296	n a	expanding	concave	barbed	corner	n a	n a	n a	n	y	n	n a	y	
A4141-0296	n a	expanding	straight	barbed	corner	n a	n a	n a	n	y	n a	n a	n a	

Catalogue #	Comments
A7167-0296	impact fracture, burinated
A7196-0296	tip broken, Impact
A7191-0296	hinge fractures
A2616-0296	
A5295-0296	assymetrical from reworking
A7183-0296	
A7237-0296	tip missing, snap fracture
A7165-0296	very bulky, hinge fractures
A7206-0296	one corner missing
A7174-0296	tip reworked into cutting edge (post impact frac), hinge fractures
A7178-0296	
A2229-0296	reworked distal end, tip missing, one barb missing
A7193-0296	heavy damage, impact fractures
A7219-0296	snap fracture
A3944-0296-3	snap fracture
A7173-0296	snap fracture
A7228-0296	snap fracture
A4586-0296	snap fracture
A7166-0296	snap fracture?
A7331-0296	snap fracture?
A4698-0296	snap fracture
A4793-0296	
A4019-0296	
A3803-0296	
A1882-0296	
A2271-0296-3	
A2828.5-0296	snap fractured, fire fractured
A2380-0296	snap fracture
A3617-0296-3	snap fracture
A5076-0296-4	
A6852-0296-2	snap fracture
A7229-0296	impact frac on distal end,*tip is missing
A4262-0296	portion of blade appears alt beveled
A7232-0296	snap fracture, one base tang missing
A4892-0296-3	Base fragmetns, snap fracture
A2163-0296-3	Fire fractured
A5076-0296-3	Snap fracture
A5646-0296	edge crushing, hinge fractures on blade edges
A1811-0296	hafted scraper
A5273-0296	hafted scraper; impact fracture
A7221-0296	base fragment, indention on upper side, possibly notching
A7171-0296	base fragment; snap fracture
A2307-0296-2	base fragment; snap fracture
A7190-0296	
A1747-0495	Reworked post patination
A2624-0296-1	Snap fracture
A2615-0296	snap fracture
A7161-0296	snap fracture
A7233-0296-2	snap fracture; found 12.7m, 175degrees from N165 E75
A6321-0296-3	base and small portion of blade, beveled,snap fracture
A6215-0296	distal end missing, including barb ends
A7164-0296	snap fracture; large flake scars on blade -unused?
A7181-0296	
A7197-0296	snap fracture on distal end, one tang of base missing
A4141-0296	snap fracture, part of base missing

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	FN #	N	E	Depth, cmbg	Raw Material	Class	Func	Port	Stage/Type	L	W	Th	Wt	Stem W	Base W	Base L	Bcon	Notch W	Notch D
A7187-0296	1569					SB	PPK	prox	Var X 1 k	42.82	37.05	7.61	12.9	17.36	20.69	13.24	n a	9.23	4.55
A5550-0296	850	165	61	30-40	Plattsmouth A	SB	PPK	prox	Var X 1 L	30.37	29.14	8.03	7.5	14.98	15.18	10.81	n a	11.53	3.24
A7186-0296-2	1347	Trans 1		surface	Plattsmouth	SB	PPK	prox	Var X 2 a	44.81	26.52	9.81	11.7	17.96	18.13	13.75	n a	13.17	3.10
A0599-0495		148.24	56.26	29 cm	Florence	SB	PPK	prox	Var X 2 b	13.01	20.97	5.04	1.6	n a	n a	n a	n a	n a	n a
A7218-0296	1339			Surface T2	Florence	SB	PPK	comp	Var X 3 a	21.58	25.53	6.09	3.3	15.98	(16.45)	(9.44)	n a	(9.44)	(4.13)
A7201-0296	14			Surface	Toronto	SB	PPK	med	Var X 3 b	25.81	18.57	8.26	3.6	n a	n a	naa	n a	n a	n a
A4263-0296	91	147	61	0-10	Unidentified	SB	PPK	comp	Var X 3 c	20.58	19.65	6.24	2.7	14.68	17.85	10.69	n a	6.75	2.33
A7234-0296				Surface T3	Unidentified	SB	PPK	comp	Var X 3 d	36.41	26.09	8.52	6.5	16.43	18.51	11.83	n a	9.89	4.00
A1356-0495	75	164.26	57.5	38 cm	Mississippian	SB	PPK	prox	Var X 4 a	26.17	21.46	5.80	3.1	16.38	(9.86)	(18.03)	n a	n a	n a
A1864-0296-2		149	57	30-40	Toronto	SB	PPK	prox	Var X 4 b	28.09	20.10	7.35	3.9	(14.47)	(16.47)	(9.56)	n a	7.67	3.71
A4487-0296	62	151	61	no depth	Toronto	SB	PPK	dist	Var X 4 c	36.41	26.79	6.50	5.8	16.77	n a	(8.87)	n a	n a	n a
A7189-0296	1364			Surface T2	Florence	SB	PPK	med	Var X 4 d	48.90	30.07	8.65	10.1	n a	n a	n a	n a	11.75	5.23
A7192-0296	1573			Surface T4	Winterset	SB	PPK	med	Var X 4 e	45.33	38.98	9.92	16.3	21.38	n a	n a	n a	n a	n a
A2590-0296		161	57	0-10	Toronto	SFT	PPK	comp	Var XI 1 a	19.93	16.45	3.57	0.9	7.77	17.09	8.02	2.23	7.60	3.76
A3584-0296-2	905	156	59	0-10	Toronto	SB	PPK	comp	Var XI 1 b	21.58	13.90	3.88	0.8	7.34	13.91	9.06	2.40	3.68	2.56
A7230-0296	Area B			graded Surf	Winterset	SB	PPK	comp	Var XI 1 c	19.12	11.36	3.02	0.6	7.60	10.40	6.54	1.10	5.21	1.55
A7217-0296	8			graded Surf	Toronto	FT	PPK	comp	Var XI 1 d	19.84	9.59	2.80	0.3	5.09	10.08	6.67	(1.75)	3.46	2.53
A7242-0296	752	165	85	Surface 10x	Toronto	SB	PPK	comp	Var XI 2 a	21.75	14.00	3.05	0.8	7.22	13.33	6.48	n a	3.96	2.61
A3130-0296-4		149	59	0-10	Mississippian	SFT	PPK	comp	Var XI 2 b	18.55	7.69 (bw)	1.96	0.5	6.44	12.39	6.77	n a	4.97	2.23
A7227-0296				Surface T2	Mississippian	SB	PPK	comp	Var XI 2 c	18.27	10.27(bw)	3.44	0.7	8.18	13.68	5.62	0.79	5.24	1.94
A3032-0296		147	59	10-20	Unidentified	SB	PPK	prox	Var XI 2 d	11.63	12.28	2.73	0.4	7.10	12.02	6.25	n a	3.47	2.07
A4261-0296	16	147	61	0-10	Toronto	SB	PPK	comp	Var XI 2 e	20.68	10.04 (bw)	4.03	0.6	9.03	10.96	5.80	n a	3.37	1.18
A7203-0296	705	135	45	Surface 10x	Toronto	SB	PPK	comp	Var XI 3 a	18.87	15.35	4.25	0.9	n a	n a	n a	n a	n a	n a
A7205-0296	954			Surface	Toronto	FT	PPK	comp	Var XI 3 b	22.98	11.58	3.50	0.8	n a	n a	n a	n a	n a	n a
A7215-0296	559			Surface	Mississippian	SB	PPK	prox	Var XI 3 c	13.04	18.19	3.66	0.9	(10.54)	18.19	13.04	n a	n a	n a
A2614-0296	724	161	57	0-10	Florence	SB	PPK	comp	Var XI 4 a	21.42	15.45	3.58	0.9	(8.16)	(9.03)	(3.42)	(1.17)	1.94	2.57
A1723-0296-1		147	57	20-30	Unidentified	SB	PPK	med	Var XI 4 b	10.36	4.02	2.06	<0.1	n a	n a	n a	n a	n a	n a
A2739-0296-2		163	57	0-10	Unidentified	SB	PPK	prox	Var XI 4 c	5.49	12.63	2.30	0.1	n a	n a	n a	n a	n a	n a
A1713-0296	93	147	57	10-20	Winterset	B	SCR	med	End	38.93	22.86	12.18	9.4	n a	n a	n a	n a	n a	n a
A3923-0296-4		161	59	10-20	Westerville	FT	SCR	dist?	End	14.70	25.59	7.19	3.5	n a	n a	n a	n a	n a	n a
A5554-0296	875	165	61	30-40	Plattsmouth	FT	SCR	comp	End	42.26	22.64	15.72	9.2	n a	n a	n a	n a	n a	n a
A5873-0296	1421	158	63	20-30	Unidentified	FT	SCR	med	End	19.02	18.44	8.84	3.0	n a	n a	n a	n a	n a	n a
A5874-0296	1431	158	63	20-30	Mississippian	FT	SCR	comp	End	56.26	44.88	17.16	36.5	n a	n a	n a	n a	n a	n a
A2819-0296	909	163	57	20-30	Florence	FT	SCR	comp	End	57.27	43.88	24.84	47.2	n a	n a	n a	n a	n a	n a
A5033-0296	390	158	61	10-20	Florence	FT	SCR	comp	End	39.82	24.68	11.75	11.2	n a	n a	n a	n a	n a	n a
A2591-0296		161	57	0-10	Plattsmouth	FT	SCR	comp	Side	25.27	26.94	16.31	10.1	n a	n a	n a	n a	n a	n a
A4140-0296	715	165	59	0-10	Plattsmouth A	FT	SCR	prox	Side	28.40	23.87	8.23	5.5	n a	n a	n a	n a	n a	n a
A4293-0296	123	147	61	10-20	Toronto	FT	SCR	comp	Side and End	31.98	22.01	9.58	6.8	n a	n a	n a	n a	n a	n a
A5218-0296	1017	160	61	20-30	Niobrara Jasper	FT	SCR	comp	Side and End	36.74	24.09	16.49	9.2	n a	n a	n a	n a	n a	n a
A7160-0296	1518			Surface T3	Florence	FT	SCR	dist	Side and End	36.46	36.57	14.09	17.7	n a	n a	n a	n a	n a	n a
A1686-0296	47	147	57	0-10	Winterset	FT	SCR	dist	Side and End	23.24	21.93	5.80	3.2	n a	n a	n a	n a	n a	n a
A7185-0296	565A			Surface	Unidentified	FT	SCR	prox	SIde and End	21.13	23.84	5.49	3.4	n a	n a	n a	n a	n a	n a
A4292-0296	112	147	61	10-20	Toronto	FT	SCR	dist	Side and End	45.84	23.27	5.30	7.2	n a	n a	n a	n a	n a	n a
A7182-0296	537	158	61	40-50	Westerville	FT	SCR	comp	Side and End	67.46	23.55	5.51	8.8	n a	n a	n a	n a	n a	n a
A2885-0296	710	165	57	0-10	Unidentified	FT	SCR	comp	Side and End	44.11	24.77	9.71	10.3	n a	n a	n a	n a	n a	n a
A7200-0296	1625			Surface T5	Unidentified	FT	SCR	comp	Side and End	51.67	22.00	8.41	8.2	n a	n a	n a	n a	n a	n a
A7204-0296	1577			Surface T4	Unidentified	FT	SCR	comp	Side and End	34.05	33.02	9.34	12.8	n a	n a	n a	n a	n a	n a
A2524-0296	1004	157	61	0-10	Toronto	FT	SCR	comp	Utilized	45.36	41.46	19.32	28.7	n a	n a	n a	n a	n a	n a
A5654-0296	1418	154	63	20-30	Plattsmouth A	Core	SCR	comp	Utilized	58.31	43.81	36.30	35.9	n a	n a	n a	n a	n a	n a
A6706-0296-2		158	66	40-45		Core	SCR	comp	Utilized	53.39	31.48	19.74	33.8	n a	n a	n a	n a	n a	n a
A7213-0296	1568			Surface T1 s	Toronto	Core	SCR	comp	Utilized	44.00	34.92	20.35	26.3	n a	n a	n a	n a	n a	n a
A1934-0296		151	57	20-30	Plattsmouth A	FT	SCR	comp	Utilized	42.16	34.40	12.04	20.4	n a	n a	n a	n a	n a	n a
A2818-0296	908	163	57	20-30	Florence	FT	SCR	comp	Utilized	48.32	32.79	20.26	29.8	n a	n a	n a	n a	n a	n a
A7093-0296	1075	154	66	0-10	Plattsmouth A	Core	SCR	comp	Utilized	53.15	40.13	31.80	58.3	n a	n a	n a	n a	n a	n a

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	Reworking	Stem	Base	Shoulders	Notch/ lateral indentation	Angle 1	Angle 2	Scr edges worked	Basal Grnding	Basal Thinning	St Bev	Bl Bev	Bl Serr	Heat Altered
A7187-0296	y-blade retouch	expanding	convex	barbed	corner	n a	n a	n a	n	n	n	n	n	
A5550-0296	y-retouch balde edges	straight	convex	square	corner	n a	n a	n a	n	n	n	y	n	
A7186-0296-2	y-bev	straight	straight	square	corner	n a	n a	n a	n	n	y	y	n	
A0599-0495	n a	straight	straight	n a	n a	n a	n a	n a	b=y, s=n	y	n	n a	n a	
A7218-0296	y-rewkd into scraper	str-expanding	n a	barbed	corner	n a	n a	n a	n	y	y	n	n	
A7201-0296	y-into scraper	n a	n a	barbed	corner	n a	n a	n a	n a	n a	n a	y	n	y
A4263-0296	y-retouch, wkd into scr	expanding	straight	barbed	side/corner	n a	n a	n a	n	y	n	n	n	
A7234-0296	y-retouch, exhausted, flake scar island	expanding	straight	barbed	corner	n a	n a	n a	n	y	n	n	n	
A1356-0495	n	straight	n a	square	n a	n a	n a	n a	n	n	n	n a	n a	
A1864-0296-2	y-retouch, base and blade	expanding	convex?	barbed	side	n a	n a	n a	n	y	n a	n a	n a	y
A4487-0296	y-retouch	n a	n a	barbed	corner	n a	n a	n a	n a	n a	n a	y	n	y
A7189-0296	y-retouch	exp?	n a	rounded?	side	n a	n a	n a	n a	n a	n a	n a	n a	
A7192-0296	y-bev	n a	n a	barbed	corner	n a	n a	n a	n a	n a	n a	n	n	
A2590-0296	y-tip rwkd into scr?	straight*	concave*	square	side	n a	n a	n a	n	n	n	n	n	
A3584-0296-2	y-retouch	straight	concave	square	side	n a	n a	n a	n	n	n	n	n	
A7230-0296	y-retouch	straight	concave (notched)	square	side	n a	n a	n a	n	n	n	n	n	
A7217-0296	n a	Str, notched	concave	square	side	n a	n a	n a	n	n	n	n	n	
A7242-0296	n	straight	straight	rounded	side	n a	n a	n a	n	n	n	n	n	
A3130-0296-4	y-blade retouch	straight	straight	rounded	side	n a	n a	n a	n	n	y	n	n	
A7227-0296	y-retouch	expanding	concave	rounded	side	n a	n a	n a	n	y	n	n	n	
A3032-0296	n a	expanding	convex	square	side	n a	n a	n a	n	n	n	n a	n a	
A4261-0296	y-retouch	straight	straight	rounded	side	n a	n a	n a	n	n	n	y	n	
A7203-0296	y-blade retouch	expanding	straight	n a	naa	n a	n a	n a	n	n	y	n	n	
A7205-0296	n	straight	straight	n a	n a	n a	n a	n a	n	n	n	y	y	
A7215-0296	n a	exp	straight	n a	n a	n a	n a	n a	n	y	n	n a	n a	
A2614-0296	y-retouch	expanding	concave	barbed	corner	n a	n a	n a	n	y	n	n	y	
A1723-0296-1	n a	n a	n a	square	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A2739-0296-2	n	expanding	straight	barbed	n a	n a	n a	n a	n	y	n a	n a	n a	
A1713-0296	y-retouch	n a	n a	n a	n a	55	n a	n a	n a	n a	n a	n a	n a	
A3923-0296-4	n	n a	n a	n a	n a	n a	n a	1	n a	n a	n a	n a	n a	
A5554-0296	n a	n a	n a	n a	n a	70	n a	1	n a	n a	n a	n a	n a	
A5873-0296	n	n a	n a	n a	n a	60	n a	1	n a	n a	n a	n a	n a	
A5874-0296	n	n a	n a	n a	n a	55	n a	1	n a	n a	n a	n a	n a	y
A2819-0296	n	n a	n a	n a	n a	65	n a	n a	n a	n a	n a	n a	n a	
A5033-0296	y	n a	n a	n a	n a	50=E	n a	2	n a	n a	n a	n a	n a	
A2591-0296	n	n a	n a	n a	n a	85=side	n a	3	n a	n a	n a	n a	n a	
A4140-0296	y	n a	n a	n a	n a	45=side	n a	1	n a	n a	n a	n a	n a	
A4293-0296	y-retouch	n a	n a	n a	n a	n a	n a	3	n a	n a	n a	n a	n a	
A5218-0296	y	n a	n a	n a	n a	60=end	50=2sides	4	n a	n a	n a	n a	n a	
A7160-0296	n(usewear)	n a	n a	n a	n a	90	60	3	n a	n a	n a	n a	n a	
A1686-0296	y-retouch	n a	n a	n a	n a	E=70	S=50	2	n a	n a	n a	n a	n a	
A7185-0296	y-retouch	n a	n a	n a	n a	n a	75	3	n a	n a	n a	n a	n a	
A4292-0296	y-retouch	n a	n a	n a	n a	60	n a	3	n a	n a	n a	y	n a	
A7182-0296	y-retouch	n a	n a	n a	n a	n a	50	3	n a	n a	n a	n a	n a	
A2885-0296	y-retouch	n a	n a	n a	n a	60	40	3	n a	n a	n a	n a	y	
A7200-0296	y	n a	n a	n a	n a	65,end	n a	2	n a	n a	n a	n a	n a	
A7204-0296	y-retouch	n a	n a	n a	n a	80	60	2	n a	n a	n a	n a	n a	
A2524-0296	n (usewear)	n a	n a	n a	n a	75	n a	n a	n a	n a	n a	n a	n a	
A5654-0296	n	n a	n a	n a	n a	60	n a	1	n a	n a	n a	n a	n a	
A6706-0296-2	edge mod	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	n a	
A7213-0296	usewear	n a	n a	n a	n a	65	n a	n a	n a	n a	n a	n a	n a	
A1934-0296		n a	n a	n a	n a	n a	n a	1	n a	n a	n a	n a	n a	
A2818-0296	usewear	n a	n a	n a	n a	75=side	n a	n a	n a	n a	n a	n a	n a	
A7093-0296	y-utilized	n a	n a	n a	n a	90	n a	1	n a	n a	n a	n a	n a	

14LV1071 DB Site

Chip Stone Tool Analysis

Catalogue #	Comments
A7187-0296	Sanp fracture
A5550-0296	snap fracture
A7186-0296-2	snap fracture, notch more of a removal
A0599-0495	snap fracture, base fragment
A7218-0296	hafted scraper; base snapped off
A7201-0296	hafted scraper
A4263-0296	hafted scraper
A7234-0296	hafted scraper; exhausted, reworked in haft
A1356-0495	snap fracture, base broken
A1864-0296-2	hafted scrapermajority of blade missing & part of base; snap fracture
A4487-0296	base corners missing, burin? removed off blade edge
A7189-0296	broken during scraping, serious hinge fracture
A7192-0296	base and tip broken, snap fracture
A2590-0296	arrow point; *stem is notched at sides and base;reworked into sraper
A3584-0296-2	arrow; 2 side notches, stem is notched at midsection as well
A7230-0296	arrow; triangular biface with side and basal notching
A7217-0296	arrow; 2 notches, stem side notched; base tang missing
A7242-0296	arrow; made on flake blank
A3130-0296-4	arrow; made on flake blank
A7227-0296	arrow;base hinge fracture
A3032-0296	arrow; distal tip missing
A4261-0296	arrow; triangular biface with side notches
A7203-0296	arrow; tip missing, triangular biface
A7205-0296	arrow
A7215-0296	arrow
A2614-0296	arrow; tang of base missing
A1723-0296-1	lateral fragment of arrow
A2739-0296-2	tang of base fragment-hard to identify
A1713-0296	usewear
A3923-0296-4	distal? portion of scraper DD-end
A5554-0296	cortical flake, DD end worked
A5873-0296	DD(scraper edge)
A5874-0296	DP (scraper edge); burned
A2819-0296	some cortex- DD (end scraper)
A5033-0296	DD worked, DL slightly worked
A2591-0296	DLs worked
A4140-0296	VL-scraper-polish?
A4293-0296	DD, 2DL's edges worked
A5218-0296	DD,DP,2DL edges worked
A7160-0296	usewear on end and sides, DD, 2DL edges
A1686-0296	DD, DL edges
A7185-0296	2DL,2DD edges worked
A4292-0296	DD,2DL edges worked
A7182-0296	both DL edge and DD edges worked
A2885-0296	well worked-possibly composite tool-DD,2 DL's edges worked
A7200-0296	DD, DL edges worked, cortical
A7204-0296	DD, DL edges worked
A2524-0296	crude, usewear indicates scraping function
A5654-0296	
A6706-0296-2	modified core
A7213-0296	modified core
A1934-0296	lateral edge modified
A2818-0296	DL-1 scraper, DD worked usewear
A7093-0296	DD end worked

Appendix 2

Lithic Raw Material Data

Janice McLean

Catalogue #	Raw Material	Level of Certainty	Component	Elevation	Local, NL, E,Unid	Size Grade	PPK Stage/Type	PPK Age	Reworking	Thermal Alt.	Evidence?	Patination	Cortex	Comments
A0193-0495	Winterset	Positive	Lower	37 cm	Near-Local	>25mm	Var III a	Archaic	yes	No	No	0	Absent	
A0387-0495	Florence	Probable	Lower	54 cm	Exotic	>25mm	tn		yes	No	No	0	Absent	Permian
A0599-0495	Florence	Probable	Lower	29 cm	Exotic	<25mm	Var X 2 b	Archaic	no	Yes	Potlids	0	Absent	
A0681-0495	Wreford	Probable	Lower	63 cm	Exotic	<25mm	tn		no	Yes	Potlids	0	Absent	
A1176-0495	Unidentified	Exotic	Lower	69 cm	Unidentified	>25mm	Var I e	Paleoindian	yes	No	No	0	Absent	brown chalcedony
A1356-0495	Mississippian	Probable	Lower	38 cm	Exotic	>25mm	Var X 4 a	Archaic	no	Yes	Reddening	0	Absent	Slightly pink
A1665-0296-1	Plattsmouth B	Positive	Transition	10-20	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	Slightly pink
A1665-0296-3	Winterset	Positive	Upper	0-10	Near-Local	<25mm	tn		?	No	No	0	Absent	classic, shatter
A1686-0296	Winterset	Positive	Upper	0-10	Near-Local	<25mm	Side and End		yes	No	No	0	Absent	
A1713-0296	Winterset	Indeterminate	Transition	10-20	Near-Local	>25mm	End		yes	No	No	0	Absent	Wreford?, brown fossiliferous
A1723-0296-1	Unidentified		Lower	20-30	Unidentified	<25mm	Var XI 4 b	Late Prehistoric	no	Yes?	Reddening	0	Absent	too small to assign LOC
A1723-0296-2	Mississippian	Probable	Lower	20-30	Exotic	<25mm	tn		yes	No	No	0	Absent	
A1747-0495	Mississippian	Indeterminate	Lower	23cmbd	Exotic	>25mm	Var VIII b	Archaic	yes	Yes	Reddening	0	Absent	oolitic white chert?
A1811-0296	Winterset	Positive	Upper	0-10	Near-Local	<25mm	Var-VI b	Archaic	yes	No	No	0	Absent	
A1832-0296	Plattsmouth B	Positive	Transition	10-20	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	
A1845-0296	Unidentified	Indeterminate	Lower	20-30	Unidentified	<25mm	tn		no	Yes	Reddening	0	Absent	heat-treated dark blue chert?
A1864-0296-1	Plattsmouth C	Probable	Lower	30-40	Local	<25mm	tn		yes	Yes	Reddening	3	Absent	
A1864-0296-2	Toronto	Indeterminate	Lower	30-40	Local	>25mm	Var X 4 b	Archaic	yes	Yes	Reddening	0	Absent	Mississippian?
A1882-0296	Toronto	Positive	Upper	0-10	Local	<25mm	Var V c	Archaic	no	Yes	Reddening	0	Absent	
A1934-0296	Plattsmouth A	Positive	Lower	20-30	Local	>25mm	Utilized		?	No	No	2	Absent	weathering stain
A1997-0296	Toronto	Probable	Transition	10-20	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A2011-0296	Plattsmouth C	Probable	Transition	10-20	Local	<25mm	tn		no	No	No	0	Absent	
A2039-0296	Plattsmouth A	Positive	Upper	0-10	Local	<25mm	tn		no	No	No	0	Absent	
A2084-0296	Toronto	Positive	Lower	20-30	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A2128-0296	Plattsmouth C	Probable	Lower	30-40	Local	>25mm	tn		yes	No	No	0	Absent	
A2129-0296	Toronto	Positive	Lower	30-40	Local	>25mm	tn		?	No	No	0	Absent	
A2163-0296-1	Toronto	Positive	Upper	0-10	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A2163-0296-2	Unidentified	Indeterminate	Upper	0-10	Unidentified	<25mm	tn		?	Yes	Reddening	0	Absent	fusilinid?
A2163-0296-3	Wreford	Probable	Upper	0-10	Exotic	>25mm	Var V n	Archaic	no	Yes	Potlids	0	Absent	
A2166-0296	Unidentified	Indeterminate	Upper	0-10	Unidentified	<25mm	?		?	No	No	0 or 3	Absent	Permian banded chert?
A2175-0296	Unidentified	Indeterminate	Transition	10-20	Unidentified	<25mm	tn		no	Yes	Reddening	0	Absent	buff, grainy heat-treated chert
A2209-0296	Plattsmouth B	Positive	Lower	20-30	Local	<25mm	tn		yes	No	No	0	Absent	
A2210-0296	Toronto	Probable	Lower	20-30	Local	<25mm	F		no	Yes	Reddening	0	Absent	
A2229-0296	Mississippian	Probable	Lower	20-30	Exotic	>25mm	Var IX L	Woodland/Archaic	yes	Yes	Reddening	0	Absent	
A2271-0296-1	Florence	Probable	Upper	0-10	Exotic	<25mm	tn		yes	No	No	3	Absent	
A2271-0296-2	Winterset	Positive	Upper	0-10	Near-Local	<25mm	k/ mod flake		yes	No	No	0	Absent	
A2271-0296-3	Plattsmouth C	Positive	Upper	0-10	Local	<25mm	Var V d	Archaic	no	No	No	2	Absent	
A2294-0296	Florence	Positive	Upper	0-10	Exotic	<25mm	tn		yes	Yes	Potlids	2	Absent	FL A??
A2295-0296	Plattsmouth A	Positive	Upper	0-10	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	
A2307-0296-1	Toronto	Probable	Transition	10-20	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	
A2307-0296-2	Toronto	Probable	Transition	10-20	Local	<25mm	Var VII c	Archaic	no	Yes	Reddening	0	Absent	
A2335-0296	Plattsmouth C	Indeterminate	Lower	20-30	Local	<25mm	tn		no	No	No	0	Absent	gray fossiliferous
A2380-0296	Plattsmouth B	Positive	Upper	0-10	Local	<25mm	Var V f	Archaic	yes	Yes	Reddening	0	Absent	
A2467-0296-1	Plattsmouth	Positive	Lower	30-40	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	

Catalogue #	Raw Material	Level of Certainty	Component	Elevation	Local, NL, E,Unid	Size Grade	PPK Stage/Type	PPK Age	Reworking	Thermal Alt.	Evidence?	Patination	Cortex	Comments
A2490-0296	Plattsmouth A	Positive	Lower	30?	Local	>25mm	tn		no	No	No	0	Absent	
A2503-0296	Plattsmouth C	Probable	Upper	0-10	Local	<25mm	tn		no	Yes	Reddening	3	Absent	
A2524-0296	Toronto	Positive	Upper	0-10	Local	>25mm	Utilized		no	Yes	Reddening	0	No	
A2527-0296	Winterset	Probable	Transition	10-20	Near-Local	<25mm	tn		yes	No	No	0	Absent	grainy
A2544-0296	Plattsmouth A	Positive	Lower	20-30	Local	<25mm	?		yes	Yes	Reddening	0	Present	
A2579-0296	Plattsmouth C	Probable	Lower	30-40	Local	>25mm	tn		yes	Yes	Reddening	0	No	
A2580-0296	Wreford	Probable	Lower	30-40	Exotic	>25mm	Scr/k		yes	No	No	3	Present	cobble cortex, brown patina
A2590-0296	Toronto	Positive	Upper	0-10	Local	<25mm	Var XI 1 a	Late Prehistoric	yes	Yes	Reddening	0	Absent	
A2591-0296	Plattsmouth	Positive	Upper	0-10	Local	>25mm	Side		no	Yes	Reddening	3	Present	weathering + patina
A2614-0296	Florence	Probable	Upper	0-10	Exotic	<25mm	Var XI 4 a	Late Prehistoric	yes	No	No	0	Absent	
A2615-0296	Plattsmouth C	Probable	Upper	0-10	Local	<25mm	Var X 1 b	Archaic	no	Yes	Reddening	2	Absent	
A2616-0296	Plattsmouth A	Probable	Upper	0-10	Local	>25mm	Var IX d	Woodland/Archaic	yes	No	No	0	Absent	
A2624-0296-1	Plattsmouth C	Positive	Transition	10-20	Local	<25mm	Var X 1 a	Archaic	no	No	No	0	Absent	
A2624-0296-3	Plattsmouth B	Positive	Transition	10-20	Local	>25mm	tn		yes	No	No	0	Absent	
A2624-0296-4	Plattsmouth	Positive	Transition	10-20	Local	<25mm	tn		no	Yes	Reddening	3	Absent	
A2651-0296	Unidentified		Lower	20-30	Unidentified	<25mm	tn		no	Yes	Potlids	0	Present	can't assign LOC
A2683-0296	Plattsmouth C	Probable	Lower	30-40	Local	<25mm	?		yes	Yes	Reddening	1	Absent	
A2739-0296-1	Plattsmouth	Indeterminate	Upper	0-10	Local	<25mm	tn		no	No	No	0	Absent	
A2739-0296-2	Unidentified	Indeterminate	Upper	0-10	Unidentified	<25mm	Var XI 4 c	Late Prehistoric	no	Yes	Reddening	0	Absent	Winterset?
A2739-0296-3	Toronto	Indeterminate	Upper	0-10	Local	<25mm	tn		no	Yes	Potlids	0	Absent	Westerville?
A2739-0296-4	Unidentified	Indeterminate	Upper	0-10	Unidentified	<25mm	tn		yes	Yes	Reddening	0	Absent	Permian?
A2798-0296	Unidentified	Indeterminate	Lower	20-30	Unidentified	<25mm	tn		no	Yes	Potlids	0	Absent	gray fossiliferous
A2799-0296	Unidentified	Exotic	Lower	20-30	Unidentified	<25mm	F		?	No	No	0	Absent	Red chalcedony? similar to Alibates.
A2818-0296	Florence	Indeterminate	Lower	20-30	Exotic	>25mm	Utilized		yes	No	No	3	Absent	heavy patina
A2819-0296	Florence	Positive	Lower	20-30	Exotic	>25mm	End		no	No	No	1	Present	
A2828.5-0296	Unidentified	Indeterminate	Lower	30-40	Unidentified	<25mm	Var V e	Archaic	no	Yes	Reddening	0	Absent	Toronto?
A2847-0296	Mississippian	Probable	Lower	30-40	Exotic	>25mm	tn		no	No	No	0	Absent	
A2862-0296-1	Winterset	Probable	Upper	0-10	Near-Local	<25mm	F		yes	No	No	1	Absent	reddish weathering stain
A2862-0296-2	Toronto	Positive	Upper	0-10	Local	<25mm	tn		?	No	No	0	Absent	
A2885-0296	Unidentified		Upper	0-10	Unidentified	>25mm	Side and End		yes	No	No	0	Absent	Similar to Westerville
A2948-0296-1	Plattsmouth	Indeterminate	Lower	30-40	Local	<25mm	tn		no	No	No	0	Absent	
A2948-0296-2	Unidentified		Lower	30-40	Unidentified	>25mm	tn		no	Yes	Reddening	3	Present	yellowish-tan fossiliferous chert or complete patina?
A2948-0296-3	Westerville	Probable	Lower	30-40	Near-Local	<25mm	tn		no	No	No	0	Absent	no fossils
A2975-0296	Plattsmouth C	Positive	Lower	20-30	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	Alibates banding
A2976-0296	Plattsmouth A	Probable	Lower	40-45	Local	<25mm	tn		no	No	No	0	Absent	
A2998-0296	Unidentified	Indeterminate	Upper	0-10	Unidentified	<25mm	tn		yes	Yes	Reddening	0	Present	Wreford or Winterset?
A3017-0296	Winterset	Positive	Upper	0-10	Near-Local	<25mm	tn		no	No	No	0	Absent	
A3032-0296	Unidentified		Transition	10-20	Unidentified	<25mm	Var XI 2 d	Late Prehistoric	no	No	No	2	Absent	blue gray chert
A3095-0296	Wreford	Probable	Lower	30-40	Exotic	<25mm	Var I b	Paleoindian	no	Yes	Reddening	0	Absent	productid spines are abundant, overlaps with Winterset
A3096-0296	Winterset	Probable	Lower	30-40	Near-Local	>25mm	tn		yes	Yes	Reddening	0	Absent	
A3130-0296-1	Winterset	Probable	Upper	0-10	Near-Local	<25mm	tn		no	Yes	Reddening	0	Absent	shatter: calcite, blue-gray
A3130-0296-3	Plattsmouth C	Positive	Upper	0-10	Local	>25mm	tk		yes	No	No	3	Absent	
A3130-0296-4	Mississippian	Indeterminate	Upper	0-10	Exotic	<25mm	Var XI 2 b	Late Prehistoric	yes	No	No	0	Absent	Toronto?
A3172-0296-1	Mississippian	Probable	Transition	10-20	Exotic	<25mm	tn		?	Yes	Reddening	0	No	

Catalogue #	Raw Material	Level of Certainty	Component	Elevation	Local, NL, E,Unid	Size Grade	PPK Stage/Type	PPK Age	Reworking	Thermal Alt.	Evidence?	Patination	Cortex	Comments
A3172-0296-2	Florence	Probable	Transition	10-20	Exotic	<25mm	tn		no	Yes	Reddening	0	Absent	
A3203-0296	Toronto	Positive	Lower	20-30	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	
A3223-0296	Plattsmouth C	Positive	Lower	20-30	Local	>25mm	tn		yes	Yes	Potlids	0	Absent	
A3255-0296	Plattsmouth A	Probable	Upper	0-10	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A3280-0296	Toronto	Indeterminate	Transition	10-20	Local	<25mm	tn		yes	No	No	0	Absent	Whitish stuff
A3364-0296	Mississippian	Probable	Lower	40-50	Exotic		tn		no	No	No	0	No	lots of druses
A3379-0296	Ferrous Oxide	Positive	Lower	40-50	Local	>25mm	tk		no	No	No	0	Present	
A3382-0296	Florence	Positive	Lower	40-50	Exotic	>25mm	Scr/k		yes	No	No	0	Present	
A3414-0296	Unidentified	Indeterminate	Transition	10-20	Unidentified	<25mm	tn		no	No	No	0	Absent	Buff chert with calcite stringer
A3457-0296	Unidentified	Indeterminate	Lower	30-40	Unidentified	>25mm	tn		no	No	No	1	Absent	Plattsmouth? gray fossiliferous, weathering rind
A3525-0296	Plattsmouth A	Probable	Lower	20-30	Local	<25mm	tn		no	Yes	Reddening	2	Absent	
A3584-0296-1	Plattsmouth A	Probable	Upper	0-10	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	
A3584-0296-2	Toronto	Indeterminate	Upper	0-10	Local	<25mm	Var XI 1 b	Late Prehistoric	yes	No	No	0	Absent	whitish
A3617-0296-1	Plattsmouth C	Probable	Transition	10-20	Local	<25mm	tn		no	Yes	Reddening	3	Absent	
A3617-0296-2	Plattsmouth A	Probable	Transition	10-20	Local	>25mm	tn		no	Yes	Reddening	0	Absent	
A3617-0296-3	Plattsmouth	Indeterminate	Transition	10-20	Local	<25mm	Var V g	Archaic	yes	No	No	0	Present	gray fossiliferous
A3644-0296-1	Toronto	Positive	Lower	20-30	Local	<25mm	tn		no	No	Reddening	0	Absent	
A3644-0296-2	Plattsmouth C	Indeterminate	Lower	20-30	Local	>25mm	tn		yes	No	No	2	Absent	gray fossiliferous, weathering
A3664-0296-1			Lower	30-40			tn		yes					
A3664-0296-2	Unidentified	Exotic	Lower	30-40	Unidentified	>25mm	tn		no	Yes	Reddening		Absent	yellow-brown fusilinacean chert. Patinated?
A3664-0296-3	Toronto	Indeterminate	Lower	30-40	Local	>25mm	tn		no	No	No	0	Absent	whitish
A3694-0296-1	Plattsmouth A	Positive	Upper	0-10	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A3694-0296-2	Unidentified	Indeterminate	Upper	0-10	Unidentified	<25mm	tn		no	Yes	Reddening	0	Absent	blue-gray fossiliferous chert
A3694-0296-3	Toronto	Probable	Upper	0-10	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A3770-0296	Plattsmouth A	Probable	Lower	20-30	Local	>25mm	tn		?	No	No	2	Absent	
A3803-0296	Toronto	Probable	Upper	0-10	Local	<25mm	Var V b	Archaic	no	Yes	Reddening	0	Absent	
A3825-0296-1	Unidentified	Indeterminate	Transition	10-20	Unidentified	>25mm	tn		no	Yes	Reddening	0	Absent	Permian?
A3847-0296	Toronto	Probable	Lower	20-30	Local	<25mm	tn		no	No	No	0	Absent	grainy whitish
A3866-0296	Florence	Probable	Lower	20-30	Exotic	>25mm	tn		no	No	No	3	Absent	hevay patina
A3870-0296-1	Plattsmouth C	Probable	Lower	30-40	Local	<25mm	tn		no	Yes	Potlids	3	Absent	
A3870-0296-2	Plattsmouth C	Positive	Lower	30-40	Local	>25mm	tn		no	Yes	Reddening	1	Present	alibates banding
A3895-0296	Toronto	Probable	Lower	40-45	Local	>25mm	tn		yes	No	No	0	Absent	
A3923-0296-1	Toronto	Positive	Transition	10-20	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	
A3923-0296-2	Unidentified	Indeterminate	Transition	10-20	Unidentified	<25mm	tn		no	Yes	Reddening	0	Absent	heat-treated blue-gray fossiliferous chert
A3923-0296-3	Florence	Probable	Transition	10-20	Exotic	<25mm	tn		no	Yes	Potlids	0	Absent	
A3923-0296-4	Westerville	Indeterminate	Transition	10-20	Near-Local	<25mm	End		no	Yes	Reddening	0	Present	Toronto?, calcite blobs
A3944-0296-1	Plattsmouth A	Probable	Lower	20-30	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	
A3944-0296-2	Florence	Indeterminate	Lower	20-30	Exotic	<25mm	tn		yes	No	No	3	Absent	heavy patina
A3944-0296-3	Plattsmouth C	Indeterminate	Lower	20-30	Local	<25mm	Var IX L	Woodland/Archaic	no	No	No	3	Absent	heavy patina
A3974-0296-1	Winterset	Probable	Lower	30-40	Near-Local	<25mm	tn		no	Yes	Reddening	0	Absent	angular shatter
A3974-0296-2	Toronto	Probable	Lower	30-40	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A4019-0296	Unidentified		Upper	0-10	Unidentified	>25mm	Var V a	Archaic	yes	No	No	3	Absent	completely yellow-brown patina
A4089-0296	Florence	Positive	Lower	30-40	Exotic	<25mm	tn		no	Yes	Potlids	0	Absent	
A4090-0296	Plattsmouth	Probable	Lower	30-40	Local	>25mm	Scr/k		no	No	No	0	Absent	

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A4112-0296	Plattsmouth A	Probable	Upper	0-10	Local	<25mm	tn		no	No	No	0	Absent	
A4138-0296	Mississippian	Probable	Upper	0-10	Exotic	<25mm	tn		yes	No	No	2	Absent	
A4140-0296	Plattsmouth A	Positive	Upper	0-10	Local	>25mm	Side		yes	Yes	Reddening	0	Present	
A4141-0296	Plattsmouth C	Positive	Upper	0-10	Local	<25mm	Var X 1 j	Archaic	no	Yes	Reddening	3	Absent	
A4145-0296	Toronto	Positive	Transition	10-20	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	
A4156-0296	Toronto	Probable	Transition	10-20	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	
A4170-0296	TRSS	Probable	Lower	20-30	Local	>25mm	tn		no	No	No	0	Absent	same cobble as A7169
A4194-0296	Plattsmouth A	Probable	Lower	30-40	Local	<25mm	tn		?	Yes	Reddening	3	Absent	
A4261-0296	Toronto	Indeterminate	Upper	0-10	Local	<25mm	Var XI 2 e	Late Prehistoric	yes	No	No	0	Absent	whitish
A4262-0296	Toronto	Indeterminate	Upper	0-10	Local	<25mm	Var V k	Archaic	no	No	No	0	Absent	whitish
A4263-0296	Unidentified	Indeterminate	Upper	0-10	Unidentified	<25mm	Var X 3 c	Archaic	yes	Yes	Reddening	3	Present	blue-gray patinated chert
A4274-0296	Toronto	Positive	Transition	10-20	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	
A4292-0296	Toronto	Indeterminate	Transition	10-20	Local	>25mm	Side and End		yes	No	No	0	Absent	whitish
A4293-0296	Toronto	Positive	Transition	10-20	Local	>25mm	Side and End		yes	No	No	0	Present	
A4295-0296	Winterset	Positive	Transition	10-20	Near-Local	>25mm	?		yes	No	No	0	Present	cf 23CL11
A4327-0296	Permian	Probable	Lower	20-30	Exotic	>25mm	tn		yes	No	No	3	Present	brown patina
A4339-0296	Plattsmouth C	Probable	Lower	30-40	Local	<25mm	tn		yes	No	No	3	Absent	
A4360-0296-1	Toronto	Indeterminate	Upper	0-10	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	whitish
A4360-0296-2	Florence	Indeterminate	Upper	0-10	Exotic	<25mm	tn		no	No	No	0	Absent	Mississippian?
A4379-0296	Toronto	Probable	Upper	0-10	Local	>25mm	tn		yes	No	No	0	Absent	Calcite vein
A4408-0296	Winterset	Positive	Transition	10-20	Near-Local	>25mm	Scr/k		yes	No	No	1	Absent	Brownish banded + blue-gray, stained weathering surf.
A4463-0296-1	Unidentified	Indeterminate	Upper	0-10	Unidentified	<25mm	tn		yes	Yes	Reddening	0	Absent	bluish fossiliferous chert. Florence?
A4463-0296-2	Unidentified	Indeterminate	Upper	0-10	Unidentified	<25mm	tn		no	No	No	0	Absent	Westerville?/Toronto?
A4487-0296	Toronto	Probable	Unknown	no depth	Local	>25mm	Var X 4 c	Archaic	yes	Yes	Reddening	0	Absent	
A4494-0296	Plattsmouth A	Probable	Transition	10-20	Local	<25mm	ppk/scr		yes	Yes	Reddening	0	Absent	
A4522-0296	Unidentified	Indeterminate	Lower	20-30	Unidentified	<25mm	tn		no	No	No		Absent	gray fossiliferous chert
A4558-0296	Toronto	Positive	Lower	30-40	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	
A4586-0296	Toronto	Positive	Lower	40-50	Local	<25mm	Var IX o	Woodland/Archaic	no	Yes	Reddening	0	Absent	
A4652-0296-1	Toronto	Probable	Lower	20-30	Local	>25mm	tn		no	Yes	Reddening	0	Absent	grainy whitish
A4652-0296-2	Florence	Probable	Lower	20-30	Exotic	<25mm	tn		yes	Yes	Reddening	0	Absent	
A4673-0296-1	Unidentified	Indeterminate	Lower	30-40	Unidentified	<25mm	F		yes	No	No	3	Absent	hints of blue-gray chert
A4673-0296-2	Plattsmouth A	Positive	Lower	30-40	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A4698-0296	Florence	Probable	Upper	0-10	Exotic	<25mm	Var IX r	Woodland/Archaic	no	No	No	0	Absent	
A4720-0296	Plattsmouth C	Positive	Upper	0-10	Local	>25mm	tk		no	No	No	0	Absent	
A4723-0296-1	Florence	Probable	Transition	10-20	Exotic	<25mm	ppk/scr		yes	Yes	Potlids	0	Absent	
A4723-0296-2	Unidentified	Exotic	Transition	10-20	Unidentified	<25mm	tn		no	Yes	Reddening		Absent	Patinated? or yellow-brown unknown.
A4793-0296	Toronto	Probable	Lower	30-40	Local	<25mm	Var IX g	Woodland/Archaic	no	Yes	Reddening	0	Absent	
A4827-0296-2	Plattsmouth A	Probable	Upper	0-10	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	
A4849-0296	Winterset	Probable	Upper	0-10	Near-Local	>25mm	tn		yes	No	No	0	Absent	grainy
A4851-0296-1	Winterset	Probable	Transition	10-20	Near-Local	<25mm	tn		?	No	No	0	Absent	similar to Florence D
A4892-0296-1	Toronto	Positive	Lower	20-30	Local	>25mm	tn		yes	No	No	0	Absent	
A4892-0296-3	Plattsmouth C	Indeterminate	Lower	20-30	Local	<25mm	Var V m	Archaic	no	No	No	2	Absent	gray fossiliferous/Permian?
A4966-0296	Plattsmouth	Indeterminate	Upper	0-10	Local	<25mm	tn		no	No	No	3	Absent	gray fossiliferous
A5032-0296	Plattsmouth A	Positive	Transition	10-20	Local	>25mm	tn		no	Yes	Reddening	0	Absent	

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A5033-0296	Florence	Positive	Transition	10-20	Exotic	>25mm	End		yes	No	No	3	Present	
A5076-0296-1	Toronto	Positive	Lower	30-40	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A5076-0296-3	Plattsmouth	Probable	Lower	30-40	Local	<25mm	Var V o	Archaic	yes	No	No	2	Absent	
A5076-0296-4	Plattsmouth A	Indeterminate	Lower	30-40	Local	<25mm	Var V h	Archaic	no	Yes	Reddening	0	Absent	Wreford?
A5100-0296	Plattsmouth C	Positive	Lower	30-40	Local	<25mm	tn		no	No	No	3	Absent	
A5101-0296	Toronto	Indeterminate	Unknown	?	Local	<25mm	tn		no	No	No	0	Absent	grainy whitish
A5140-0296	Florence	Probable	Lower	40-50	Exotic	>25mm	tn		yes	Yes	Potlids	0	Absent	
A5177-0296	Unidentified	Indeterminate	Transition	10-20	Unidentified	<25mm	tn		?	No	No	3	Absent	Plattsmouth0
A5198-0296-1	Plattsmouth	Probable	Lower	20-30	Local	<25mm	tn		yes	No	No	3	Absent	
A5198-0296-2	Unidentified	Indeterminate	Lower	20-30	Unidentified	<25mm	tn		yes	No	No	0	Absent	Westerville?
A5218-0296	Niobrara Jasper	Probable	Lower	20-30	Exotic	>25mm	Side and End		yes	No	No	0	Absent	chalky NJ
A5239-0296	Plattsmouth C	Positive	Lower	30-40	Local	>25mm	F		no	No	No	1	Present	alibates-like banding
A5273-0296	Toronto	Probable	Upper	0-10	Local	<25mm	Var VI c	Archaic	yes	Yes	Reddening	0	Present	
A5295-0296	Mississippian	Probable	Transition	10-20	Exotic	>25mm	Var Vr	Archaic	yes	Yes	Reddening	0	Absent	
A5296-0296	Plattsmouth	Probable	Lower	20-30	Local	>25mm	tn		no	Yes	Present	3	Absent	dark fossils- Florence? pale yellow-brown patina
A5317-0296	Toronto	Probable	Lower	20-30	Local	>25mm	tn		yes	No	No	0	Absent	grainy light tan
A5322-0296	Plattsmouth C	Positive	Lower	30-40	Local	>25mm	Scr/k		yes	Yes	Reddening	2	Absent	potlid?
A5342-0296	Florence	Probable	Upper	0-10	Exotic	<25mm	tn		no	No	No	0	Absent	angular shatter
A5369-0296	Florence	Probable	Transition	10-20	Exotic	<25mm	tn		yes	No	No	0	Absent	
A5397-0296-2	Toronto	Positive	Lower	20-30	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A5426-0296	Plattsmouth	Indeterminate	Lower	30-40	Local	<25mm	tn		no	No	No	0	Absent	Permian?
A5480-0296	Toronto	Probable	Transition	10-20	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A5512-0296-1	Plattsmouth A	Probable	Lower	20-30	Local	>25mm	tn		no	Yes	Reddening	0	Absent	
A5512-0296-2	Plattsmouth A	Probable	Lower	20-30	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A5534-0296-1	Plattsmouth B	Positive	Lower	30-40	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A5534-0296-2	Plattsmouth B	Positive	Lower	30-40	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	
A5550-0296	Plattsmouth A	Positive	Lower	30-40	Local	>25mm	Var X 1 L	Archaic	yes	Yes	Reddening	0	Absent	
A5554-0296	Plattsmouth	Positive	Lower	30-40	Local	>25mm	End		no	Yes	Reddening	0	Present	
A5646-0296	Unidentified	Indeterminate	Lower	20-30	Unidentified	>25mm	Var VI a	Archaic	yes	No	No	3	Absent	Fossilferous chert, possibly Wreford or Winterset
A5647-0296	Plattsmouth C	Indeterminate	Lower	20-30	Local	>25mm	tn		?	No	No	2	Absent	Permian?
A5654-0296	Plattsmouth A	Positive	Lower	20-30	Local	>25mm	Utilized		no	No	No	1	Present	Weathering
A5695-0296	Florence	Indeterminate	Upper	0-10	Exotic	<25mm	tn		no	No	No	0	Absent	fossils are dark
A5719-0296	Winterset	Probable	Upper	0-10	Near-Local	>25mm	Var III d	Archaic	yes	No	No	0	Absent	grainy, calcite
A5722-0296	Toronto	Indeterminate	Transition	10-20	Local	<25mm	tn		yes	No	No	0	Absent	whitish
A5744-0296-1	Plattsmouth A	Probable	Lower	20-30	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A5744-0296-2	Permian	Probable	Lower	20-30	Exotic	<25mm	Var I d	Paleoindian	no	No	No	0	Absent	blue-gray fossiliferous
A5744-0296-3	Florence	Probable	Lower	20-30	Exotic	<25mm	tn		no	No	No	0	Absent	
A5763-0296	Westerville	Probable	Lower	20-30	Near-Local	<25mm	tn		yes	Yes	Reddening	0	Absent	tip is pinkish
A5806-0296	Plattsmouth A	Positive	Upper	0-10	Local	<25mm	tn		yes	No	No	0	Absent	
A5846-0296	Toronto	Positive	Transition	10-20	Local	>25mm	tn		no	Yes	Reddening	0	Absent	
A5854-0296	Toronto	Probable	Lower	20-30	Local	<25mm	?		no	No	No	0	Absent	
A5873-0296	Unidentified	Indeterminate	Lower	20-30	Unidentified	<25mm	End		no	Yes	Reddening	0	Present	Toronto/Westerville?
A5874-0296	Mississippian	Probable	Lower	20-30	Exotic	>25mm	End		no	Yes	Reddening	0	Present	
A5902-0296	Plattsmouth C	Positive	Lower	30-40	Local	>25mm	tn		yes	No	No	3	Absent	

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A5904-0296	Ferrous Oxide	Positive	Lower	30-40	Local	>25mm	tk		no	No	No	0	Yes	
A5926-0296	Plattsmouth	Positive	Upper	0-10	Local	<25mm	tn		yes	No	No	3	Absent	
A5962-0296	Plattsmouth A	Positive	Upper	0-10	Local	>25mm	tn		?	Yes	Reddening	0	Absent	
A5968-0296-1	Plattsmouth B	Probable	Transition	10-20	Local	<25mm	tn		no	No	No	0	Absent	
A5968-0296-2	Plattsmouth A	Probable	Transition	10-20	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	
A5988-0296-4	Mississippian	Indeterminate	Lower	20-30	Exotic	>25mm	tn		no	Yes	Reddening	0	Absent	Permian?
A6001-0296-1	Florence	Probable	Lower	20-30	Exotic	<25mm	F		yes	No	No	0	Absent	grainy
A6001-0296-2	Florence	Probable	Lower	20-30	Exotic	<25mm	tn		yes	No	No	0	Absent	
A6001-0296-4	Plattsmouth A	Positive	Lower	20-30	Local	<25mm	tn		no	Yes	Reddening	2	Absent	
A6050-0296	Toronto	Indeterminate	Lower	30-40	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	
A6071-0296	Plattsmouth C	Positive	Lower	30-40	Local	>25mm	Scr/gouge		yes	No	No	1	Absent	brown weathering patina, alibates banding
A6095-0296-2	Plattsmouth C	Probable	Upper	0-10	Local	<25mm	tn		no	No	No	3	Absent	
A6095-0296-4	Unidentified	Indeterminate	Upper	0-10	Unidentified	<25mm	tn		no	Yes	Crazing	0	Absent	Florence D, Ervine Creek, or other blue-gray chert
A6095-0296-5	Plattsmouth C	Probable	Upper	0-10	Local	<25mm	tn		no	No	No	2	Absent	patina?
A6095-0296-6	Plattsmouth C	Probable	Upper	0-10	Local	<25mm	tn		yes	No	No	3	Absent	patina?
A6119-0296	Plattsmouth A	Probable	Upper	0-10	Local	<25mm	tn		no	No	No	0	Absent	
A6170-0296	Plattsmouth	Indeterminate	Lower	20-30	Local	>25mm	tk		no	No	No	2	Absent	
A6210-0296	Ferrous Oxide	Positive	Lower	30-40	Local	>25mm	tk		no	No	No	0	Present	
A6215-0296	Westerville	Indeterminate	Upper	0-10	Near-Local	<25mm	Var X 1 f	Archaic	no	Yes	Reddening	0	Absent	Toronto?
A6216-0296	Florence	Probable	Upper	0-10	Exotic	<25mm	F		yes	No	No	2	Absent	
A6247-0296	Plattsmouth	Indeterminate	Transition	10-20	Local	>25mm	tn		no	No	No	3	Absent	heavy patina?
A6269-0296-1	Toronto	Positive	Lower	20-30	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A6269-0296-2	Winterset	Probable	Lower	20-30	Near-Local	<25mm	tn		yes	Yes	Reddening	0	Absent	banding
A6321-0296-1	Unidentified	Indeterminate	Upper	0-10	Unidentified	<25mm	tn		no	Yes	Potlids	0	Absent	Wreford or Winterset?
A6321-0296-2	Mississippian	Probable	Upper	0-10	Exotic	<25mm	tn		no	No	No	0	Absent	
A6321-0296-3	Toronto	Indeterminate	Upper	0-10	Local	<25mm	Var X 1 e	Archaic	no	No	No	0	Absent	grainy whitish
A6405-0296	Plattsmouth A	Probable	Transition	10-20	Local	>25mm	tn		yes	Yes	Reddening	3	Absent	
A6447-0296-1	Plattsmouth	Probable	Upper	0-10	Local	<25mm	tn		no	No	No	3	Absent	
A6447-0296-2	Toronto	Positive	Upper	0-10	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	
A6476-0296	Unidentified	Indeterminate	Transition	10-20	Unidentified	<25mm	tn		no	No	No	0	Absent	blue-gray grainy chert
A6525-0296-1	Unidentified	Indeterminate	Lower	30-40	Unidentified	<25mm	tn		no	Yes	Reddening	0	Absent	heat-treated buff chert
A6525-0296-3	Toronto	Indeterminate	Lower	30-40	Local	<25mm	tn		no	Yes	Reddening	0	Absent	whitish
A6624-0296	Unidentified		Transition	10-20	Unidentified	>25mm	tn		yes	No	No	0	Absent	blue-gray, buff, banded. Winterset/Westerville/exotic?
A6673-0296-1	Toronto	Probable	Lower	30-40	Local	<25mm	tn		no	No	No	0	Absent	
A6691-0296	Mississippian	Probable	Lower	30-40	Exotic	<25mm	Var I a	Paleoindian	no	No	No	0	Absent	
A6692-0296	Plattsmouth A	Positive	Lower	30-40	Local	>25mm	F		yes	No	No	2	Absent	
A6706-0296-1	Winterset	Positive	Lower	40-45	Near-Local	<25mm	tn		no	No	No	0	Absent	
A6706-0296-2			Lower	40-45			Utilized		yes					
A6706-0296-3	Winterset	Probable	Lower	40-45	Near-Local	<25mm	tn		no	Yes	Reddening	0	Absent	blue-gray fossiliferous, angular shatter
A6745-0296	Toronto	Probable	Upper	0-10	Local	>25mm	tn		no	No	No	0	Absent	
A6775-0296-1	Toronto	Positive	Lower	20-30	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	
A6794-0296	Ferrous Oxide	Positive	Lower	30-40	Local	>25mm	tk		no	No	No	0	Present	
A6852-0296-2	Plattsmouth A	Probable	Transition	10-20	Local	<25mm	Var V i	Archaic	no	No	No	0	Present	
A6874-0296	Winterset	Positive	Transition	10-20	Near-Local	<25mm	tn		no	Yes	Potlids	0	Absent	

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A6876-0296-1	Plattsmouth B	Probable	Lower	20-30	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A6897-0296	Unidentified	Indeterminate	Lower	30-40	Unidentified	<25mm	tn		no	Yes	Reddening	3	Absent	completely patinated gray fossiliferous chert
A6925-0296-2	Ferrous Oxide	Positive	Lower	30-40	Local	>25mm	?		yes	No	No	0	Present	
A6953-0296	Winterset	Indeterminate	Upper	0-10	Near-Local	>25mm	tn		yes	Yes	Reddening	0	Absent	background looks good, but not convinced
A6971-0296	Toronto	Positive	Transition	10-20	Local	>25mm	?		yes	No	No	0	Absent	
A6975-0296-1	Toronto	Indeterminate	Lower	20-30	Local	<25mm	tn		yes	No	No	0	Absent	whitish grainy
A6975-0296-2	Plattsmouth A	Probable	Lower	20-30	Local	<25mm	tn		no	No	No	2	Absent	
A7020-0296-1	Toronto	Probable	Lower	40-50	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	
A7036-0296	Plattsmouth A	Probable	Lower	40-50	Local	>25mm	tk		no	Yes	Reddening	0	Absent	
A7091-0296	Plattsmouth C	Positive	Upper	0-10	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	alibates banding
A7093-0296	Plattsmouth A	Positive	Upper	0-10	Local	>25mm	Utilized		yes	Yes	Reddening	2	Present	Weathering stain
A7114-0296	Plattsmouth A	Positive	Lower	20-30	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	
A7134-0296	Plattsmouth C	Probable	Lower	20-30	Local	>25mm	tn		no	No	No	0	Absent	
A7144-0296	Plattsmouth	Positive	Lower	30-40	Local	>25mm	tn		yes	Yes	Potlids	0	Absent	
A7146-0296	Toronto	Positive	Graded Surface	Surface T2	Local	>25mm	tn		yes	No	No	0	Absent	
A7147-0296	Plattsmouth B	Positive	Graded Surface	Surface T4	Local	>25mm	tn		yes	No	No	0	Absent	calcite vein
A7148-0296	Florence	Positive	Surface	Surface	Exotic	>25mm	tn		no	Yes	Reddening	3	Absent	
A7149-0296	Florence	Probable	Surface	Surface	Exotic	>25mm	tn		yes	No	No	3	Absent	
A7150-0296	Plattsmouth A	Positive	Graded Surface	Surface T3	Local	>25mm	tn		yes	No	No	1	Present	weathering rind+cortex
A7151-0296	Toronto	Positive	Graded Surface	Surface T4	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	
A7152-0296	Plattsmouth C	Probable	Surface	Surface	Local	>25mm	tn		yes	No	No	2	Absent	
A7153-0296	Unidentified	Indeterminate	Graded Surface	Surface T1	Unidentified	>25mm	tn		yes	No	No	3	Absent	patinated gray fossiliferous chert
A7154-0296	Plattsmouth	Indeterminate	Graded Surface	graded Surface	Local	>25mm	tn		yes	Yes	Potlids	3	Absent	Wreford?
A7155-0296	Toronto	Probable	Surface	Surface	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A7156-0296	Permian	Probable	Graded Surface	Surface T4	Exotic	>25mm	tn		yes	Yes	Reddening	0	Absent	fenestrate bryozoa, blue-gray fossiliferous
A7157-0296	Winterset	Probable	Surface	Surface	Near-Local	<25mm	tn		yes	No	No	0	Absent	
A7158-0296	Toronto	Positive	Surface	Surface	Local	<25mm	tn		no	No	No	0	Absent	
A7159-0296	Florence	Positive	Graded Surface	Surface T5	Exotic	>25mm	Scr/k		yes	No	No	0	Present	
A7160-0296	Florence	Probable	Graded Surface	Surface T3	Exotic	>25mm	Side and End		no	No	No	0	Absent	grainy
A7161-0296	Winterset	Positive	Surface	Surface	Near-Local	<25mm	Var X 1 c	Archaic	no	No	No	0	Absent	
A7162-0296	Florence	Positive	Lower	20-30	Exotic	>25mm	tn		yes	No	No	3	Present	
A7163-0296	Plattsmouth A	Positive	Graded Surface	Surface T2	Local	>25mm	Var II b	Archaic	yes	No	No	0	Absent	
A7164-0296	Toronto	Indeterminate	Graded Surface	Surface T2	Local	>25mm	Var X 1 g	Archaic	no	No	No	0	Absent	Westerville?
A7165-0296	Plattsmouth C	Positive	Surface	Surface	Local	>25mm	Var Vr	Archaic	yes	No	No	2	Absent	
A7166-0296	Winterset	Positive	Graded Surface	Surface T4	Near-Local	<25mm	Var IX p	Woodland/Archaic	no	No	No	0	Absent	
A7167-0296	Westerville	Indeterminate	Surface	Surface	Near-Local	>25mm	Var IX a	Woodland/Archaic	no	No	No	0	Absent	Toronto? buff, waxy luster
A7168-0296 (2?)	Toronto	Indeterminate	Surface	Surface	Local	>25mm	tn		yes	No	No	0	Absent	Westerville?
A7169-0296	TRSS	Probable	Unknown	out of wall	Local	>25mm	tk		yes	No	No	0	Yes	cobble
A7170-0296	Unidentified	Indeterminate	Surface	Surface	Unidentified	<25mm	tn		yes	Yes	Reddening	0	Absent	fossiliferous, very orangish
A7171-0296	Toronto	Positive	Surface	Surface	Local	<25mm	Var VII b	Archaic	no	Yes	Reddening	0	Absent	
A7172-0296	Permian	Probable	Surface	Surface	Exotic	>25mm	tn		no	Yes	Reddening	3	Absent	pink
A7173-0296	Plattsmouth C	Positive	Surface	Surface	Local	<25mm	Var IX m	Woodland/Archaic	no	Yes	Reddening	0	Absent	
A7174-0296	Toronto	Indeterminate	Surface	Surface	Local	>25mm	Var IX g	Woodland/Archaic	yes	Yes	Reddening	0	Absent	whitish
A7175-0296	Plattsmouth A	Positive	Graded Surface	Surface T3	Local	>25mm	Scr/gouge		no	No	No	0	Present	

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A7176-0296	Florence	Probable	Surface	Surface	Exotic	<25mm	ppk/scr		yes	No	No	0	Absent	
A7177-0296	Florence	Positive	Graded Surface	Surface T3	Exotic	<25mm	Var IV b	Woodland/Archaic	no	No	No	0	Absent	
A7178-0296	Mississippian	Probable	Graded Surface	Surface T4	Exotic	>25mm	Var IX h	Woodland/Archaic	yes	Yes	Reddening	0	No	
A7179-0296	Mississippian	Probable	Graded Surface	Surface T3	Exotic	>25mm	Scr/k		yes	Yes	Reddening	0	No	
A7180-0296	Winterset	Positive	Graded Surface	Surface T2	Near-Local	>25mm	Var II a	Archaic	yes	No	No	0	Absent	classic
A7181-0296	Permian	Probable	Graded Surface	Surface T1	Exotic	>25mm	Var X 1 h	Archaic	yes	No	No	3	Present	yellow patina
A7182-0296	Westerville	Indeterminate	Lower	40-50	Near-Local	>25mm	Side and End		yes	No	No	1	Absent	Stoner Chert? (KUMA-LCC#14) brown weathering patina
A7183-0296	Westerville	Probable	Lower	20-30	Near-Local	>25mm	Var IX e	Woodland/Archaic	yes	Yes	Reddening	0	Absent	fossiliferous buff chert
A7184-0296	Toronto	Positive	Graded Surface	Surface T2	Local	>25mm	tn		yes	No	No	0	Absent	
A7185-0296	Unidentified		Surface	Surface	Unidentified	<25mm	Side and End		yes	Yes	Potlids	2	Present	blue-gray + white patina
A7186-0296-2	Plattsmouth	Indeterminate	Surface	Surface	Local	>25mm	Var X 2 a	Archaic	yes	No	No	0	Absent	Gray fossiliferous
A7187-0296			Graded Surface	Surface T4	not coded		Var X 1 k	Archaic	yes					
A7188-0296	Toronto	Indeterminate	Transition	10-20	Local	>25mm	Var IV a	Woodland/Archaic	yes	No	No	0	Absent	whitish, specks
A7189-0296	Florence	Positive	Graded Surface	Surface T2	Exotic	>25mm	Var X 4 d	Archaic	yes	No	No	0	Absent	
A7190-0296	Mississippian	Positive	Graded Surface	Surface T4	Exotic	>25mm	Var VIII a	Archaic	yes	Yes	Reddening	0	No	
A7191-0296	Wreford	Positive	Lower	30-40	Exotic	>25mm	Var IX c	Woodland/Archaic	yes	Yes	Reddening	0	Absent	
A7192-0296	Winterset	Positive	Graded Surface	Surface T4	Near-Local	>25mm	Var X 4 e	Archaic	yes	No	No	0	Absent	classic: calcite, blue-gray
A7193-0296	Mississippian	Probable	Plowed Surface	Surface 10x10	Exotic	>25mm	Var IX j	Woodland/Archaic	yes	Yes	Reddening	0	Absent	
A7194-0296	Mississippian	Probable	Graded Surface	Surface T5	Exotic	<25mm	tn		yes	No	No	0	Absent	
A7195-0296	Mississippian	Probable	Surface	Surface	Exotic	>25mm	Var III b	Archaic	no	No	No	0	Absent	
A7196-0296	Unidentified	Indeterminate	Graded Surface	Surface T4	Unidentified	>25mm	Var IX b	Woodland/Archaic	yes	No	No	0	Absent	whitish, weird. Possibly Miss, or Toronto, but still weird
A7197-0296	Florence	Indeterminate	Surface	Surface	Exotic	<25mm	Var X 1 i	Archaic	no	Yes	Reddening	0	Absent	grainy, dark blue-gray chert
A7198-0296-1	Plattsmouth A	Probable	Surface	Surface	Local	>25mm	tn		no	No	No	3	Absent	
A7198-0296-2	Unidentified	Indeterminate	Surface	Surface	Unidentified	<25mm	tk		no	No	No	3	Present	calcite blobs, PLC?
A7199-0296	Plattsmouth A	Probable	Graded Surface	Surface T2	Local	>25mm	Var I f	Paleoindian	yes	Yes	Reddening	0	Absent	
A7200-0296	Unidentified	Exotic	Graded Surface	Surface T5	Unidentified	>25mm	Side and End		yes	No	No	0	Present	Atypical Flattop? white cortex, swirly bands, chalcedonic.
A7201-0296	Toronto	Probable	Surface	Surface	Local	>25mm	Var X 3 b	Archaic	yes	Yes	Reddening	0	Absent	
A7202-0296	Toronto	Positive	Surface	Surface	Local	<25mm	F		yes	No	No	0	Absent	
A7203-0296	Toronto	Positive	Plowed Surface	Surface 10x10	Local	<25mm	Var XI 3 a	Late Prehistoric	yes	Yes	Reddening	0	Absent	
A7204-0296	Unidentified		Graded Surface	Surface T4	Unidentified	>25mm	Side and End		yes	No	No	2	Absent	yellow-brown patina, dark fossils
A7205-0296	Toronto	Positive	Surface	Surface	Local	<25mm	Var XI 3 b	Late Prehistoric	no	No	No	0	Absent	
A7206-0296	Florence	Indeterminate	Graded Surface	Surface T4	Exotic	>25mm	Var IX f	Woodland/Archaic	yes	Yes	Reddening	3	Absent	
A7207-0296	Plattsmouth	Indeterminate	Graded Surface	Surface T1	Local	>25mm	Scr/k		yes	No	No	1	Present	weathering stain, also whitish cortex?
A7208-0296	Plattsmouth B	Positive	Plowed Surface	Surface 10x10	Local	<25mm	tn		no	Yes	Yes	0	Absent	
A7209-0296	Plattsmouth B	Positive	Graded Surface	Surface T6	Local	>25mm	tn		yes	No	No	0	Absent	
A7210-0296	Plattsmouth A	Probable	Graded Surface	graded Surface	Local	>25mm	tn		yes	No	No	0	Absent	
A7212-0296	Plattsmouth	Indeterminate	Graded Surface	Surface T2	Local	>25mm	tn		yes	No	No	2	Absent	gray fossiliferous
A7213-0296	Toronto	Positive	Graded Surface	Surface T1 spoil	Local	>25mm	Utilized		yes	No	No	0	Present	Weathering Surface
A7214-0296	Wreford	Probable	Graded Surface	graded Surface	Exotic	<25mm	tn		yes	Yes	Potlids	0	Absent	
A7215-0296	Mississippian	Probable	Surface	Surface	Exotic	<25mm	Var XI 3 c	Late Prehistoric	no	No	No	0	Absent	
A7216-0296	Toronto	Indeterminate	Surface	Surface	Local	>25mm	Scr/k		yes	Yes	Reddening	0	Absent	awful grayish
A7217-0296	Toronto	Indeterminate	Graded Surface	graded Surface	Local	<25mm	Var XI 1 d	Late Prehistoric	no	Yes	Reddening	0	Absent	whitish
A7218-0296	Florence	Positive	Graded Surface	Surface T2	Exotic	<25mm	Var X 3 a	Archaic	yes	No	No	3	Absent	heavy patina
A7219-0296	Plattsmouth A	Positive	Graded Surface	Surface T2	Local	<25mm	Var IX k	Woodland/Archaic	no	Yes	Reddening	0	Absent	

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A7220-0296	Unidentified	Exotic	Plowed Surface	plowed Surface	Unidentified	>25mm	tn		yes	No	No	0	Absent	white-tan mottled chert. No local analog.
A7221-0296	Unidentified		Graded Surface	graded Surface	Unidentified	<25mm	Var VII a	Archaic	?	No	No	2	Absent	gray fossiliferous chert
A7222-0296	Toronto	Probable	Graded Surface	Surface T2	Local	<25mm	tn		yes	Yes	Reddening	0	Absent	
A7223-0296	Wreford	Positive	Graded Surface	Surface T4	Exotic	>25mm	tn		yes	No	No	0	Present	
A7224-0296	Plattsmouth A	Positive	Graded Surface	graded Surface	Local	>25mm	tn		yes	No	No	0	Absent	
A7225-0296	Florence	Positive	Graded Surface	Surface T3	Exotic	>25mm	tn		yes	Yes	Reddening	2	Absent	
A7226-0296	Wreford	Probable	Graded Surface	graded Surface	Exotic	>25mm	Scr/gouge/ k		yes	No	No	2	Absent	
A7227-0296	Mississippian	Probable	Graded Surface	Surface T2	Exotic	<25mm	Var XI 2 c	Late Prehistoric	yes	Yes	Reddening	0	No	
A7228-0296	Toronto	Positive	Graded Surface	graded Surface	Local	<25mm	Var IX n	Woodland/Archaic	no	Yes	Reddening	0	Absent	
A7229-0296	Winterset	Probable	Graded Surface	Surface T4	Near-Local	>25mm	Var Xi	Archaic	yes	No	No	0	Absent	calcite, banded
A7230-0296	Winterset	Positive	Graded Surface	graded Surface	Near-Local	<25mm	Var XI 1 c	Late Prehistoric	yes	No	No	0	Absent	
A7231-0296	Plattsmouth	Positive	Graded Surface	Surface T2	Local	>25mm	Var I g	Paleoindian	yes	Yes	Reddening	0	Absent	wavy bands, fusulinids
A7232-0296	Plattsmouth A	Positive	Graded Surface	graded Surface	Local	<25mm	Var V L	Archaic	yes	No	No	0	Absent	
A7233-0296-1			Plowed Surface	plowed Surface			tn		?					
A7233-0296-2	Unidentified	Indeterminate	Plowed Surface	plowed surface	Unidentified	<25mm	Var X 1 d	Archaic	no	No	No	0	Absent	buff chert
A7234-0296	Unidentified		Graded Surface	Surface T3	Unidentified		Var X 3 d	Archaic	yes	No	No	0	Absent	whitish-blue-tan banded chert.
A7235-0296	Unidentified		Plowed Surface	Surface 10x10	Unidentified	<25mm	tn		?	Yes	Reddening	0	Absent	
A7236-0296	Toronto	Positive	Graded Surface	graded Surface	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	
A7237-0296	Plattsmouth C	Positive	Graded Surface	Surface T1	Local	>25mm	Var Vg	Archaic	yes	Yes	Reddening	0	Absent	
A7238-0296	Mississippian	Indeterminate	Plowed Surface	Surface 10x10	Exotic	<25mm	tn		yes	Yes	Reddening	0	Absent	Toronto?
A7239-0296	Plattsmouth B	Positive	Graded Surface	graded Surface	Local	<25mm	tn		no	Yes	Reddening	0	Absent	
A7240-0296	Plattsmouth C	Positive	Graded Surface	graded Surface	Local	>25mm	tn		yes	No	No	0	Absent	
A7241-0296	Wreford	Positive	Graded Surface	graded Surface	Exotic	<25mm	tn		no	No	No	0	Absent	
A7242-0296	Toronto	Positive	Plowed Surface	Surface 10x10	Local	<25mm	Var XI 2 a	Late Prehistoric	no	No	No	0	Absent	
A7243-0296	Florence	Positive	Plowed Surface	Surface 10x10	Exotic	>25mm	tn		yes	Yes	Reddening	1	Absent	2 weathering surfaces
A7247-0296	Florence	Probable	Graded Surface	graded Surface	Exotic	<25mm	tn		yes	No	No	2	Absent	
A7248-0296	Mississippian	Probable	Graded Surface	graded Surface	Exotic	<25mm	Var III c	Archaic	no	No	No	No	Absent	
A7311-0296	Florence	Positive	Lower	30-40	Exotic	<25mm	tn		yes	No	No	0	Absent	
A7330-0296	Toronto	Probable	Upper	0-10	Local	>25mm	tn		yes	Yes	Reddening	0	Absent	
A7331-0296	Florence	Probable	Surface	Surface	Exotic	<25mm	Var IX q	Woodland/Archaic	no	Yes	Reddening	0	Present	
A7353-0296	Toronto	Indeterminate	Upper	0-10	Local	>25mm	tn		yes	Yes	Reddening	0	Present	whitish
A7427-0296	Plattsmouth A	Probable	Graded Surface	trans 3	Local	>25mm	Var I c	Paleoindian	yes	No	No	2	Absent	gray fossiliferous